DEPARTMENT OF COMMERCE AND LABOR

# TECHNOLOGIC PAPERS
OF THE
# BUREAU OF STANDARDS

S. W. STRATTON, Director

## No. 2

## THE STRENGTH OF REINFORCED CONCRETE BEAMS; RESULTS OF TESTS OF 333 BEAMS

(FIRST SERIES)

BY

RICHARD L. HUMPHREY
AND
LOUIS H. LOSSE

[JUNE 27, 1911]

WASHINGTON
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## PREFACE

The investigations herein reported were made by the Technologic Branch of the United States Geological Survey at the Structural Materials Testing Laboratories, St. Louis, Mo. When this work was transferred to the Bureau of Standards July 1, 1910, this manuscript was transmitted for publication.

# THE STRENGTH OF REINFORCED CONCRETE BEAMS, RESULTS OF TESTS OF 333 BEAMS

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## I. INTRODUCTION

The field covered by the United States Geological Survey's investigations was so large that the work, for convenience, was divided into several groups. The first group embraces the strength of concrete beams without reinforcement at ages 4, 13, 26, and 52 weeks, of which all except the 52-weeks' tests have been reported in Bulletin 344[1] covering the properties of concrete, the relative values of various types of aggregates, and the influence of a variation in consistency or an increase in age on their strength and elasticity and the uniformity attainable in tests of this character.

The tests herein reported cover what is probably the simplest and most readily interpreted failure of reinforced concrete in flexure, viz, where the unit stress exceeds the yield point of the reinforcement.

The materials entering into the tests herein described were generously supplied by the following-named companies:

CEMENT

Atlas Portland Cement Co., Hannibal, Mo.
Edison Portland Cement Co., Stewartsville, N. J.
Illinois Steel Co., Chicago, Ill.
Iola Portland Cement Co., Iola, Kans.
Lehigh Portland Cement Co., Mitchell, Ind.
Omega Portland Cement Co., Jonesville, Mich.
St. Louis Portland Cement Co., St. Louis, Mo.
Virginia Portland Cement Co., Fordwick, Va.
Whitehall Portland Cement Co., Cementon, Pa.

STEEL

Illinois Steel Co., Chicago, Ill.

CRUSHED STONE, GRAVEL, AND CINDERS

Fruin-Bambrick Construction Co., St. Louis, Mo., crushed limestone.
Schneider Granite Co., St. Louis, Mo., crushed granite.
Union Sand & Material Co., St. Louis, Mo., gravel.
United Railways Co. of St. Louis, St. Louis, Mo., cinders.

SAND

Union Sand & Material Co., St. Louis, Mo.

For services rendered in the work of computing and compiling the data on which this bulletin is based acknowledgment is made to Harry Kaplan, William A. Camphell, E. B. Tolsted, and Norman De Witt Betts, assistant engineers, United States Geological Survey.

[1] U. S. Geological Survey.

## II. PURPOSE OF TESTS

These tests form a part of the study of the behavior of reinforced concrete beams under load, as influenced by the character of the concrete, and the arrangement and percentage of reinforcement.

## III. SCOPE OF TESTS

The scope of tests is outlined in the following table:

TABLE 1

| Concrete | | | | Number of Test Pieces | | | | Half-inch Round Bars Mild Steel [2] | | | Variables |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mortar | | Aggregate | Consistency | Beams | Cylinders | Cubes | Bond [3] | Per cent | Number of Bars | | |
| 1 | 2 | 4 | | | | | | | In Beam | Tested | |
| Typical cement | Meramec River sand | One set each with gravel, limestone, granite and cinders | Medium | 48 | 48 | 48 | One set of 12 for each aggregate | 0.49 | 2 | 96 | Aggregate age and percentage of reinforcement |
| | | | | 48 | 48 | 48 | | .74 | 3 | 144 | |
| | | | | 48 | 48 | 48 | | .98 | 4 | 192 | |
| | | | | 48 | 48 | 48 | | 1.24 | 5 | 240 | |
| | | | | 48 | 48 | 48 | | 1.47 | 6 | 288 | |
| | | | | 48 | 48 | 48 | | 1.72 | 7 | 336 | |
| | | | | 48 | 48 | 48 | | 1.96 | 8 | 384 | |
| Total | | | | 336* | 336 | 336 | 48 | | | 1680 | |

[2] Elastic limit steel approximately 40,000 pounds.
[3] Detail tests to be published in separate paper.
* Three of these beams were not tested.

The series consisted of 336 beams, together with the corresponding cylindrical and cubical test pieces for compression tests, and 48 bond test pieces to determine the adhesive strength of the aggregates used: Representative material of each of four classes of aggregates, gravel, crushed granite, crushed limestone, and cinders, were used in making up the test pieces, which were tested in triplicate at the ages of 4, 13, 26, and 52 weeks, respectively.

The report of these tests has been confined exclusively to a presentation of test data in such a way as to indicate with considerable certainty the various elements which affect the design of architectural and engineering structures. Studies have therefore been made near maximum load between external load conditions, as measured by the bending moment, and resistance of the beam as determined by the resisting moment. There is included the relation between the unit stress at maximum load and the yield point of the reinforcement.

Studies have been made for maximum load and for unit stresses of 16 000 and 32 000 pounds of the relation between the effective percentage of reinforcement and (1) the resistance of the beam as measured by $\frac{M}{bd^2}$, (2) percentage depth to the neutral axis, (3) unit compressive stress in the extreme upper fiber, (4) the deflection at the center of the beam. The results are presented diagrammatically and in greater detail in tabular form.

The change of such relation with age and the difference due to the nature of the aggregate have also been determined and are presented in the following pages.

The development and spacing of the tension cracks below the neutral axis for the various aggregates, ages, and percentages of reinforcement is plainly shown by photographs of the beams.

There is also included a study of plain concrete in direct compression. The growth in strength with age and the increase in stiffness, as measured by the initial modulus of elasticity, are clearly brought out. The variation with age of the ratio of the yield point to the ultimate strength for the different aggregates has been determined.

No extended discussion of the theory of reinforced concrete is attempted in this bulletin and theoretic formulas have been introduced only where necessary for the intelligent presentation of the data. The formulas used are, however, not original with this bulletin but are based on assumptions which are thought to approximate the truth.

## IV. TESTS OF THE CONSTITUENT MATERIALS

### 1. CEMENT

The cement used in all the tests in these laboratories is known as typical Portland cement. It is prepared by thoroughly mixing together a number of Portland cements. The method of preparing the typical Portland cement that was used in the tests herein reported was as follows:

One thousand eight hundred sacks of cement, 200 from each of nine companies, were used. Two hundred sacks of one brand were spread over a concrete floor 25 by 40 feet in area and thoroughly mixed by hoeing from side to side. Two samples were then taken, a 50-pound sample for tests to be made by the constituent-materials section, and a smaller one for chemical tests. The cement was then resacked. When all the brands had been separately mixed in this way two sacks of each brand were spread on the floor in a layer about 3 inches thick. One brand was spread upon another in blanket form, making nine separate layers of cement for the nine brands used. The mass was mixed very carefully with shovels until a uniform mixture was obtained. A 10-pound sample was taken for physical tests and the cement was sealed in air-tight cans, two cans of 800 pounds capacity each being required to hold one mix.

Table 2 (p. 9) of the present bulletin contains the physical tests on the individual cans of cement which were used in the preparation of all concrete reported in this bulletin. The samples of cement on which these tests were made were taken at the time the typical Portland cement was prepared, just before the individual cans were sealed.

### 2. SAND

The sand used was what is known as Meramec River sand and was identical with that used in the series of plain concrete beams reported in Bulletin 344.[4] The physical properties of this sand are given in Table 3 (p. 11).

### 3. AGGREGATES

With the exception of the cinders the aggregates used were practically identical with those used in the concrete beams reported

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[4] U. S. Geological Survey.

## Table 2.—Physical Properties of Cements Used in First Series

| Reg. No. | Specific Gravity | Temperature, Fahrenheit | | Water, Per Cent | Time of Set, Minutes | | | | Fineness of Residue on Sieve | | Tensile Strength, Age in Days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Vicat | | Gilmore | | | | | | | | | |
| | | Water | Air | | I | F | I | F | 100 | 200 | 1 | 7 | 28 | 90 | 180 | 360 |
| 387 | .... | ... | ... | 20.75 | 240 | 445 | 285 | 480 | 5.25 | 21.75 | 375 | 669 | 747 | 875 | 695 | ... |
| 392 | 3.165 | 75.2 | 87.0 | 21.00 | 130 | 298 | 213 | 365 | 5.20 | 21.50 | 402 | 685 | 814 | 774 | 723 | 793 |
| 397 | 3.162 | 80.0 | 95.0 | 21.00 | 140 | 299 | 236 | 366 | 5.00 | 21.65 | 460 | 711 | 722 | 780 | 748 | 779 |
| 399 | .... | ... | ... | 21.00 | 193 | 385 | 252 | 480 | 5.10 | 21.60 | 277 | 665 | 735 | 899 | 748 | ... |
| 400 | .... | ... | ... | 21.00 | 193 | 406 | 257 | 483 | 5.30 | 21.75 | 277 | 656 | 721 | 807 | 754 | ... |
| 402 | 3.163 | 79.0 | 86.0 | 21.00 | 161 | 310 | 227 | 379 | 5.20 | 21.65 | 416 | 689 | 811 | 783 | 827 | 803 |
| 406 | 3.165 | 79.0 | 86.0 | 21.00 | 157 | 310 | 225 | 385 | 5.00 | 21.60 | 427 | 659 | 828 | 795 | 809 | 823 |
| 419 | 3.165 | 79.0 | 86.0 | 21.00 | 177 | 310 | 239 | 393 | 5.00 | 21.40 | 440 | 688 | 741 | 790 | 789 | 802 |
| 427 | 3.166 | 77.0 | 85.0 | 21.00 | 168 | 342 | 221 | 397 | 5.50 | 22.00 | 447 | 691 | 790 | 797 | 813 | 803 |
| 443 | 3.164 | 79.0 | 86.0 | 21.00 | ... | 310 | 230 | 387 | 4.90 | 21.50 | 427 | 685 | 786 | 791 | 776 | 832 |
| 451 | 3.164 | 75.2 | 87.0 | 21.00 | 137 | 303 | 211 | 366 | 5.45 | 22.80 | 416 | 690 | 795 | 784 | 799 | 823 |
| 453 | 3.163 | 77.0 | 82.0 | 21.00 | 142 | 305 | 282 | 358 | 5.25 | 21.70 | 460 | 675 | 751 | 778 | 778 | 814 |
| 456 | .... | 77.0 | 85.0 | 21.00 | 188 | 343 | 226 | 395 | ... | .... | 455 | 695 | 690 | 779 | 843 | 778 |
| 463 | .... | ... | ... | 21.00 | ... | 335 | 247 | 455 | 5.55 | 21.75 | 224 | 641 | 727 | 876 | 770 | ... |
| 478 | 3.157 | 75.2 | 87.0 | 21.00 | 134 | 303 | 210 | 369 | 5.00 | 21.80 | 422 | 684 | 798 | 787 | 805 | 811 |
| 485 | 3.167 | 68.0 | 71.0 | 20.75 | ... | 395 | 266 | 457 | 5.55 | 22.25 | 290 | 688 | 680 | 786 | 860 | 904 |
| 487 | 3.165 | 68.0 | 73.0 | 20.75 | 207 | 387 | 263 | 453 | 5.35 | 22.30 | 301 | 693 | 789 | 798 | 853 | 861 |
| [5] 490 | 3.168 | 68.0 | 78.0 | 20.75 | 183 | 364 | 236 | 436 | 5.40 | 22.45 | 269 | 702 | 790 | 812 | 853 | 857 |

[5] In water and air warped one sixty-fourth of an inch around edge of pat.

Table 2.—Physical Properties of Cements Used in First Series—Continued

| Reg. No. | Specific Gravity | Temperature, Fahrenheit | | Water, Per Cent | Time of Set, Minutes | | | | Fineness of Residue on Sieve | | Tensile Strength, Age in Days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Vicat | | Gilmore | | | | | | | | | |
| | | Water | Air | | I | F | I | F | 100 | 200 | 1 | 7 | 28 | 90 | 180 | 360 |
| 492 | 3.162 | 80.0 | 89.0 | 21.25 | 148 | 336 | 230 | 406 | ... | .... | 451 | 695 | 783 | 779 | 748 | 753 |
| [6] 493 | 3.172 | 78.8 | 92.0 | 21.00 | 133 | 276 | 204 | 346 | 5.15 | 20.95 | 450 | 698 | 786 | 769 | 772 | 883 |
| 494 | 3.167 | 80.6 | 94.0 | 21.00 | 103 | 267 | 191 | .... | 5.20 | 21.60 | 420 | 724 | 759 | 746 | 754 | 752 |
| 498 | 3.160 | 77.0 | 95.0 | 21.00 | 125 | 285 | 202 | 346 | 4.80 | 21.30 | 460 | 671 | 754 | 760 | 756 | 791 |
| 501 | 3.172 | 80.6 | 98.0 | 21.00 | 127 | 277 | 204 | 346 | 4.85 | 21.60 | 465 | 672 | 763 | 771 | 778 | 820 |
| 503 | 3.163 | 80.0 | 85.0 | 21.25 | 142 | 296 | 217 | 352 | 5.10 | 21.65 | 431 | 692 | 753 | 757 | 740 | 819 |
| 504 | 3.163 | 77.0 | 89.0 | 21.00 | 135 | 287 | 194 | 335 | ... | .... | 455 | 655 | 775 | 762 | 790 | 814 |
| 513 | 3.165 | 68.0 | 71.0 | 20.75 | ... | 382 | 271 | 466 | 5.30 | 22.20 | 321 | 684 | 802 | 813 | 863 | 871 |
| 516 | .... | 68.9 | 89.0 | 20.75 | 155 | 339 | 214 | 383 | 5.40 | 22.35 | 326 | 673 | 784 | 807 | 863 | 898 |
| 518 | 3.163 | 80.0 | 85.0 | 21.25 | 160 | 335 | 264 | 413 | 4.80 | 22.50 | 468 | 679 | 702 | 765 | 767 | 800 |
| 519 | 3.166 | 80.0 | 89.0 | 21.25 | 162 | 334 | 230 | 411 | 5.01 | 20.90 | 440 | 686 | 753 | 778 | 744 | 813 |
| 520 | 3.165 | 79.0 | 82.0 | 21.00 | 164 | 379 | 247 | 440 | 5.30 | 22.65 | 453 | 676 | 775 | 773 | 763 | 788 |
| [7] 523 | 3.160 | 68.0 | 73.0 | 20.75 | 208 | 405 | 282 | 454 | 5.30 | 22.40 | 311 | 690 | 774 | 827 | 865 | 854 |
| 526 | 3.165 | 68.0 | 78.0 | 20.75 | ... | 344 | 239 | 429 | 5.40 | 22.35 | 287 | 697 | 799 | 797 | 860 | 910 |
| Ave.. | 3.165 | 75.8 | 85.0 | 20.97 | 160 | 334 | 235 | 404 | 5.19 | 21.86 | 391 | 683 | 765 | 794 | 791 | 823 |

[6] Steam warped one thirty-second of an inch around edge of pat.
[7] Air warped one sixty-fourth of an inch around edge of pat.

in above bulletin, Table 6, page 17. While the cinders were obtained from the same source as those previously used they came in a different car and were therefore treated as a separate sample. The physical tests on all the aggregates are given in Table 3.

Table 3. —Physical Properties of Sand and Other Materials Forming Aggregates Used in Beams

| Kind of Material | Specific Gravity | Percentage of Voids, Computed | Weight, Pounds Per Cubic Foot | Percentage Passing Sieve or Screen | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 200 | 100 | 80 | 50 | 40 |
| Cinders | 1.750 | ........ | ........ | 2.35 | 3.24 | 3.87 | 4.90 | 5.87 |
| Granite | 2.585 | 40.90 | 95.30 | 1.59 | 2.29 | 2.62 | 3.22 | 3.74 |
| Gravel No. 1, Beams 333 to 388 | 2.450 | 33.00 | 102.40 | 0 | 0 | 0 | 0 | 0 |
| Gravel No. 2, Beams 389 to 416 | 2.479 | ........ | ........ | ...... | ...... | ...... | ...... | ...... |
| Limestone | 2.489 | 37.10 | 97.70 | 2.96 | 3.48 | 3.70 | 4.18 | 4.68 |
| Meramec River Sand No. 1, Beams 162 to 197 | 2.597 | 37.90 | 100.60 | .20 | 1.30 | 3.60 | 13.90 | 37.00 |
| Meramec River Sand No. 2 | 2.619 | 33.89 | 107.91 | .20 | 1.94 | 6.09 | 24.11 | 43.90 |

| Kind of Material | Percentage Passing Sieve or Screen | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 20 | 10 | ¼ inch | ½ inch | ¾ inch | 1 inch | 1¼ inches |
| Cinders | 7.10 | 9.13 | 14.15 | 21.58 | 77.06 | 93.23 | 96.50 | 100.00 |
| Granite | 4.38 | 5.45 | 8.50 | 19.88 | 57.54 | 99.25 | 99.71 | 100.00 |
| Gravel No. 1, Beams 333 to 388 | 0 | 0 | .95 | 43.00 | 79.30 | 95.20 | 98.50 | 100.00 |
| Gravel No. 2, Beams 389 to 416 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | ...... |
| Limestone | 5.23 | 6.21 | 10.69 | 28.71 | 60.86 | 96.04 | 99.37 | 100.00 |
| Meramec River Sand No. 1, Beams 162 to 197 | 64.00 | 81.50 | 97.00 | 100.00 | ...... | ...... | ...... | ...... |
| Meramec River Sand No. 2 | 60.28 | 74.64 | 88.96 | 100.00 | ...... | ...... | ...... | ...... |

### 4. REINFORCEMENT

The maximum load carried by a beam of given dimensions, which is insufficiently reinforced to develop failure by compression and in which the concrete is sufficiently strong to prevent failure by bond or diagonal tension, is proportional to the percentage and to the yield point of the reinforcement. The failure in this case will be caused by the unit stress in the reinforcement exceeding the yield point. If for a given percentage of reinforcement the yield point is low the maximum load carried will also be low as compared with that carried by a beam containing reinforcement having a higher yield point.

In order, however, to establish a consistent relation between the maximum load carried and the percentage of reinforcement, and in order to study the effect of the yield point of the reinforcement on the carrying capacity of the beam, the yield point of all the reinforcement used in a given beam should be identical. If the yield points of the reinforcement used in a given beam vary widely the failure of the beam, instead of being due to the simultaneous failure of all the reinforcement, will be caused by the failure in detail of the reinforcement. The coefficient of elasticity of the reinforcement being independent of the yield point, all the bars in the beam will elongate equally for a uniform, well-bedded vertically and axially loaded beam, for all stresses below that corresponding to the lowest yield point of the reinforcement in the beam. When this lowest yield point has been reached this particular bar will elongate much more rapidly and under a practically constant unit stress, thereby throwing much more of the load on the remaining bars. One would expect, therefore, that the increment of the elongation of the reinforcement for the same increment of load will now be greater than it was when the unit elongation was less than the lowest yield point of the reinforcement.

For bars of different yield points in the same beam the elongation curve of the reinforcement will suffer a change of direction as each bar fails, the curve becoming flatter as the load increases. Where there is considerable difference in the yield point of the reinforcement and for high percentages of reinforcement, this progressive flattening begins at some load prior to maximum load. If the yield point of the bars used is, however, practically identical, the increments of deformation of the reinforcement should be proportional to the increments of load almost to the maximum load.

In order, therefore, to compare the maximum loads carried by identical beams or to study the effect of a change in the percentage of reinforcement the yield point of the reinforcement used in all the beams of a series should, as far as possible, be identical.

The reinforcement supplied to the laboratory was mild steel of presumably 55 000 to 65 000 pounds ultimate strength. It was thought, however, that in the steel as shipped there would be a greater variation in the yield point than should be permissible in a series of tests which it was hoped would furnish data for the conclusive investigation of reinforced concrete. It was therefore necessary to test a coupon from each bar to be used and then classify the steel according to the yield point.

### (a) METHODS OF TESTING REINFORCEMENT

All the steel was tested, using the following method:

After the diameter of the 16-inch coupon had been determined at several points along its length and averaged, two punch marks were made, exactly 8 inches apart. The test piece was then placed between the flat wedges of the grips so that there was a space of about 1½ inches between the punch marks on the test piece and the ends of the wedges. The surface of the steel around the lower punch mark was then whitened with a soapstone pencil. As the load was being applied one operator pivoted one point of a pair of dividers (whose points were firmly clamped 8 inches apart) in the upper punch mark and drew a line on the whitened surface of the steel at the other punch mark. As the steel elongated uniformly below the yield point a series of parallel lines was drawn by the lower divider point, their distance apart for equal load increments being approximately the same. To aid in distinguishing between these lines a magnifying glass was used. Near the yield point a sudden increase was noticed in the distance between these lines for the same increment of load. The unit stress in the steel at that point has been designated "elastic limit (by dividers)." At a somewhat higher unit stress there was a more or less sharp drop of the scalebeam. This unit stress has been called the "yield point." The "ultimate strength" is the maximum unit stress in the steel. The unit stress based on the load at rupture and the original cross section has been called the "breaking strength."

After rupture the character of the fracture, whether silky or granular, was noted and the average diameter of the "neck" calipered. The pieces were then placed together and the percentage elongation read from a special rule. From the measured diameter of the neck the reduced cross section was determined, and the difference from the original cross section was calculated. The ratio of this difference to the original area has been called the "reduction in area."

#### (b) RESULTS OF TESTS OF REINFORCEMENT

The average results of the tests of the reinforcement in each beam have been compiled in Table 4 (p. 121).

Examining the values in column 6 it will be seen that the ultimate strength varies between 52 000 and 64 000 pounds, with the majority lying between 55 000 and 60 000 pounds. The steel therefore corresponds to what is known as "mild" steel.

The elastic limit by dividers varies between 33 000 and 41 000 pounds while the yield point lies between 35 000 and 43 000 pounds. The steel was classified on the basis of the elastic limit, each group differing by 2000 pounds.

The group 37 000 to 38 000 would be limited by unit stresses of 36 500 and 38 499 and similarly for all groups. The steel was first classified on this basis, but it was noticed that the values obtained for the elastic limit were subject to much more variation than was the case for the yield point. This was due to the fact that the operators found great trouble in fixing definitely the point at which the rate of change of the distance between the closely drawn parallel lines on the surface of the steel would change.

In all steel classified subsequently, the groups were based on the yield point, which, for mild steel at least, is a very definite point and independent of any personal equation of observation.

The average tests on reinforcement compiled in this table represent 1260 tests and furnish ample data for the study of the relation between the various qualities reported.

An examination of this table will show that for even the same or practically identical ultimate strengths there may be considerable variation in the elongation and in the reduction in area.

A considerable difference is noticeable in the yield point of steel having the same ultimate strength, the difference in some cases being as much as 5 000 pounds per square inch.

The change in the yield point and the ultimate strength do not necessarily go hand in hand, an increase in the ultimate strength not always being accompanied by an increase in the yield point.

A rough comparison showing the variation of the various qualities with a change in the ultimate strength can readily be made, and is summarized below:

Table 5.—Effect of Changes in Ultimate Strength of Reinforcement

(MILD STEEL)

| Elastic Limit (Pounds Per Square Inch) | Yield Point (Pounds Per Square Inch) | Ultimate Strength (Pounds Per Square Inch) | Percentage Elongation in 8 Inches | Percentage Reduction in Area | Number of Tests Averaged |
|---|---|---|---|---|---|
| 36 100 | 38 600 | 53 400 | 30.1 | 72.5 | 10 |
| 39 400 | 41 100 | 60 900 | 28.2 | 59.7 | 12 |
| 37 300 | 44 000 | 72 800 | 23.6 | 53.0 | 5 |

In comparing the values in these tables, however, it should be borne in mind that the extreme variation in the value of the ultimate strength occurs within comparatively narrow limits and that the tests were made on coupons tested just as they were cut from the bar and not on turned test pieces.

## V. DETAILS OF TESTS

### 1. DESCRIPTION OF TEST PIECES

#### (*a*) BEAMS

The beams, 13 feet long, 8 by 11 inches in cross section, were tested on a 12-foot span by two equal loads applied at the third points. The cross sections of the various beams, giving the horizontal and vertical spacing of the reinforcement are shown in Fig. 1.

The reinforcement throughout consists of one-half inch round bars having a yield point of approximately 40 000 pounds. The percentage of reinforcement was varied by changing the number of bars. For all percentages above 1 the size of the beam

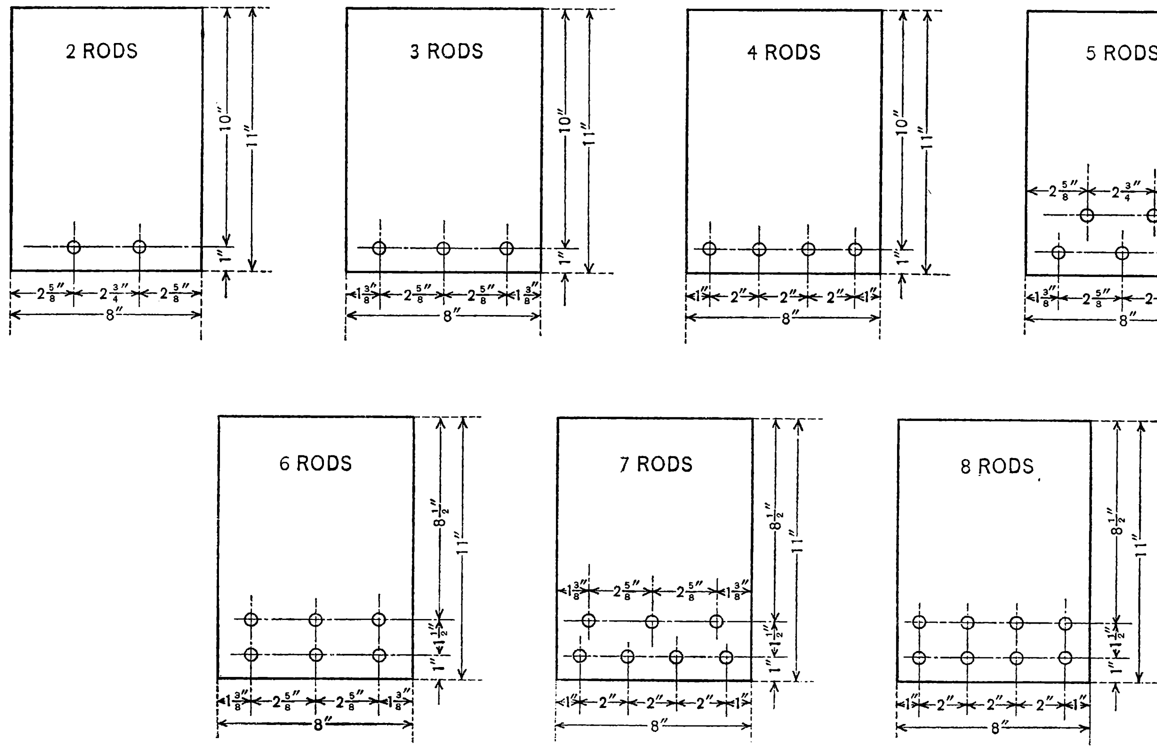


Fig. 1.—*Distribution of Reinforcement*

used made it impossible to place the reinforcement in a single layer. For these percentages the reinforcement was therefore placed in two layers, the depth from the top of the beam being 8½ inches to the center of the top layer and 10 inches to the center of the bottom layer. The "nominal" percentages of reinforcement 0.5, 0.75, 1, 1.25, 1.50, 1.75, and 2, corresponding to 2, 3, 4, 5, 6, 7, and 8, one-half inch round bars respectively were based on the cross section of the beam above the lower layer of bars. The percentages thus obtained are not, however, the effective percentages that determine the resistance of the beam. The method of obtaining the "effective" percentages will be described in detail later.

#### (*b*) COMPRESSION TEST PIECES

The cylindrical test pieces were 8 inches in diameter by 16 inches in length while the cubes were 6 inches on the side.

#### (*c*) BOND TEST PIECES

For the bond test pieces a one-half inch round bar was embedded on the axis of a cylinder (8 inches in diameter and 6 inches in length) so that one end projected one-fourth inch beyond the cylinder and the other end projected sufficiently to permit gripping it in the jaws of the testing machine.

### 2. METHOD OF MAKING TEST PIECES

#### (*a*) PROPORTIONS

A 1 : 2 : 4 volume proportion was adopted for all the concrete used in the following tests. Since, however, the volume of a given weight of dry sand is greatly affected by the percentage of moisture present, it was thought best to do the actual proportioning by weight. The weight of 1 cubic foot of cement was assumed to be 100 pounds. The weight per cubic foot of the dry, loose sand and the dry, loose aggregate as determined by tests in the constituent-materials laboratory, was used in reducing the proportions by volume to the proportions by weight.

With this as a basis, the necessary weight of dry material for the desired batch was determined. Since the sand and stone, as stored in the bins, contained an appreciable amount of moisture, the dry weight of the material had to be increased by the weight of the moisture present before the batch could be weighed out.

The percentage of moisture was determined on a 500-gram sample of the sand and stone representing as nearly as possible an average of the material in the bin and this was then maintained constant.

(b) MIXING

All concrete was mixed in a motor-driven cubic-yard cube mixer, equipped with a charging hopper. All water used in mixing concrete was weighed and supplied to the mixer through a hose attached to a water barrel, mounted on a platform scale on a support above the mixer. To insure uniform conditions the interior of the mixer was wet down each morning before the first mix of the day. All concrete was mixed two minutes dry and three minutes wet, after which it was dumped on the cement floor, shoveled in wheelbarrows and wheeled to the molding floor. Sufficient material was charged into the mixer to make three beams, three cylinders, and three cubes from the same batch of concrete.

In order to eliminate the personal equation as far as possible, the amount of water required to bring the batch to the desired consistency for a particular aggregate was carefully determined by trial before the test pieces were molded. Thereafter the weight of water to be used with each aggregate for that consistency could be obtained by making a simple correction, depending upon the percentage of water contained in the aggregate as it came from the bins. The total amount of water, including moisture, was expressed as a percentage of the total weight of the dry material and was maintained constant.

Concrete of medium consistency had a smooth appearance in the mixer, but showed a tendency to lump. When dumped, it stood in a pile with steep slopes, exhibiting a somewhat lumpy appearance and showing individual stones, but no voids. The stones showed an even coating of mortar. No water collected on the surface of the beam in the mold. The surface was easily finished with a trowel.

(c) MOLDING

The beam molds consisted of three long steel channels with flanges turned outward, forming the sides and bottom of the mold.

The ends were closed by short pieces of channels. The side and end pieces were removable. The molds were oiled before the concrete was placed, to prevent adhesion to the surface of the steel. In molding reinforced concrete beams two methods were used, depending upon whether the reinforcement was placed in one or two layers.

Where the reinforcement was in one layer it was placed 1 inch from the bottom of the beam. Sufficient concrete was first placed in the bottom of the mold to bring the surface of the layer a little above the center of the reinforcement. After this layer had been tamped once with a hand tamper, the reinforcement was placed upon it and held in the proper position by slotted wooden templets. The reinforcement was then tamped down into the concrete the required depth; the distance from the top being gauged by means of a T-shaped templet, the arms of which rested on the top of the sides of the mold and the end of the leg on the reinforcement. The concrete was then placed in three equal layers, each layer being tamped once, then spaded back from the surface of the mold and tamped again. The tamping was done by a pneumatic tamper working under 60 pounds pressure and having a 3 by three-fourths inch rectangular head.

Where the reinforcement was in two layers the manner of placing the first layer of concrete and the bottom layer of reinforcement was identical with that followed when there was but one layer of reinforcement. When the lower layer of reinforcement had been placed a layer of concrete was added of such a thickness that, when tamped, its surface came almost to the depth of the center of the upper layer of reinforcement which was placed 2½ inches from the bottom of the beam. This layer of reinforcement was then placed in the same manner as the first layer. The concrete in the remainder of the beam was placed in three layers in the usual manner and the top troweled.

The molds were removed at the end of 24 hours and the beams covered with burlap until, at the end of from two to three weeks, they were moved into the damp closet. Both before and after being placed in damp closet they were sprinkled every eight hours. The temperatures on the molding floor and in the damp closet were maintained as near 70° F as possible.

### 3. METHODS OF TESTING TEST PIECES

#### (a) BEAMS

The method of testing reinforced beams has been described in a previous bulletin[8] but it is thought best to repeat some of this information for the purpose of facilitating the study of the results.

Fig. 2 shows a reinforced beam under load with all the attachments. The construction of the box girder, through which the load is transmitted to the beam, and the deformeter are fully described in Bulletin 329.[8] While the gauge length, 29.25 inches, was the same as that used in the tests on plain beams, the vertical spacing of the contact points was different, the upper point being 0.5 inch below the top, while the lower one was placed 1 inch above the bottom of the beam on the plane of the lower layer of reinforcement. By this arrangement the elongation of the reinforcement in the lower layer was read directly, no error due to the reduction of the readings from one horizontal plane to another being possible. The only source of error with this arrangement would be the irregularity in the vertical position of the reinforcement and on the assumption that the elongation read by the micrometers is the uniform lengthening of the reinforcement in the gauge length, uninfluenced by the incasing concrete and free of any comparatively large local elongations where the reinforcement spans a crack in the concrete.

Since the upper contact point is placed 0.5 inch below the top surface of the beam it does not record the exact total deformation of the extreme outer fiber, at which crushing will first appear. With the usual arrangement of deformeters in which the contact points are clamped against the sides of the beam this is the only method possible and it therefore becomes necessary to reduce the readings of the upper micrometer to the outer fiber, making the usual assumption of conservation of plane section.

The deflections were read directly to the nearest 0.005 inch by a wire fastened at each end of the beam, at a point 4 inches below the top surface, and passing in front of a mirror and scale fastened to the center of one face of the beam. The scale was graduated to 0.01 inch, but by reading always the same part of the top or bottom

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[8] U. S. Geological Survey.

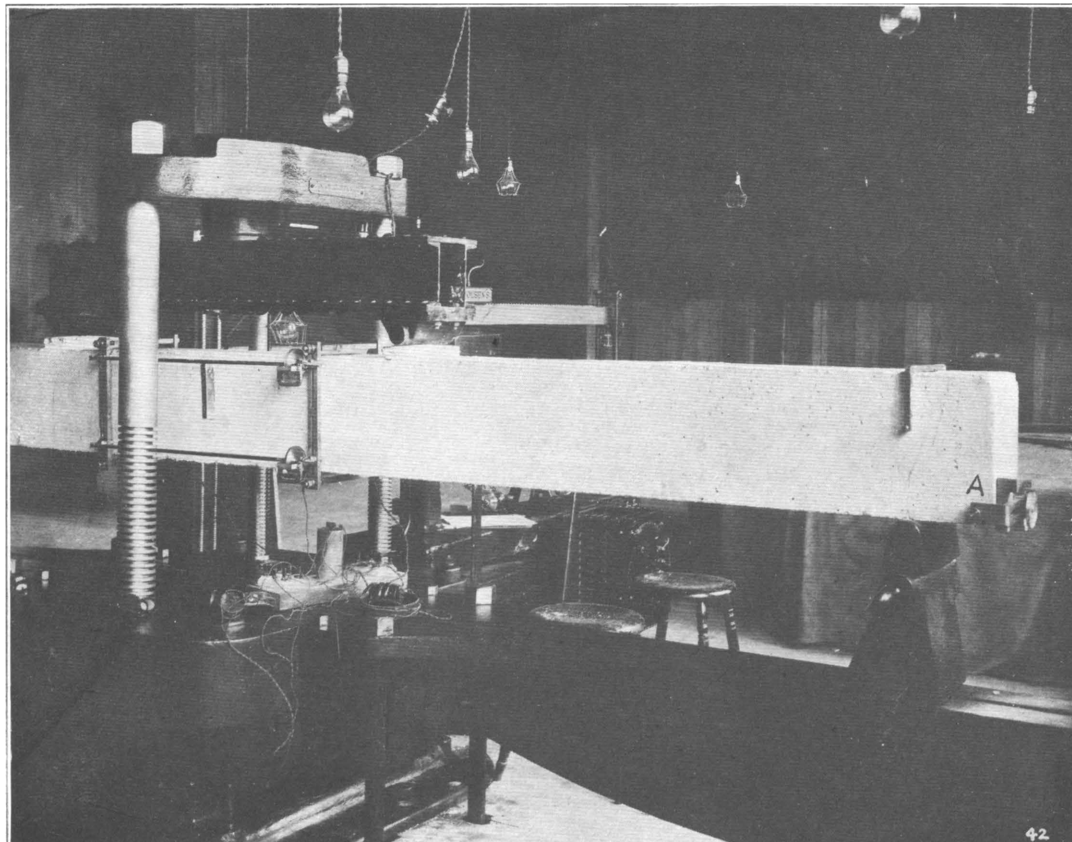


**Fig. 2.**—*Beam with Electric Contact Deformeters*

of the wire when it coincided with its image in the mirror 0.005 inch could be easily and accurately measured.

In order to measure any slip that might occur between the end of the reinforcement and the adjacent concrete, a stirrup (Fig. 3) was clamped to the beam, with the contact points in the plane of the reinforcement. This stirrup carried a micrometer screw reading directly to 0.0001 inch, which bore against the smoothed end of one of the reinforcing bars in the lower layer. Since if a slip occurs it is usually an appreciable quantity the readings for these micrometers were thought sufficiently accurate if read by manual contact, and consequently no electric circuit was used.

The electric-contact deformeters were used on all beams with the exception of a few of the 13 and 26 week tests on which Johnson deformeters (Fig. 3) were used. In this type of instrument the rod extending from one yoke to the other is pivoted at one end similarly to that for the electric-contact deformeters. To the other end of the rod is fastened a slip of metal, which rests lightly on a small drum fastened to a little shaft, to one end of which a pointer is attached. One end of the pointer carries a vernier which travels along a circular scale on the circumference of a dial in which the pointer moves. By means of the vernier, deformations can be read to 0.0001 inch.

In order to trace the development of cracks on the surface of the beam it was necessary to examine it with magnifying glasses. In examining the surface of the beam within the gauge length it was almost impossible to avoid disturbing the rods extending across the surface from one deformeter yoke to another. In the case of the Johnson deformeters this was a very serious matter, for any movement or jarring of the rod would result in a permanent movement of the indicating pointer over the face of the dial so that the reading of any dial in this case would be the legitimate movement due to the deformation of the concrete between the contact points, plus or minus the movement caused by any disturbance to the rods.

A disturbance of the rods where the electric-contact deformeters were used made no material difference, since a reading of the micrometers could be only taken when the end of the micrometer screw bore against the end of the rod and caused the closing of an electric circuit. After this reading was taken the screws would, in any case, be turned back a little, in order to prevent the end of the micrometer screw jamming against the end of the rod when load was being applied. What happened to the rod between readings was comparatively unimportant; provided, always, that the fixed end of the rod was always pressed home snugly and the free end returned to its position in the grooved roller when being replaced.

When, therefore, the surface of the beam was being examined for cracks the lower rod would be removed, and replaced when more load was being applied.

The method of "zero moments" described in detail in Bulletin 344 [9] was used on the reinforced beams. While this method seems warranted for the deformations it has no rational basis for the deflections. Since, however, the deflection curve for loads below that which causes the concrete to crack on the tension side is practically a straight line the position of the deflection due to the weight of the beam could be estimated on this assumption with but little error.

While in the majority of cases load increments of 1000 pounds were used throughout the greater part of a beam test, no arbitrary set of loads was adopted and used. The increments of load applied were determined largely by the aggregate and percentage reinforcement as well as the behavior under load. In all cases the attempt was made to so choose the loads that the greater number of points would be obtained where the deformation curves suffered a change of direction. Such points would occur when the beam first commenced cracking and for some little time after that, depending on the percentage of reinforcement. Near maximum load and particularly for the higher percentages of reinforcement and the weaker aggregates the deformation curves would in many cases again change their direction, making a greater number of points desirable in order to accurately define the curve.

In some cases, with the low percentages of reinforcement in the four-week tests, the increments of load were as low as 250 to 500 pounds while for higher percentages and greater ages 1000-pound increments could be used throughout.

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[9] U. S. Geological Survey.

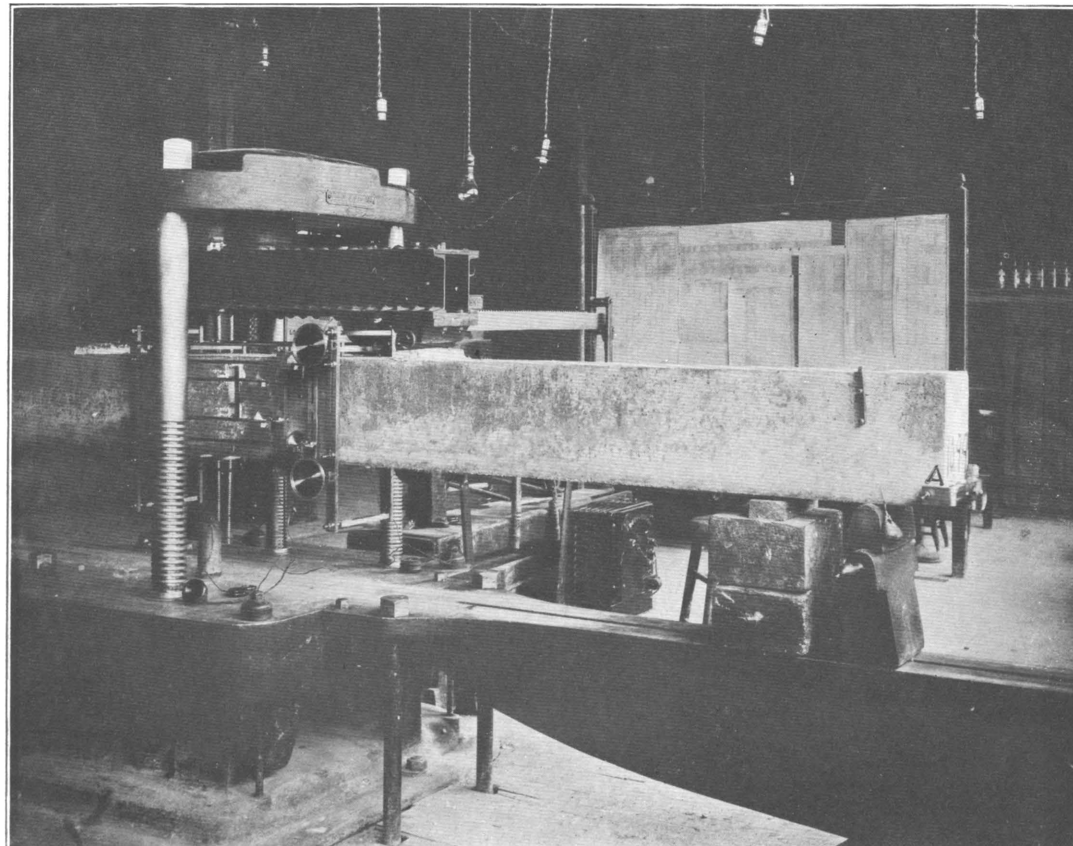

Fig. 3.—*Beam with Johnson Deformeters*

In the earlier tests, in order to more definitely fix the load at which the first crack appears, the surface of the beam was examined after the application of each increment of load succeeding that at which the rate of change of the deformations was seen to increase. It was soon noticed, however, that a beam at this stage could not be permitted to rest under load for the time necessary to hunt for cracks, since a noticeable flattening of the deformation curves would occur due to this rest. In order to prevent this the surface of the beam was examined only after each 1000-pound increment during this period of the test, although deformations might have been read for every 250 or 500 pounds. In many cases there is, therefore, an apparent discrepancy between the loads at which the first crack appears in three identical test pieces. If the development of cracks is traced only after each 1000-pound increment of load and in one case a crack appears between 2750 and 3000 pounds load, while in another identical test piece it occurs between 3000 and 3250 pounds, in the first instance the first crack would be recorded at 3000 pounds, while in the latter it would be reported for 4000 pounds. Under these conditions a total maximum apparent discrepancy of nearly 1000 pounds could be reported.

The frequency with which the development of cracks was traced was governed entirely by the behavior of the beam under load. If it was noticed that the cracks increased in height very slowly between successive load increments, cracks would be traced every other load or even less frequently if the case would warrant it.

The endeavor was made in each case to trace the essential development of the cracks but not every detailed change. It is not possible to obtain a detailed history of the development of the cracks and an accurate set of deformation readings from the same beam, since, in order to trace the cracks, the beam must remain under load for a considerable time and the deformation readings are consequently affected.

For each increment of load there were four micrometers to be read. It was desirable to read these simultaneously at all times but particularly so near maximum load to eliminate the effect of rest on the concrete for those beams that failed by compression, and in order to obtain the exact elongation of the reinforcement for those that failed by tension to compare it with that corresponding to the yield point.

When, therefore, the rapid increase of the readings of the upper micrometers indicated the proximity of a compression failure, these were read first while, if the elongation of the steel approached that for the yield point, the lower micrometers were not only read first but read continuously as the load was applied. This was made necessary by reason of the fact that, when approaching maximum load, the elongations are increasing regularly, the increment of deformation being proportional to the increment of load. At the instant that maximum load is reached, there is a sudden sharp drop of the scalebeam and a correspondingly sudden large increase in the elongation of the reinforcement. This behavior necessitates reading both lower micrometers simultaneously and continuously and recording the last reading previous to the sudden increase in the deformation.

The time required to take the four micrometer readings and the deflection varies from 30 to 45 seconds so that the effect of rest between the separate micrometer readings may be considered negligible.

As the cracks developed their course was traced with a lead pencil on the surface of the beam, a short line being drawn across the crack at the point where it became invisible. At this point the applied load at that particular time is marked on the beam. After testing, the beams (piled in groups of three identical test pieces, with the cracks and numbers marked with black paint) were photographed. These photographs, giving a complete history of the development of the cracks, are shown in Figs. 22 to 30, facing page 96.

(*b*) COMPRESSION TEST PIECES

The cylinders and cubes are tested on a four-screw 200 000-pound machine. To insure an even distribution of load over the entire cross section the ends of the cylinders are bedded in plaster of Paris to a thickness of about one-half inch on a piece of plate glass (previously oiled to prevent adhesion of the plaster). The bearing surfaces are made normal to the axis of the cylinder by means of a spirit level applied to its sides. The cubes are not capped with plaster of Paris, but a thin piece of asbestos is placed on a spherical bearing plate when under test, in order to take up all nonparallelism of the ends.

The load is in each case carried to failure, being applied continuously to rupture in the case of the cubes and in increments of 5000 pounds, or approximately 100 pounds per square inch, for the cylinders. For each increment gross deformations are read on two opposite sides of the cylinder over a gauge length of 12 inches.

## 4. METHODS OF COMPUTATION

### (a) BEAMS

Throughout this Bulletin a "parabolic formula" has been used in discussing the resistance of reinforced concrete to flexure. This was thought necessary, as it was desired to have a close agreement between the external bending moment, based on the loading and dimensions, and the internal resisting moment, based on the stresses and position of the neutral axis. In the formulas used, the character of the deformation curve of the concrete in compression is determined by the percentage of the ultimate compression deformation which has been developed for that particular concrete in the beam under discussion. Even if there were but little difference in the stress deformation curve in compression for different materials (which is not the case), the varying percentages of reinforcement used in the beams develop widely different compressive deformations at maximum load and consequently different distribution of the compressive stresses. For working stresses, the differences are probably small. For some of the beams one would expect considerable variation in the results obtained with different assumptions as to the distribution of the stress, particularly those with the higher percentages of reinforcement and all the cinder concrete. While it would have been very desirable to use the actual percentage of the ultimate compressive deformation that was developed in each beam in the computations, the large number of beams to be reviewed made necessary the assumption of some average stress deformation relation, to be kept constant throughout all computations. It was therefore assumed that one-half the ultimate deformation of the concrete in compression was developed in the upper fiber of the reinforced concrete beams. For independent analysis of the results of this series, the logs of the tests are given on pages 142 to 200.

The symbols and the formulas used in these tests are the same as those used in Bulletin No. 4 of the University of Illinois Engineering Experiment Station[10] and their derivation will therefore not be repeated here. The formulas there given, however, are applicable only to reinforcement placed in one layer and the modification necessary to adapt them to reinforcement in two layers will therefore be given.

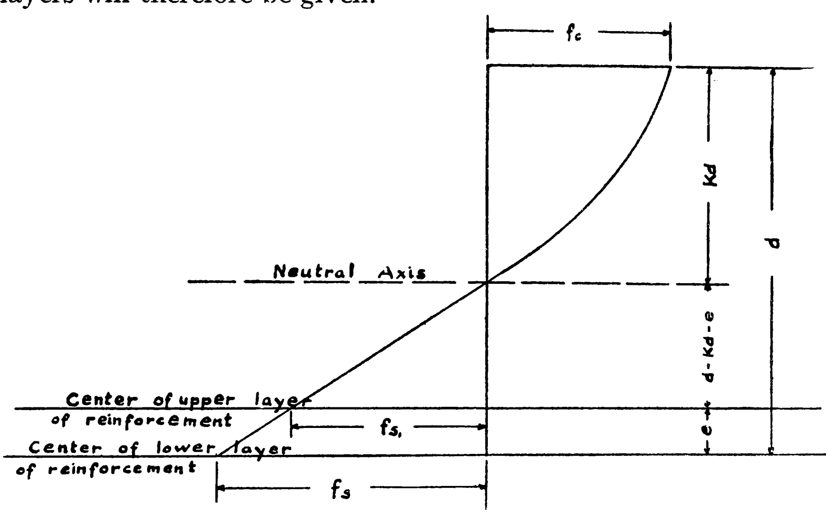


Fig. 4.—*Illustration of Symbols*

**(1) Definition of Symbols Used.**—

$b$ = breadth of beam, in inches.

$d$ = depth of beam, in inches, to center of lower layer of reinforcement.)

$e$ = distance, in inches, between center of lower and center of upper layer of reinforcement.

$z$ = distance, in inches, from top of beam to the center of gravity of the compressive stresses.

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[10] Talbot, A. N., Tests of Reinforced Concrete Beams, Series of 1905, University of Illinois Bulletin, vol. 3, No. 14, 1905.

(1) **Definition of Symbols Used**—Continued.

$Kd$ = distance, in inches, from the top of the beam to the neutral axis. (The distance is obtained directly from the measured deformations of the concrete and the reinforcement.)

$A$ = total area, in square inches, of reinforcement in lower layer.

$A_1$ = total area, in square inches, of reinforcement in upper layer.

$q$ = ratio of the unit compressive deformation of the concrete developed in the beam for any given load to the ultimate compressive deformation of that concrete.

$m$ = number of bars in lower layer of reinforcement.

$o$ = circumference of each bar.

$\Sigma_o$ = sum of circumferences of all bars.

$p$ = "nominal" percentage of reinforcement based on the area of the concrete above the center of the lower layer of steel.

$f_s$ = unit stress in lower layer of reinforcement.

$f_{s1}$ = unit stress in upper layer of reinforcement.

$f_c$ = unit compressive stress on extreme fiber of beam.

$M$ = total bending moment or total resisting moment, in inch pounds.

$V$ = total vertical shear in pounds.

$u$ = bond stress per unit area of surface of bar.

The general formula for the resisting moment of beams containing but one layer of reinforcement expressed in terms of the unit stress in the reinforcement, and neglecting all tensile stresses in the concrete is

$$M = Af_s\ (d-z).$$

In Bulletin No. 4 above referred to it has been shown that $z$ varies with the different assumptions made as to the shape of the stress deformation diagram for concrete in compression and with the magnitude of the stress. For a straight line stress deformation diagram for concrete in compression $z = \frac{1}{3}Kd$ while for $q = 1$, i. e., for a beam that fails in compression, $z = 0.375\ Kd$. For beams in which the compressive strength of the concrete is not developed $z$ lies between 0.33 $Kd$ and 0.375 $Kd$. For our case $q$ has been made equal to one-half and is kept constant throughout all computations.

(2) **Formulas for Reinforcement in One Layer.**—The formulas given in Bulletin No. 4 of the University of Illinois Engineering Experiment Station were used directly and are given below:

$$M = Af_s\,(d - 0.35\,Kd) \qquad (1)$$

$$f_c = \frac{2pf_s}{K} \times \frac{1 - \frac{1}{2}q}{1 - \frac{1}{3}q} \qquad (2)$$

$$u = \frac{V}{om(d - 0.35\,Kd)} \qquad (3)$$

for $q = \frac{1}{2}$, equation (2) becomes

$$f_c = \frac{1.8\,pf_s}{K} \qquad (4)$$

While equation (4) was used throughout all the computations it was thought advisable to give equation (2) from which it is derived. Whether a straight line stress deformation diagram or a parabola with the apex at the extreme fiber is chosen makes very little difference in the values of $M$ or $u$. This is not the case, however, with the values of $f_c$. While for a straight line formula the resisting moment will differ but little from that when the parabola is used, the unit compressive stress for the former case will be 33 per cent higher than in the latter. This difference will become smaller and smaller as the ratio of the compressive deformation developed in a given beam to the ultimate compressive deformation of the concrete decreases. It should, therefore, be realized that the unit compressive stress in the extreme fiber of those beams having a high percentage of reinforcement, particularly for the cinders and perhaps the majority of the four week tests, may be as much as 20 per cent high.

With equation (2), however, any one who cares to do so can analyze the results using the actual values of $q$.

(3) **Formulas for Reinforcement in Two Layers.**—For any given distribution of reinforcement and a given fraction of the ultimate deformation of the concrete developed, the position of

the center of the compressive stresses is fixed. It has been indicated above that the variation in the position of the center of the compressive stresses, for varying intensities of stress in the concrete, is very small, and that the position as governed by this variable can be considered constant.

The theoretical influence on the position of the neutral axis of a distribution of the reinforcement in more than one layer has not been determined, since the position of the neutral axis that is used in the computations is determined directly from the measured deformations assuming conservation of plane section.

(4) **Formula for Unit Stress in Lower Layer of Reinforcement.**—If, then, we may consider the position of the center of compressive stresses as known for a particular case, we may write the following expression for the total bending moment at the center of the beam:

$$M = A_1 f_{s1}(d - 0.35\ Kd - e) + A f_s(d - 0.35\ Kd) \qquad (5)$$

Within the elastic limit of the steel

$$\frac{f_{s1}}{f_s} = \frac{d - Kd - e}{d - Kd}$$

Substituting this value of $f_{s1}$ in (5)

$$M = \frac{A_1 f_s\,(d - 0.35\ Kd - e)\ (d - Kd - e)}{d - Kd.} + A f_s(d - 0.35\ Kd) \qquad (6)$$

This formula gives the unit stress in the lower layer of reinforcement, provided the elastic limit of the reinforcement is not exceeded.

(5) **Formula for Unit Compressive Stress in Extreme Fiber of Beam.**—For the reinforcement arranged in two layers equation (2) must be modified as follows:

The sum of all the tensile stresses is now $A_1 f_{s1} + A f_s$

but
$$\frac{f_{s1}}{f_s} = \frac{d - Kd - e}{d - Kd}$$

Making these changes in equation (2) we obtain

$$f_c = \frac{2 f_s[A_1\,(d - Kd - e) + A\ (d - Kd)]}{Kbd\,(d - Kd)} \times \frac{1 - \frac{1}{2} q}{1 - \frac{1}{3} q} \qquad (7)$$

For the approximate formula $q = \frac{1}{2}$ we obtain

$$f_c = \frac{1.8 f_s [A_1 (d - Kd - e) + a (d - Kd)]}{Kbd (d - Kd).} \qquad (8)$$

**(6) Formula for Unit Bond Stress.**—For the reinforcement placed in two layers, it has been proven (6)

$$M = \frac{A_1 f_s (d - 0.35\, Kd - e)\ (d - Kd - e)}{d - Kd} + A f_s (d - 0.35\, Kd)$$

Differentiating

$$\frac{\delta M}{\delta x} = \left[\frac{A_1 (d - 0.35\, Kd - e)\ (d - Kd - e)}{d - Kd} + A\ (d - 0.35\, Kd)\right]\frac{\delta f_s}{\delta x}$$

But
$$\frac{\delta M}{\delta x} = V$$

Therefore

$$V = \left[\frac{A_1 (d - 0.35 Kd - e)\ (d - Kd - e)}{d - Kd} + A\ (d - 0.35 Kd)\right]\frac{\delta f_s}{\delta x} \qquad (9)$$

But
$$A\ \delta f_s = \Sigma_0 u \delta x$$

Therefore
$$\frac{\delta f_s}{\delta x} = \frac{u \Sigma_0}{A}$$

Substituting this value of $\frac{\delta f_s}{\delta x}$ in equation (9) and solving for $u$

$$u = \frac{VA\ (d - Kd)}{\Sigma_0 [A_1 (d - 0.35 Kd - e)(d - Kd - e) + A (d - 0.35 Kd)(d - Kd)]} \qquad (10)$$

If in equation (10) $A_1$ is made zero

$$u = \frac{V}{\Sigma_0\ (d - 0.35\, Kd)}$$

which is the formula for reinforcement in one layer.

### (b) COMPRESSION TESTS

The compression tests reported in this paper were made primarily with a view of determining the elastic behavior and the ultimate strength of the concrete that was used in the corresponding reinforced beams. While it was thought necessary to have the ultimate strength of the concrete as given by a compression test in order to compare with the computed extreme fiber stress of any beams that might fail by the compression of the concrete in the upper fiber, it is also thought extremely desirable to have a complete record of the elastic behavior of the concrete under pure compression. By comparing the extreme fiber stress, as computed from the bending moment for a given load, with the unit compressive stress for the same unit deformation of the cylinder, the relation between the behavior of concrete in direct compression and in compression in a beam may be established.

The stress deformation curve of the cylinders is further useful in determining the character of the stress deformation curve of the concrete in compression in the beam.

No study of the possible influence of the initial modulus of elasticity of the concrete upon the position of the neutral axis, as given by a theoretical formula, can be made, unless this quantity is observed in a compression test.

Considered apart from their value in aiding in the interpretation of the tests on the reinforced beams, these tests in themselves form a very complete investigation of the compressive strength of concrete.

For each age and aggregate 21 beams were molded, three each for seven percentages of reinforcement. For each beam one cylinder and one cube were molded, making 21 identical test pieces of each. It seems reasonable to believe therefore that the accuracy of any relations brought out by the average of such a large number of tests will have sufficient weight to warrant the almost self-evident conclusions that have been arrived at by a study of the present tests.

(1) **Definition of Terms and Symbols.**—While the significance of the terms and symbols used in these tests is similar to those used in other investigations, it is thought advisable to define them briefly here.

*Weight in Pounds per Cubic Foot.*—This was computed from the weight as obtained for the cylinder or cube as it was brought from the damp closet and the volume as given by the measured dimensions.

*Ultimate Strength.*—The ultimate strength was obtained by dividing the maximum load carried by the test piece by the actual sectional area as given by the measured dimensions.

*Initial Modulus of Elasticity.*—This term is defined as the ratio of the unit stress to the unit gross deformation, as given by the ordinate and absiccæ of a point on a line drawn tangent to the initial part of the curve, or coincident with it when there is straight line variation. The direction in which this line is to be drawn is determined by eye on the plotted curve, the aim being to draw a straight line through as many points as possible even if by so doing it will not pass through the origin.

*Yield Point.*—At some unit stress, which differs with the material and age, the curve showing the relation between the unit stresses and the corresponding unit gross deformations will turn from the line of the initial modulus of elasticity. Below this point, which is herein called the "yield point, the unit stresses are directly proportional to the unit deformations.

*Stress Ratio of Cylinders to Cubes.*—This ratio is obtained by dividing the ultimate strength of the cylinders by the ultimate strength of the cubes.

## VI. RESULTS OF TESTS

### 1. BEAMS

The complete log of all beam tests is given in Appendix II, page 142.

Some of the results of the tests of reinforced concrete beams are summarized in Tables 6 to 21, facing page 128, and typical curves are shown in Figs. 41 to 45.

It is not the aim of these tables to present the results of a detailed study of the tests, but rather the values that are usually used in the design of a beam. The greater part of each table has therefore been devoted to a comparison of the resisting moment with the bending moment, and the relation between the unit stress in the reinforcement at the failure of the beam and the yield point of the reinforcement used. The unit compressive stress in the extreme fiber of the beam, as figured from the bending moment

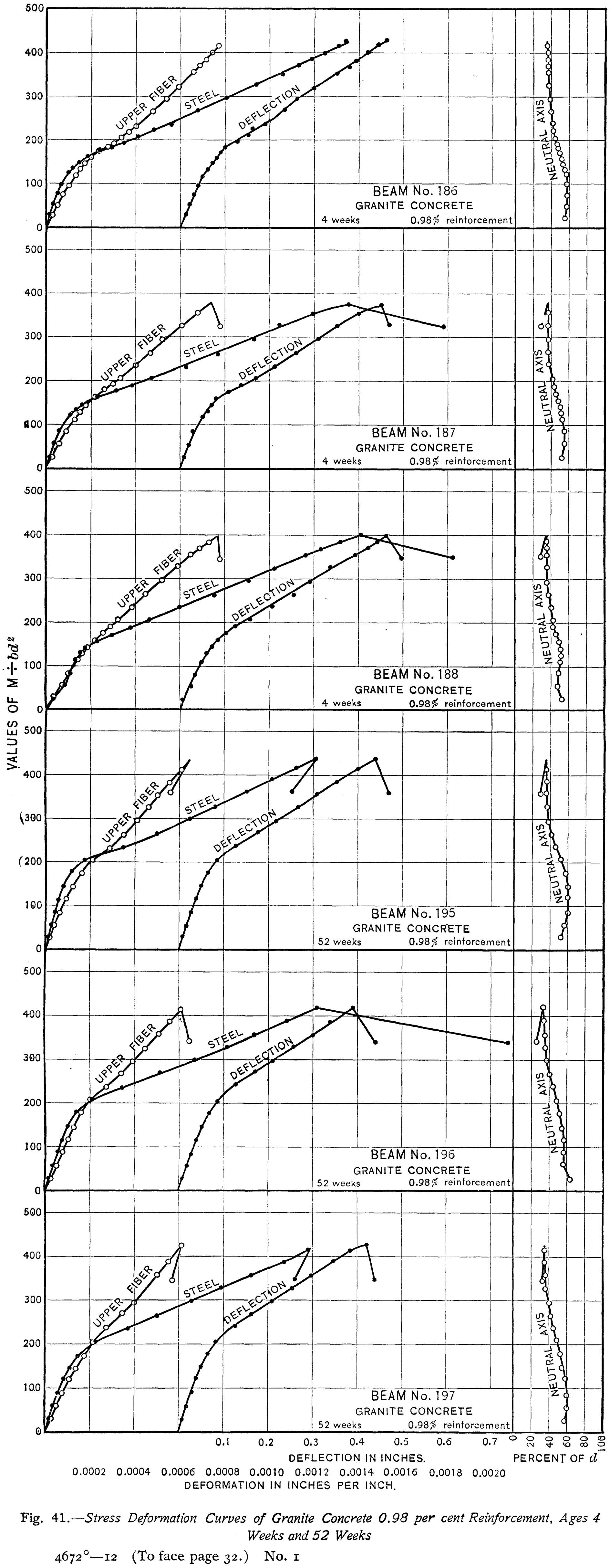


Fig. 41.—*Stress Deformation Curves of Granite Concrete 0.98 per cent Reinforcement, Ages 4 Weeks and 52 Weeks*

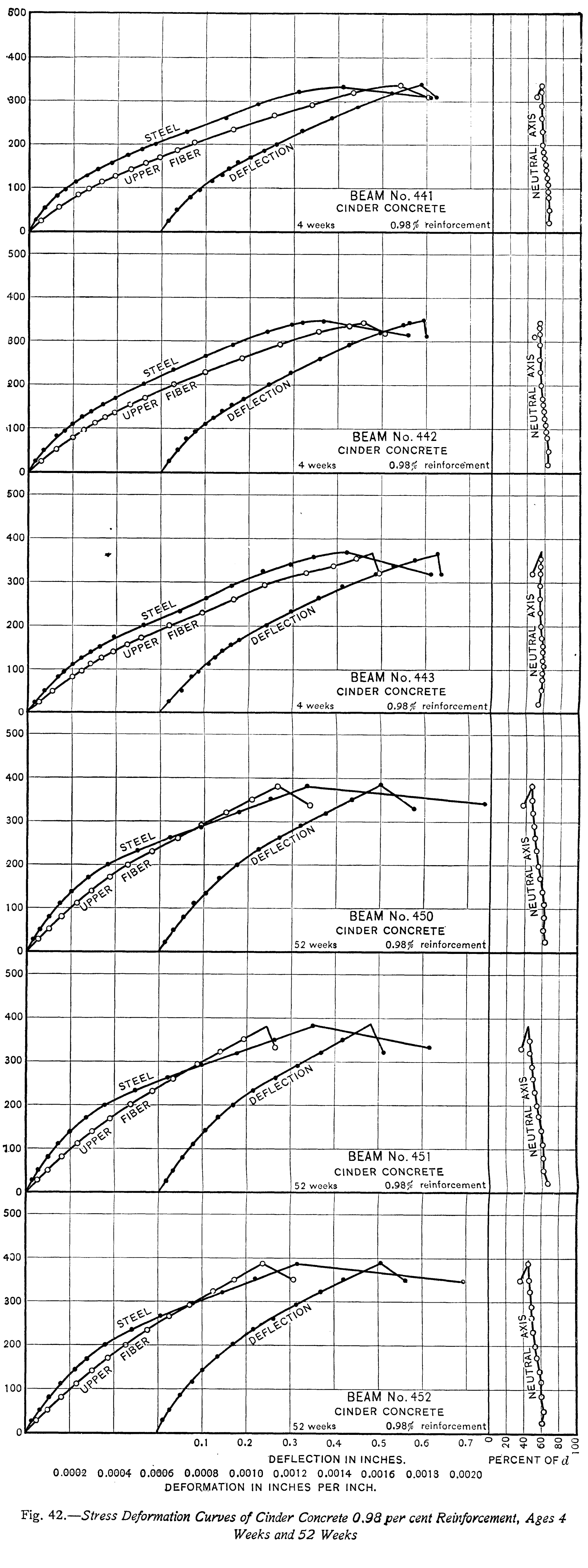


Fig. 42.—*Stress Deformation Curves of Cinder Concrete 0.98 per cent Reinforcement, Ages 4 Weeks and 52 Weeks*

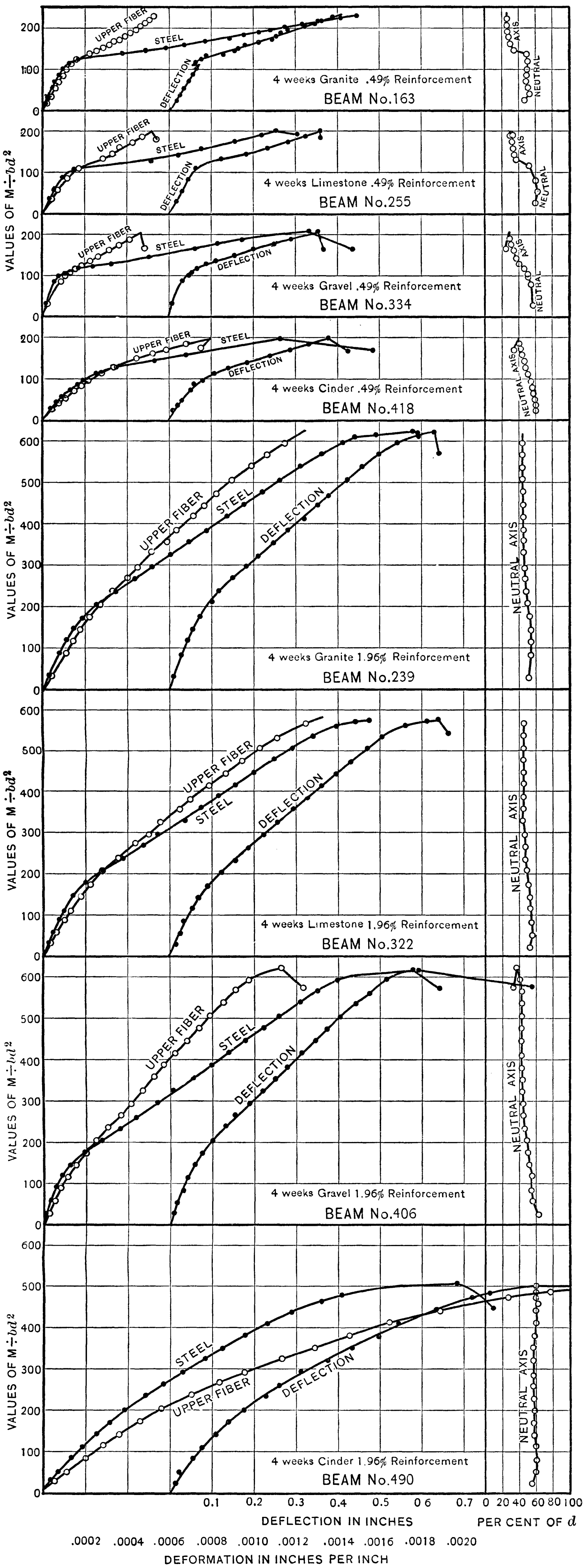


Fig. 43.—*Stress Deformation Curves of Different Aggregates at 4 Weeks with .49 and 1.96 per cent Reinforcement*

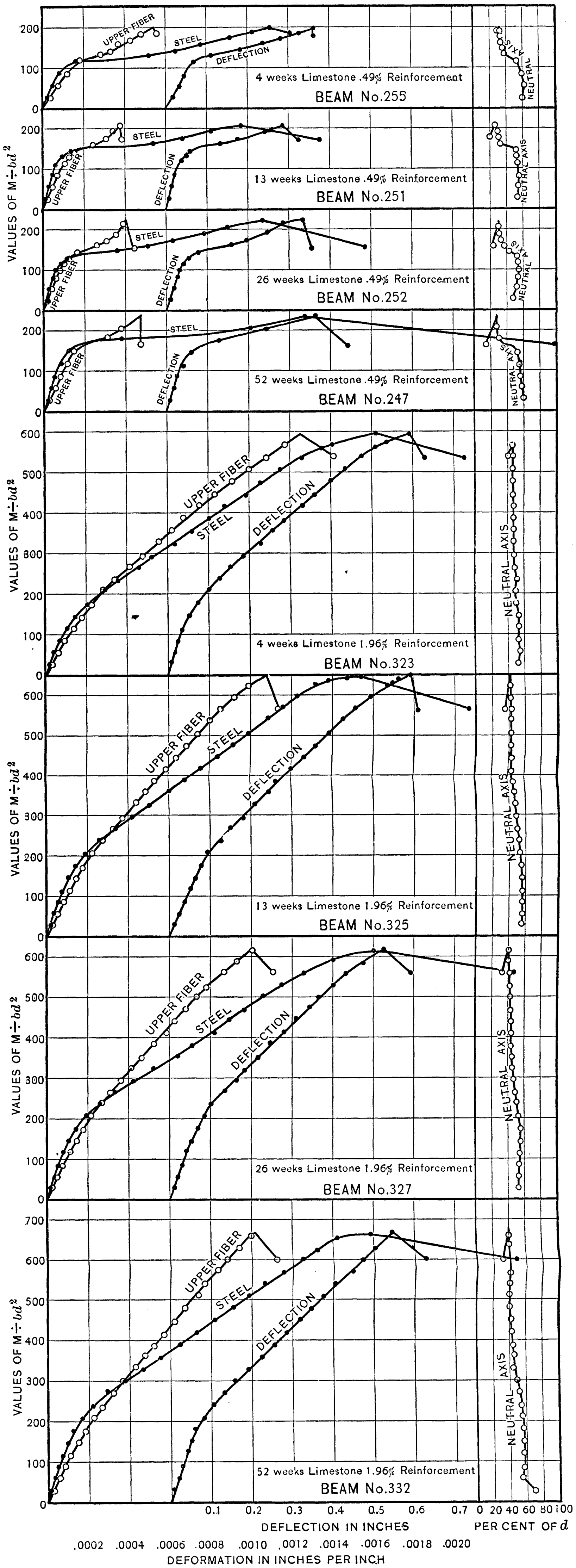


Fig. 44.—*Stress Deformation Curves of Limestone Concrete at Different Ages with .49 and 1.96 per cent Reinforcement*

4672°—12 (To face page 32.) No. 2

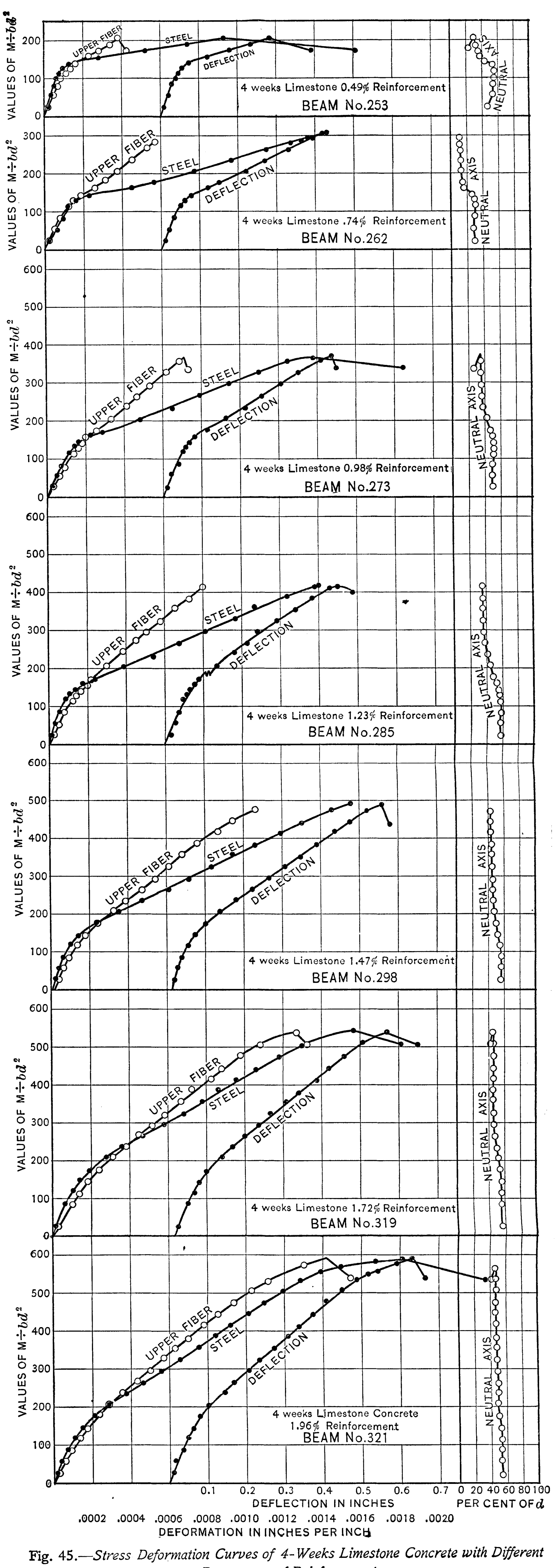


**Fig. 45.**—*Stress Deformation Curves of 4-Weeks Limestone Concrete with Different Percentages of Reinforcement*

4672°—12 (To face page 32.) No. 3

and also the resisting moment, has been compared with the unit stress taken from the gross deformation curve of the cylinder for a unit deformation equal to that in the beam. The computed unit bond stress of the reinforcement in the lower fiber has also been given.

(*a*) EXPLANATION OF TABLES 6 TO 21

*Column 1.*—The register number of the beam which is the same as that of the corresponding cylinder and cube.

*Column 2.*—The weight of the beam within 5 pounds.

*Column 3.*—The weight per cubic foot of the concrete.

*Column 4.*—Number of one-half inch round bars used.

*Column 5.*—Nominal percentage of reinforcement.

*Column 6.*—Effective percentage of reinforcement.

*Column 7.*—Total area of reinforcement, in square inches, based on a diameter of one-half inch.

*Column 8.*—Applied load at the first crack.

*Column 9.*—Unit elongation of the lower fiber at first crack.

*Column 10.*—Maximum applied load, in pounds.

*Column 11.*—Deflection of the beam, in inches, at maximum load.

*Column 12.*—Unit elongation of reinforcement at maximum load.

*Column 13.*—Unit stress in reinforcement at maximum load.

*Column 14.*—Average yield point of reinforcement used in each beam.

*Column 15.*—Ratio of unit stress in reinforcement at maximum load to yield point.

*Column 16.*—Applied load carried by the beam at the time moments were compared. This load has been so chosen that the unit elongation of the reinforcement will be below that corresponding to the yield point of the reinforcement.

*Column 17.*—The unit elongation of reinforcement for the load chosen.

*Column 18.*—Unit stress corresponding to this load.

*Column 19.*—Depth of neutral axis below top of the beam.

*Column 20.*—The lever arm of the reinforcement. This is the distance, in inches, between the center of gravity of the compressive stresses and the tensile stresses in the lower layer of reinforcement which is necessarily lower than the center of gravity of the total tensile stress in all the reinforcement.

*Column 21.*—The resisting moment, in inch pounds, as computed by equation (1), page 28, for the reinforcement in one layer and by equation (6), page 29, for the reinforcement in two layers.

*Column 22.*—External bending moment, in inch pounds, due to the applied load, the weight of the beam, and that of the deformeter.

*Column 23.*—Comparison of external bending moment with the resisting moment, based on the unit stress in the reinforcement.

*Column 24.*—Unit deformation of the upper fiber of the beam.

*Column 25.*—Unit compressive stress as read from the individual compressive stress gross deformation diagram of the cylinders.

*Column 26.*—Unit compressive stress in extreme upper fiber based on stress in reinforcement.

*Column 27.*—Unit compressive stress in extreme upper fiber as computed from bending moment.

*Column 28.*—Comparison of compressive stress, read from individual compressive stress gross deformation diagrams and compressive stress in extreme upper fiber, based on stress in reinforcement.

*Column 29.*—Comparison of compressive stress, read from individual compressive stress gross deformation diagrams and compressive stress in extreme upper fiber, as computed from bending moment.

*Column 30.*—The unit bond stress as computed from equation (3) page 28 for the applied load shown in column 16.

(*b*) DISCUSSION OF TABLES 6 TO 21

In computing the weight per cubic foot the following formula was used:

$$\text{Weight per cubic foot} = \frac{W-w}{V-v}$$

$W$ = total weight of beam, in pounds.

$w$ = weight of reinforcing bars, in pounds, for the beam under consideration.

$V$ = volume of beam, in cubic feet, based on the measured breadth, depth, and length.

$v$ = volume of reinforcing bars, in cubic feet.

The average of these columns for each particular aggregate compares very closely with the average weight per cubic foot as obtained from the weight of the cylinders and cubes.

As in the case with the cylinders and cubes, there is no increase in the weight per cubic foot with age.

The average weights per cubic foot for the beams, cylinders and the cubes for the ages of 4, 13, 26 and 52 weeks have been compiled in the following table and unless otherwise indicated is the average of 21 tests.

Table 22.—The Average Weight Per Cubic Foot of the Concrete

| Age, in Weeks | Granite | | | Limestone | | |
|---|---|---|---|---|---|---|
| | Beams | Cylinders | Cubes | Beams | Cylinders | Cubes |
| 4 | 147.9 | 149.4 | 147.1 | 147.1 | 145.8 | 144.9 (18) |
| 13 | 148.5 | 147.7 | 146.4 | 146.9 | 146.0 (20) | 142.4 |
| 26 | 148.2 | 148.2 | 147.8 (20) | 145.9 | 147.6 (20) | 147.4 |
| 52 | 147.2 | 148.9 | 148.1 | 146.6 | 147.4 | 147.9 |
| Average | 148.0 | 148.6 | 147.4 | 146.6 | 146.7 | 145.7 |

| Age, in Weeks | Gravel | | | Cinders | | |
|---|---|---|---|---|---|---|
| | Beams | Cylinders | Cubes | Beams | Cylinders | Cubes |
| 4 | 144.5 | 144.0 | 142.0 (12) | 119.0 | 118.4 | 116.6 (15) |
| 13 | 145.2 | 144.2 | 143.2 | 120.1 | 119.4 | 117.9 |
| 26 | 143.0 | 144.9 | 144.8 (20) | 118.9 | 119.5 | 118.7 |
| 52 | 143.5 | 145.9 | 145.9 | 118.1 | 119.7 | 119.2 |
| Average | 144.1 | 144.8 | 144.0 | 119.0 | 119.3 | 118.1 |

Column 5, Tables 6–21, contains the "nominal" percentage of reinforcement. The "nominal" percentage of reinforcement is that obtained by dividing the total sectional area of the reinforcement in the beam, calling the diameter of all bars one-half inch, by the area of the cross section of the beam above the center of the lower layer of reinforcement, assuming this to be 8 by 11 inches.

Where the reinforcement is in but one layer the resistance of the beam to the flexure is proportional to this "nominal" percentage, but where the reinforcement is arranged in two or more layers this is no longer the case. For such a condition, for two equal areas of reinforcement placed at different distances below the neutral axis, that farthest away is the more effective in resisting flexure. The effect of placing the reinforcement in two layers is equivalent to reducing the percentage of reinforcement, and all comparisons between the beams of a given series must be based on this reduced or "effective" percentage and not on the "nominal" percentage which is shown in these tables. The manner of computing this "effective" percentage of reinforcement, as well as the use that is made of it, will be shown later in connection with a discussion on the effect of a variation in "effective" per cent on the behavior of a beam, page 54.

(1) **Analysis at First Crack.**—Column 8 gives the applied load at the first crack, while column 9 contains the unit elongation of the lower fiber at first crack. While a beam was being tested the surface was carefully examined with a magnifying glass in order to detect the first crack; the applied load on the beam at that time was noted and has been called the "applied load at first observed crack," and is the value reported on the log sheets, following page 128.

It should be recognized, however, that the crack was not detected until it became of such a size as to be visible to the eye through a magnifying glass. It may, however, have existed in the beam for a short time previous to this, and the load at which it occurred may be approximated as follows: Before the unit elongation of the lower fiber of the beam has exceeded the ultimate unit elongation for that particular concrete the beam acts as a homogeneous material the deformations of the upper fiber and the deflections being practically independent of the percentage of reinforcement. During this period the fiber deformations, as well as the deflections, are closely proportional to the load carried. At some load, however, which varies somewhat with the percentage of reinforcement, the unit elongation of the lower fiber exceeds the ultimate unit elongation for the concrete. The concrete below the neutral axis, beginning at the outer surface, will now fail in tension, and will cause a portion of the weight of the beam, together with that part of the applied load which was taken care of by the tensile strength of the concrete to be thrown on the reinforcement. The increments of deformation will now no longer be proportional to the increments of load, and the curve showing the relation between the $\frac{M}{bd^2}$ and the unit elongation of the reinforcement will undergo a change of direction. The abruptness of this change depends entirely on the percentage of reinforcement, the lower the percentage the greater the change.

Since this abrupt change is due only to the cracking of the concrete in tension below the neutral axis these curves form a ready means of determining the $\frac{M}{bd^2}$ and consequently the applied load at which this cracking took place.

For some of the higher percentages that were used in this series, the change of direction took place very gradually and over a comparatively large field, so that it became rather difficult to say at what $\frac{M}{bd^2}$ the curvature started. For the lower percentages, however, no difficulty was experienced, as the curvature took place very suddenly, forming an abrupt break in the "steel curve," for which point the $\frac{M}{bd^2}$ was easily obtainable.

The applied loads corresponding to these $\frac{M}{bd^2}$ are shown in column 8, being recorded to the nearest 500 pounds applied load.

These values, however, do not correspond to the "applied load at first *observed* crack," but are in many cases considerably less. The values in column 8 are practically constant and independent of the percentage of reinforcement which is not true for the first *observed* crack. This latter value increases with the percentage of reinforcement, varying on an average from about 4000 pounds for a "nominal" percentage of reinforcement of 0.5 per cent to 7000 to 9000 pounds for one of 2 per cent.

This difference is largely due to the fact that for the greater percentages which were obtained by putting in a larger number of bars of the same diameter, a better distribution of reinforcement is obtained than is the case with fewer bars. An inspection of the photographs of the beams showing the development of cracks will show that for the higher percentages of reinforcement the cracks are closer together, and consequently not as wide as for lower percentages. This means that the applied load that will render them visible in the case of the higher percentages will be greater than that necessary with the lower percentages of reinforcement.

The unit elongation of the lower fiber, which is given in column 8, is obtained from the unit elongation of the reinforcement corresponding to the $\frac{M}{bd^2}$, obtained as already described, by multiplying by the ratio of the distance from the neutral axis to the lower outer fiber to the distance from the neutral axis to the center of the lower layer of reinforcement.

The value for the ultimate unit elongation of the lower fiber, as obtained above, should be the same as the unit elongation at rupture of beams without reinforcement made of the same aggregate and having the same proportions and consistency as were used in the present series.

It is possible to make such a comparison with the results of the tests reported in Bulletin 344.[11] With the exception of the cinders, the material used in the series of beams without reinforcement and in that of the reinforced beams of the present Bulletin was not only from the same source but was practically identical, since it was taken from the same storage bin.

As was explained in the above bulletin it was found impossible to obtain the unit elongation of the lower fiber at the instant the beam without reinforcement broke, owing to the difficulty of reading the micrometers when the elongations were increasing so rapidly. The exact value for the ultimate-unit elongation could consequently not be obtained. The value that has been reported is that obtained from the complete set of micrometer readings taken at the last load increment preceding maximum load. This value is, therefore, less than the ultimate unit elongation by a varying amount, depending upon whether the maximum load corresponded to the load for which the last full set of readings had been

[11] U. S. Geological Survey.

taken, or was more nearly equal to this load, increased by the usual load increment for which readings were being taken in that particular test.

The values for the 13-foot beams of medium consistency have been taken from Bulletin 344 [12] and are summarized in Table 23, each value being the average of three tests.

Table 23.—Unit Elongation in Lower Fiber of Concrete Beam Without Reinforcement, as Taken from Bulletin 344 [12]

| Age, in Weeks | Granite | Limestone | Gravel | Cinders |
|---|---|---|---|---|
| 4 | 0.000115 | 0.000117 | 0.000095 | 0.000335 |
| 13 | .000109 | .000121 | .000100 | .000288 |
| 26 | .000132 | .000120 | .000104 | .000267 |
| 52 | .000109 | .000116 | .000120 | .000334 |
| Average | .000116 | .000119 | .000105 | .000306 |

For convenience of comparison it seems warranted to average the four values for each aggregate.

Table 24 contains the average of the unit elongation of the extreme lower fiber at first crack, as given in column 9, Tables 6 to 21, following page 128, for each age and aggregate. Each figure is the average of from 19 to 21 tests.

Table 24.—Unit Elongation of Lower Fiber of Reinforced Concrete Beams at First Crack

| Age, in Weeks | Granite | Limestone | Gravel | Cinders |
|---|---|---|---|---|
| 4 | 0.000130 | 0.000126 | 0.000103 | 0.000180 |
| 13 | .000117 | .000132 | .000107 | .000163 |
| 26 | .000107 | .000115 | .000109 | .000180 |
| 52 | .000102 | .000101 | .000112 | .000192 |
| Average | .000114 | .000119 | .000108 | .000179 |

In this table, also, the apparent independence of the results from the influence of age seems to warrant the averaging of the four values for each aggregate.

[12] U. S. Geological Survey.

When the method of obtaining the values that have been used in the preparation of Tables 23 and 24 are considered, the agreement between the average ultimate unit elongation of the lower fiber for each aggregate is remarkably close.

The values of the stone and gravel concrete are about the same, while that for cinders is somewhat larger, as given in Table 24, and considerably greater in Table 23. The difference between the value for the ultimate-unit elongation for the cinders of the beam series without reinforcement and that of the reinforced beam series can be satisfactorily explained. As has already been pointed out, the granite, gravel, and limestone used in the two series were almost identical, and the same 1 : 2 : 4 volume proportion was used for each. Since, however, there was not a sufficient amount of the cinder used in the first series to complete the tests to be made in the second more had to be obtained. While comparison of the physical tests for these two samples will show no considerable difference, the weight per cubic foot of that used in the plain beam series was 47, while that used in the reinforced series was 49.3, but as was pointed out in Bulletin 344,[13] the cinder concrete there used was more nearly a 1 : 2 : 5 volume proportion than a 1 : 2 : 4 mixture, and this is the probable explanation of the different values for cinder concrete in Tables 23 and 24. It is believed, however, that a study of the values of these two tables will indicate conclusively that the point at which the curve plotted between $\frac{M}{bd^2}$ and unit elongations of the reinforcement, first changes its direction corresponds closely to the occurrence of the first crack in the concrete.

(2) **Analysis at Maximum Load.**—The failure of all the beams, reported in the present Bulletin, was due to the failure of the reinforcement. The strength of the concrete did not influence the character of the failure of the beam in any way, although the load carried when the beam failed did vary slightly with the material, due to the difference in the position of the neutral axis.

Since the failure of the beam was caused by the failure of the reinforcement, a comparison of the yield point of the reinforce-

[13] U. S. Geological Survey.

ment, used in the beam, with the unit stress, based on the elongation of the reinforcement at maximum load, should be of interest.

These "maximum load" conditions have been summarized in columns 10, 11, 12, 13, 14, and 15, Tables 6 to 21, following page 128. Column 10 contains the maximum applied load in pounds.

If the fact that the yield point of the reinforcement used in the beams of this series varied from 36 000 to 43 000 pounds is taken into consideration, the results, particularly at 26 weeks, may be considered independent of the aggregate considered.

This, however, is not strictly true, particularly at the ages of 4 and 13 weeks, since the lower modulus of elasticity of the cinders will give a shorter moment arm for the same unit elongation of the reinforcement, and consequently a less load carried at the yield point of the reinforcement, than is the case for a concrete having a higher modulus of elasticity. For these ages, the aggregates can be separated into the stone and gravel concretes on one hand, and the cinder on the other. Examining the curves for the cinder beams and more particularly those for the beams containing a high percentage of reinforcement, facing page 32, it will be noticed that the curve for the upper fiber is very flat, even under the low loads at which the concrete first starts cracking. The slope of this curve with the horizontal decreases very rapidly as the load increases, the curve being almost horizontal for quite a while before the maximum load is reached. The reinforcement is affected similarly near maximum load, there being large increases in the elongation for very slight increases in the applied load.

This behavior in every case is the sign of a compression failure, the proximity to which is indicated by the degree of the slope of the upper fiber curve. In the case of the four-week cinder beams with 2 per cent "nominal" reinforcement there was probably simultaneous failure of the reinforcement in tension and the concrete in compression. The failure of these beams was not marked by a sudden increase in the readings of the lower micrometers, followed immediately by a sharp drop of the scalebeam as is the case with a typical tension failure.

For these compression failures and even, although to a less extent, for the four-week cinder beams having 1.50 and 1.75 per cent "nominal" reinforcement, the weighing beam rose very slowly as load was being applied for some time before maximum load was reached and there was no definite indication of the failure of the reinforcement. The relation between the percentage of reinforcement and the resistance of the beam, as measured by the applied load carried, can be obtained from these tables.

When the reinforcement is arranged in one layer, as is the case for 0.5, 0.75, and 1 per cent, this comparison will lead to results that are quite near the truth. When, however, the bars are arranged in two layers the results as given in this table require considerable modification. The "nominal" percentage of reinforcement has first to be reduced to "effective" percentage and for theoretical considerations a correction applied for the varying yield point of the reinforcement, an increase in the yield point for the same sectional area of bar being equivalent to an increase in the percentage of reinforcement. Instead of making this comparison on the basis of applied loads, a better method is to reduce all values to $\frac{M}{bd^2}$: A study of the tests on this basis has been made on page 72.

The deflections, in inches, of the beams at maximum load are given in column 11.

The increase in the deflection with percentage of reinforcement is brought out in a general way by these values, but the deflection is not strictly proportional to the "nominal" percentages shown. As was the case in comparing the maximum values of $\frac{M}{bd^2}$, the deflections must also be compared on the basis of the effective percentage of reinforcement. In making this comparison, however, the method of measuring the deflection at maximum load must not be lost sight of. As has been indicated, the failure of the beam causes an abrupt and large increase in the elongation of the reinforcement. The deflection is affected similarly, though apparently to a somewhat less degree, and consequently the values reported are liable to be somewhat in error. The deflection at maximum load is, of course, the last reading immediately preceeding the sudden increase in the deflection. If this value is obtained, the deflection is correct, but if obtained a moment later it is too large by what, in many cases, is an appreciable amount. A comparison of the deflections for maximum load will, therefore, not lead to as consistent conclusions as to the effect of an increase in the percentage of reinforcement as will a similar comparison made at some point below the maximum load for which the deflections are definitely known. A study of the influence of an increase in the amount of reinforcement on the deflection for stresses of 32 000 and 16 000 pounds per square inch in the reinforcement has been made on page 82. These tables further bring out the fact that while the load carried at the failure of the beam may differ but little for the ages of 4, 13, 26, and 52 weeks as long as the yield point of the reinforcement is the governing factor, there can nevertheless be a considerable increase in stiffness, as measured by the decreased deflections.

Column 12, Tables 6 to 21, contains the unit elongation of the reinforcement at maximum load. This was obtained by dividing the average total deformation of the reinforcement by the gauge length, 29.25 inches. With the arrangement of the deformeters that was used on the four-week tests it was not possible to read both lower micrometers of the deformeter simultaneously. The two vertical longitudinal halves of the deformeters were not insulated from each other, so that with two observers reading the lower micrometers at the same time it was impossible for either to distinguish between the click in the telephone receiver that was caused by the closing of the electric circuit through his micrometer or through that of the other observer. With this arrangement it was therefore possible to read but one lower micrometer at one time. For reasons, however, that have already been mentioned it was very important that these readings be taken simultaneously at the moment the beam fails. In order to make this possible the deformeter was altered by the introduction of a hard rubber bushing which made it possible to take simultaneous readings of the lower micrometers. In obtaining the unit elongation of the reinforcement at maximum load for the earlier tests, the following approximation was used with what are believed to be satisfactory results. Assume, first, the following data, the columns E and W giving the total deformations of the reinforcement for each side of the beam:

| Applied Load, Pounds | Total Deformation of Reinforcement | |
|---|---|---|
| | Deformeter E | Deformeter W |
| 16 000 | 280 | 356 |
| 17 000 | 304 | 390 |
| 18 000 | 333 | 427 |
| 19 000 | 410 | 517 |
| 19 150 M. L. | .... | 533 |

The deformations in column E have been increasing at the rate of from 24 to 77 points for the same increment of load, while the values in column W for the same additions of load have increased by from 26 to 90 points. It has been assumed that the ratio of any increase in the total deformation in column E to the increase in column W for a given load increment is equal to the ratio of the increase in E and W for the preceding increment of load. In the data shown above the reading of the lower micrometer at maximum load was not obtained and the increase ($X$) of the deformation must be estimated as follows:

$$X = \frac{77}{90} \times 16 = 14$$

The lower total deformation is therefore 424, which, averaged with 533, gives the average total deformation of the reinforcement. Since, however, this is not an observed value, it was thought advisable to make a distinction in the table, so whenever the unit deformation of the reinforcement is based on an approximated average total deformation it has been inclosed in parentheses.

While the method outlined is an approximation, and introduces an error in the unit deformation of the reinforcement at maximum load, the magnitude of the error is probably small. Assume, for instance, that the error made in estimating the increment "14" for deformeter E may be either 25 per cent too large or too small, which is believed to be an extreme case. The greatest error in the average increment will then be 13 per cent while the error in the average total deformation will be less than 0.5 per cent.

The closeness of this approximation may be seen by an inspection of the deformation curves of those beams for which this method had to be used. It will be seen that the maximum load point lines up very satisfactorily with the preceding portion of the curve.

Given the unit elongation of the reinforcement and assuming a coefficient of elasticity of 30 000 000 the unit stress is easily obtained. It must be borne in mind, however, that the proportionality of stress and strain holds only within the elastic limit of the material. If, therefore, the unit elongation given in column 12 is greater than the unit elongation which corresponds to the yield point of the reinforcement, which is given in column 14 for each beam, the unit stress in the reinforcement based on this elongation will be incorrect. The computed unit stress in the reinforcement will be too great by an amount which will depend upon the difference between the observed unit elongation and the unit elongation at the yield point. While the unit stresses of column 13 have been obtained as described above, it must be remembered that the values there given are, in most cases, much too large. It is believed that the true stress in the reinforcement differs but little from the yield point, for it is a known peculiarity of reinforcement that it suffers a large increase in elongation at the yield point with but little if any increase in stress. Excepting high carbon steel, for which the yield point is not so well defined, the increase in elongation from the time the reinforcement reaches the yield point, until it again takes load, is almost without exception much greater than the whole elongation below the yield point.

That, for a tension failure, the reinforcement acts thus in a beam seems to be indicated by the fact, that after the sharp drop of the scalebeam and the sudden increase of the lower micrometer readings at maximum load, the beam will continue to deflect and the elongations of the reinforcement increase under a load several thousand pounds less than that at which the beam failed. This action will continue until the concrete begins to spall on the compression side of the beam when a more or less sudden collapse of the beam takes place.

Column 14 contains the average yield point of the reinforcement used in each beam. The values have been taken from Table 4,

p. 121, which give a summary of the physical tests of the reinforcement used in this series.

Column 15 gives the ratio of the unit stress in the reinforcement at maximum load, as computed from the measured elongation in column 12 to the yield point of the reinforcement. In no case is the unit stress in the reinforcement exactly equal to the yield point, the ratio varying from about 83 per cent for 0.5 per cent "nominal" reinforcement to about 1.30 for 2 per cent "nominal" reinforcement. In a general way, the ratio is less than 1 for percentages of reinforcement up to and including 1 per cent, and greater than 1, for all higher percentages.

Age seems to have little effect on the ratio and leads to the belief that the increase in the tensile strength of the concrete below the neutral axis, as well as the change in position of the neutral axis due to the increased stiffness of the concrete in compression, have little influence on this ratio.

Since age seems to have so little influence on this ratio the values given in column 15 have been averaged for all ages for each aggregate and are tabulated in Table 25.

Table 25.—Average Ratio of Unit Stress in Reinforcement to Yield Point at Maximum Load

| Cinder | | Granite | | Gravel | | Limestone | | Grand Average | |
|---|---|---|---|---|---|---|---|---|---|
| Effective Percentage of Reinforcement | Ratio | Effective Percentage of Reinforcement | Ratio | Effective Percentage of Reinforcement | Ratio | Effective Percentage of Reinforcement | Ratio | Effective Percentage of Reinforcement | Ratio |
| 0.49 | 0.86 | 0.49 | 0.83 | 0.49 | 0.82 | 0.49 | 0.79 | 0.49 | 0.83 |
| 0.74 | 0.93 | 0.74 | 0.89 | 0.74 | 0.95 | 0.74 | 0.89 | 0.74 | 0.92 |
| 0.98 | 0.99 | 0.98 | 0.97 | 0.98 | 1.04 | 0.98 | 0.93 | 0.98 | 0.97 |
| 1.08 | 1.13 | 1.11 | 1.08 | 1.12 | 1.12 | 1.11 | 1.05 | 1.11 | 1.09 |
| 1.24 | 1.24 | 1.30 | 1.06 | 1.30 | 1.20 | 1.30 | 1.17 | 1.28 | 1.17 |
| 1.48 | 1.35 | 1.54 | 1.13 | 1.54 | 1.22 | 1.53 | 1.10 | 1.52 | 1.20 |
| 1.62 | 1.38 | 1.71 | 1.17 | 1.72 | 1.29 | 1.71 | 1.28 | 1.69 | 1.28 |

For a ready comparison, these average values have again been averaged in Table 26. These values are shown graphically in Fig. 5, an inspection of which will show that as a general proposition it may be stated that the ratio of the unit stress in the reinforcement at maximum load to the yield point varies with the percentage of reinforcement.

(3) **Analysis of conditions in a beam at a load preceding maximum load for which the unit elongation in the reinforcement is less than that at the yield point.**—One of the most pertinent questions that can be asked in regard to any series of tests of reinforced concrete beams is that bearing on the relation of the internal resisting moment to the external bending moment. The external

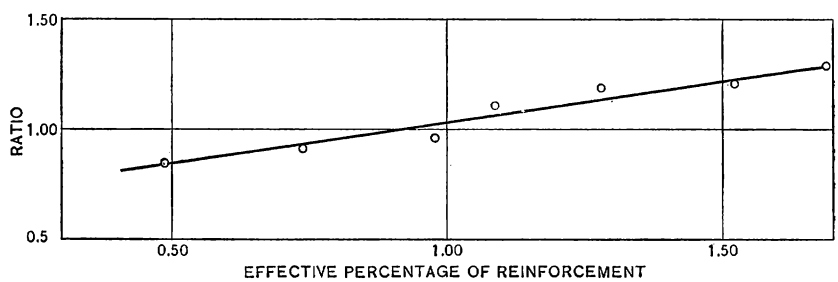


Fig. 5.—*Ratio of Unit Stress at Maximum Load to the Yield Point as a Function of the Effective Percentage of Reinforcement*

bending moment represents outside load conditions which must be met and resisted by the stresses set up in the beam. The magnitude and distribution of the load to be carried and the size of the span determine the external bending moment and are themselves determined largely by the use to which the structure is to be subjected.

The resisting moment, while depending also on the dimensions—i. e., the breadth and depth of the beam—is affected by the quality of the material used in making the beam, the care used in mixing and placing the concrete, and the age at which it is subjected to load.

If the weight of the beam and any attached test apparatus, the applied load when the beam failed, and the span are known, the bending moment can easily be computed. The bending moment thus computed should theoretically be equal to the resisting moment of the beam.

The flexure of a simple beam develops within it two groups of horizontal stresses, one of which is above the neutral axis and is entirely compressive, while the other is below the neutral axis and is tensile. A necessary condition of equilibrium requires that the summation of the horizontal tensile stresses be equal to the horizontal compressive stresses. For a beam which contains no horizontal reinforcement above the neutral axis, all the compressive stresses that are developed are taken by the concrete alone. Below the neutral axis, the distribution of stress is, however, different. When horizontal reinforcement is used, the tensile stresses are divided between it and the concrete. As long as the unit elongation of the lower fiber is less than the unit ultimate elongation of concrete without reinforcement the division of the total tensile stress between the concrete and the reinforcement is determined by their respective coefficients of elasticity, the unit stress in the concrete at the level of the reinforcement and in the reinforcement where both have the same elongation, being directly proportional to these coefficients. When, however, the concrete cracks, these conditions begin to change; the nearer the load at a particular instant approaches the maximum load, for that beam, the greater the change. The cracks can in no case extend through to the neutral axis for below it there must always be a point at which the unit elongation is equal to the unit ultimate elongation of the concrete so that immediately above this fiber the concrete will be at the point of breaking while below it, it will just have broken. There must, therefore, be in every cross section of a beam, no matter to what extent the cracks are developed, a portion furnishing a source of tensile resistance, which would otherwise have to be provided by the reinforcement. If the concrete did not carry some tension the total tensile stresses that must be developed in a beam for equilibrium, could only be provided by an increase in the deformation of the reinforcement.

In all formulas, that are in use in the design of reinforced concrete, however, the reinforcement is assumed to carry all the tensile stresses and this uncertain resistance of the concrete in tension is neglected.

While it is entirely warranted to neglect so uncertain an element in all formulas intended for design, it should nevertheless be included in a discussion of theoretical results. If it is not included, the effect of its neglect on any results, that may be compared with theory, should be recognized, for in many instances this is the only influence whose exclusion would account for the apparent discrepancies in some of the tabulated ratios.

A comparison of the resisting and bending moments will show, for instance, that whenever the resisting moment of the beam is based on the stress in the reinforcement, as computed from its measured deformation, it will theoretically fall below the bending moment obtained from the external loading and dimensions of the beam, since the elongation of the reinforcement, on which it is based, is smaller than what it would be if there were no tensile resistance in the concrete below the neutral axis.

Reversing this process and figuring the stress in the reinforcement from the bending moment, the values will theoretically, always be too great, for we now assume that the entire bending moment to be carried by the reinforcement, which is never the case even at maximum load.

All methods for computing the resisting moment have, heretofore, been based on the tensile stress in the reinforcement. Neglecting the effect of the tensile stress of the concrete in adding to the resisting moment of the reinforcement, the quantities involved, when this method is used, are the unit stress in the reinforcement, the percentage of reinforcement, the position of the neutral axis and the character of the stress deformation diagram of concrete in compression, as affecting the position of the center of gravity of the compressive stresses. Theoretical discussions indicate however, that the various assumptions as to the character of this curve have very little effect on the position of the center of the compressive stresses, although it does affect the extreme fiber stress of the concrete in compression.

In the discussion of all tests that have been made up to the present time, the resisting moment has been thus based on the measured stress in the reinforcement, and while it does not lead to results that are strictly comparable to the bending moment it has nevertheless the sanction of wide usage. A further reason for the use of this method has been the supposedly greater reliability of data which is based on the properties of steel. As steel is manufactured in a mill with what is believed to be greater care than is exercised in the mixing and molding of concrete, the belief that it is more homogeneous and reliable is perhaps not altogether unfounded.

For stresses below the yield point, steel has, further, a constant coefficient of elasticity, which is unaffected by variations in either the yield point or the ultimate strength. For a given elongation in the steel, the unit stress is, therefore, easily obtained for all elongations below that corresponding to the yield point. When the failure of a beam is due to the failure of the reinforcement, the unit stress in the reinforcement is usually very little above the yield point, while for those cases in which the failure of the beam is by compression, diagonal tension or bond—i. e., a failure caused by some weakness of the concrete—the unit stress in the reinforcement at maximum load is always well below the yield point.

In no case, however, not even for the beams failing by tension, is the ultimate strength of the reinforcement approached, so that as far as the initial failure of the beam is concerned the ultimate strength is unimportant.

While the above method of computing the resisting moment makes use of the greater portion of the tensile stresses below the neutral axis, another method, based on the compressive stresses above the neutral axis should, theoretically, lead to better results, since the action of no stresses is neglected.

That concrete under compression in a beam acts in an identical manner with concrete in pure compression is the fundamental assumption on which this method is based. While this assumption may be a debatable question a majority hold that, at the moment of failure in compression, the only portion of the concrete, that is seriously affected, is the extreme outer fiber; for, considering the fibers above the neutral axis, each is adjacent to one which is stressed higher and to another which is stressed lower than itself.

The latter helps to aid or reinforce the fiber in question, while the former will itself be aided by it. If, however, we consider, as is nearly always done, all the horizontal compressive forces applied at a point one-third of the distance to the neutral axis below the top of the beam, we would have conditions which would approximate those in a horizontal strut loaded at the upper limit of the middle third. In this case, we would have zero stress in the extreme lower fiber of this imaginary strut, and this would correspond to the zero stress at the neutral axis of the beam. It would seem that the two cases are almost parallel, particularly over the middle third of the beam where the shear is practically zero. While the ultimate micrometer reading on either side of one of the regular cylindrical compression pieces is in no case zero, it frequently happens that the ultimate deformation of one side is as much as twice that of the other. This would indicate that the load is eccentrically applied to the cylinder and while it never gets out to the limit of the middle third, the conditions nevertheless approximate those assumed above for a beam. The results arrived at by the use of this method would further appear to warrant the correctness of the assumption that the concrete in compression in a beam acts similarily to that in a simple compression test.

The physical properties of concrete, while paralleling, in a general way, those of steel, are much more sensitive to external influences. From a discussion of the compression tests on pages 98 to 109 it may be concluded, in a very general way, that concrete in compression has a yield point, which is fairly well defined, and below which the relation between unit stress and unit strain can be represented by a straight line whose slope is the initial coefficient of elasticity. The unit stress for any deformation below this yield point can, therefore, readily be obtained when the coefficient of elasticity is known.

This coefficient of elasticity, unlike that for steel, which is fairly constant, is subject to considerable variation. It varies with material and proportions; it increases somewhat with age, and decreases as the concrete is made of wetter consistency. While the increase with age is slight and could be neglected, the variation due to material, proportions, and consistency must be considered.

Unfortunately, this is not all that must be taken into account, for in all beams that fail by the compression of the concrete, and in many that fail by the tension of the reinforcement, the unit stress in the concrete is above the yield point. The unit stress can not, therefore, be obtained directly from the elongation and the initial coefficient of elasticity, as was the case for unit stresses below the yield point. A study of the compression tests shows, however, that the stress gross deformation curves for the individual cylinders differ in but few instances more than is permissible from the average curve of a group, so that we may assume that any material used in concrete of a given proportion, age, and consistency is sufficiently homogeneous to yield practically identical results on similar test pieces. With the aid of this curve, the unit stress for any given deformation is easily obtainable, whether it be above or below the yield point of the concrete.

Since this is the case, we are furnished with a method of computing the resisting moment of the beam which does not, as does the method based on the unit stress in the reinforcement, neglect a portion of the horizontal stresses in the beam. It does, however, introduce a source of error, in necessitating an assumption as to the character of the stress deformation diagram above the neutral axis. Yet, even with the assumption that has been made in this bulletin, and which has been maintained constant for all degrees of loading and all aggregates, the results obtained by this method are more nearly comparable with the external load conditions than are those which are based on the reinforcement, and which neglect the tensile stresses in the concrete.

Theoretically, this method would be applied in the following manner: The average stress gross deformation diagram of the concrete under consideration would be entered, with the unit deformation of the extreme upper fiber of the reinforced beam at the $\frac{M}{bd^2}$ for which the resisting and the bending moment were to be compared. With this unit compressive stress column 25, tables 6 to 21 as a basis, the total compressive stress would be computed, making use of the particular stress deformation diagram above the neutral axis which has been assumed in this bulletin. The resisting moment would then follow, by multiplying by the distance from the center of gravity of the compressive stresses to that of the tensile stresses in the reinforcement.

The ratio of the resisting moment thus computed, to the bending moment could then be obtained. Since, however, we already have in column 26 the unit compressive stress in the extreme upper fiber, based on the tensile stress in the reinforcement, and in column 25 the unit compressive stress, taken from the compressive stress gross deformation diagram for the compressive cylinder, paralleling the beam under consideration it has been thought advisable to reverse the process outlined above, and compute the extreme fiber stress from the bending moment. This has been done and the values entered in column 27.

Making use of the necessary condition of equilibrium, that the sum of all the horizontal forces must be equal to zero, it is possible to figure the unit compressive stress of the extreme upper fiber of the beam from the tensile stress below the neutral axis. If, as a basis for this computation, the total tensile stress—i. e., the total tensile stress in the reinforcement plus the total tensile stress in the concrete—is used, the value obtained for the unit compressive stress in the extreme upper fiber of the beam should be the same as that which would be obtained if it had been computed directly from the bending moment.

If, however, as was done for the values in column 26, it is based on the total tensile stress in the reinforcement alone, the values obtained for the unit compressive stress will be smaller than that obtained from the bending moment, due to the neglect of the tensile stresses in the concrete below the neutral axis.

The values given in column 26 will, therefore, be found to be smaller than if computed from the bending moment, making use of the known position of the neutral axis.

Column 26 contains the unit compressive stress in the upper fiber of the beam as it would be computed from the bending moment, using the position of the neutral axis as given in column 18, the compressive stress deformation diagram with $q = \frac{1}{2}$, as has been assumed throughout this bulletin, and the external bending moment as given in column 22. Theoretically the values in column 27 would be obtained in this manner, but since, in column 26, we already have the unit compressive stress in the upper fiber, based on the total tensile stress in the reinforcement, and in column 22 the ratio of the resisting moment, based on the tensile stresses in the reinforcement, to the bending moment it was only necessary to divide the values in column 26 by those in column 23.

Examining the values of $\frac{M_r}{M_b}$ given in column 23, we find, as might have been expected, that the ratio more nearly approaches unity as the percentage of reinforcement increases, due to the relatively greater importance of the neglect of the tensile resistance of the concrete below the neutral axis for the lower percentages.

As might be expected, the same behavior is indicated by the ratio in column 28, which is more nearly equal to unity, the higher the percentage of reinforcement.

The values of the ratio of the unit compressive stress in the upper fiber, as figured from the bending moment to the unit compressive stress, taken from the cylinders, is given in column 29 and is, as it should be, more nearly independent of the percentage of reinforcement than are the values in column 28, although the ratio does increase somewhat with the percentage of reinforcement.

The value of the computed unit bond stress, column 30, is seen to be entirely independent of the percentage of reinforcement, and has therefore been averaged for each age and aggregate. Under the heading of "Remarks" is given the unit bond stress at maximum load for tests on bond test pieces, the details of which have been given on page 17, and also the ratio of this unit bond stress to the average computed unit bond stress in the reinforced beams given in column 30. An examination of this ratio will show that in no case was the beam in danger of failure due to the slipping of the bars since the value of the ratio was in no case less than 3.

### (c) THE EFFECT OF VARIATIONS IN THE PERCENTAGE OF REINFORCEMENT ON THE BEHAVIOR OF THE BEAM

The influence of treatment and environment is of great importance in the case of concrete. Concrete is in a state of change for a long time after it has been placed, a continual though slow increase in strength being accompanied by a corresponding increase in stiffness. For a given age, aggregate, and consistency its strength varies almost directly as the percentage of cement, while a change in consistency causes a marked change in the ultimate strength for periods even up to one year. The strength of the concrete is greatly affected by the kind of aggregate used, and when this is kept constant, it is again affected by the uniformity of the grading, and, for the same grading, whether it grades down from a large or a comparatively small size. Even for a good hard stone, the fact that it was crushed and screened dry or wet exerts a marked influence on the strength and stiffness, while the character and amount of sand used in the concrete introduces another variable whose importance must not be overlooked.

When, therefore, concrete is combined with steel in a reinforced beam the behavior of the beam under load depends largely on the quality of the concrete used. The behavior of the beam, particularly one in which the percentage of reinforcement is comparatively high, is also slightly influenced by a peculiarity, which is common to all qualities of concrete, though in a different degree, in the following manner:

As was seen by an inspection of the diagrams giving the average compressive stress gross deformation curves for the concrete used in the present series, the maximum unit stress within which the relation of stress to deformation can be accurately represented by a straight line varies from 30 to 40 per cent of the ultimate strength. Even at a unit stress 50 per cent in excess of this amount, the variation from a straight line is but between 4 and 5 per cent. That is, the unit stress as given for a certain deformation on the curve is 4 or 5 per cent less than that computed from the given deformation using the initial coefficient of elasticity.

If, in a given series of beams in which the concrete is identical, we arbitrarily fix certain intensities of stress in the lower layer of the reinforcement, the behavior of the beam will, for all intensities of unit compressive stress in the extreme upper fiber which are greater than that corresponding to the limit of the straight-line variation, be governed largely by the character of the compressive stress gross deformation diagram. For this case, therefore, the behavior of the beam will not be in a direct relation to the percentage of reinforcement. For all unit compressive stresses in the extreme upper fiber which are below this value the behavior of the beam will be a direct function of the percentage of reinforcement.

With these peculiarities in mind a study has been made of the relation between the percentage of reinforcement and the strength and the stiffness of the reinforced beams.

Nearly all building laws and specifications prescribe an allowable working stress of 16 000 pounds per square inch in the reinforcement. It is a matter of interest, therefore, to know exactly (1) how an actual beam for which this stress has been developed in the reinforcement would behave under load; (2) the load carried, and its variation with the amount of reinforcement; (3) the position of the neutral axis; (4) the effect of an increase or decrease of the area of the reinforcement; (5) the relation of the unit compressive stress in the extreme upper fiber to the unit tensile stress in reinforcement.

The questions are often asked (1) to what extent have the cracks developed below the neutral axis when the beam is subject to working loads; (2) does the deflection vary with the percentage of reinforcement; (3) does the allowable deflection increase directly with the span for a given concrete and percentage of effective reinforcement; (4) what is the effect of variations in the unit stress of the reinforcement; (5) what is the effect of an extreme variation in the yield point of the reinforcement.

While undoubtedly other studies leading to interesting results can be made from the data herein presented, it is thought that some of the principal points of interest in reinforced concrete have been covered and are summarized as follows.

#### Principal Considerations in Design of Reinforced Concrete Beams

With a view to furnishing information on these points, the following studies (for a maximum load and a unit stress of 16 000 and 32 000 pounds per square inch in the lower layer of reinforcement) have been made, involving the influence of the character of the aggregate and age of the concrete in the relation of the effective percentage of the reinforcement to:—(1) the position of neutral axis, (2) value of $\frac{M}{bd^2}$, (3) compressive stress in extreme upper fiber, (4) deflection.

As has already been indicated, it is necessary to use from two to eight, one-half inch round bars in order to bring about the desired variation in the nominal percentage of reinforcement. As the test beams were only 8 inches wide, it would probably not have been possible to place more than four bars in one layer and prevent the splitting of the concrete in the plane of the reinforcement. When, therefore, more than four bars were used they had to be arranged in two layers as shown in Fig. 1.

For those cases in which the reinforcement consisted of two, three, or four bars the entire area of reinforcement was effective in the same degree in resisting flexure. When, however, more than four bars were used, and it became necessary to place the reinforcement in two layers, this was no longer true. A square inch of reinforcement in the lower layer becomes now more effective than a square inch in the upper layer, in resisting flexure, in proportion to the distance from the neutral axis to the center of the lower layer of reinforcement and from the neutral axis to the upper layer of reinforcement.

If, therefore, the area of the reinforcement in the upper layer were multiplied by the ratio between the distance from the neutral axis to the upper layer and the distance from the neutral axis to the lower layer, an area would be obtained which, when added to the area of the reinforcement in the lower layer, would give a new area of reinforcement concentrated in the lower layer and causing the beam to duplicate its behavior for the original arrangement of the reinforcement in two layers.

While it was thought unnecessary to give in detail all the computations required in the preparation of Figs. 6 to 21, it was thought best to include the computation sheet for one set of beams in order that the basis underlying Figs. 6 to 21 might be clearly understood.

Table 26, p. 60, shows, therefore, the computation sheet for beams of 1 : 2 : 4 granite concrete tested at the age of 13 weeks.

Column 1 contains the register number of the beam, while column 2 contains the number of one-half-inch round bars with which each beam was reinforced.

Column 3 contains the maximum value of $\frac{M}{bd^2}$. For those beams for which the maximum load was observed, this value could be figured directly from the maximum applied load, the weight of the deformater, and that of the beam. In computing $bd^2$ the nominal dimensions, 8 inches wide, 10 inches to the center of the lower layer of reinforcement were adhered to. Whenever the tabulated values have been followed by an asterisk, they are based on actual measured values.

The unit deformation of the upper fiber at maximum load is given in column 4. In but a few instances was this quantity measured directly. Since the failure of all the beams was due to the tension in the reinforcement the readings of the lower micrometers at maximum load were far more important than those at the top of the beam. The observer on each side of the beam therefore concentrated his attention on the lower micrometer when maximum load was being approached, in order to detect the first sign of failure in the reinforcement. In order, therefore, to approximate the unit deformation of the upper fiber at maximum load it was necessary to produce the upper fiber curve (Figs. 41 to 45, facing p. 32) beyond the $\frac{M}{bd^2}$ corresponding to the last load increment preceding maximum load until it intersected a horizontal line through the maximum value of $\frac{M}{bd^2}$. The values thus obtained were entered in column 4.

In a few instances the beam failed just after a full set of readings had been taken, and before any additional load had been applied. The values thus obtained by direct measurement have been followed by an asterisk in column 4.

In column 5 is given the unit deformation of the reinforcement. These values were obtained, as already indicated, from the reading of the lower micrometer just previous to the sudden increase in the readings which indicated that the yield point of the reinforcement had been reached. Since this reading was considered one of the most important in the entire test it was always observed and therefore all the values in the column have been followed by an asterisk.

The percentage depth of the neutral axis below the top of the beam is given in column 6, and is based on the usual assumption that the deformations are proportional to the distance from the neutral axis. Since these values have been obtained from those in columns 4 and 5, they involve in many cases an approximate value, particularly of the unit deformation of the upper fiber.

Column 7 contains the average yield point of the reinforcement used in each beam and are the averages of the individual values given in the summary of the tests on the reinforcement. (Table 4.) The usual percentage of reinforcement is obtained by dividing the total sectional area of the reinforcement by the cross section of the beam above the center of the lower layer of reinforcement.

The values in column 8 have been obtained in this way, and are based on bars of one-half inch nominal diameter, a constant breadth of 8 inches and a constant depth to the center of the lower layer of reinforcement of 10 inches. In all discussions that follow, this percentage of reinforcement will be referred to as the "nominal" percentage.

In order to obtain the "effective" percentage at maximum load, which is the percentage of reinforcement which, when concentrated in the plane of the lower layer of reinforcement, will cause identical behavior under load, it is necessary to multiply the area of the reinforcement in the upper layer by the ratio between the distance from the neutral axis to the upper layer of the reinforcement and the distance from the neutral axis to the lower layer of reinforcement. This reduced area is added to the cross section of the lower layer, and the sum divided by the cross section of the beam above the lower layer. Since the final study was to be made on average values, this reduction was made only for the average values of the position of the neutral axis as given in column 6.

The values thus obtained for the "effective" percentage, theoretically, still require modification at maximum load, due to the fact that the average yield point of the reinforcement used in the different beams is not the same. An increase in yield point is equivalent to an increase in the percentage of reinforcement, and in order to reduce all sets of beams to the same basis, the "effective" percentages of column 9 have been altered to correspond to a yield point of 40 000 pounds per square inch, the approximate average yield point of all the reinforcement used, and are given in column 10.

The value of the deflection, in inches, at maximum load is shown in column 11. With the exception of the values in columns No. 1, 2, and 8 all values, that have been mentioned up to this point, refer to maximum load conditions only.

The next five columns give conditions in the beam at a unit stress of 32 000 pounds per square inch in the lower layer of the reinforcement. Assuming a modulus of elasticity of 30 000 000, the unit deformation corresponding to a stress of 32 000 pounds per square inch is 0.001067. With this as a basis, the values in columns 12 to 16, inclusive, were obtained as follows: Figs. 41 to 45, facing page 32, for the above unit deformation for the lower fiber the corresponding $\frac{M}{bd^2}$ was read from the steel curve and entered in column No. 12.

With the value of $\frac{M}{bd^2}$ corresponding to a unit deformation in the reinforcement of 0.001067 known, the unit deformation of the upper fiber was read from the upper curve and entered in column 13.

The percentage depth of the neutral axis below the top (column 14) and the deflection, in inches, at the center of the beam (column 15) were obtained in the same manner.

The "effective" percentage in column 16, and also the values in column 9, were obtained from the known distribution of the reinforcement in the beam and the known position of the neutral axis.

Columns 17 to 21, inclusive, contain the same information for a unit stress of 16 000 pounds per square inch in the lower layer of the reinforcement as is given in columns 12 to 16 for a unit stress of 32 000 pounds per square inch.

An inspection of columns 16 and 21 will indicate that the higher the unit stress in the lower layer of reinforcement the higher the neutral axis, and therefore the greater the "effective" percentage of reinforcement.

## Table 26.—Computation Sheet for Beams of 1 : 2 : 4 Granite Concrete Tested at 13 Weeks

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Conditions in the Beam at a Unit Stress of 32 000 lbs. per sq. in. in the Lower Layer of Steel | | | | | Conditions in the Beam at a Unit Stress of 16 000 lbs. per sq. in. in the Lower Layer of Steel | | | | |
| Beam No. | Number of ½-Inch Round Rods | Maximum Value of $\frac{M}{bd^2}$ | Unit Deformation Upper Fiber at Maximum Load | Unit Deformation of Reinforcement | Percentage Depth of Neutral Axis Below Top Beam | Average Yield Point of Reinforcement Used | Nominal Percentage of Reinforcement | Percentage of Effective Reinforcement | Uniform Percentage of Reinforcement | Deflection in Inches at Maximum Load | $\frac{M}{bd^2}$ | Unit Deformation Upper Fiber | Percentage Depth Neutral Axis Below Top | Deflection in Inches | Effective Percentage Reinforcement | $\frac{M}{bd^2}$ | Unit Deformation Upper Fiber | Percentage Depth Neutral Axis Below Top | Deflection in Inches | Effective Percentage Reinforcement |
| 165 | 2 | [1] 229.47 | 0.000480 | [1] 0.001138 | 29.5 | 42 230 | | | | [1] 0.350 | 223.5 | 0.000460 | 30.5 | 0.323 | | 180.0 | 0.000322 | 37.5 | 0.170 | |
| 166 | 2 | [1] 220.26 | [1] 418 | [1] 1176 | [1] 26.2 | 42 200 | | | | [1].325 | 209.0 | 393 | 27.0 | .296 | | 165.5 | 276 | 34.8 | .156 | |
| 167 | 2 | [1] 223.68 | 464 | [1] 1164 | 28.3 | 41 910 | | | | [1].345 | 210.0 | 428 | 28.8 | .292 | | 165.0 | 280 | 35.1 | .138 | |
| Average | | 224.47 | .000454 | .001159 | 28.0 | 42 110 | 0.49 | 0.49 | 0.517 | .340 | 214.2 | .000427 | 28.8 | .304 | 0.491 | 170.2 | .000293 | 35.8 | .155 | 0.491 |
| 177 | 3 | [1] 301.77 | .000544 | [1].001215 | 31.2 | 41 940 | | | | [1].410 | [1] 280.5 | .000490 | [1] 31.5 | [1] .340 | | 197.0 | .000305 | 36.9 | .158 | |
| 178 | 3 | [1] 325.47 | [1] 560 | [1] 1248 | [1] 31.0 | 43 390 | | | | [1].410 | 298.5 | 503 | 32.1 | .353 | | 210.0 | 326 | 38.1 | .172 | |
| 179 | 3 | [1] 320.67 | 564 | [1] 1070 | 33.0 | 43 470 | | | | [1].390 | [1] 320.7 | 564 | 34.0 | [1] .390 | | 226.5 | 333 | 39.0 | .182 | |
| Average | | 315.97 | .000556 | .001178 | 31.7 | 42 930 | .74 | .74 | .790 | .403 | 299.9 | .000519 | 32.5 | .361 | .736 | 211.2 | .000321 | 38.0 | .171 | .736 |
| 189 | 4 | [1] 407.29 | .000695 | [1].001226 | 36.2 | 41 950 | | | | [1].455 | 372.0 | .000626 | 37.0 | .379 | | 251.0 | .000371 | 41.3 | .203 | |
| 190 | 4 | [1] 402.06 | 690 | [1] 1374 | 33.6 | 42 480 | | | | [1].475 | 343.0 | 568 | 34.7 | .351 | | 245.0 | 375 | 41.6 | .187 | |
| 191 | 4 | [1] 378.87 | 634 | [1] 1176 | 36.7 | 40 670 | | | | [1].400 | 363.0 | 603 | 36.4 | .365 | | 254.5 | 388 | 42.6 | .186 | |
| Average | | 396.07 | .000673 | .001259 | 35.5 | 41 700 | .98 | .98 | 1.024 | .443 | 359.3 | .000599 | 36.0 | .365 | .982 | 250.2 | .000378 | 41.8 | .192 | .982 |
| 201 | 5 | [1] 433.68 | .000689 | [1].001443 | 36.0 | 40 920 | | | | [1].430 | 390.0 | .000608 | 36.3 | .333 | | 262.0 | .000368 | 41.0 | .172 | |
| 202 | 5 | [1] 435.18 | 713 | [1] 1323 | 35.2 | 41 460 | | | | [1].435 | 380.5 | 596 | 35.9 | .344 | | 258.0 | 361 | 40.7 | .176 | |
| 203 | 5 | [1] 451.08 | 725 | [1] 1479 | 35.0 | 40 410 | | | | [1].465 | 390.0 | 589 | 35.6 | .352 | | [1] 265.7 | [1] 363 | [1] 40.5 | .185 | |
| Average | | 439.98 | .000709 | .001415 | 35.4 | 40 930 | 1.23 | 1.11 | 1.139 | .443 | 386.8 | .000598 | 35.9 | .343 | 1.112 | 261.9 | .000364 | 40.7 | .178 | 1.103 |
| 213 | 6 | [1] 522.59 | .000819 | [1].001321 | 37.8 | 41 460 | | | | [1].470 | [1] 446.1 | .000670 | 38.7 | .365 | | 290.0 | .000405 | 43.4 | .179 | |
| 214 | 6 | [1] 529.68 | 845 | [1] 1494 | 37.7 | 41 230 | | | | [1].525 | 437.0 | 667 | 38.4 | .381 | | 290.0 | 410 | 43.5 | .203 | |
| 215 | 6 | [1] 521.29 | 837 | [1] 1422 | 36.8 | 41 080 | | | | [1].495 | 422.0 | 631 | 37.2 | .355 | | 276.0 | 376 | 41.6 | .173 | |
| Average | | 524.52 | .000834 | .001412 | 37.4 | 41 260 | 1.47 | 1.30 | 1.337 | .497 | 435.0 | .000656 | 38.1 | .367 | 1.294 | 285.3 | .000397 | 42.8 | .185 | 1.279 |
| 225 | 7 | [1] 573.38 | .000933 | [1].001503 | 40.3 | 41 180 | | | | [1].510 | 479.5 | .000741 | 40.9 | .379 | | 312.0 | .000444 | 45.0 | .192 | |
| 226 | 7 | [1] 584.69 | 865 | [1] 1694 | 38.3 | 42 110 | | | | [1].505 | 490.0 | 691 | 39.3 | .360 | | 314.0 | 403 | 43.2 | .174 | |
| 227 | 7 | [1] 589.69 | 890 | [1] 1443 | 39.1 | 40 750 | | | | [1].495 | 494.0 | 723 | 40.4 | .362 | | 320.5 | 428 | 44.7 | .185 | |
| Average | | 582.59 | .000896 | .001547 | 39.2 | 41 350 | 1.72 | 1.54 | 1.588 | .503 | 487.8 | .000718 | 40.2 | .367 | 1.533 | 315.5 | .000425 | 44.3 | .184 | 1.520 |
| 243 | 8 | [1] 665.29 | .001115 | [1].001706 | 40.0 | 41 790 | | | | [1].615 | 546.0 | .000822 | 43.6 | .414 | | 346.5 | .000487 | 47.9 | .217 | |
| 244 | 8 | [1] 665.11 | 950 | [1] 1405 | 40.1 | 41 780 | | | | [1].530 | 556.0 | 734 | 40.8 | .386 | | [1] 356.7 | [1] 427 | [1] 44.5 | [1] .195 | |
| 245 | 8 | [1] 690.10 | 1062 | [1] 1831 | 38.3 | 41 400 | | | | [1].595 | 548.0 | 725 | 40.5 | .382 | | 343.0 | 414 | 44.0 | .189 | |
| Average | | 673.50 | .001042 | .001647 | 39.5 | 41 660 | 1.96 | 1.72 | 1.791 | .580 | 550.0 | .000760 | 41.6 | .394 | 1.712 | 348.7 | .000443 | 45.5 | .200 | 1.694 |

[1] Actual measured values, or computed from actual measured values.

While Table 26 has been given as an illustration of the basis of the tabulated values, and as furnishing in detail the method of calculation that was used, like all tabulated values they are unsatisfactory for the purpose of comparing a large number of results. Therefore but one set of computations has been published and the remainder of the data presented graphically in Figs. 6 to 21, pages 62 to 95, which will now be discussed.

(1) **Variation in the Position of the Neutral Axis with the "Effective" Percentage of Reinforcement.**—An accurate knowledge of the position of the neutral axis is one of the first requisites in determining the resistance of a beam to flexure. It seems logical, therefore, to discuss the change in the position of the neutral axis when the amount or disposition of the reinforcement is altered, before taking up the resistance of the beam to flexure.

Figs. 6 to 9, pages 62 to 65, have therefore been prepared to show the change in the position of the neutral axis with change in percentage of reinforcement. Each point in the figures is the average of three tests and every figure gives the results of the tests on a given aggregate made at a particular age. On each figure three curves have been drawn. One shows the relation between the variables under consideration for a unit stress in the lower layer of steel equal to 16 000 pounds per square inch, one for a unit stress of 32 000 pounds, and one has been drawn for maximum load conditions.

A general inspection of these curves will show that if we except the points observed for limestone concrete beams which were reinforced with two, one-half inch round bars or 0.5 per cent reinforcement, the curves are all very uniform, and all sets seem to have the same general shape irrespective of the aggregate considered.

What difference there is in the uniformity seems to be in favor of the 16 000 pounds stress curve, while that for maximum load conditions is the most irregular of the three.

The curve for maximum load conditions is perhaps even more regular than might be expected when the various reductions that have been made in the preparation of these figures is taken into consideration.

4672°—12——5

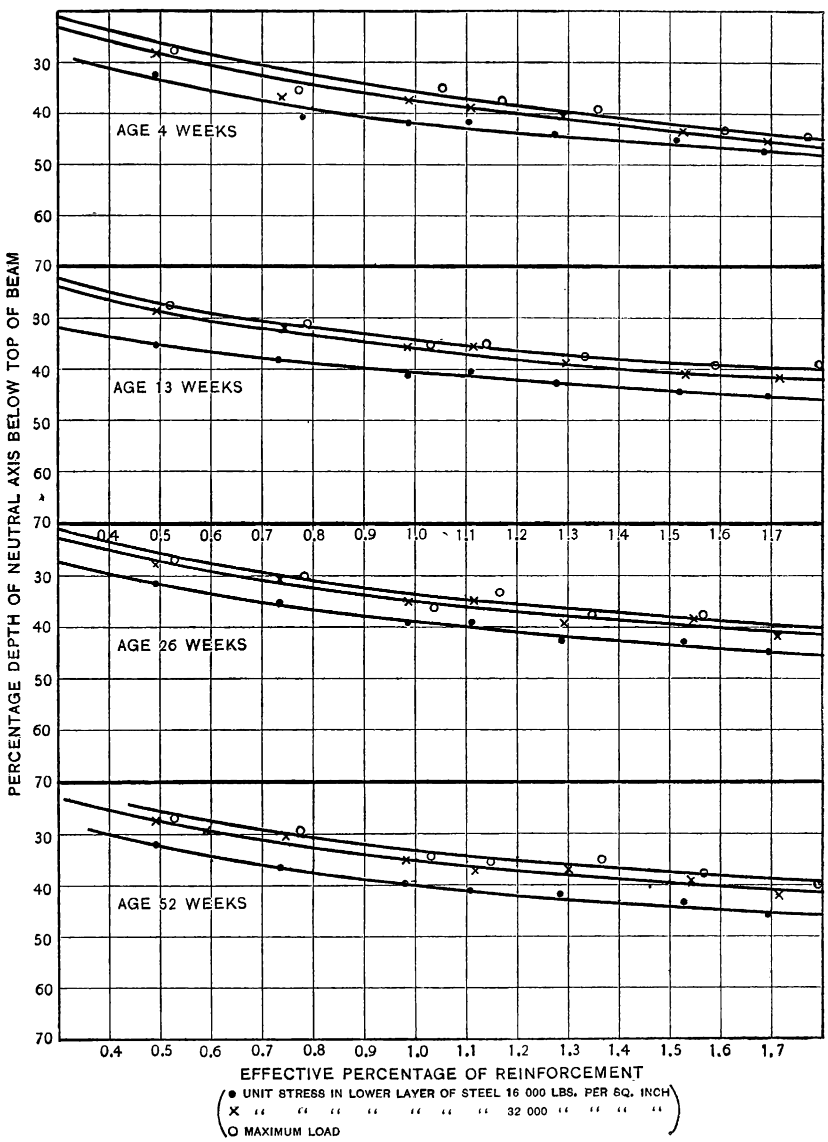


Fig. 6.—*Relation Between Position of Neutral Axis and Effective Percentage of Reinforcement for Granite Concrete*

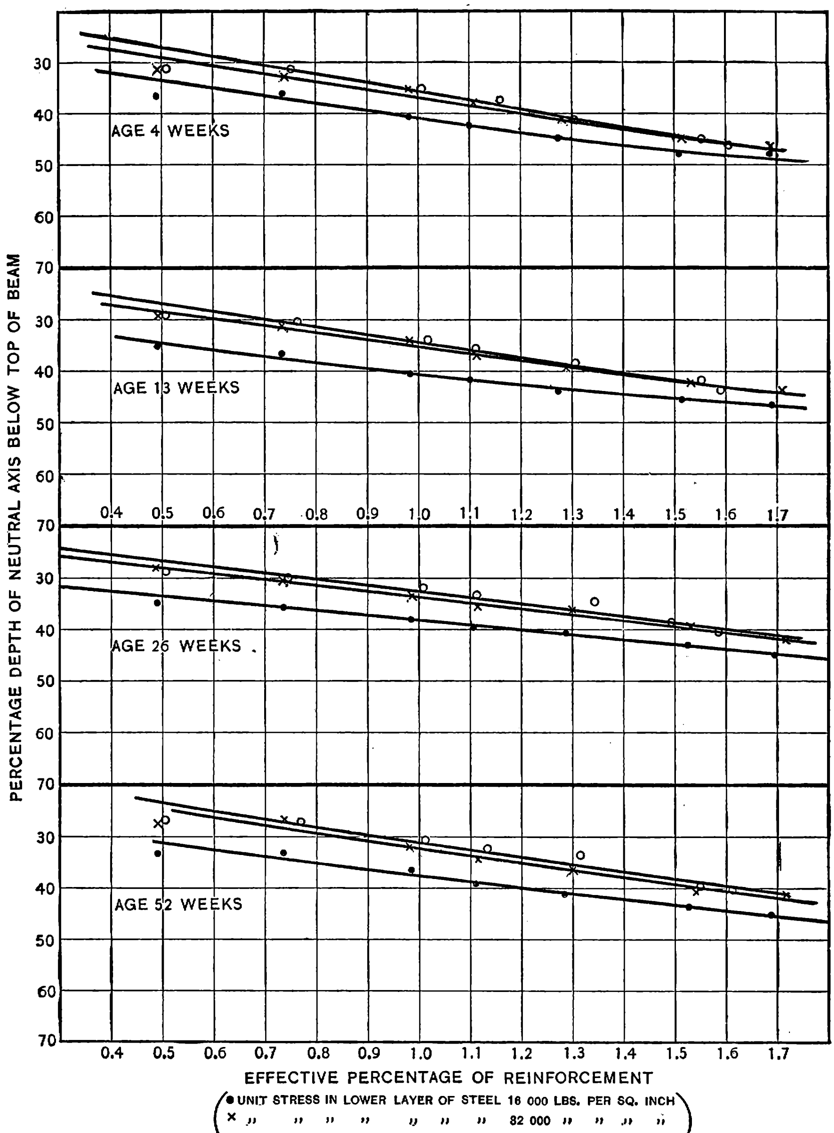


Fig. 7.—*Relation Between Position of Neutral Axis and Effective Percentage of Reinforcement for Limestone Concrete*

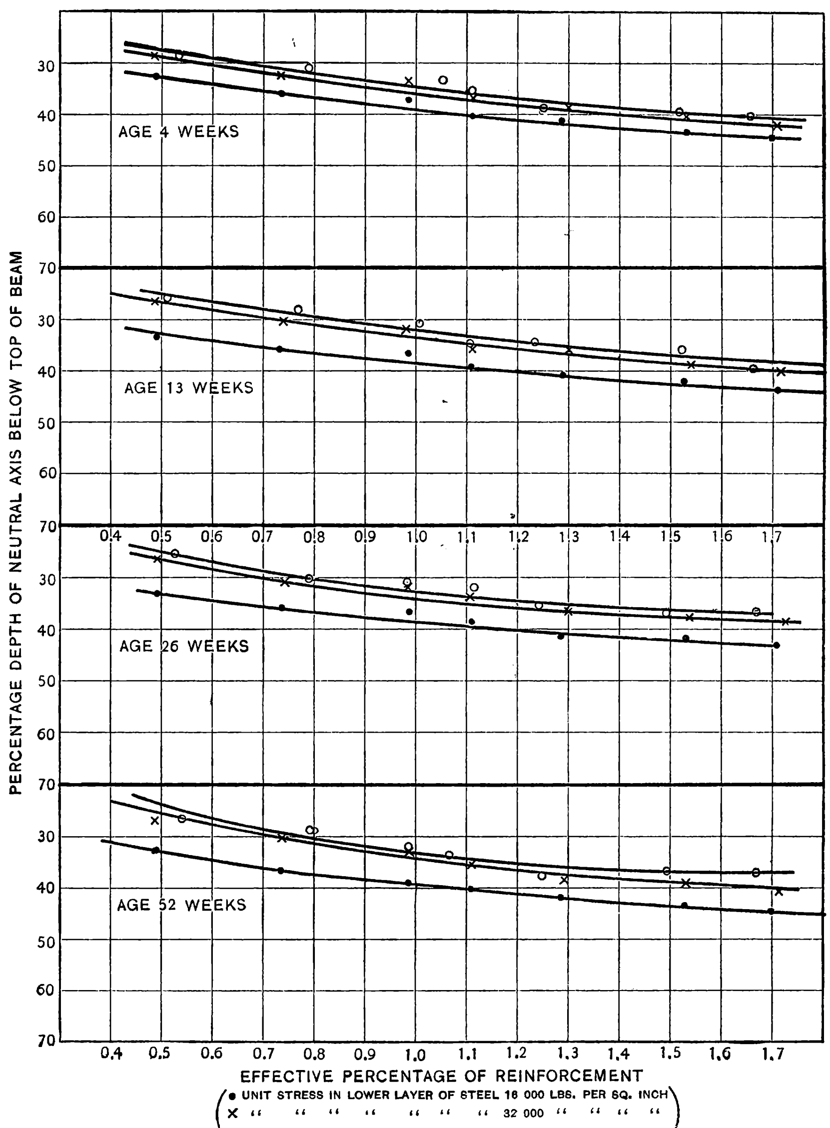


Fig 8.—*Relation Between Position of Neutral Axis and Effective Percentage of Reinforcement for Gravel Concrete*

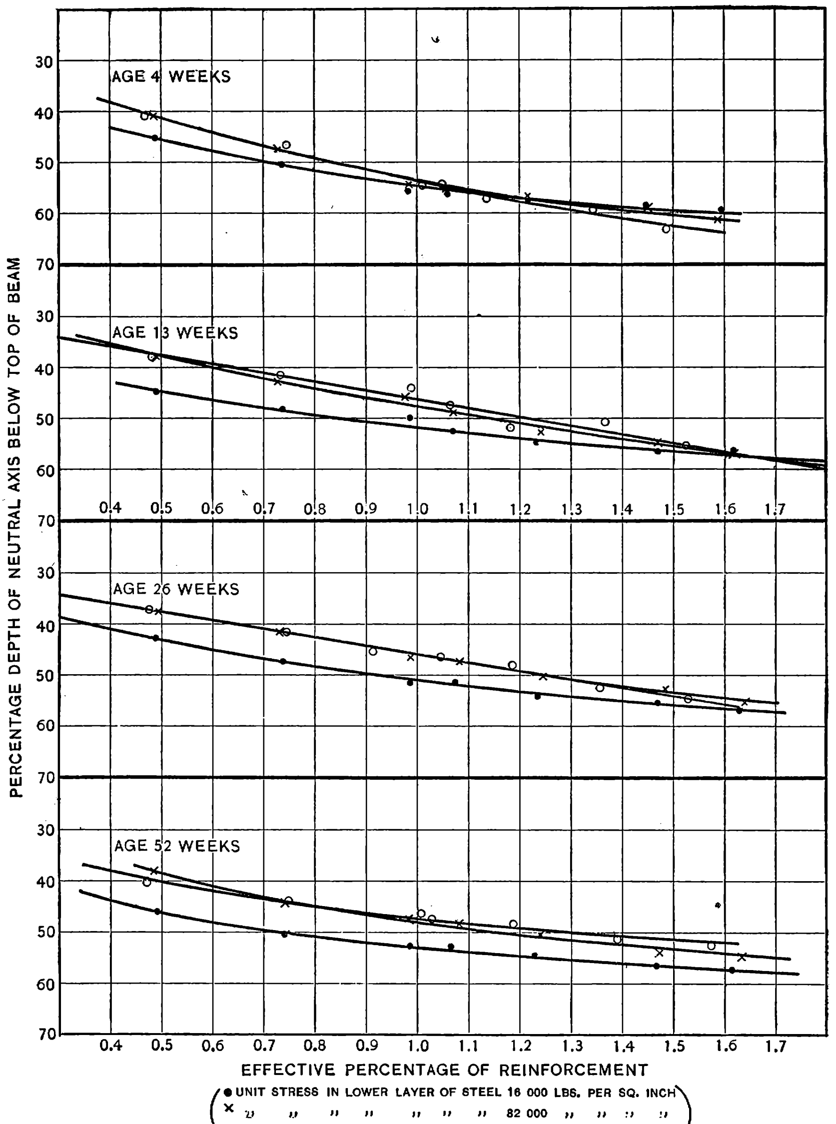


Fig. 9.—*Relation Between Position of Neutral Axis and Effective Percentage of Reinforcement for Cinder Concrete*

As was the case for the other curves, any error in the vertical placing of the bars in the beam as well as any instrumental errors in the deformeters inasmuch as it affects the position of the neutral axis influences the "effective percentage" of reinforcement.

Since, however, the yield point of the reinforcement used in the beams varied from 35 000 to about 42 000 pounds per square inch, the possibility of another error was introduced at maximum load when the "effective" percentage was reduced to correspond with a yield point of 40 000 pounds.

As might be expected from the upward bend of the neutral axis curves in Figs. 6 to 9, pages 62 to 65, the 32 000 pounds curve is in all cases well above the 16 000 pounds curve for 0.5 per cent reinforcement.

For the gravel and stone concrete having 1.6 per cent reinforcement the 4-week tests appear in one group and the 13, 26, and 52 week tests in another. For the 4-week tests the change in the position of the neutral axis when the stress in the reinforcement increases from 16 000 to 32 000 pounds per square inch is appreciably less than for ages of 13, 26, and 52 weeks. A reference to the average compressive stress gross deformation curves for the cylinders (Figs. 37 to 40, pp. 111 to 114) and the ultimate compressive strength at the age of 4 weeks as contrasted with that at 13, 26, and 52 weeks, Tables 33 to 36, pages 129 to 136, will furnish an explanation for this behavior. As may be seen, the increase in strength and stiffness from 4 to 13 weeks is quite appreciable, while the increase after 13 weeks is much less.

The tendency of the neutral axis to rise with the increasing development of cracks below the neutral axis as the unit stress in the reinforcement changes from 16 000 to 32 000 pounds per square inch is therefore partly counteracted by the lowering of the neutral axis, due to the uniformly changing stress conditions above the neutral axis, after the yield point of the concrete in compression has been reached.

When the age of 13 weeks is reached the concrete above the neutral axis has apparently increased sufficiently in strength and stiffness to make the development of cracks below the neutral axis the only factor in determining the change in its position.

This action is even more clearly brought out by the tests on the cinder concrete. For example, the 4-week tests on cinder concrete, below an effective percentage of about 1.1, shows that the neutral axis rises as the unit stress in the reinforcement increases from 16 000 to 32 000 pounds, the amount of the rise, however, steadily decreasing to zero at this percentage. For percentages of reinforcement above 1.1 the distance of the neutral axis below the top of the beam increases when the stress in the reinforcement changes from 16 000 to 32 000 pounds per square inch—the amount of the change increasing regularly as the percentage of reinforcement increases.

This lowering of the neutral axis above a reinforcement of 1.1 per cent is quite noticeable at maximum load, and would indicate that the ultimate compressive strength of the concrete has been almost developed. The individual tests at four weeks on cinder concrete having 1.50, 1.75 and 2 per cent nominal reinforcement present all the characteristics of the proximity or presence of a compression failure, becoming more marked as the percentage of reinforcement increases. From an examination of representative deformation curves for cinder concrete for the upper fiber it is seen that the abrupt change in direction at maximum load, which is always indicative of a tension failure, is absent. The curves, on the contrary, are very regular, although the deformations increase rapidly near the maximum load. The deformations of the upper fiber, as might be expected when the low modulus of elasticity (1 610 000) is taken into consideration, are very large even for comparatively low loads and continue to increase until near maximum load the increase in deformation is so great, for a small increase in load that the curves are practically horizontal.

Table 36, page 136, shows that the ultimate strength of cinder concrete at the age of 4 weeks as based on the tests of the cylinders is 1647 pounds per square inch.

Fig. 21, page 95, showing the relation between the "effective" percentage of reinforcement and the unit compressive stress in the extreme upper fiber, gives a unit compressive stress equal to 1750 pounds per square inch for 1.6 per cent reinforcement. This figure also indicates that at maximum load the unit compressive stress in the extreme upper fiber for all percentages of reinforcement greater than 1 per cent is nearly equal to the ultimate strength of the concrete.

Fig. 9, page 65, showing the variation of position of the neutral axis with the "effective" per cent at the age of 13 weeks, brings out clearly the effect of the increase in strength and stiffness with age. At the age of 4 weeks it is seen that the depth of the neutral axis below the top of the beam remains constant for all intensities of loading for a percentage of reinforcement of 1.1.

For the 13-week tests this same condition is seen to occur at about 1.6 per cent, while for all percentages below this amount the distance of the neutral axis below the top of the beam decreases as the unit stress in the reinforcement increases.

Examining Table 36, page 136, and Fig. 21, page 94, it is seen that even at the age of 13 weeks the ultimate strength of the concrete in compression is approached when the amount of the reinforcement is 1.6 per cent.

All data illustrated in part by representative curves (Figs. 41 to 45, facing page 32) show the concrete still increasing in strength and stiffness for ages of 26 and 52 weeks, the latter figure being nearly similar in outline to those for the stone and gravel concretes at an age of 4 weeks, although the neutral axis for the cinder concrete is, of course, lower, due to the lower modulus of elasticity.

Table 27 has been prepared to show the distance of the neutral axis below the top of the beam for every age and aggregate and for 0.5 and 1.6 per cent "effective" reinforcement with stresses of 16 000 and 32 000 pounds per square inch respectively. These percentages read directly from the figures were chosen since they are the maximum values and minimum values that are common to all of Figs. 6 to 21, pages 62 to 95, and permit rough comparison of the tests to be made.

While it appears that age has an influence on the absolute position of the neutral axis for the purpose of comparison the percentage distance below the top of the beam has been averaged for all four ages and tabulated in Table 27, since the difference between stone and gravel concretes and cinder concrete is quite marked.

Table 27.—Percentage Depth of Neutral Axis Below Top of Beam, Based on Effective Depth

Unit Stress in Lower Layer of Reinforcement, 16 000 Pounds

| Age, in Weeks | Granite | | Gravel | | Limestone | | Cinders | |
|---|---|---|---|---|---|---|---|---|
| | Effective Percentage of Reinforcement | | Effective Percentage of Reinforcement | | Effective Percentage of Reinforcement | | Effective Percentage of Reinforcement | |
| | 0.5 | 1.6 | 0.5 | 1.6 | 0.5 | 1.6 | 0.5 | 1.6 |
| 4 | 34.5 | 46.5 | 32.5 | 44.0 | 33.5 | 48.0 | 45.5 | 60.0 |
| 13 | 35.5 | 45.0 | 32.5 | 43.0 | 34.5 | 46.0 | 45.0 | 57.0 |
| 26 | 32.0 | 44.0 | 33.0 | 42.0 | 33.5 | 44.0 | 43.5 | 57.0 |
| 52 | 32.5 | 44.5 | 33.0 | 44.0 | 31.0 | 44.5 | 46.0 | 57.5 |
| **Average** | 33.6 | 45.0 | 32.8 | 43.2 | 33.1 | 45.9 | 45.0 | 57.9 |
| Unit Stress in Lower Layer of Reinforcement, 32 000 Pounds | | | | | | | | |
| 4 | 29.0 | 45.0 | 29.0 | 42.0 | 29.0 | 46.0 | 41.0 | 61.5 |
| 13 | 29.0 | 40.5 | 26.5 | 39.0 | 28.5 | 43.0 | 38.0 | 57.0 |
| 26 | 27.0 | 40.0 | 26.0 | 38.0 | 28.0 | 40.0 | 37.5 | 55.0 |
| 52 | 27.5 | 40.0 | 26.5 | 39.0 | 25.0 | 41.0 | 38.0 | 55.0 |
| **Average** | 28.1 | 41.4 | 27.0 | 39.5 | 27.6 | 42.5 | 38.6 | 57.1 |

Table 28.—Relation Between Distance of Neutral Axis Below Top of Beam and Relative Value of Modulus of Elasticity

| Kind of Aggregate | Average Ratio of Moduli of Elasticity Cinders= Unity | Stress in Reinforcement 16 000 Pounds Per Square Inch | | Stress in Reinforcement 32 000 Pounds Per Square Inch | |
|---|---|---|---|---|---|
| | | Effective Percentage of Reinforcement | | Effective Percentage of Reinforcement | |
| | | 0.5 | 1.6 | 0.5 | 1.6 |
| Gravel | 2.63 | 32.8 | 43.2 | 27.0 | 39.5 |
| Granite | 2.37 | 33.6 | 45.0 | 28.1 | 41.4 |
| Limestone | 2.13 | 33.1 | 45.9 | 27.6 | 42.5 |
| Average | 2.38 | 33.2 | 44.7 | 27.6 | 41.1 |
| Cinders | 1.00 | 45.0 | 57.9 | 38.6 | 57.1 |
| Ratio cinders to rock | | 1.36 | 1.30 | 1.40 | 1.39 |

The values in column 2 of this table were obtained from Tables 33 to 36, pages 129 to 136, by averaging the ratios of the moduli of elasticity calling that of cinders which is the lowest equal to unity. The change in the position of the neutral axis below the top of the beam is not influenced in direct proportion to the modulus of elasticity, the neutral axis for different concretes changing much less rapidly than the corresponding moduli of elasticity.

The values in this table have been arranged in decreasing order of the magnitude of the ratio of the moduli of elasticity, the stone and gravel concretes being grouped together, while the cinder concrete is shown separately.

The average ratio for stone and gravel concrete to cinder concrete is 2.38, which is about 4.5 times the change in that of the stone and gravel concrete. Bearing this in mind, it may reasonably be expected that the difference between the distance of the neutral axis below the top of the beam for cinder concrete and that for stone and gravel concrete is greater than that found in the stone and gravel concrete group. From the table this is seen to be the case, the ratio of the depth to the neutral axis for cinder concrete to that for stone and gravel concrete varying from 1.30 to 1.40, with an average value of 1.36.

Table 29.—Comparison of Computed and Observed Values of K for 0.5 Per Cent and 1.6 Per Cent "Effective Reinforcement."

| Age in Weeks | Granite | | | | | Gravel | | | | | Limestone | | | | | Cinders | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [14] N | K in Per Cent for the Following Percentage of Reinforcement | | | | N | K in Per Cent for the Following Percentage of Reinforcement | | | | N | K in Per Cent for the Following Percentage of Reinforcement | | | | N | K in Per Cent for the Following Percentage of Reinforcement | | | |
| | | 0.5 | | 1.6 | | | 0.5 | | 1.6 | | | 0.5 | | 1.6 | | | 0.5 | | 1.6 | |
| | | Computed | Observed | Computed | Observed | | Computed | Observed | Computed | Observed | | Computed | Observed | Computed | Observed | | Computed | Observed | Computed | Observed |
| 4 | 6.99 | 25.0 | 29.0 | 40.0 | 45.0 | 6.52 | 24.0 | 29.0 | 39.0 | 42.0 | 8.36 | 27.0 | 29.0 | 43.0 | 46.0 | 18.63 | 37.0 | 41.0 | 56.0 | 62.0 |
| 13 | 6.77 | 25.0 | 29.0 | 40.0 | 41.0 | 6.49 | 24.0 | 27.0 | 39.0 | 39.0 | 7.88 | 26.0 | 29.0 | 42.0 | 43.0 | 16.48 | 36.0 | 38.0 | 54.0 | 57.0 |
| 26 | 6.70 | 25.0 | 27.0 | 39.0 | 40.0 | 5.73 | 23.0 | 26.0 | 37.0 | 38.0 | 6.96 | 25.0 | 28.0 | 40.0 | 40.0 | 14.15 | 34.0 | 38.0 | 52.0 | 55.0 |
| 52 | 6.29 | 24.0 | 28.0 | 39.0 | 40.0 | 5.56 | 23.0 | 27.0 | 37.0 | 39.0 | 6.59 | 24.0 | 25.0 | 40.0 | 41.0 | 14.22 | 34.0 | 38.0 | 52.0 | 55.0 |
| Average | | 24.7 | 28.2 | 39.5 | 41.5 | | 23.5 | 27.2 | 38.0 | 37.0 | | 25.5 | 27.8 | 41.2 | 42.5 | | 35.2 | 38.7 | 53.5 | 57.2 |

[14] N=Ratio of modulus of elasticity of steel (30 000 000) to the average initial modulus of elasticity of concrete. (Tables 33 to 36.)

While it is somewhat foreign to the purpose of this bulletin to enter into any theoretical discussions, and while it has been the aim to adhere strictly to a presentation and discussion of experimental results, the preceding table giving the computed and experimental position of the neutral axis is of interest.

The experimental or observed value of the depth of the neutral axis below the top of the beam has been read from the 32 000 pounds stress curve. (Figs. 6 to 9.) Since the formula, by which the computed values of the neutral axis were obtained, is based in part on the assumption that the concrete below the neutral axis has no tensile resistance, the observed values, with which the computed values are to be compared, should be obtained at a stage during the test when the beam most nearly approximates the conditions assumed in the formula. Since the maximum load values are in no case as accurate as could be desired, the computed values have been compared with the observed values for a stress of 32 000 pounds per square inch in the lower layer of the reinforcement.

The general formula for proportionate distance of the neutral axis below the top of the beam is as follows:

$$K = \sqrt{\frac{2pn}{1 - \frac{1}{3}q} + \frac{p^2 n^2}{\left[1 - \frac{1}{3}q\right]^2}} - \frac{pn}{1 - \frac{1}{3}q}$$

$K$ = proportionate depth of the neutral axis below top of beam.
$P$ = "Effective" percentage of reinforcement.
$n$ = ratio of the modulus of elasticity of the reinforcement to the initial modulus of elasticity of the concrete.
$q$ = ratio of unit compressive deformation developed in the upper fiber of the beam to the ultimate unit compressive deformation of the concrete.

In this formula, as in others, $q$ has been made equal to ½.

The values for the four ages have been averaged. The computed value is in all except one case less than the observed value. In examining this table it should be remembered that in the theoretical formula $q$ has been retained equal to ½, irrespective of the kind of concrete, and further that the assumed condition of total absence of tensile resistance below the neutral axis is not true.

(2) **Variation of $\frac{M}{bd^2}$ with "Effective" Percentage of Reinforcement.**—The data plotted in Figs. 10 to 13 was obtained in tables similar to Table 27, page 69. An inspection of these diagrams shows that the variation of $\frac{M}{bd^2}$ with "effective" per cent of reinforcement can be represented sufficiently well by a straight line. A straight line has therefore been drawn through every group of points, one for a unit stress in the lower layer of reinforcement equal to 16 000 pounds, another for 32 000 pounds, and a third at maximum load. The curve for 32 000 pounds per square inch is always well above that for 16 000 pounds, and the direction of both is such that they would converge at about the same point for zero percentage of reinforcement. This is, however, not the case for the line drawn at maximum load. In many cases the line crosses that for 32 000 pounds stress in the reinforcement, seeming to indicate that the $\frac{M}{bd^2}$ or load carried at "maximum" load was actually less than that carried for a stress of 32 000 pounds per square inch in the reinforcement. As was pointed out in the preparation of Table 27, page 69, the "effective" percentage of reinforcement at maximum load had to be modified, due to the fact that the yield point of the reinforcement used varied from 35 000 to 42 000 pounds per square inch. Since a unit stress of 40 000 pounds was taken as a basis for comparison, the effective per cent of all beams having reinforcement of a higher yield point was increased, when corrected, above what it would be if based only on the position of the neutral axis, while if the reinforcement were of lower yield point it would be decreased. The effect of such an increase in percentage is to move the plotted point over horizontally a distance which is in several cases great enough to cause the maximum load line to intersect that for a stress of 32 000 pounds in the reinforcement.

This behavior would seem to throw suspicion on the correctness of the assumptions made in the preparation of the data used in plotting this line. In studying any of these diagrams, too much emphasis can not be laid on the necessity for remembering how

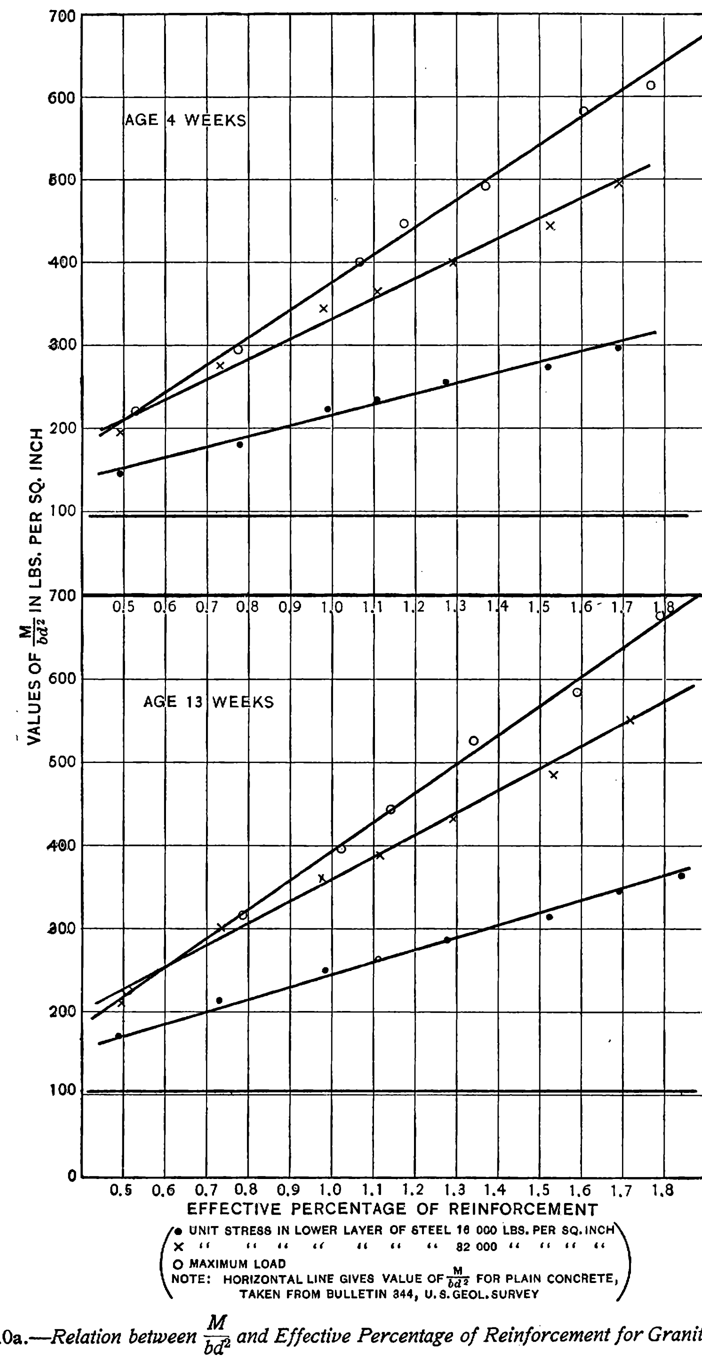


**Fig. 10a.**—*Relation between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcement for Granite Concrete*

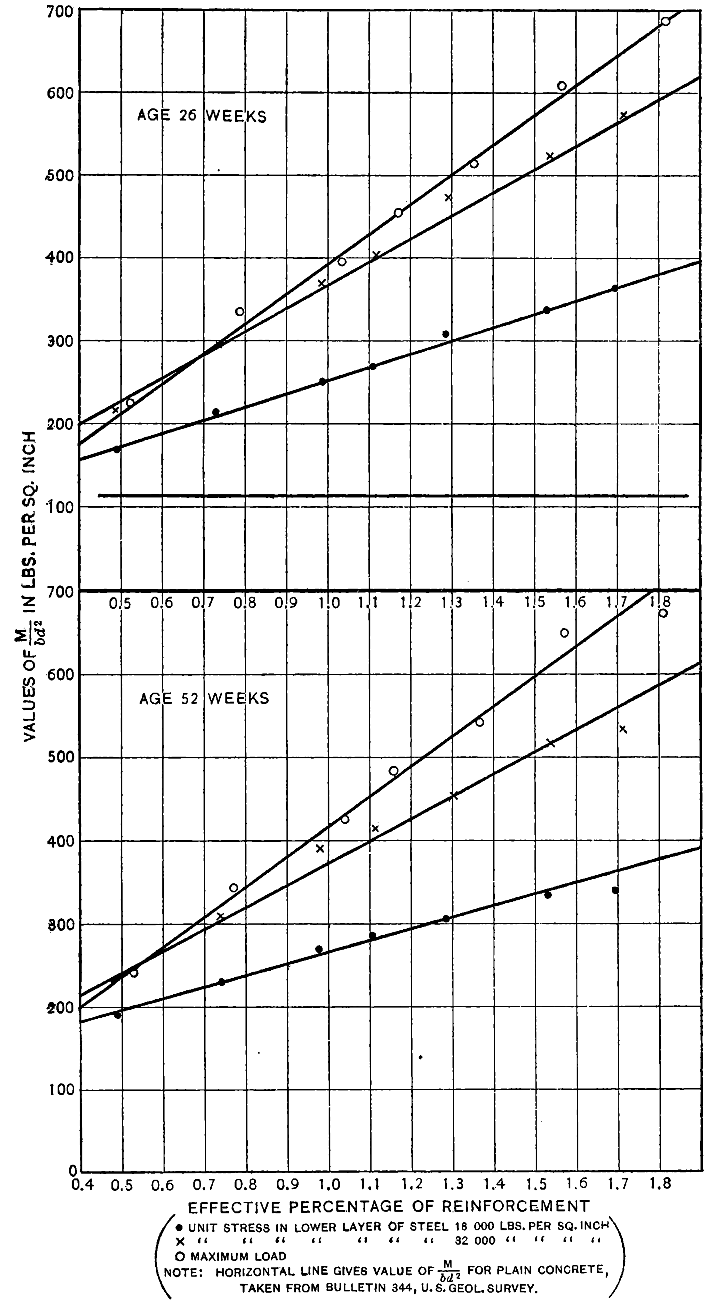


Fig. 10b.—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcement for Granite Concrete*

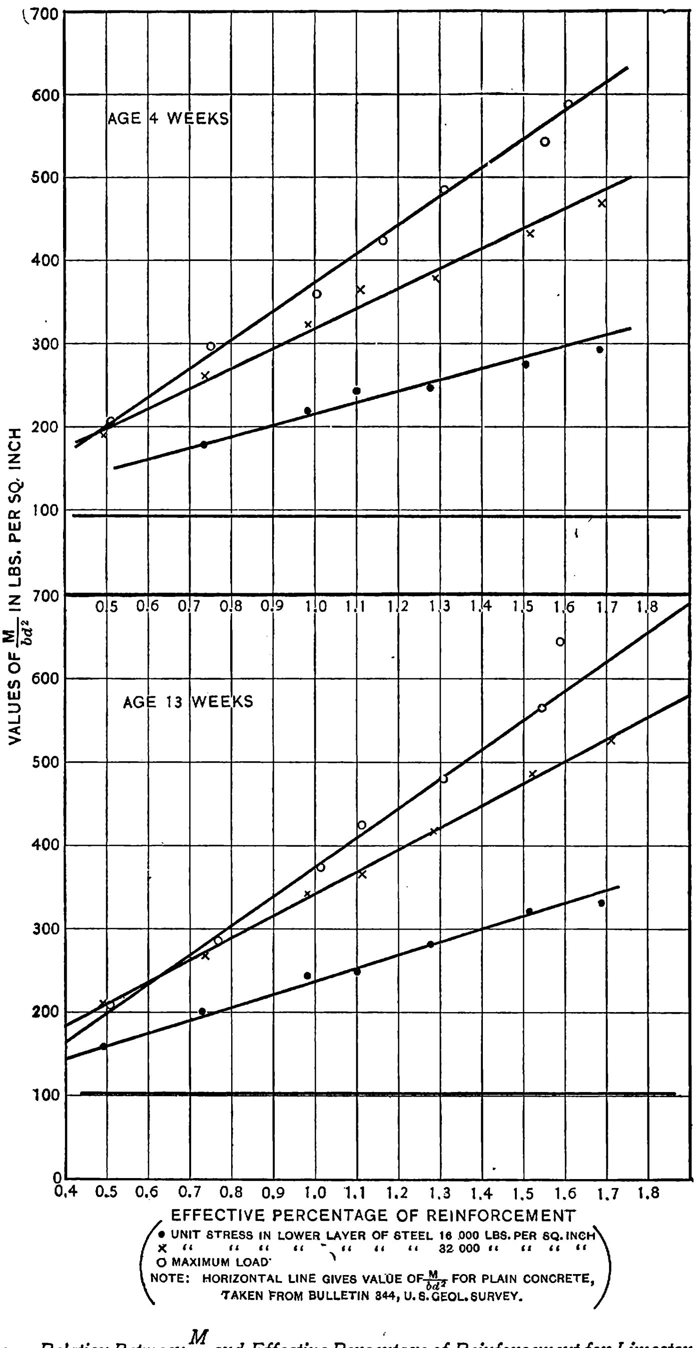


**Fig. 11a.**—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcement for Limestone Concrete*

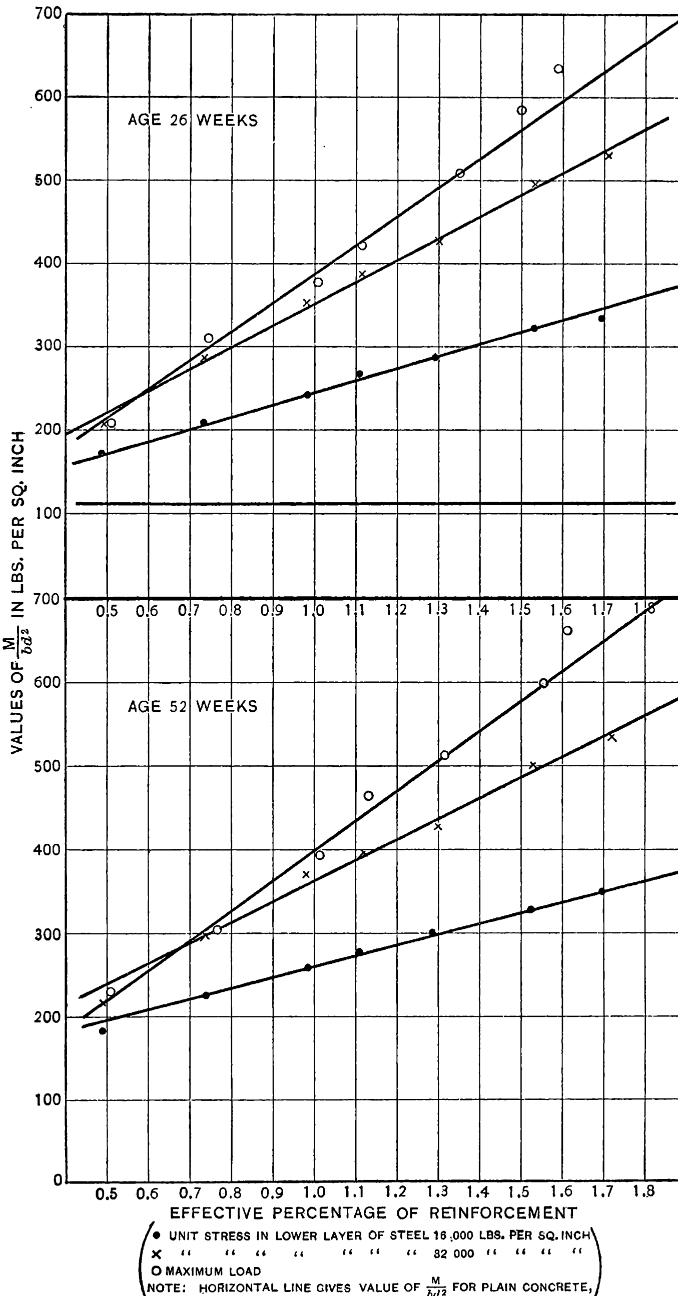


**Fig. 11b.**—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcewent for Limestone Concrete*

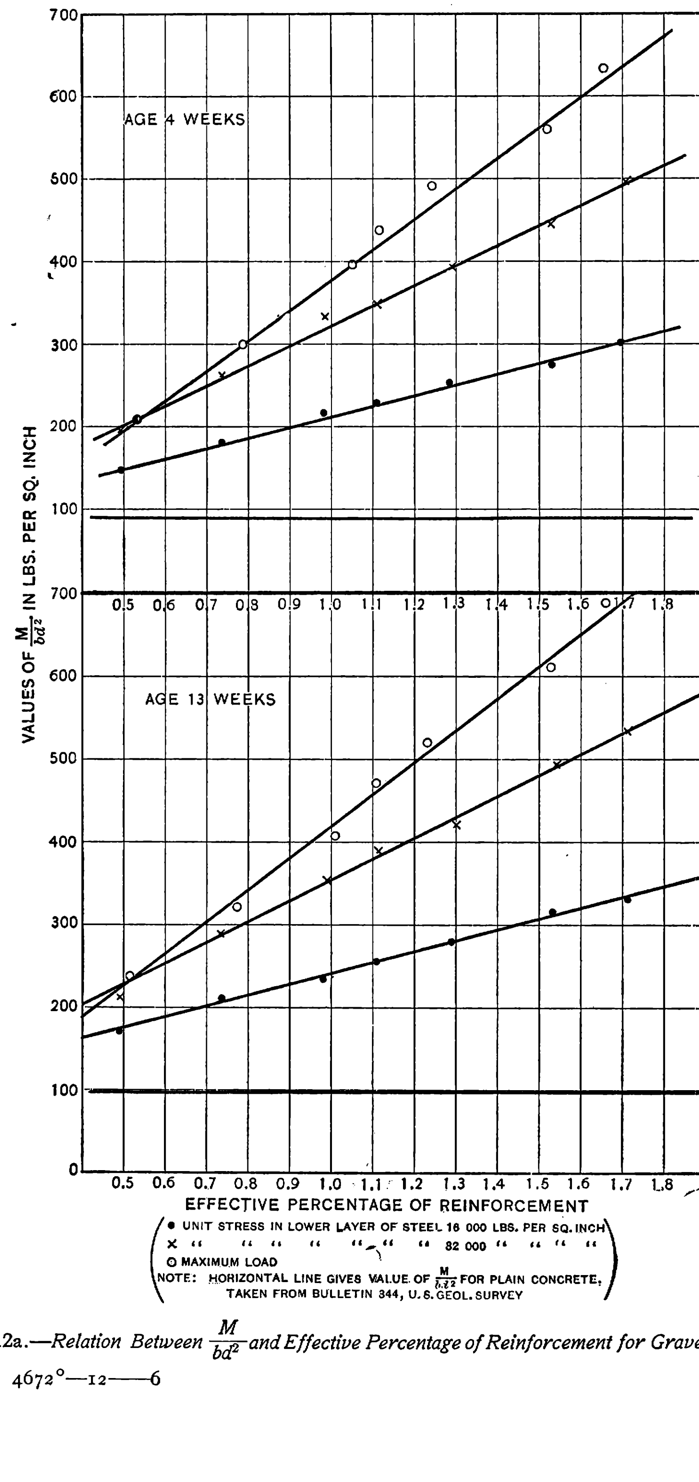


Fig. 12a.—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcement for Gravel Concrete*

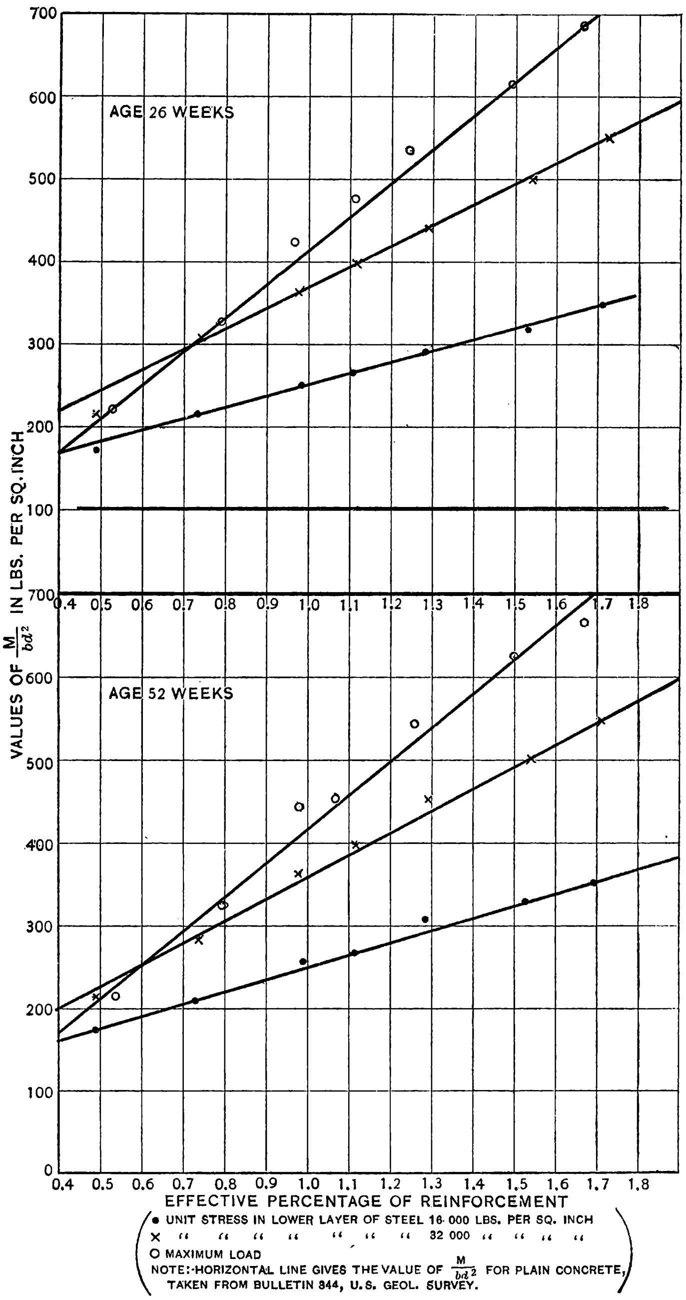


Fig. 12b.—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reinforcement for Gravel Concrete*

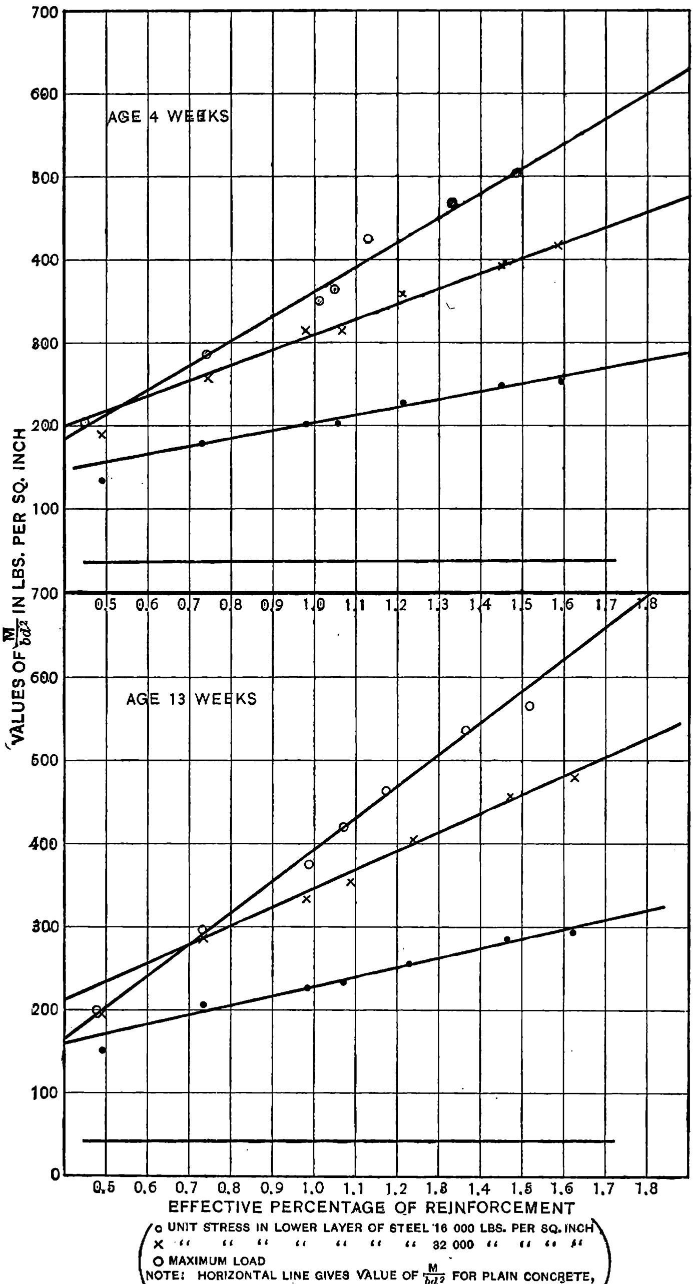


Fig. 13a.—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage for Reenforcement of Cinder Concrete*

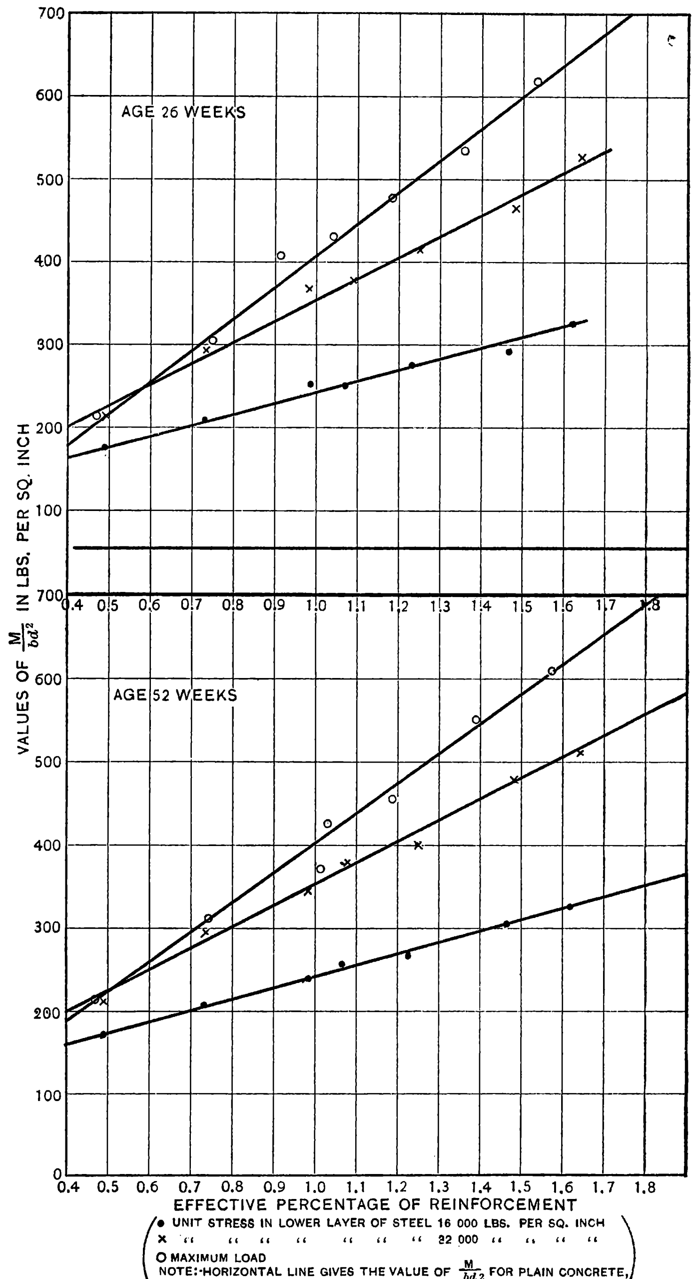


Fig. 13b.—*Relation Between* $\frac{M}{bd^2}$ *and Effective Percentage of Reenforcement for Cinder Concrete*

the various values used were obtained. The value of $\frac{M}{bd^2}$ is, of course, almost correct since it is based on a load which could be accurately determined and on dimensions, span, position of load points, breadth, and depth, all of which can be accurately measured.

As has already been pointed out this was not the case in determining the "effective" percentage of reinforcement. There is also the possibility that for the same "effective" percentage all concentrated in the lower layer in one case and in another distributed in two layers, there may be sufficient difference in behavior in the action of the beam under load, to cause some of the more or less erratic values that are noticeable.

The lines for 16 000 and 32 000 pounds per square inch in the reinforcement are therefore in one group and are comparable among themselves, while the line for maximum load can only be compared with other maximum load lines.

Examining the values for $\frac{M}{bd^2}$ at an "effective" percentage of reinforcement of 0.5 and 1.6 per cent and for a stress of 16 000 and 32 000 pounds per square inch in the reinforcement and contrasting the 4-week with the 13-week tests the effect of the character of the compressive stress gross deformation curve on the resistance of the beam is very generally brought out. At a reinforcement of 0.5 per cent for which the intensity of loading does not cause compressive stresses in the concrete much above the yield point, at the age of 4 weeks, the increase in $\frac{M}{bd^2}$ at 13 weeks is less than for 1.6 per cent reinforcement for which in many cases the compressive stress developed in the upper fiber was considerably greater than the yield point. This is particularly true for a unit stress in the steel of 32 000 pounds per square inch.

The $\frac{M}{bd^2}$ for 32 000 pounds per square inch is not exactly twice that for a stress of 16 000 pounds per square inch. This is probably due to the fact that a beam without reinforcement, 8 by

11 inches in section, has itself considerable resistance to flexure, which must be added to that due to the introduction of reinforcement.

Bulletin 344 [15] gives tests on concrete beams without reinforcement, having the same gross 8 by 11 inch section that was used in the reinforced beam series reported in this bulletin. A portion of the tests of the first series was of beams of a constant 12-foot span, while a secondary portion included beams of variable spans which consisted of the larger portion of the 12-foot span after rupture. A summary of the results of the tests on the 12-foot beams is given in Table 8, pages 36–40, while that for the beams of variable span is given in Table 9, pages 42–46 of the above bulletin. Column 19, Table 8, contains the maximum total $\frac{M}{bd^2}$ for the 12-foot beams, while column 20, Table 9, gives the same information for the variable beams. Since the value of $\frac{M}{bd^2}$ is independent of the span and the conditions of loading these values have been averaged.

Since a medium consistency was used in the reinforced beams, only the $\frac{M}{bd^2}$ for the beams without reinforcement of medium consistency has been used. As was previously indicated the value of $\frac{M}{bd^2}$ for these beams was based on a depth of 11 inches, for which $bd^2 = 968$. The $\frac{M}{bd^2}$ which is plotted on Figs. 6 to 21, pages 62 to 95, has, however, been based on the depth to the reinforcement which is 10 inches, making $bd^2 = 800$.

The value of $\frac{M}{bd^2}$ as given in Tables 8 and 9, Bulletin 344 [15] should therefore be multiplied by $\frac{968}{800} = 1.21$ to make them directly comparable with the values plotted in the figures.

Where the gravel and stone concretes were identical in both beam series, there is a tendency which seems to indicate that the three lines should meet the common point of zero reinforcement.

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[15] U. S. Geological Survey.

If we use this line as a datum, the resistance of the beam to flexure is nearly proportional to the stress in the reinforcement—that is, the distance on the ordinate from the datum line to the 32 000-pound line is nearly equal to twice the distance to the 16 000-pound line.

It has already been pointed out in Bulletin 344,[15] and called attention to in the present bulletin, in discussing the elongation of the lower fiber at first crack, that the proportion of the cinder concrete was a 1 : 2 : 5 volume proportion instead of 1 : 2 : 4. The influence of this difference is clearly seen in the position of the line for the cinder concrete in beams without reinforcement in Figs. 10 to 13, pages 73 to 80.

These figures again bring out clearly the fact, to which attention has already been called, in discussing the ratio of the external bending moment and the internal resisting moment, based on the measured stress in the reinforcement (Tables 6 to 21, column 22, following page 128), that the strength of the concrete in tension below the neutral axis has an appreciable effect on the resistance of the beam.

**(3) Variation of the Deflection at Center of Span with Effective Percentage of Reinforcement.**—Figs. 14 to 17, pages 86 to 90, showing the relation existing between the deflection of the center of the beam, in inches, and the effective percentage of reinforcement for maximum load, and for stresses of 16 000 and 32 000 pounds per square inch, have been prepared from tabulated data similar to that shown in Table 45, columns 10, 11, 15, 16, 20 and 21.

With the explanation of the method of preparation of similar diagrams that has already been given, any further comments on these figures seem unnecessary. An interesting check on the accuracy of the measured deflections, as well as the deformation of the upper and the lower fiber, and consequently the position of the neutral axis, which is obtained directly from the last two, can be obtained by computing the deflection for a stress of 16 000 and 32 000 pounds in the reinforcement. The formula used neglects the weight of the beam, and is based on a beam loaded at the third points only. The deflection at the center is obtained from the elastic curve, in the derivation of which the usual assumptions are made. The formula reduces to—

$$\varDelta = \frac{220.8\ S}{E\ (1-k)}$$

Where $\varDelta$ = deflection, in inches, at center of beam.

$E$ = modulus of elasticity of reinforcement.

$S$ = unit stress in reinforcement.

$k$ = proportionate depth to neutral axis.

For $S = 32\ 000 \qquad \varDelta = \frac{0.235}{1-k}$

$S = 16\ 000 \qquad \varDelta = \frac{0.118}{1-k}$

With these formulas and the values of '$k$' as given by Figs. 6 to 9, pages 62 to 65, as a basis, the following table has been prepared for percentages of 0.5 and 1.6 "effective" reinforcement. The deflections are paralleled by those containing the values obtained from Figs. 14 to 17, which are based on the observed deflections. As will be seen there is a very satisfactory agreement between the observed and the computed values, which not only checks the observed values but also throws light on the degree of accuracy of the deformations.

An inspection of this table will show that for a given stress in the reinforcement the deflection is independent of the age. Since there is no apparent relation between deflection and age, the values in the above table have been averaged, and the average deflection for 32 000 pounds in the reinforcement compared with that for 16 000 pounds per square inch, in the last line of the table. The deflection is apparently not quite doubled, when the stress in the reinforcement is doubled. The average deflections for the stone and gravel concretes, and that for the cinder concrete, for 0.5 and 1.6 per cent reinforcement, have been roughly expressed in terms of the span in the following table.

## Table 30.—Approximate Deflections, in Terms of the Span Length

| Kind of Concrete | Stress in Reinforcement 16 000 Pounds | | Stress in Reinforcement 32 000 Pounds | |
|---|---|---|---|---|
| | Effective Percentage of Reinforcement | | Effective Percentage of Reinforcement | |
| | 0.5 | 1.6 | 0.5 | 1.6 |
| Stone and gravel | $\frac{1}{1000}$ | $\frac{1}{720}$ | $\frac{1}{500}$ | $\frac{1}{360}$ |
| Cinder | $\frac{1}{1000}$ | $\frac{1}{600}$ | $\frac{1}{500}$ | $\frac{1}{300}$ |

## Table 31.—Computed and Measured Deflection, in inches, at the Center of the Beam

Unit Stress in Lower Layer of Reinforcement 32 000 Pounds per Square Inch

| Age, in Weeks | Granite | | | | Gravel | | | | Limestone | | | | Cinders | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Effective Percentage of Reinforcement | | | | Effective Percentage of Reinforcement | | | | Effective Percentage of Reinforcement | | | | Effective Percentage of Reinforcement | | | |
| | 0.5 | | 1.6 | | 0.5 | | 1.6 | | 0.5 | | 1.6 | | 0.5 | | 1.6 | |
| | Deflection | | | | | | | | | | | | | | | |
| | Computed | Observed | Computed | Observed | Computed | Observed | Computed | Observed | Computed | Observed | Computed | Observed | Computed | Observed | Computed | Observed |
| 4 | 0.33 | 0.30 | 0.43 | 0.40 | 0.33 | 0.31 | 0.41 | 0.39 | 0.33 | 0.30 | 0.44 | 0.41 | 0.40 | 0.37 | 0.60 | 0.56 |
| 13 | .33 | .31 | .40 | .38 | .32 | .29 | .39 | .38 | .33 | .32 | .41 | .40 | .38 | .34 | .55 | .51 |
| 26 | .32 | .31 | .39 | .40 | .32 | .28 | .38 | .37 | .33 | .31 | .39 | .38 | .38 | .34 | .53 | .51 |
| 52 | .32 | .29 | .39 | .39 | .32 | .28 | .39 | .39 | .31 | .29 | .40 | .38 | .38 | .33 | .51 | .52 |
| Average | .33 | .30 | .40 | .39 | .32 | .29 | .39 | .38 | .33 | .31 | .41 | .39 | .39 | .35 | .55 | .53 |

Unit Stress in Lower Layer of Reinforcement 16 000 Pounds per Square Inch

| Age, in Weeks | Granite 0.5 Computed | Granite 0.5 Observed | Granite 1.6 Computed | Granite 1.6 Observed | Gravel 0.5 Computed | Gravel 0.5 Observed | Gravel 1.6 Computed | Gravel 1.6 Observed | Limestone 0.5 Computed | Limestone 0.5 Observed | Limestone 1.6 Computed | Limestone 1.6 Observed | Cinders 0.5 Computed | Cinders 0.5 Observed | Cinders 1.6 Computed | Cinders 1.6 Observed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0.17 | 0.16 | 0.22 | 0.19 | 0.18 | 0.16 | 0.21 | 0.19 | 0.18 | 0.14 | 0.23 | 0.20 | 0.22 | 0.19 | 0.30 | 0.26 |
| 13 | .18 | .16 | .21 | .19 | .18 | .15 | .21 | .19 | .18 | .14 | .22 | .20 | .21 | .20 | .27 | .26 |
| 26 | .17 | .17 | .21 | .21 | .18 | .15 | .20 | .19 | .18 | .15 | .21 | .20 | .21 | .19 | .27 | .27 |
| 52 | .18 | .20 | .21 | .20 | .18 | .16 | .21 | .20 | .17 | .16 | .21 | .20 | .22 | .20 | .27 | .27 |
| Average | .18 | .17 | .21 | .20 | .18 | .16 | .21 | .19 | .18 | .15 | .22 | .20 | .22 | .20 | .28 | .27 |
| Ratio $\frac{32\,000}{16\,000}$ | 1.83 | 1.76 | 1.90 | 1.95 | 1.78 | 1.81 | 1.86 | 2.00 | 1.83 | 2.06 | 1.86 | 1.95 | 1.77 | 1.75 | 1.96 | 1.96 |

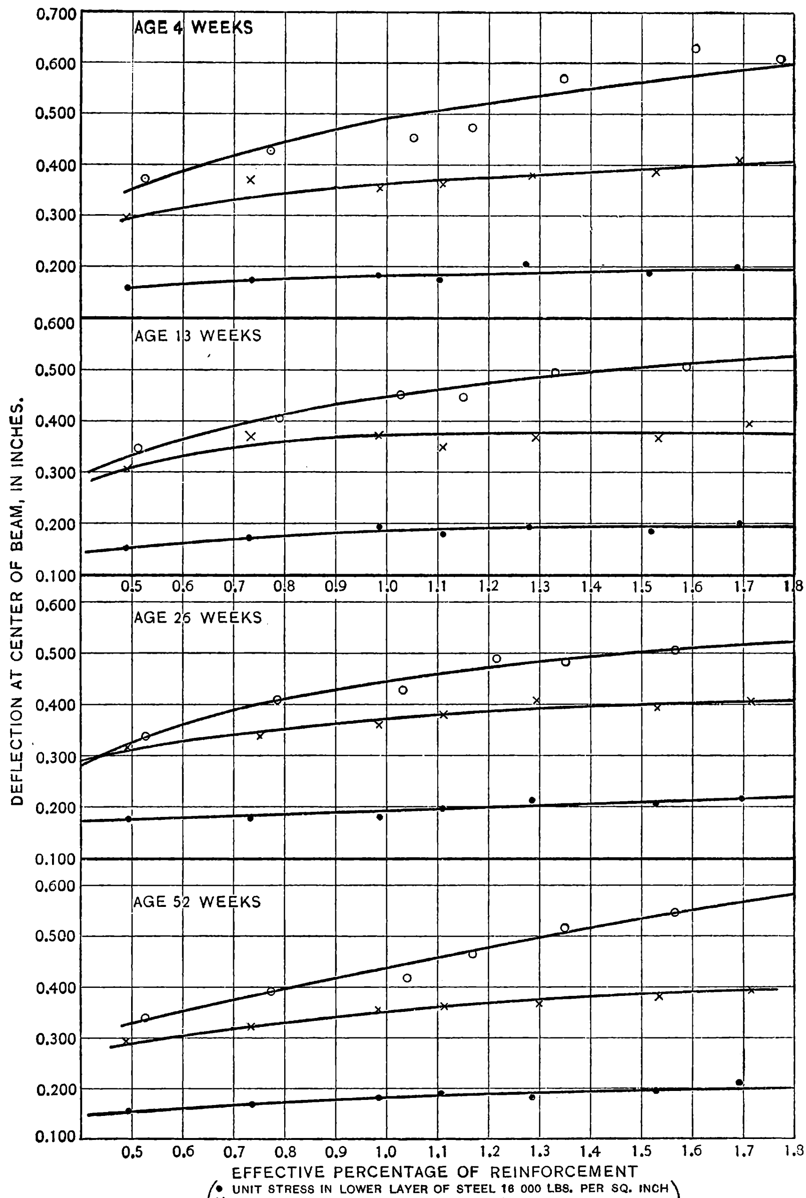



**Fig. 14.**—*Relation Between Deflection of Beam and Effective Percentage of Reinforcement for Granite Concrete*

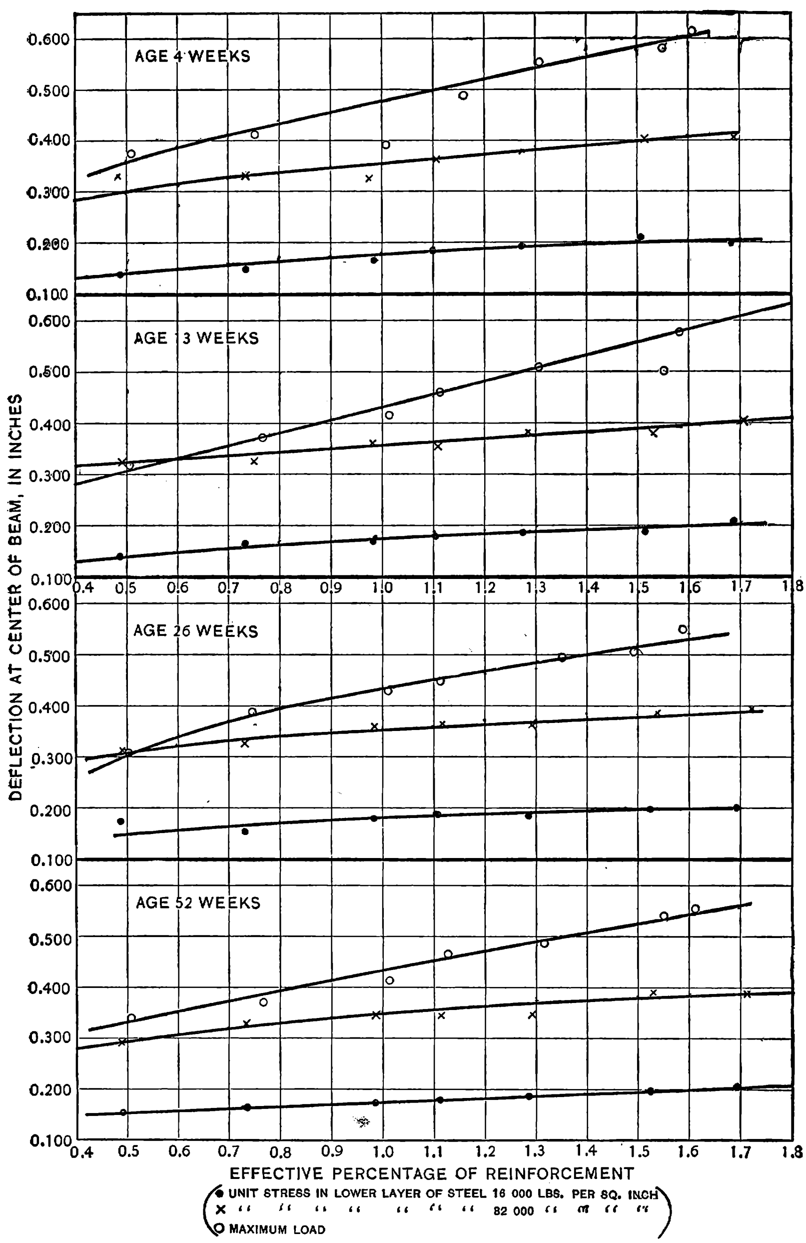



Fig. 15.—*Relation Between Deflection at Center of Beam and Effective Percentage of Reinforcement for Limestone Concrete*

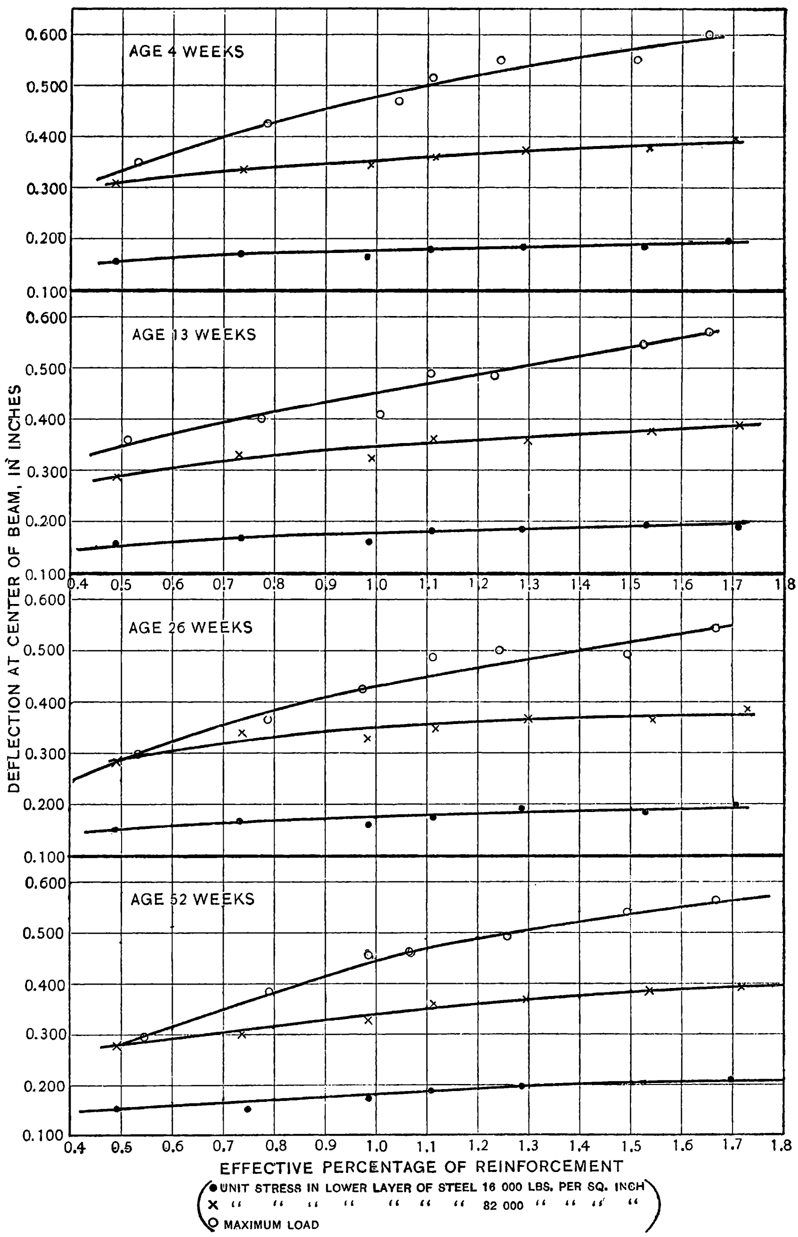



Fig. 16.—*Relation Between Deflection at Center of Beam and Effective Percentage of Reinforcement for Gravel Concrete*

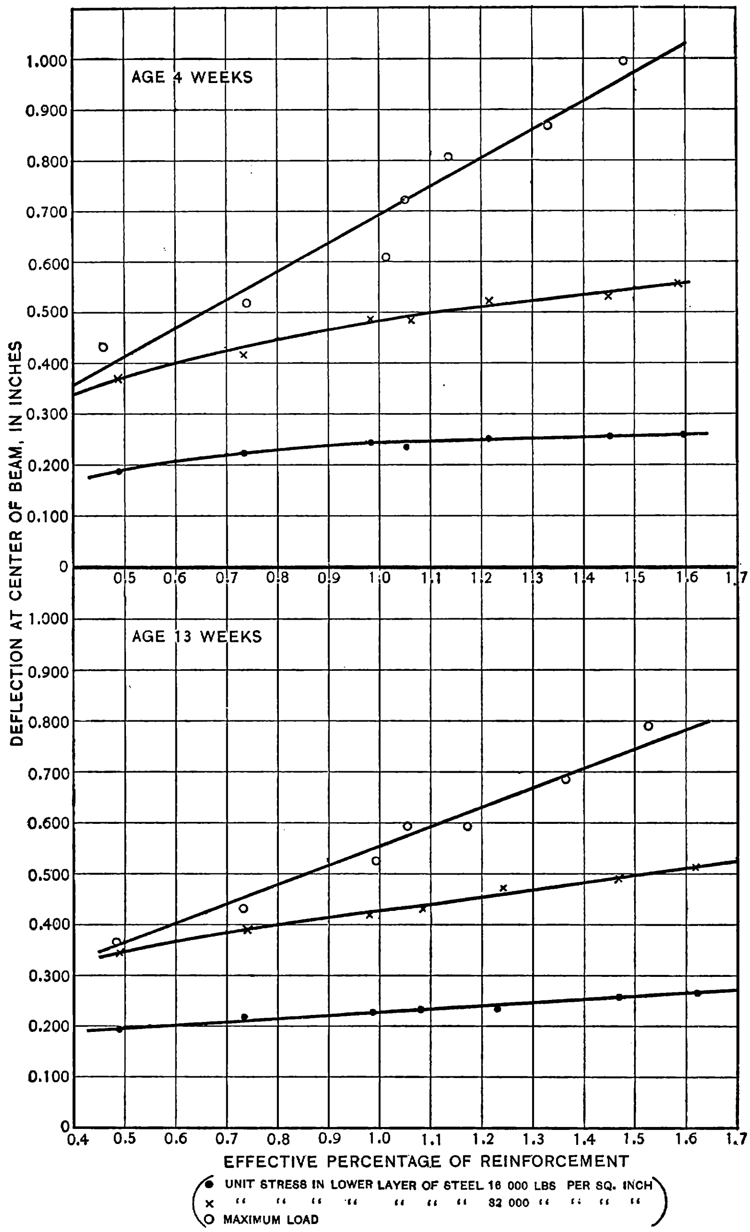



Fig. 17a.—*Relation Between Deflection at Center of Beam and Effective Percentage of Reinforcement for Cinder Concrete*

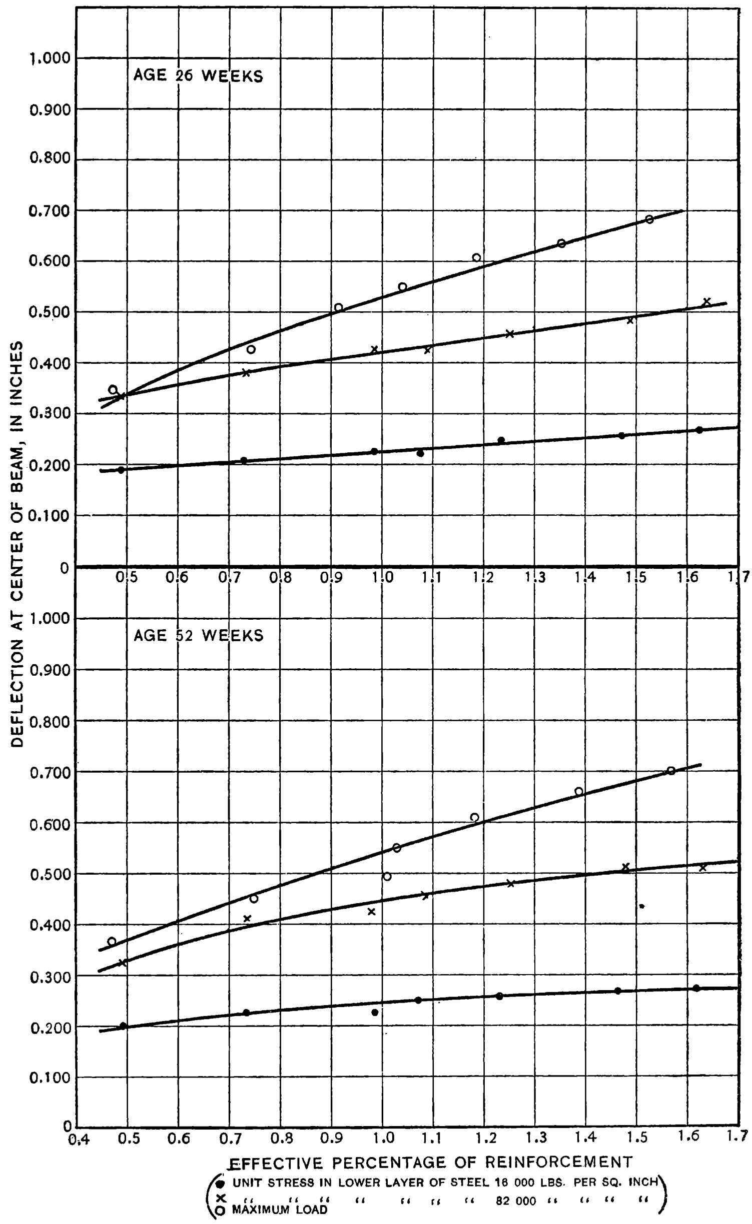



Fig. 17b.—*Relation Between Deflection at Center of Beam and Effective Percentage of Reinforcement for Cinder Concrete*

**(4) Variation of Compressive Stress in Extreme Upper Fiber with "Effective" Percentage of Reinforcement.**—The data given in Table 26, columns 4, 10, 13, 16, 18 and 21, furnishes the basis for determining the relation between the unit compressive stress in the extreme upper fiber for maximum load, 16 000 pounds and 32 000 pounds per square inch in the lower layer of the reinforcement.

As has already been pointed out in explaining the preparation of Table 27, page 69, the unit deformation of the upper fiber could in but few cases be observed directly, and the values tabulated had therefore to be estimated from the upper fiber curves.

The average compressive-stress gross-deformation curves, Figs. 37 to 40, pages 111 to 114, are entered with the values of the unit compressive deformation, columns 4, 13, and 18, Table 26, and the corresponding unit compressive stress determined. This was plotted against the "effective" percentage of reinforcement, columns 10, 16, and 21, Table 26, in Figs. 18 to 21, pages 92 to 95.

An inspection of these figures will show that the group of points for each intensity of loading can be represented with sufficient accuracy by a straight line.

A summary of the unit compressive stress in the upper fiber for 0.5 and 1.6 per cent "effective reinforcement" and at a unit stress in the lower layer of reinforcement of 16 000 and 32 000 pounds has been made in the following table:

An inspection of this table will show the fallacy of the usual assumption, made in specifications, of the simultaneous occurrence of a unit compressive stress of 500 to 800 pounds per square inch in the upper fiber and a unit stress of 16 000 pounds in the reinforcement. A beam of cinder concrete with 0.5 per cent reenforcement and 4 to 13 weeks old is the only case which even approximates the assumed conditions. For all other aggregates and ages the unit stress in the upper fiber is from about two to four times as great as that assumed.

It should be noted, therefore, that if under actual conditions of loading a unit stress of 16 000 pounds is really developed in the reinforcement the stress in the upper fiber is at least 1000 pounds per square inch and in many cases is considerably greater.

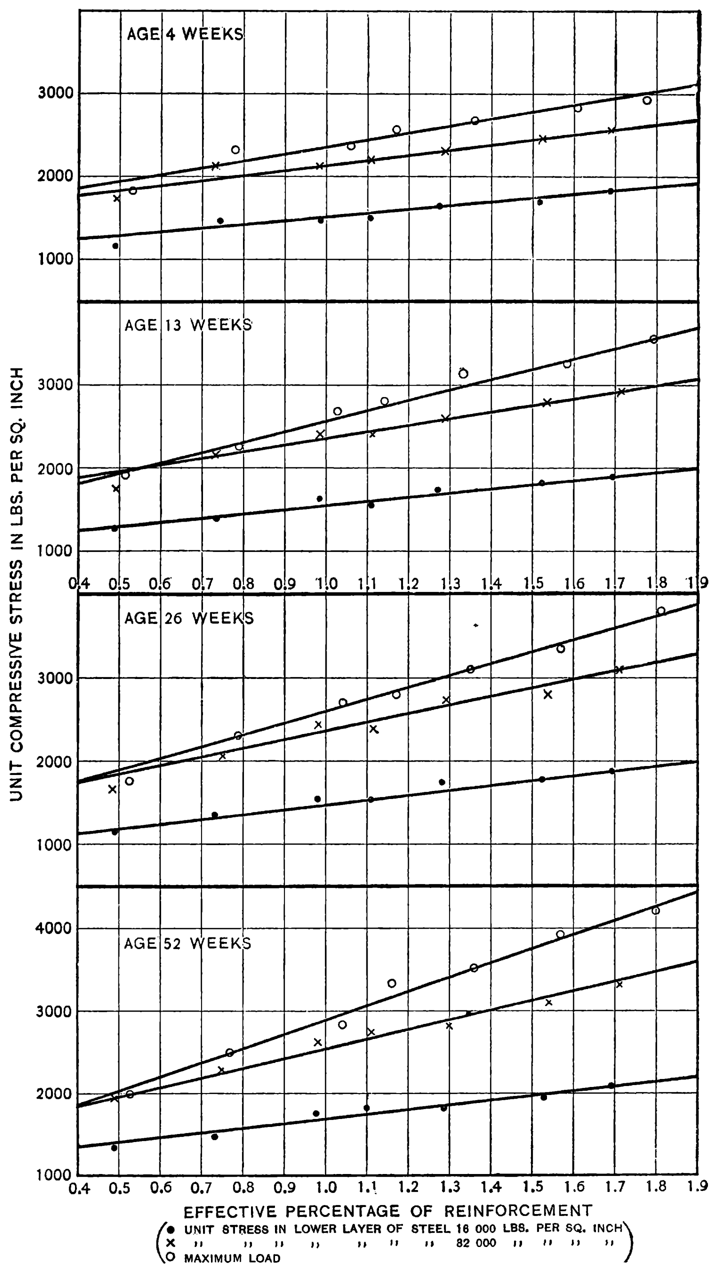



Fig. 18.—*Relation Between Unit Compressive Stress in Upper Fiber and Effective Percentage of Reinforcement for Granite Concrete*

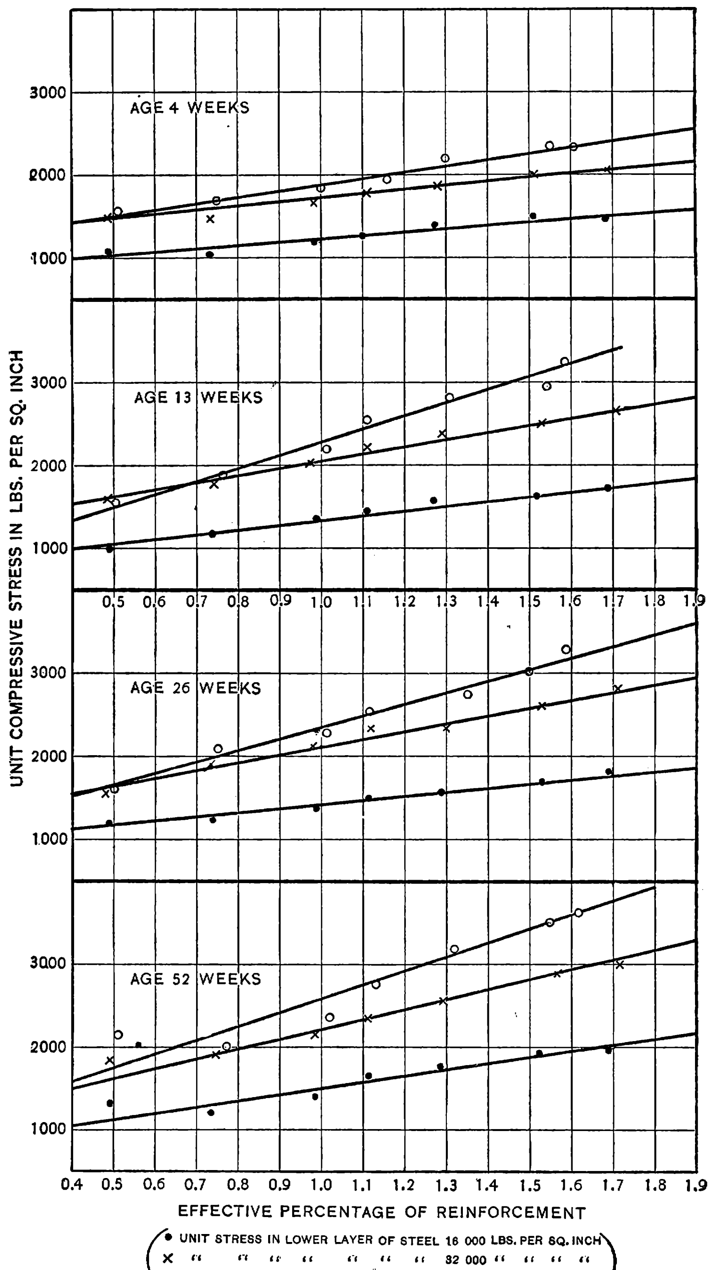



Fig. 19.—*Relation Between Unit Compressive Stress in Upper Fiber and Effective Percentage of Reinforcement for Limestone Concrete*

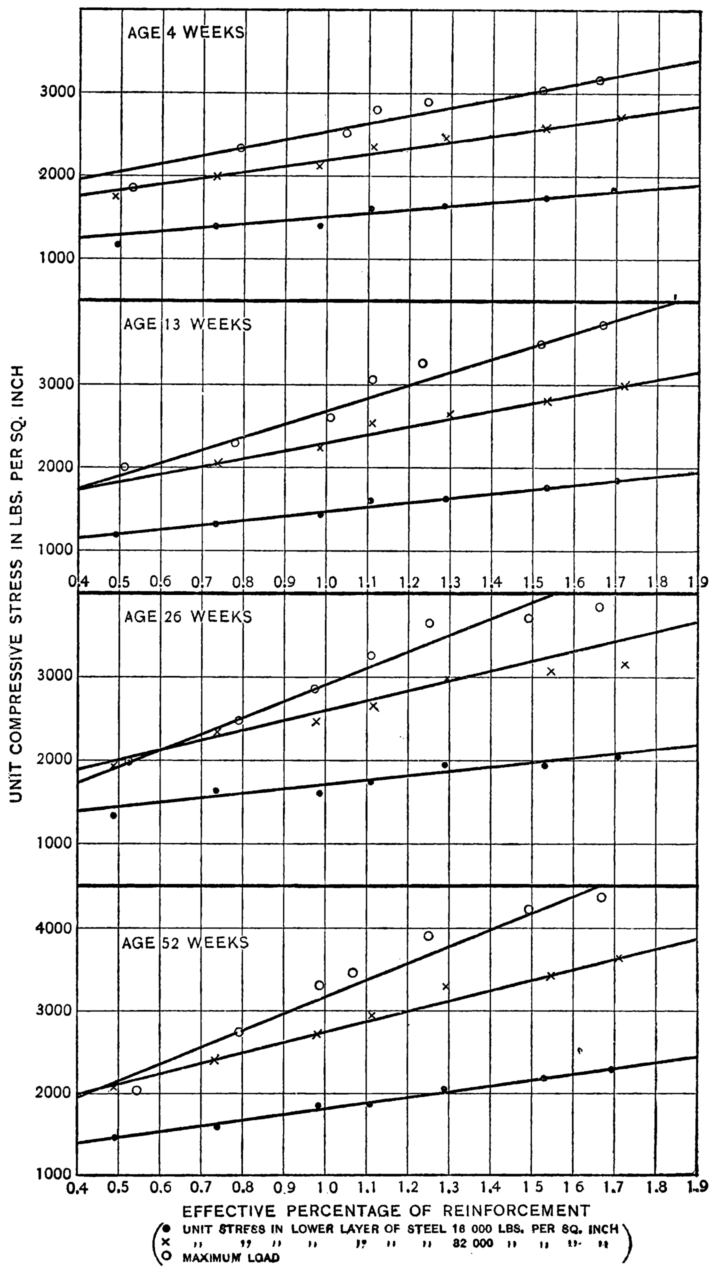



Fig. 20.—*Relation Between Unit Compressive Stress in Upper Fiber and Effective Percentage of Reinforcement for Gravel Concrete*

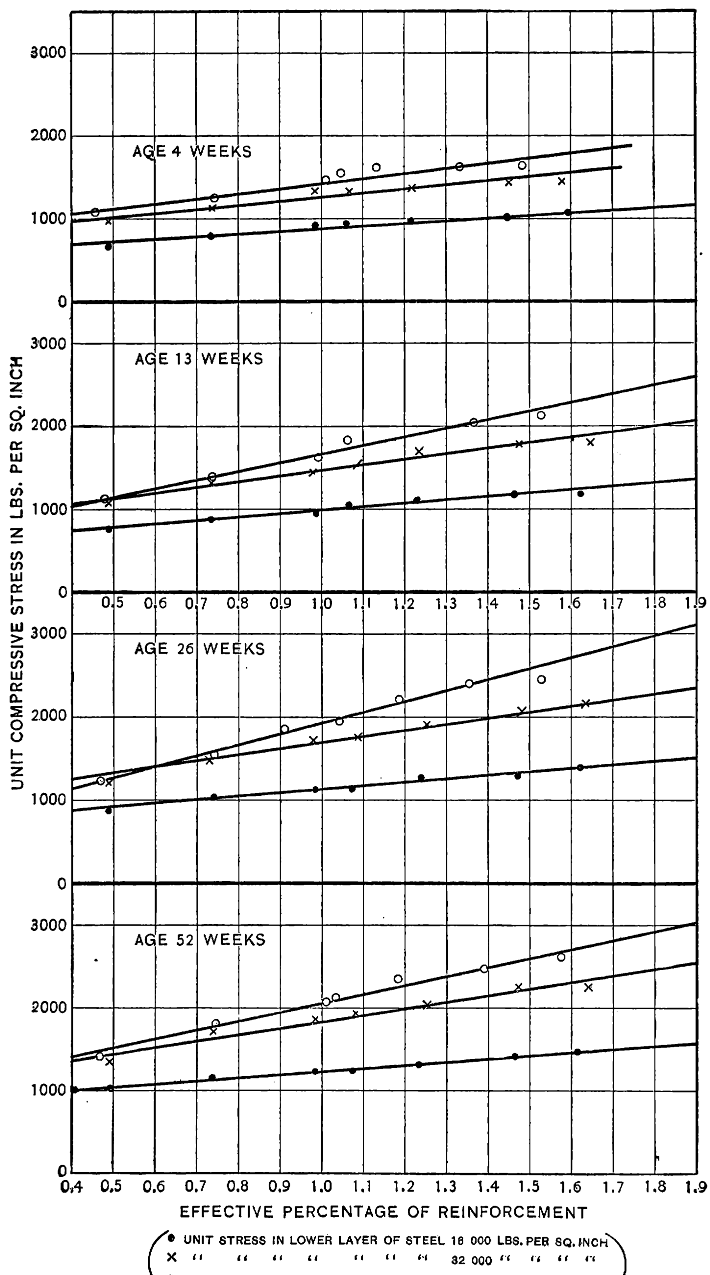



Fig. 21.—*Relation Between Unit Compressive Stress in Upper Fiber and Effective Percentage of Reinforcement for Cinder Concrete*

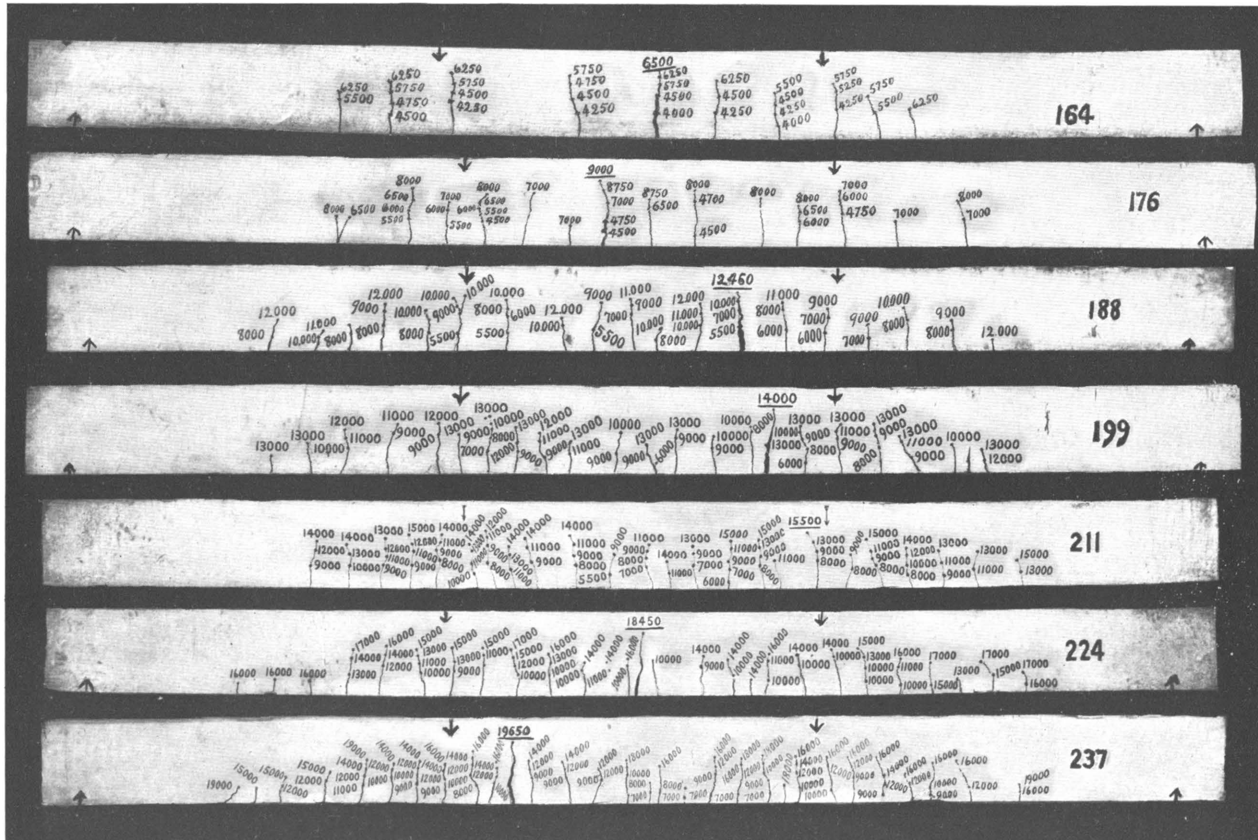
Table 32.—Summary of unit Compressive Stress in the Upper Fiber of Beam for Stresses of 16 000 and 32 000 Pounds per Square Inch in Lower Fiber

| Age, in Weeks | Granite | | Gravel | | Limestone | | Cinders | |
|---|---|---|---|---|---|---|---|---|
| | 0.5 | 1.6 | 0.5 | 1.6 | 0.5 | 1.6 | 0.5 | 1.6 |
| **Unit Stress in Lower Layer of Reinforcement 16 000 Pounds per Square Inch** | | | | | | | | |
| 4 | 1270 | 1775 | 1300 | 1760 | 1030 | 1500 | 730 | 1060 |
| 13 | 1300 | 1850 | 1210 | 1800 | 1050 | 1680 | 800 | 1240 |
| 26 | 1200 | 1830 | 1440 | 2025 | 1200 | 1700 | 925 | 1400 |
| 52 | 1420 | 1980 | 1470 | 2225 | 1120 | 1950 | 1050 | 1475 |
| **Unit Stress in Lower Layer of Reinforcement 32 000 Pounds Per Square Inch** | | | | | | | | |
| 4 | 1850 | 2520 | 1850 | 2630 | 1480 | 2030 | 1040 | 1550 |
| 13 | 1950 | 2850 | 1820 | 2880 | 1600 | 2550 | 1140 | 1870 |
| 26 | 1860 | 3000 | 1940 | 3300 | 1650 | 2670 | 1260 | 2110 |
| 52 | 1950 | 3250 | 2110 | 3500 | 1630 | 2950 | 1410 | 2300 |

### (d) DISCUSSION OF PHOTOGRAPHS OF BEAMS.

As was described on page 21, the development of the cracks, which were visible on the surface of the concrete, was in a majority of cases traced at intervals throughout the test. At the age of 4 weeks, the development of cracks was traced for each of a set of three identical beams, and this method was also followed in some of the 13-week beams. Since all the beams tested at the age of 4 weeks failed in tension, those at succeeding ages were even more certain to fail in this way, and it was suspected that the change in the beam with age would be insufficient to cause much, if any, change in the time of appearance of the first crack, their development during the test, or their height at maximum load.

In order to save time on tests subsequent to those at the age of 4 weeks, without sacrificing any test data of importance, it was thought best to trace the cracks, at the end of the test, on two beams of a set, and to trace them at various loads throughout the test on the third beam.




0.49%

0.74%

0.98%

1.23%

1.47%

1.72%

1.96%

**Fig. 22.**—*Granite Concrete, Age 4 Weeks, Showing Variation in Position of Cracks with Variation in Percentage of Reinforcement*

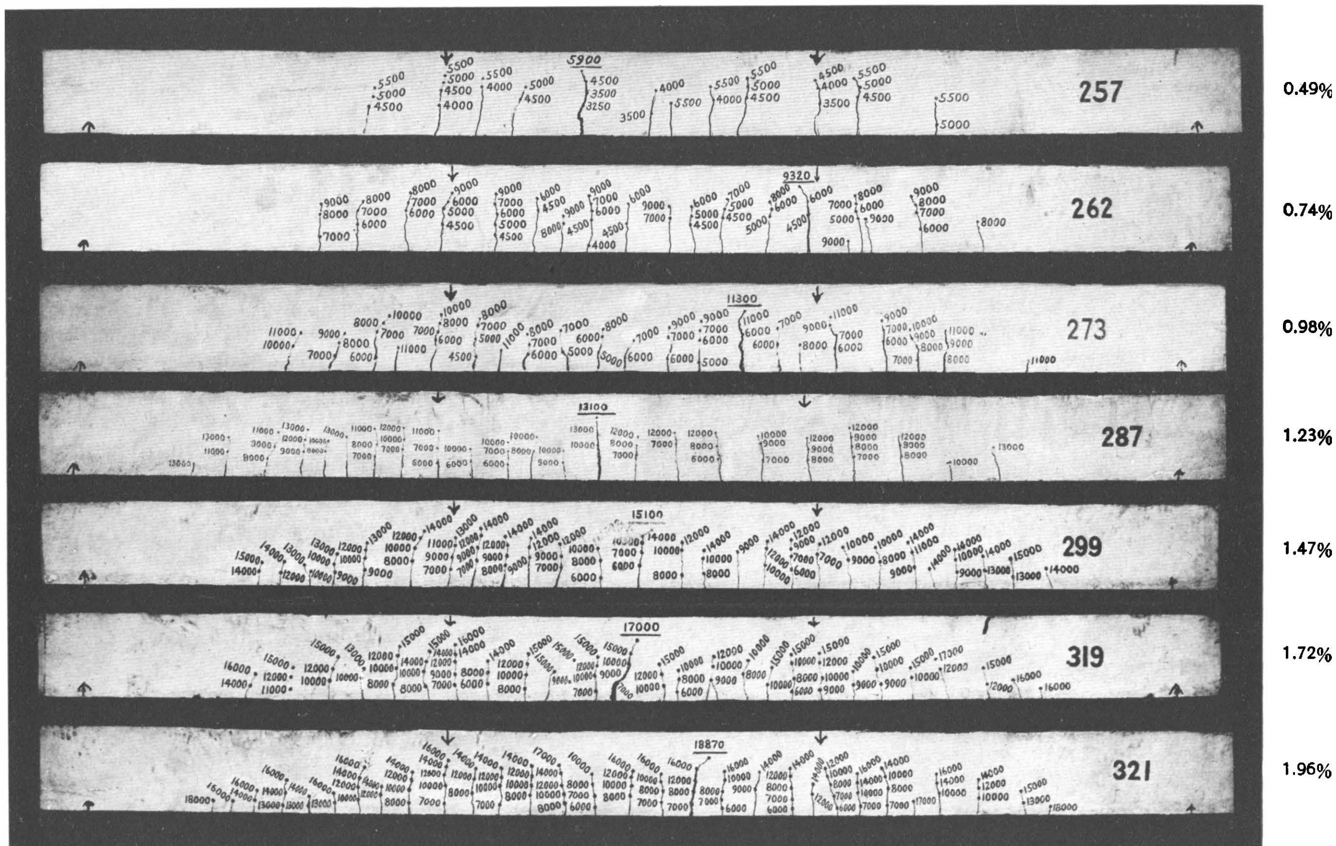



**Fig. 23.**—*Limestone Concrete, Age 4 Weeks, Showing Variation in Position of Cracks with Variation in Percentage of Reinforcement*

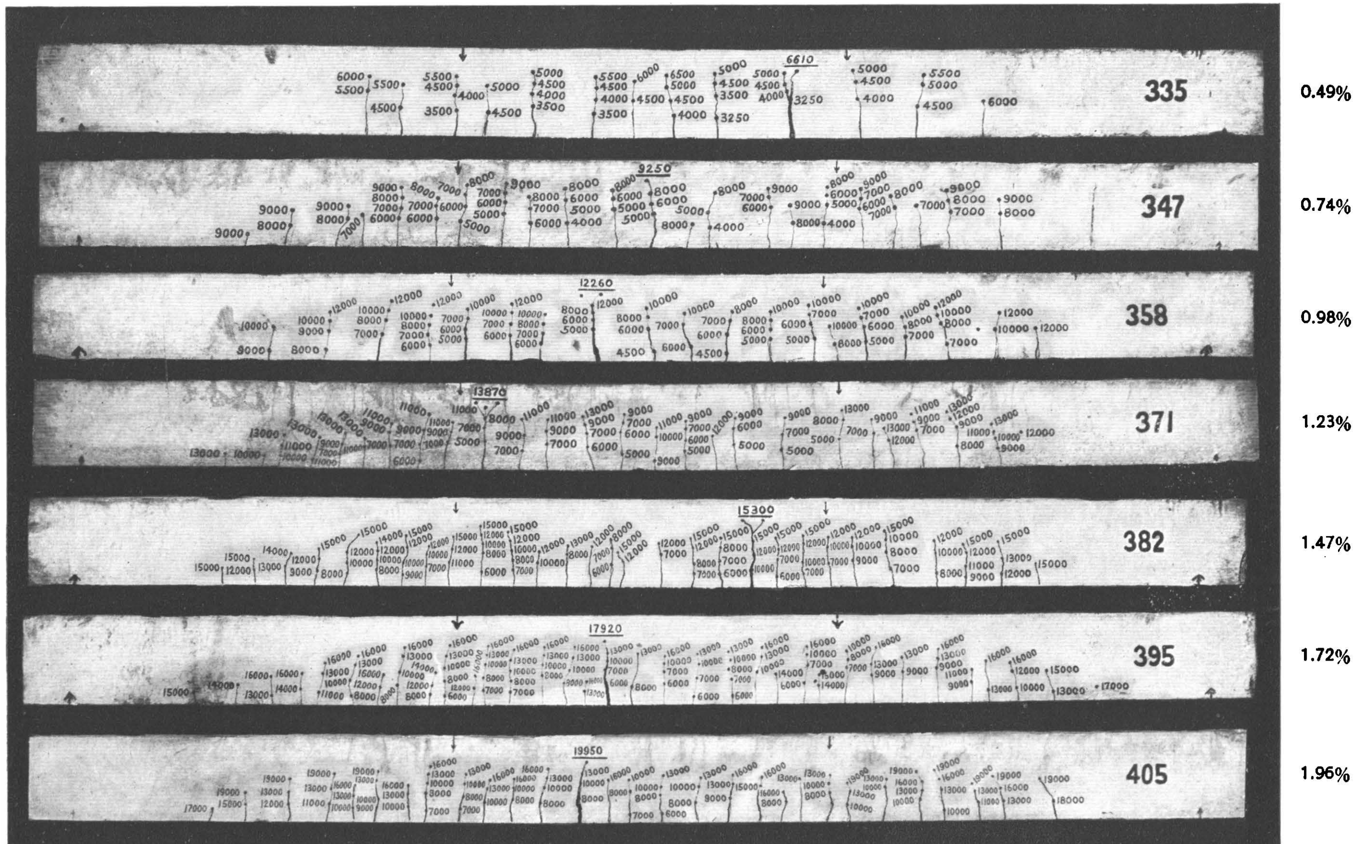



**Fig. 24.**—*Gravel Concrete, Age 4 Weeks, Showing Variation in Position of Cracks with Variation in Percentage of Reinforcement*

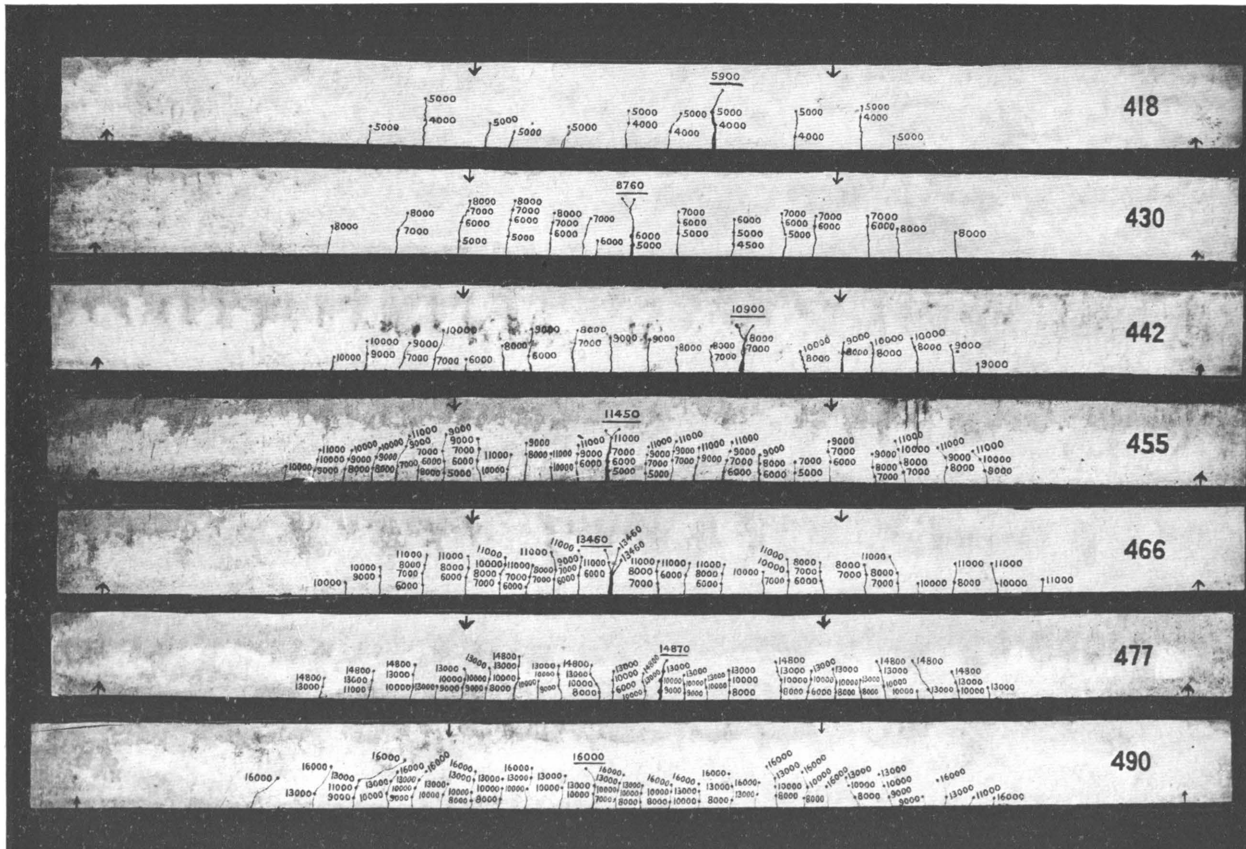



Fig. 25.—*Cinder Concrete, Age 4 Weeks, Showing Variation in Position of Cracks with Variation in Percentage of Reinforcement*

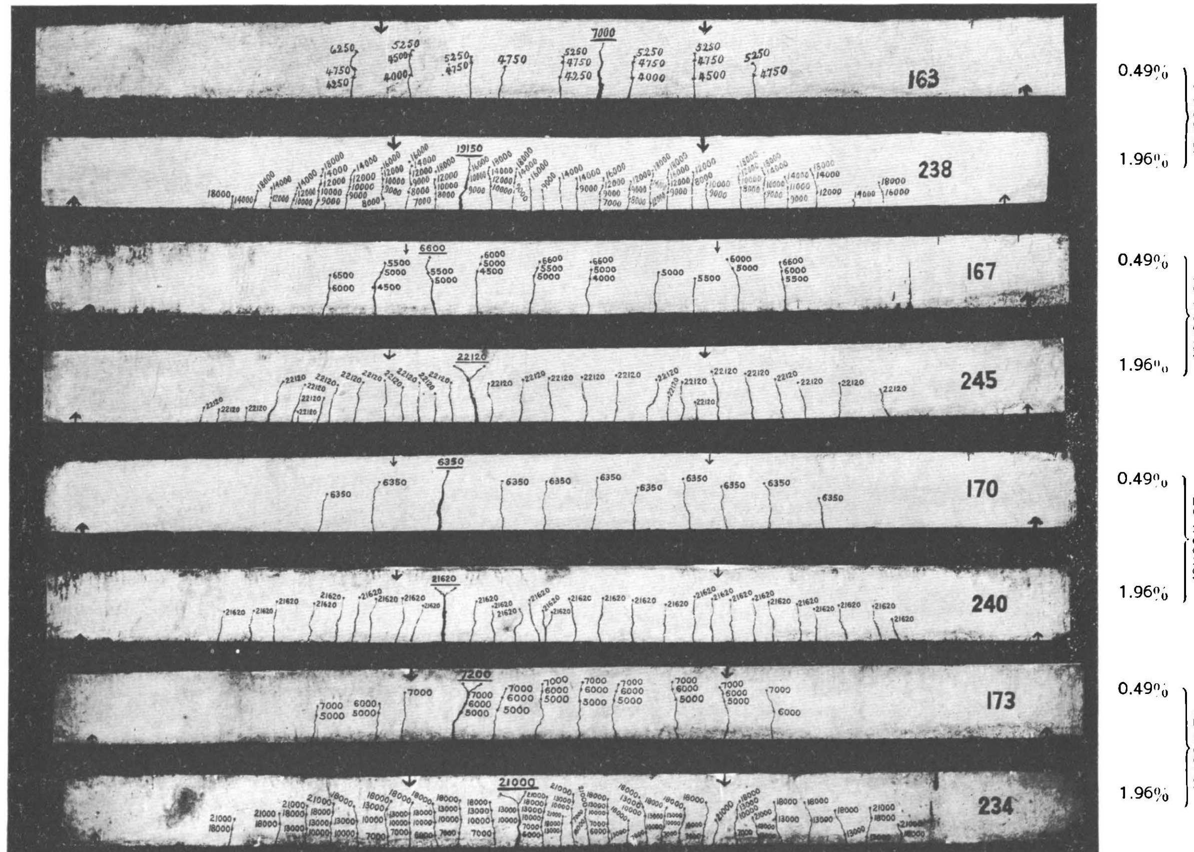



**Fig. 26.**—*Granite Concrete, Showing Beams with 0.49 and 1.96 Percentages Reinforcement*

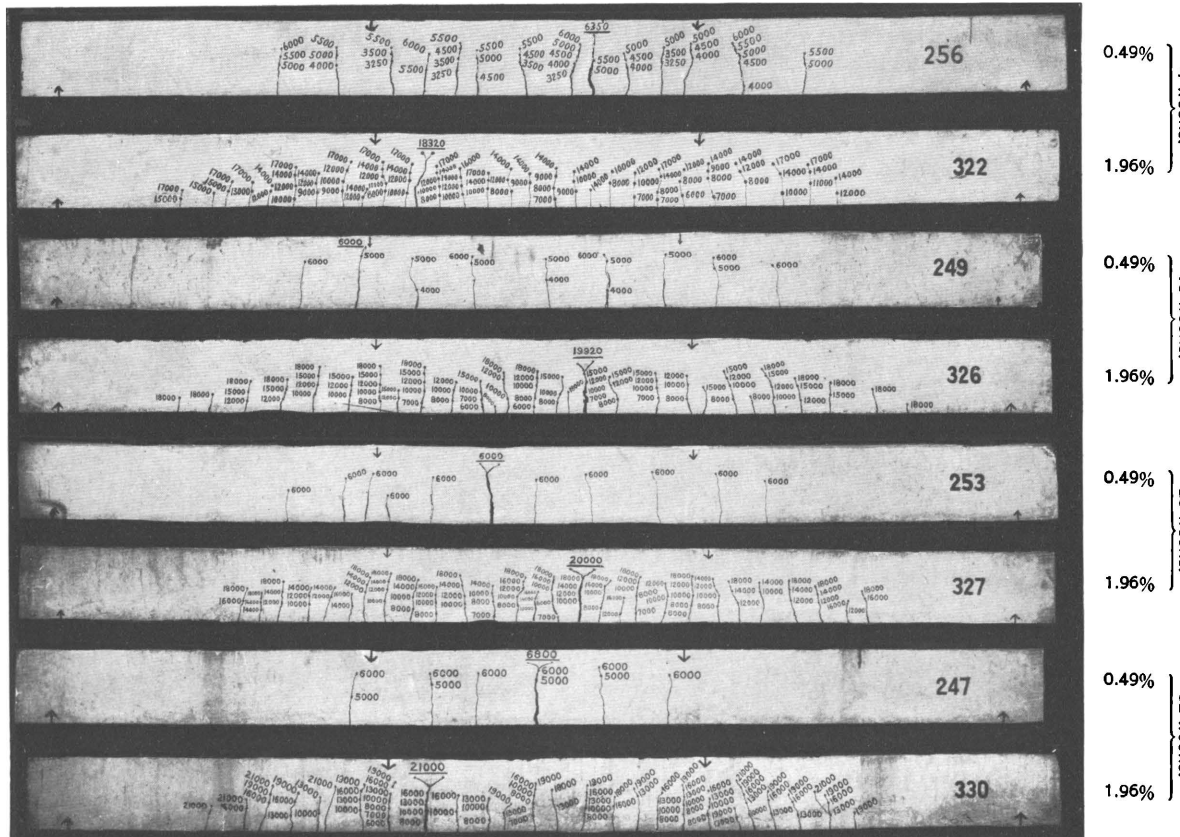



Fig. 27.—*Limestone Concrete, Showing Beams with 0.49 and 1.96 Percentages Reinforcement*

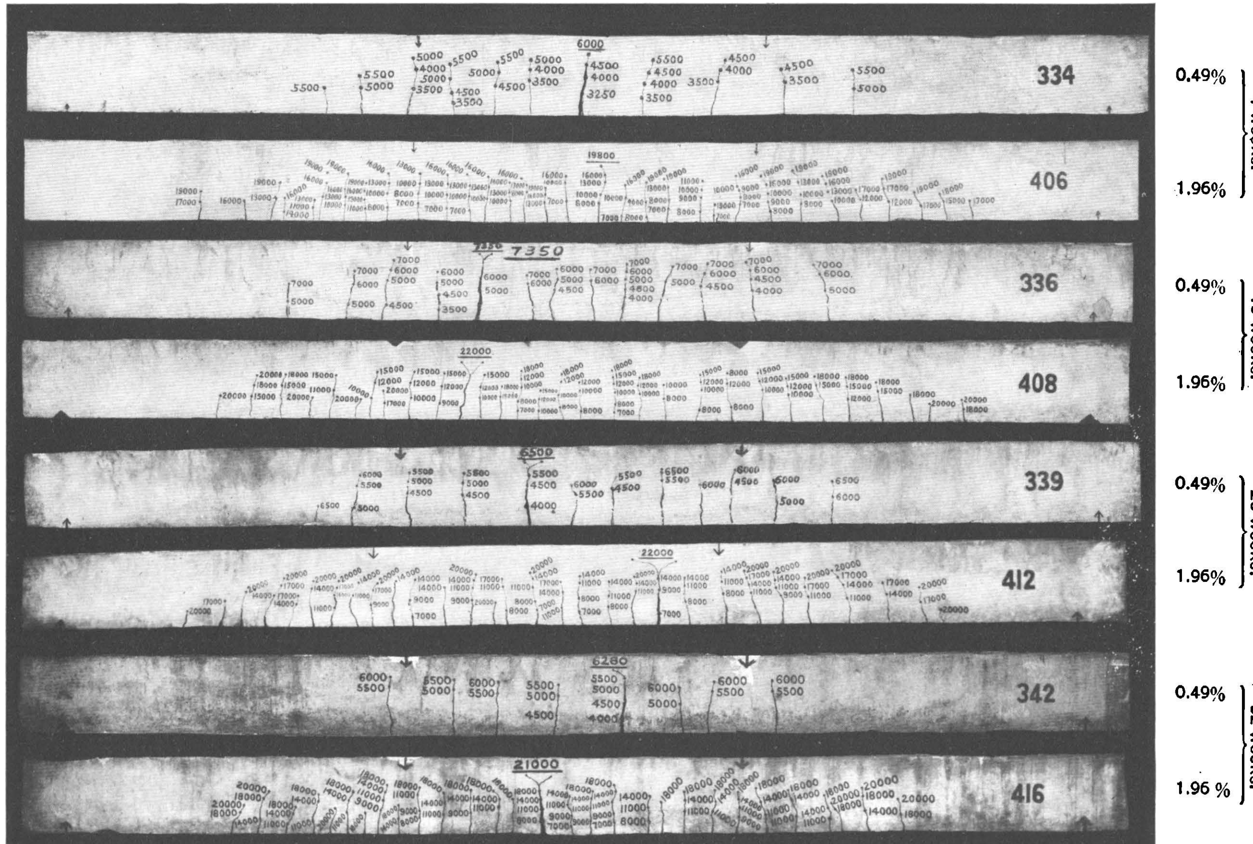



**Fig. 28.**—*Gravel Concrete, Showing Beams with 0.49 and 1.96 Percentages Reinforcement*


Fig. 29.—*Cinder Concrete, Showing Beams with 0.49 and 1.96 Percentages Reinforcement*


Cinder concrete.
Age 4 weeks.
1.96% reinforcement.

Cinder concrete.
Age 13 weeks.
1.96% reinforcement.

Cinder concrete.
Age 26 weeks.
1.96% reinforcement.

Cinder concrete.
Age 52 weeks.
1.96% reinforcement.

Fig. 30.—*Showing Similarity of Cracking in Similar Beams*

The determination of the loads, at which cracks were traced, was based entirely on the rate at which cracks developed during the test. If the cracks showed an appreciable increase in height, the loads at which cracks were traced were taken closer together, while if their development was slow, the cracks were not traced for every load increment.

With low percentages of reinforcement, cracks developed so rapidly that in many cases the surface was examined after every 500-pound load increment was applied, while with the higher percentages the interval was sometimes as much as 2000 to 3000 pounds.

At that point of the beam at which for a given applied load the crack became invisible the magnitude of the load was marked. After the test was completed the cracks were outlined and the applied loads indicated with black paint showing the height of the crack during different stages of the test. The three identical beams for a given age were then piled one on top of another and the group photographed.

Representative photographs have been reproduced in Figs. 22 to 30.

An examination of these photographs will bring out the following facts:

1. The spacing of the cracks is independent of the kind of aggregate and the age of the concrete.

2. The spacing varies with the percentage of reinforcement, being about 7 inches for 0.5 per cent nominal reinforcement for all aggregates, and varies from about 3 inches for stone aggregates to 3½ inches for cinders with 2 per cent nominal reinforcement.

3. While the difference is in all cases slight, the cracks seem to extend up higher with stone and gravel concrete than with cinder concrete. The cracks as a rule are approximately vertical, with the exception of those outside the load points, for a high percentage of reinforcement and with cinder concrete.

4. The fact that the first visible crack occurs at higher loads, as the percentage of reinforcement is increased, may be due either to the lowering of the neutral axis, as influencing the height of the cracks, or upon the larger number of cracks in a given length of beam, which for the same total deformation must cause the indi-

vidual cracks to be smaller than is the case for lower percentages of reinforcement.

5. For a nominal reinforcement of 0.5 per cent the applied load at first *visible* cracks varies from 3250 to 4000 pounds at the age of 4 weeks to 4000 to 5000 pounds at 52 weeks while with 2 per cent it varies from 6000 to 7000 pounds at 4 weeks.

## 2. COMPRESSION TESTS

While a large number of cylinders and cubes (333 of each) were tested and it was necessary to draw stress deformation curves for each cylinder in order to obtain the moduli and yield point which are reported in Tables 33 to 36, it was not deemed essential to reproduce them in this paper and only one log sheet is reproduced for each aggregate and age.

For the stone and gravel concrete there is little difference between the proportions by weight and by volume. This is due to the fact that the weight per cubic foot of the sand and of the stone differs but little from 100 pounds. The proportions by weight for the cinder concrete differs considerably from the proportions by volume, due to the low weight per cubic foot of the cinders.

The percentage of water given is obtained in the same way as already described (p. 18) and brings the concrete to medium consistency as there defined. The percentage of water required for the granite is about 8.3; limestone 10; gravel 9.5; and about 18.9 for the cinders.

The weight per cubic foot of the concrete as given in column 5, Tables 33–36, varies from about 148 to 149 pounds for granite, about 146 to 147 pounds for limestone, 143 to 144 pounds for gravel and 118 to 119 pounds for cinders. The weight per cubic foot of the 6-inch cubes as given in column 11 is much more erratic than that obtained for the cylinders although the average is not so very different. The stone and gravel concrete is seen to differ but little from 150 pounds per cubic foot, the weight usually assumed.

Column 5 contains the ultimate strength of the cylinders, while column 10 contains the ultimate strength of the cubes.

Two hundred thousand pounds was the capacity of the largest machine available at the time the 4, 13 and 26 week tests were made. The sectional area of an 8-inch cylinder is approximately

50 square inches, while a 6-inch cube is 36 square inches. Consequently all cylinders which would go above 4000 pounds per square inch, and all cubes stronger than about 5500 pounds per square inch could not be broken. This was the case with the 13 and 26 week granite cylinders and a few of the cubes, several of the 13 and 26 week limestone cylinders and all but one of the 13 and 26 week gravel cylinders. The quantity followed by an asterisk, in the columns for ultimate strengths, are not to be understood as being the ultimate compressive strength of the concrete but are obtained by dividing 200 000 pounds the capacity of the machine, by the actual sectional area of the test piece. It is thought, however, that the ultimate strength of the granite and gravel cylinders at 13 weeks differs but little from the values given in this table, as will be indicated later.

The average line of the last column of these tables contains the ratio of the ultimate strength of the cylinders to that of the cubes. Where both the cylinders and cubes broke, this ratio could be obtained directly from the data and is correct. For those cases in which the ultimate strength of all the cylinders in a given group exceeded the capacity of the machine, this ratio could not be obtained directly and the following method was used and is believed to give results which approximate the true values. These approximate values are shown diagramatically in Figs. 31 and 32.

This method assumes that the quality of the concrete is the same in both cylinders and cubes and that therefore their ultimate strength for a given age is a function of their shape alone. If this is true, the ratio of the ultimate strength of the cylinders of two different aggregates should be the same as the ratio of the ultimate strengths of the cubes of the same aggregate.

This would mean that if we started with the known ratio of the ultimate strengths of the cubes, and multiplied by the ultimate strength of the cylinders that did break, the resulting product should be the ultimate strength of the cylinders that did not break. This is, of course, only an approximation and the result is necessarily in error, but the degree of accuracy may be judged by the uniformity with which the points thus obtained line up with those at 4 and 52 weeks, at which ages all the test pieces were broken,

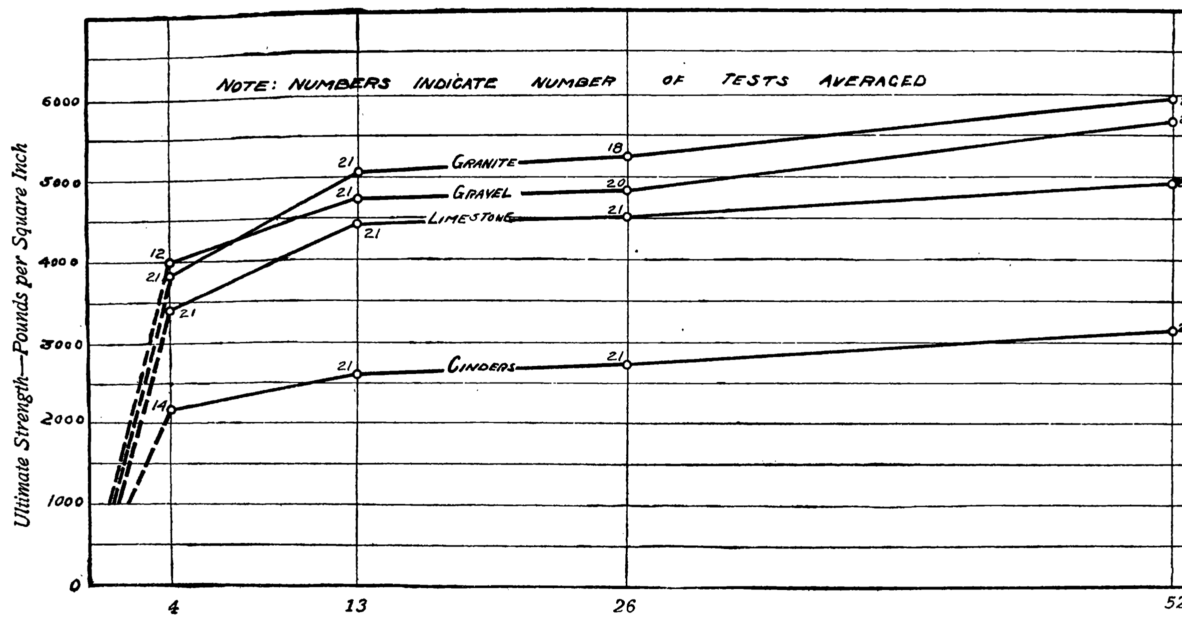



Fig. 31.—*Effect of Age on Compressive Strength of Six-Inch Cubes. (Age in Weeks)*

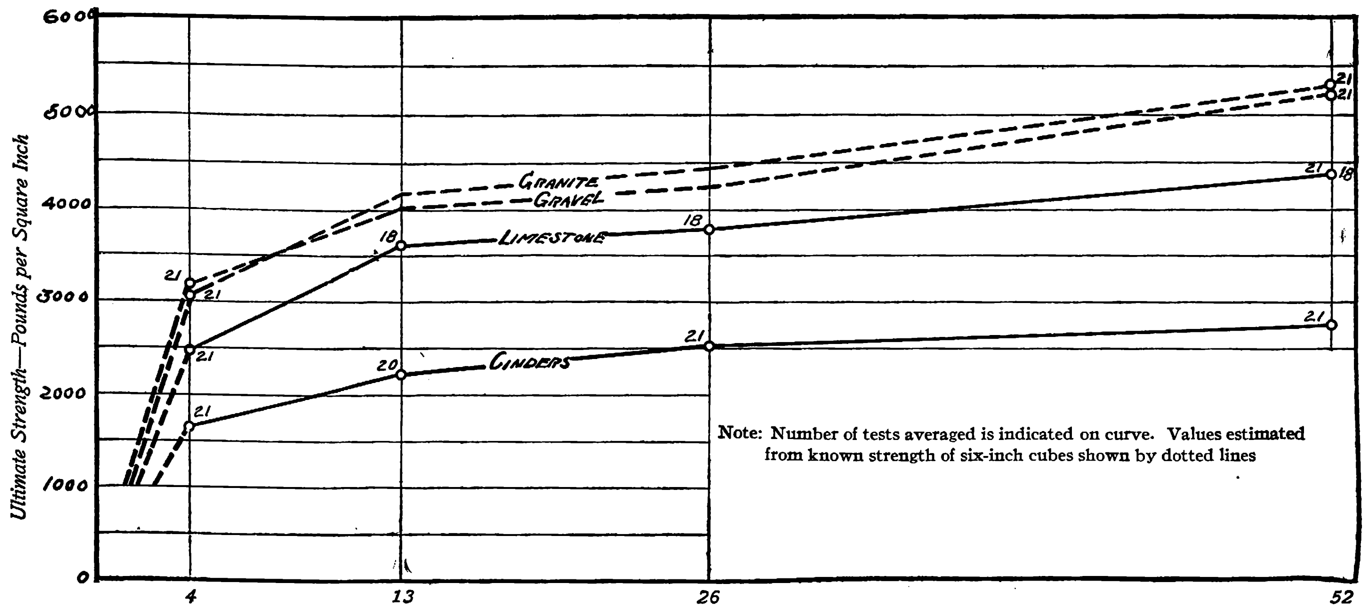



**Fig. 32.**—*Effect of Age on Compressive Strength of Eight-Inch Cylinders.* (*Age in Weeks*)

and also by the fact that the ultimate strength could not be below 4000 pounds per square inch.

Column 7 contains the initial modulus of elasticity. These values were obtained by drawing a line, as already indicated, on the individual compression-stress gross-deformation curves obtained by plotting the data as given on page 140. The average of these values gives the average modulus of elasticity obtained by drawing a line on the compressive-stress gross-deformation curve constructed with the average unit gross deformation and the average unit compressive stresses for each age and aggregate.

Column 8 contains the yield point and was obtained from the individual curves as indicated.

The data summarized in these tables will enable a comparison to be made between individual values and will serve as a check on the uniformity of the tests. For the comparison of the different materials and the influence of age on the strength and elastic behavior of the concrete, average values can be used to greater advantage and lead to conclusions of more general application. Any investigation of concrete in compression should furnish data showing the influence of age on the strength and elasticity of concrete and the relative strengths of concrete of different aggregates. The following comparisons are made on the tests herein reported:

(*a*) Influence of age on the ultimate strength of cubes and cylinders.

(*b*) Effect of age on the initial modulus of elasticity.

(*c*) Effect of age on yield point.

(*d*) Ratio of ultimate strength of cylinders to that of cubes.

(*e*) Ratio of the yield point to the ultimate strength.

### (*a*) INFLUENCE OF AGE ON THE ULTIMATE STRENGTH OF CUBES AND CYLINDERS

Fig. 31, page 100, shows the influence of age on the ultimate strength of the cubes while Fig. 32 gives the same information for the cylinders.

Examining Figs. 31 and 32 the growth in strength of cinder concrete from 4 to 13 weeks is seen to be 19.4 per cent for the cubes, 34.7 per cent for the cylinders; from 4 to 26 weeks the increase is about 25.5 per cent for the cubes to 53.4 per cent for the cylinders, while the cylinders increase 9.4 per cent from 26 to 52 weeks, and the cubes 15 per cent.

Similarly, limestone shows an increase from 4 to 13 weeks of 30 per cent for the cubes, and for the cylinders 44.5 per cent, while from 4 to 26 weeks the increase is 32.8 and 52 per cent, respectively. From 26 to 52 weeks the gain for the cylinders is 16 and for the cubes 9.8 per cent.

The granite cubes show an increase of 32.5 per cent from 4 to 13 weeks and 37.6 per cent from 4 to 26 weeks. The increase in the strength of the cylinders can not be determined exactly. Their ultimate strength at the age of 4 weeks was 3054 pounds, while at 13 and 26 weeks it exceeded 4000 pounds per square inch, the capacity of the testing machines. At 52 weeks the increase in the strength of the cylinders over that at 4 weeks was 73.4 per cent.

The gravel cubes showed an increase of 18.3 per cent from 4 to 13 weeks and 2.1 per cent from 13 to 26 weeks. The gravel cylinders at 4 weeks had an ultimate strength of 3175 pounds, and, as was the case for the granite, exceeded 4000 pounds at succeeding ages. The increase in strength at 52 weeks over that at 4 weeks was 65 per cent. What seems particularly noticeable in the above tests is the substantial and uniform increase in strength up to an age of 1 year, at which time it is still gaining strength. In general, it may be roughly stated that the concrete used in these tests increased 65 per cent in strength from an age of 4 weeks to that at the end of a year and that at that time was still increasing in strength.

### (b) EFFECT OF AGE ON THE INITIAL MODULUS OF ELASTICITY

The influence of age on the initial modulus of elasticity is shown graphically in Fig. 33, page 105. The points plotted are the averages of the values in Tables 33 to 36.

An examination of this figure will show that the modulus of elasticity does vary with age as does the ultimate strength. Granite shows the smallest increase, the modulus at 26 weeks being but 5 per cent greater than that at 4 weeks, while cinders with the least ultimate strength show an increase of 32 per cent for the same ages and just about half as much at 13 weeks. Gravel shows scarcely any increase from 4 to 13 weeks, but a substantial increase of 14 per cent from 4 to 26 weeks, while for limestone there is an increase of 6 per cent from 4 to 13 weeks and a 20 per cent increase at 26 weeks over the results at 4 weeks.

The actual values are in all cases, except the cinder concrete, fairly high and while it should be remembered that the concrete did not rest for any length of time under load before the micrometers were read (about one minute per 100 pounds per square inch), yet the moduli are not as high as would be the case if based on elastic rather than gross deformations.

### (c) EFFECT OF AGE ON YIELD POINT

It has already been indicated that for stresses below the yield point the gross deformation curve for concrete in compression is sensibly a straight line. Even beyond this point many curves follow this line for a considerable distance, so that a constant modulus of elasticity can be assumed for these concretes up to a unit stress considerably in excess of the yield point. The following table shows the percentage variation of the average curves, Figs. 37, 38, 39 and 40, pages 111 to 114, from the straight line for an assumed unit stress 1.5 times the yield point.

Table 37.—Variation of the Average Deformation Curve for a Load 1.5 Times Yield Point

| Age, in Weeks | Cinders | | Granite | | Gravel | | Limestone | |
|---|---|---|---|---|---|---|---|---|
| | Load, lbs. per sq. in. | Variation, per cent. | Load, lbs. per sq. in. | Variation, per cent | Load, lbs. per sq. in. | Variation, per cent | Load, lbs. per sq. in. | Variation, per cent |
| 4 | 750 | 4.5 | 1350 | 5.3 | 1500 | 5.2 | 1050 | 5.3 |
| 13 | 750 | 4.5 | 1950 | 3.1 | 2250 | 3.1 | 2100 | 5.0 |
| 26 | 1350 | 5.2 | 1650 | 2.1 | 1800 | 3.0 | 1500 | 4.2 |
| 52 | 1350 | 3.7 | 2700 | 4.4 | 2250 | 3.2 | 2400 | 6.5 |
| Average | .... | 4.0 | .... | 3.7 | .... | 3.6 | .... | 5.4 |

An examination of the above percentages shows that, even for such high unit stresses, the percentage variation from a straight line is relatively small.

The variation with age, of the average yield point, as given in Tables 33 to 36, pages 129 to 136, is shown in Fig. 34, page 106. In

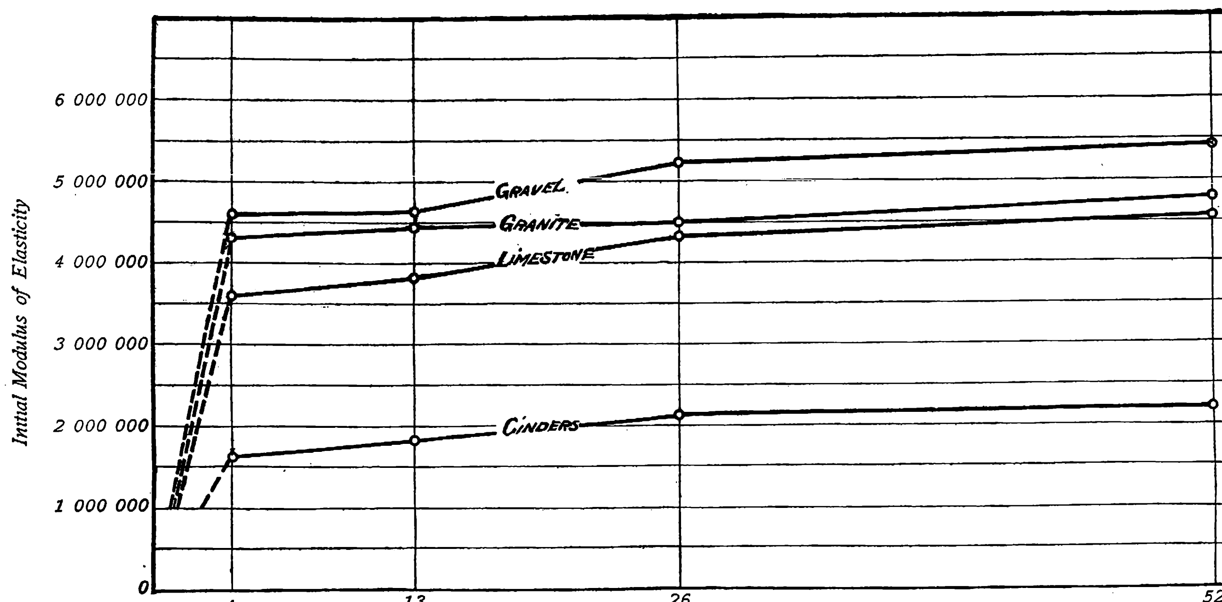



Fig. 33.—*Effect of Age on the Initial Modules of Elasticity of Concrete in Compression.* (*Age in Weeks*)

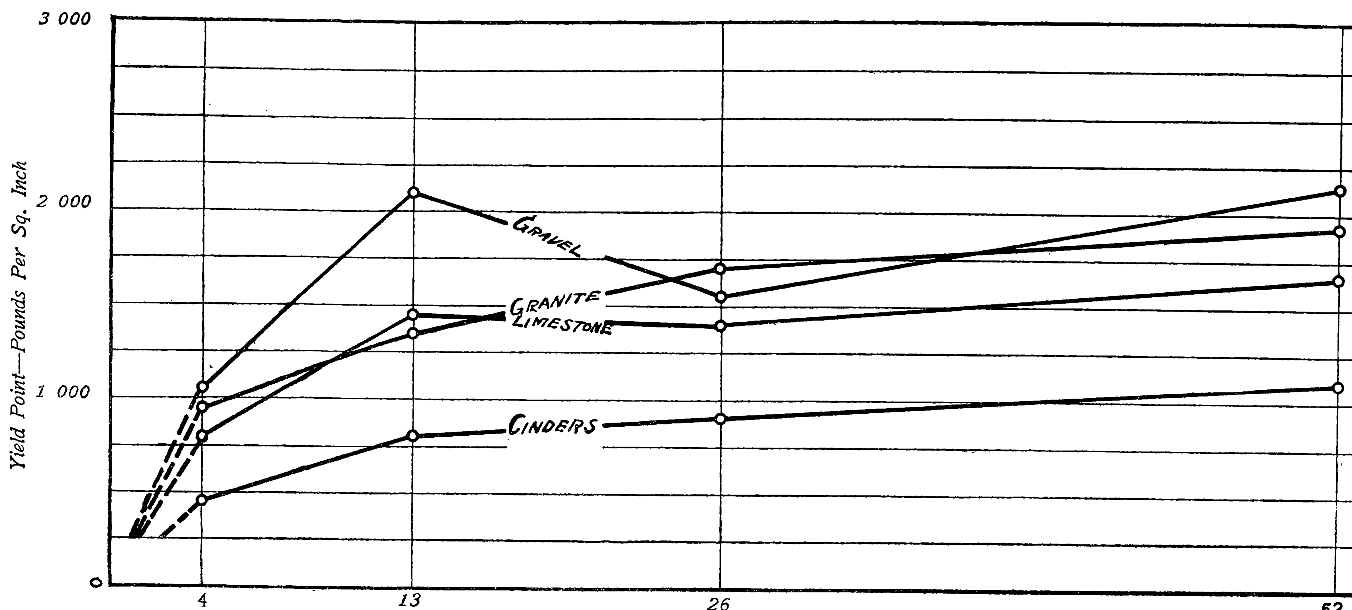



**Fig. 34.**—*Effect of Age on the Yield Point of Concrete in Compression.* (*Age in Weeks*)

every case the yield point increases from 4 to 13 weeks and for the granite and cinder continues to increase up to 52 weeks. Although the modulus of elasticity of the gravel and limestone increases from 13 to 26 weeks, the yield point seems to decrease, indicating that while the initial part of the curve at 26 weeks is steeper than at 13 weeks yet it turns from the straight line at a lower unit stress. While no explanation of this behavior is suggested, the peculiarity is similarly illustrated in Figs. 37 to 40, pages 111 to 114. At the age of 52 weeks the yield point for these aggregates again show an increase.

As may be seen from Fig. 36 in only one instance, namely, the four-week tests on cinder concrete, does the range fall below 500 pounds per square inch. It would seem, therefore, that the assumption of a straight-line stress gross-deformation diagram for concrete in compression is permissible for all average concretes of the proportions and ages given and is certainly warranted for all the stone and gravel concretes herein reported. As will be shown in discussing the results of the tests on the reinforced beams, the fact that the concrete in many of the beams is stressed considerably above this point seems to exert little influence on the position of the neutral axis and consequently upon the resisting moment of all beams failing by the tension of the reinforcement, although it does determine the stress in the extreme fiber of the concrete.

#### (*d*) RATIO OF THE ULTIMATE STRENGTH OF THE CYLINDERS TO THE ULTIMATE STRENGTH OF THE CUBES

The ratio of the ultimate strength of the cylinders to that of the cubes is shown graphically in Fig. 35, page 108. The number of tests which were averaged for the point plotted is indicated by a number at each point. Where a different number of tests were averaged for both the cylinders and cubes, the numbers are written as a fraction—i. e., $\frac{21}{14}$. This would indicate that the ratio as plotted was obtained by dividing the average ultimate strength of 21 cylinders by that of 14 cubes.

It was explained on pages 99 and 100 that in a number of cases the ultimate load of the cylinders exceeded the capacity of the testing machine and that an attempt was made to approximate their ultimate strengths. These approximate ultimate strengths were used

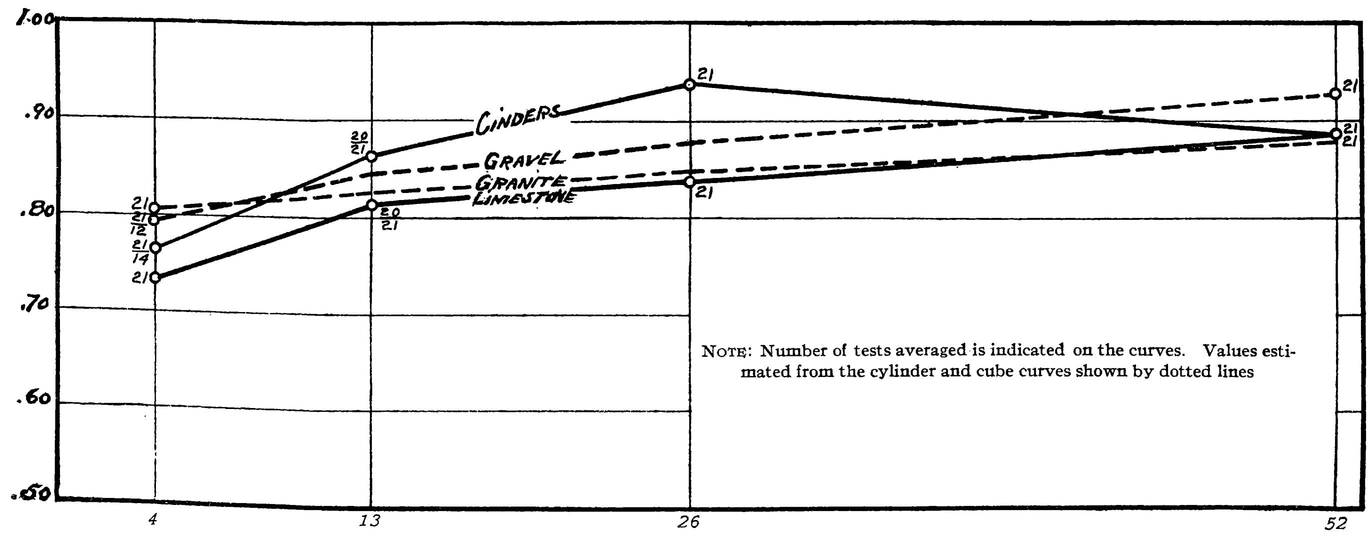



Fig. 35.—*Effect of Age on the Ratio of the Ultimate Strength of Cylinders and Cubes.* (*Age in Weeks.*)

in obtaining the ratios for the points that are connected by dash lines on the diagram.

In every case the ratio increases considerably with age, the ultimate strength of the cylinder approaching that of the cubes at the age of 52 weeks.

#### (e) RATIO OF THE YIELD POINT TO THE ULTIMATE STRENGTH

Fig. 36, page 110, shows the ratio of the yield point to the ultimate strength for different ages, computed on approximate ultimate strengths as described on page 107. The erratic value for gravel concrete at the age of 13 weeks is due to the high value of the yield point as given in Fig. 36. The ultimate strength, Fig. 32, of the gravel at the age of 13 weeks compares favorably with that at 4 and 26 weeks, and with the strength of the other concretes, and there is no apparent reason why at this age such a high value should be obtained for the yield point.

Fig. 36 shows that the ratio of the yield point to the ultimate strength increases approximately between 4 and 52 weeks, from 0.30 to 0.40.

#### (f) AVERAGE STRESS-GROSS DEFORMATION CURVES

Since general relations can be brought out much more clearly by the comparison of average curves than by the inspection of a large number of individual curves, Figs. 37, 38, 39, and 40 were prepared. In each case the average unit stress of the cylinders is plotted against the corresponding average unit gross deformation.

The values plotted, which are the averages for 21 cylinders for each age and aggregate, were obtained from the log sheets for the individual cylinders. Since there is considerable difference in the ultimate strength of supposedly identical test pieces, the compressometer for measuring the compression was necessarily removed from some test pieces earlier than others. Since the upper limit of the curve is determined by the lowest unit stress at which the compressometer is removed in a given set of 21 cylinders, the last point in several cases is considerably below the average ultimate strength. In several cases points, which are the averages of less than 21 tests, have been plotted, but in many cases after several test pieces have dropped out, the curve beyond this point does not line up with that below. In every case the curve

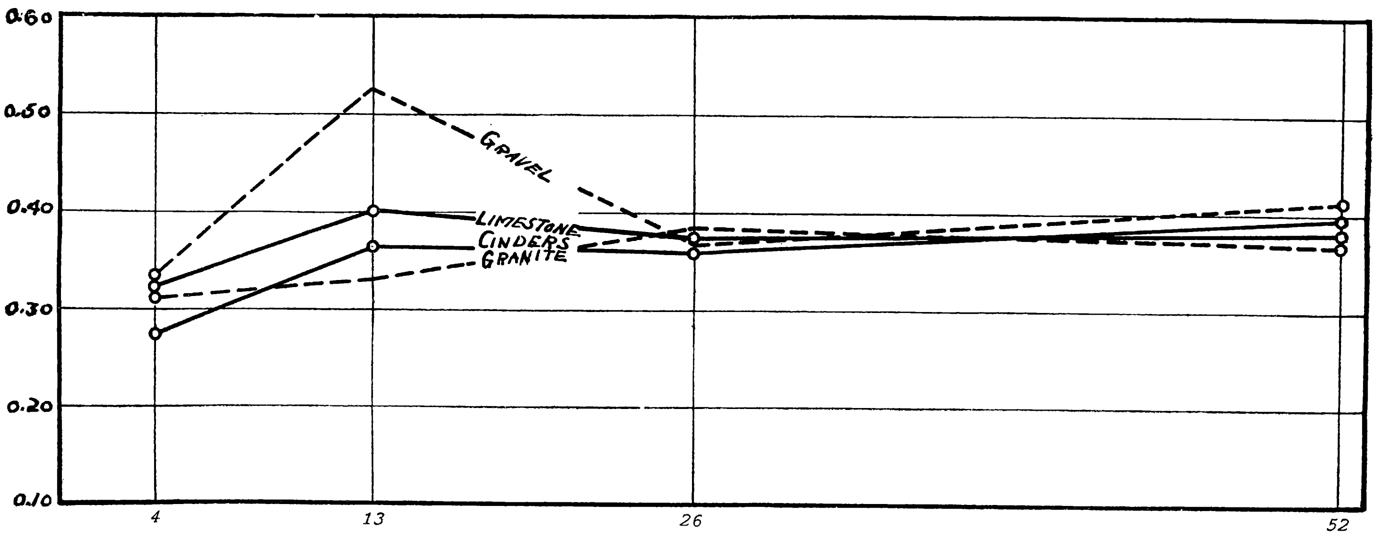



Fig. 36.—*Effect of Age on the Ratio of the Yield Point in Pounds per Square Inch to the Ultimate Strength. (Age in Weeks)*

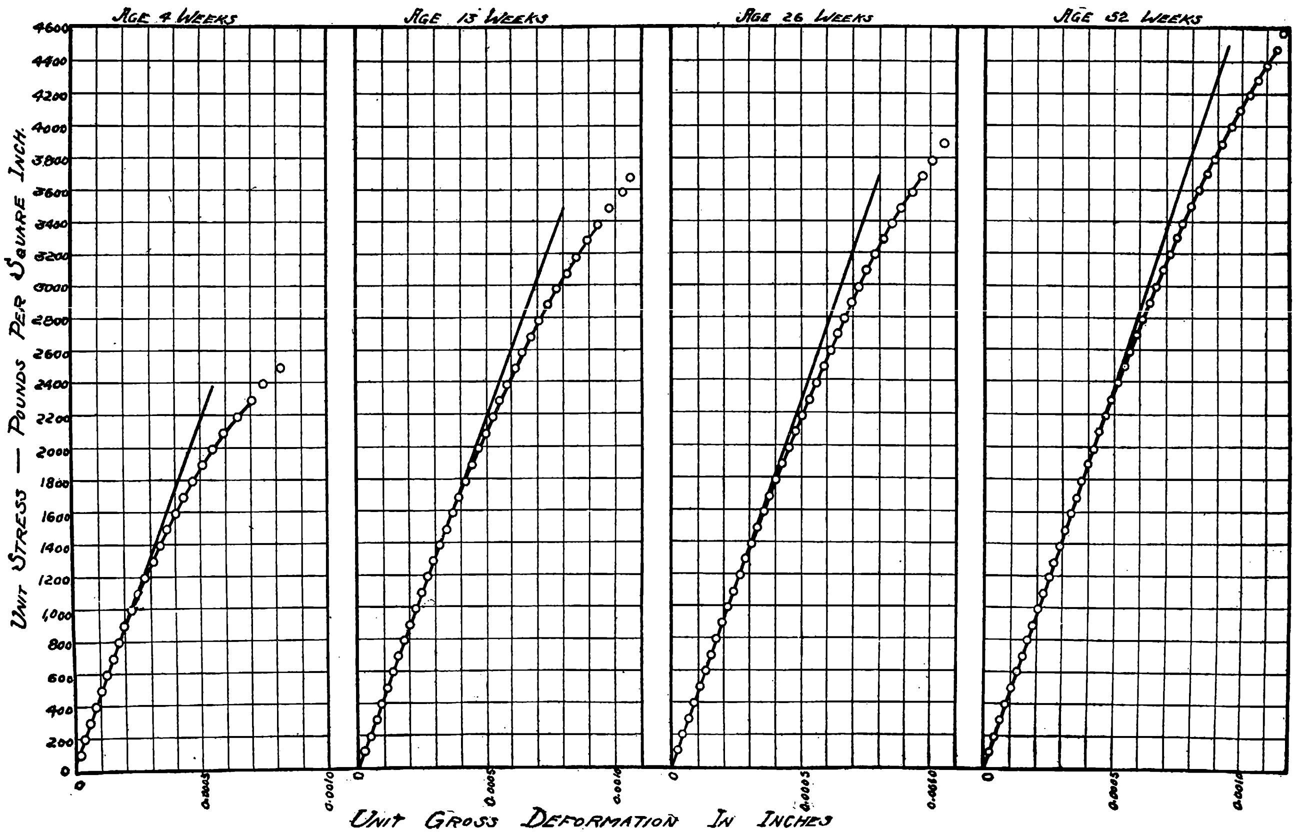



Fig. 37.—*Average Compressive Stress Gross Deformation Curve for Granite Concrete*

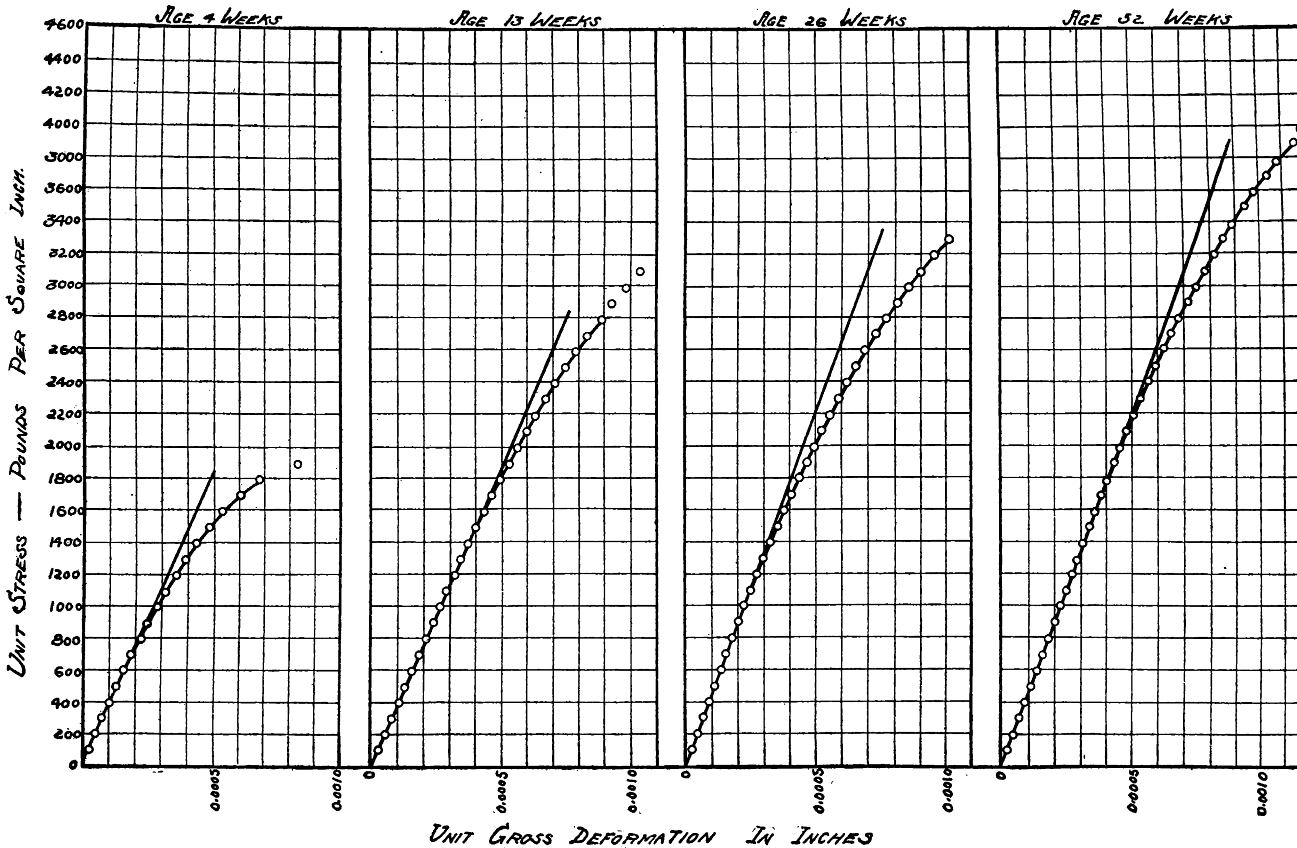



Fig. 38.—*Average Compressive Stress Gross Deformation Curves for Limestone Concrete*

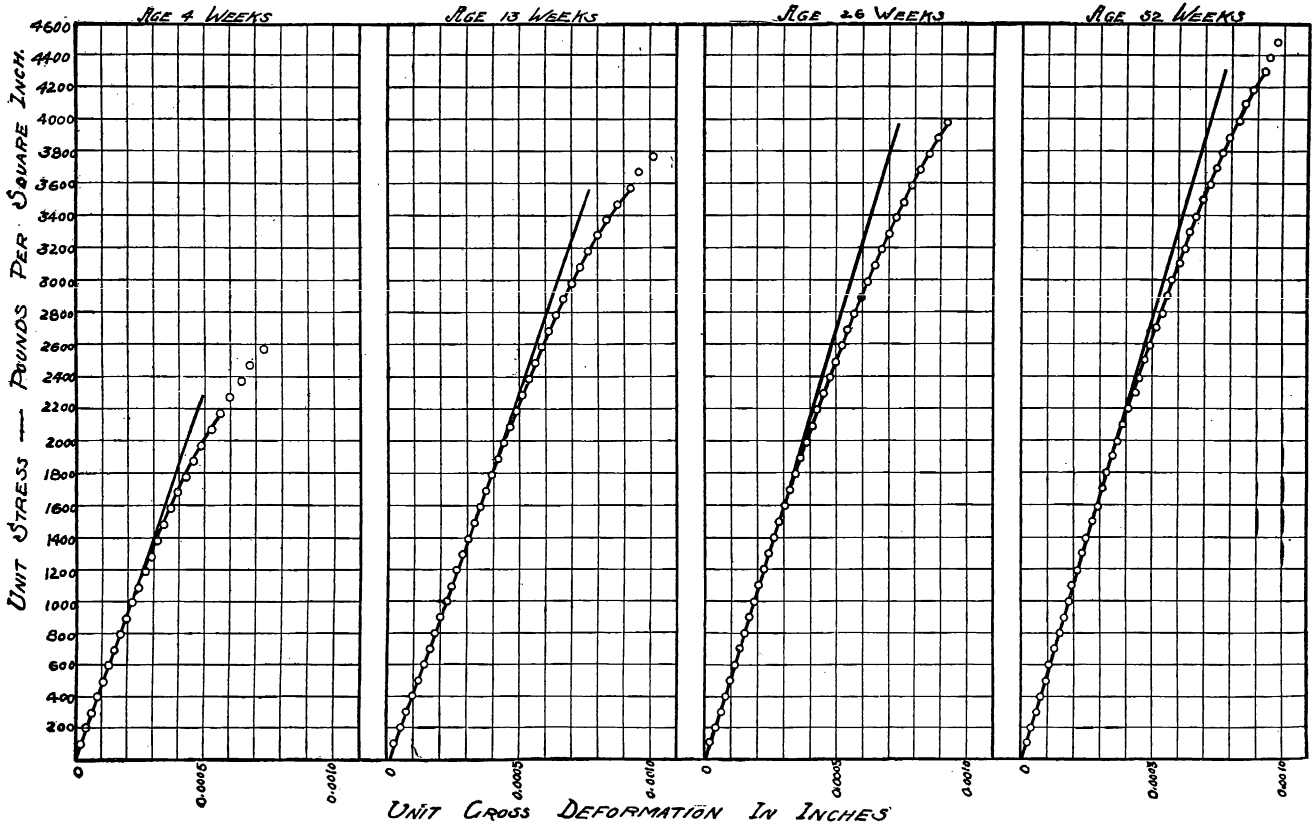



Fig. 39.—*Average Compressive Stress Gross Deformation Curves for Gravel Concrete*

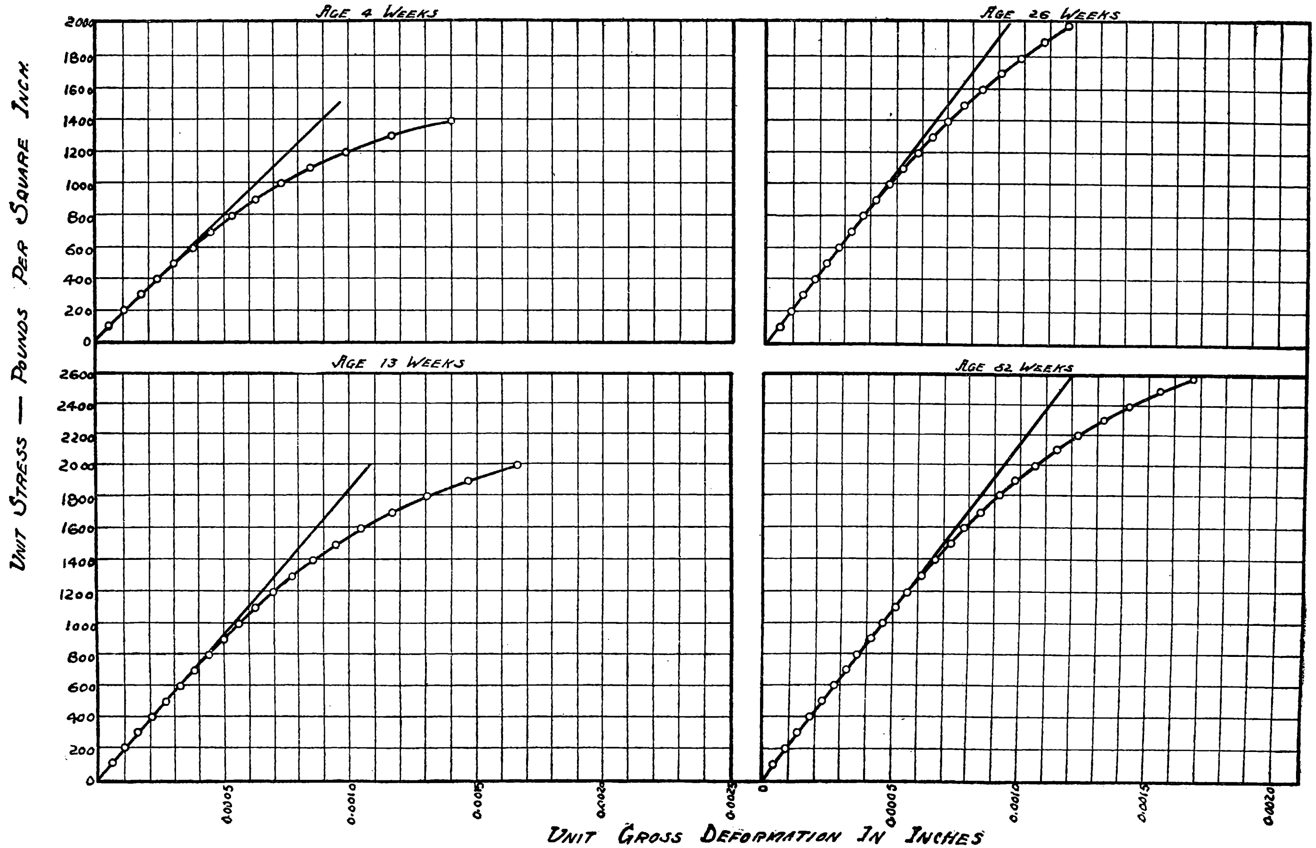



Fig. 40.—*Average Compressive Stress Gross Deformation Curves for Cinder Concrete*

itself has been drawn up to the last point only for which 21 tests have been averaged. The values from the log sheet of one representative cylinder for each age and aggregate are given in Appendix I.

The increase in slope of the line of initial coefficient of elasticity with age is very clearly brought out by these figures, and it is believed that they show very representative curves for the aggregates used.

## VII. CONCLUSIONS

### 1. REINFORCED CONCRETE IN FLEXURE

From a study of the behavior of the reinforced concrete beams herein reported the following conclusions may be stated:

#### (*a*) CONDITIONS AT FIRST CRACK

(1) The unit elongation of the extreme lower fiber at the time of the occurrence of the first crack is 0.00012, for stone and gravel concrete, 0.00018 for cinder concrete, and equals the unit elongation of the lower fiber at rupture of a beam of the same concrete without reinforcement.

(2) The unit elongation of the extreme lower fiber at time of the occurrence of the first visible crack increases with the percentage of reinforcement.

(3) The distance between cracks due to tension varies with the percentage of the reinforcement, slightly with the kind of aggregate, and is independent of the age of the concrete.

#### (*b*) STRESS IN REINFORCEMENT AT MAXIMUM LOAD

(1) The ratio of the unit stress in the reinforcement at maximum load to the yield point varies with the percentage of the reinforcement, is independent of the age of the concrete, and shows no regular variation with the initial modulus of elasticity of the concrete.

#### (*c*) BOND STRESS IN REINFORCEMENT

(1) The unit bond stress at a load just below maximum, for a unit stress in the reinforcement somewhat less than the yield point, is almost constant and equal to about 120 pounds per square inch.

It increases slightly as the percentage of the reinforcement increases, increases somewhat with age, and with the strength of the concrete.

### (*d*) RESISTING AND BENDING MOMENT

(1) Basing the resisting moment of a reinforced concrete beam on the tensile stress in the reinforcement, and neglecting the tensile resistance of the concrete, the ratio of the resisting moment to the bending moment is always less than 1 between 0.5 per cent and 1.7 per cent "effective" reinforcement. This ratio is independent of the kind of aggregate used, decreases with age, and increases with the percentage of reinforcement.

### (*e*) EFFECTIVE PERCENTAGE OF REINFORCEMENT

(1) The behavior of a reinforced concrete beam, having the reinforcement in two horizontal planes is identical with a beam having all the reinforcement concentrated in one plane, and equal in amount to the reinforcement in the lower plane plus that in the upper plane multiplied by the ratio of the distances of the upper and lower planes from the neutral axis.

### (*f*) VARIATION OF THE POSITION OF THE NEUTRAL AXIS

(1) **With effective percentage of reinforcement.**—The percentage depth of the neutral axis below the top of the beam increases with the percentage of reinforcement and increases or decreases with different amounts of reinforcement as the intensity of loading increases, depending upon the ultimate strength of the concrete as influencing a compression failure, and the relative stiffness of the concrete for varying degrees of stress as determined by the character of the stress deformation diagram of the cylinders (fixed by the proportions, consistency, kind, and age of concrete).

(2) **With age of concrete.**—For all practical purposes the percentage depth to the neutral axis for a given unit stress in the reinforcement may be taken as independent of the age of the concrete.

(3) **With modulus of elasticity of concrete.**—The character of the concrete as measured by its modulus of elasticity exerts an influence on the position of the neutral axis.

### (*g*) VARIATION OF $\frac{M}{bd^2}$

(1) **With effective percentage of reinforcement.**—For any given percentage of effective reinforcement the moment of resistance varies as the ordinates of a straight line, and based on the moment

of resistance of a plain concrete beam the moment of resistance for a reinforced concrete beam is proportional to the effective percentage of reinforcement.

(2) **With character of concrete.**—The moment of resistance is appreciably affected by the character of the aggregate used and the age of the concrete.

###### (*h*) VARIATION OF THE DEFLECTION AT CENTER OF SPAN

(1) **With effective percentage of reinforcement and character of concrete.**—For a given unit stress in the reinforcement the deflection increases with the percentage of "effective" reinforcement and increases as the modulus of elasticity and ultimate strength of the concrete decreases.

(2) **With unit stress in the reinforcement.**—The deflection of a reinforced concrete beam increases in direct proportion to the increase in the unit stress in the reinforcement.

###### (*i*) VARIATION OF THE UNIT COMPRESSIVE STRESS IN THE EXTREME UPPER FIBER

(1) **With the effective percentage of reinforcement.**—The unit compressive stress in the extreme upper fiber varies with the percentage of effective reinforcement as the ordinates to a straight line.

(2) **With a given unit stress in the reinforcement.**—Excepting cinder concrete for the earlier ages and low percentages of effective reinforcement, the unit stress of 16 000 pounds per square inch in the reinforcement corresponds to a unit compressive stress in the extreme upper fiber of at least 1000 pounds per square inch.

## 2. CONCRETE IN COMPRESSION

The conclusions as to the general effect of age on the various elements (ultimate strength, initial modulus of elasticity, and yield point) that determine the value of a given concrete are probably of fairly general application.

###### (*a*) COMPARISON OF AGGREGATES

It should be recognized that the results obtained for each class of material—i. e., granites, limestones, gravels, etc.—used in these tests may not be applicable to other materials of the same class obtained from a different source. There are too many elements affecting the strength of concrete to warrant the assertion that because an individual of a class—i. e., granite—gives excellent results, that therefore all granites will give equally good results. The gravel used in these tests had smooth round surfaces but developed a compressive strength but little inferior to that of the granite, and appreciably greater than that of the limestone. Yet it can not be stated that the use of any given gravel for concrete is permissible, because this particular sample, which originated from a hard flinty rock and is well graded, gives excellent results. A gravel deposit will necessarily partake of the physical properties of the rock from which it is derived and no good results can be hoped for by the use of a gravel which originated from a soft chalky limestone or from some weak cleavable shale or sandstone. The compressive strength of the stone affects the compressive strength of the concrete in which it is used in too great a degree to warrant the neglect of the consideration of this influence, while even for the same stone, the strength of the concrete will be greatly influenced by the uniformity or nonuniformity of the grading.

Again for equally good grading, the material which grades down from the larger particles will nearly always show the greater strength. The effect of a large amount of dust in decreasing the strength of the concrete should not be overlooked. It must be recognized that the quality of the sand used in making the concrete—i. e., its hardness, size, and grading, the presence of a large amount of very fine material—are all elements which will modify conclusions as to the excellence of a given stone or gravel.

From a consideration of the above facts it is always advisable to make careful investigation of the materials available, even though the costs of tests seem excessive.

### (b) WEIGHT PER CUBIC FOOT OF CONCRETE

The weight per cubic foot for a 1:2:4 stone and gravel concrete may be taken as 150 pounds and a cinder concrete 120 pounds.

### (c) ULTIMATE STRENGTH OF CONCRETES AT 4 WEEKS

The ultimate strength of 2000 pounds per square inch for a 1:2:4 concrete at the age of 4 weeks, frequently the basis for unit stresses, was exceeded by almost 50 per cent for the granite and gravel and by 25 per cent for the limestone concrete, but the value found was 20 per cent less than 2000 pounds per square inch for the cinder concrete.

###### (*d*) EFFECT OF AGE ON ULTIMATE STRENGTH

The ultimate compressive strength of concrete shows a substantial increase from an age of 4 to one of 52 weeks, the strength at 4 weeks being about 65 per cent of that at 52 weeks.

###### (*e*) POSITION OF THE YIELD POINT

The yield point at the age of 4 weeks averages about 0.30 the ultimate strength and for stone and gravel concretes is well above 500 pounds per square inch, but for cinders is somewhat less. The yield point shows a substantial increase with age.

###### (*f*) COMPRESSIVE STRESS GROSS DEFORMATION DIAGRAM

The compressive stress, gross deformation diagram of concrete may be represented by a straight line up to a unit stress 1.5 times the yield point with a maximum error of about 6.5 per cent. A working formula for reinforced concrete in flexure, based on a constant stress deformation diagram for concrete in compression, will therefore give correct results up to an extreme unit fiber stress of 0.30, the ultimate strength. This would correspond to a factor of safety of about 3 and for a unit fiber stress 50 per cent greater the error will not exceed 7 per cent.

###### (*g*) INITIAL MODULUS OF ELASTICITY

The initial modulus of elasticity at the age of 4 weeks exceeds 2 500 000, the amount usually specified, by about 85 per cent for gravel, 70 per cent for granite, and 45 per cent for limestone concrete but is 35 per cent less for cinder concrete. The increase in stiffness with age as measured by the modulus of elasticity while marked is not nearly so great as the increase in strength.

###### (*h*) ULTIMATE STRENGTH OF CONCRETE

The ultimate strength of concrete in compression as given by the cylinder test is always less than that given by the cube test, the ratio being about 75 per cent at the age of 4 weeks, and showing a substantial increase with age due to the greater percentage increase of strength for the cylinders.

### 3. REINFORCEMENT

A study of the 1260 tests of the steel (Table 4) used as reinforcement for the beams herein recorded shows that—

(*a*) For even practically identical ultimate strengths there is considerable variation in the percentage of elongation and reduction of area.

(*b*) The yield point bears no relation to the ultimate strength.

WASHINGTON, JUNE 27, 1911.

Table 4.—Average Results of Tests on Reinforcement. One-half Inch Round Bars.

CINDER AGGREGATE

**AGE OF BEAM, 4 WEEKS**

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 417 | 2 | 36 960 | 36 960 | 54 630 | 37 520 | 30.3 | 70.4 |
| 418 | 2 | 37 070 | 37 720 | 57 920 | 35 730 | 28.5 | 68.0 |
| 419 | 2 | 37 070 | 37 390 | 53 080 | 37 520 | 29.5 | 70.8 |
| 429 | 3 | 39 710 | 39 090 | 57 950 | 39 970 | 29.3 | 68.2 |
| 430 | 3 | 39 030 | 40 490 | 58 010 | 38 690 | 28.1 | 67.8 |
| 431 | 3 | 39 530 | 41 300 | 57 420 | 37 340 | 30.5 | 67.2 |
| 441 | 4 | 39 200 | 40 520 | 57 400 | 37 970 | 29.1 | 67.2 |
| 442 | 4 | 39 610 | 41 840 | 57 840 | 38 750 | 27.8 | 68.1 |
| 443 | 4 | 39 750 | 41 150 | 59 350 | 39 460 | 28.0 | 64.5 |
| 453 | 5 | 37 330 | 40 330 | 56 000 | 38 040 | 28.9 | 69.8 |
| 454 | 5 | 36 910 | 38 210 | 56 130 | 37 880 | 28.4 | 66.1 |
| 455 | 5 | 37 520 | 39 750 | 55 000 | 35 660 | 29.5 | 69.1 |
| 465 | 6 | 35 620 | 36 980 | 53 430 | 36 800 | 29.8 | 69.4 |
| 466 | 6 | 35 500 | 37 870 | 54 300 | 37 780 | 29.0 | 68.6 |
| 467 | 6 | 35 470 | 37 350 | 56 440 | 38 400 | 30.0 | 69.4 |
| 477 | 7 | 33 880 | 36 730 | 57 050 | 38 970 | 28.0 | 67.8 |
| 478 | 7 | 33 180 | 35 790 | 53 690 | 35 810 | 29.5 | 69.1 |
| 479 | 7 | 33 690 | 37 620 | 53 560 | 37 860 | 30.4 | 69.8 |
| 489 | 8 | 36 030 | 38 020 | 54 810 | 37 050 | 29.2 | 69.5 |
| 490 | 8 | 35 910 | 37 690 | 54 580 | 36 970 | 28.8 | 71.0 |
| 491 | 8 | 35 680 | 37 950 | 55 420 | 38 550 | 30.2 | 69.4 |

**AGE OF BEAM, 13 WEEKS**

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 420 | 2 | 37 750 | 38 400 | 55 850 | 37 670 | 28.8 | 69.8 |
| 421 | 2 | 37 440 | 39 200 | 61 130 | 44 090 | 27.5 | 59.7 |
| 422 | 2 | 37 020 | 40 010 | 57 810 | 37 650 | 28.5 | 66.3 |
| 432 | 3 | 39 020 | 39 860 | 55 460 | 36 380 | 29.8 | 68.2 |
| 433 | 3 | 38 620 | 39 550 | 57 810 | 36 990 | 29.3 | 69.1 |
| 434 | 3 | 39 300 | 40 520 | 58 140 | 36 650 | 29.0 | 65.2 |
| 444 | 4 | 39 220 | 39 900 | 56 550 | 38 340 | 32.3 | 67.8 |
| 445 | 4 | 38 220 | 39 780 | 56 640 | 36 420 | 29.9 | 67.8 |
| 446 | 4 | 39 490 | 41 670 | 57 810 | 37 180 | 28.9 | 68.5 |
| 456 | 5 | 37 320 | 38 780 | 52 840 | 36 420 | 30.7 | 70.0 |
| 457 | 5 | 37 180 | 38 000 | 54 150 | 35 750 | 29.3 | 70.4 |
| 458 | 5 | 37 650 | 40 810 | 56 770 | 39 490 | 29.3 | 67.4 |
| 468 | 6 | 35 660 | 38 010 | 55 280 | 39 590 | 30.1 | 67.8 |
| 469 | 6 | 35 380 | 37 970 | 52 710 | 36 270 | 31.9 | 69.9 |
| 470 | 6 | 35 380 | 37 630 | 54 630 | 37 390 | 30.6 | 69.8 |
| 480 | 7 | 34 180 | 36 110 | 53 260 | 35 700 | 30.7 | 66.1 |
| 481 | 7 | 34 240 | 36 260 | 54 610 | 37 640 | 31.3 | 69.1 |
| 482 | 7 | 33 810 | 36 980 | 56 450 | 40 120 | 29.6 | 69.1 |
| 492 | 8 | 36 060 | 37 210 | 54 260 | 37 330 | 30.9 | 70.3 |
| 493 | 8 | 35 580 | 38 190 | 56 740 | 37 450 | 29.5 | 67.2 |
| 494 | 8 | 35 710 | 36 440 | 53 120 | 36 680 | 29.9 | 71.1 |

Table 4.—Average Results of Tests on Reinforcement. One-half Inch Round Bars—Continued

CINDER AGGREGATE—Continued

AGE OF BEAM, 26 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 423 | 2 | 37 440 | 38 220 | 55 900 | 37 040 | 30.0 | 69.8 |
| 424 | 2 | 37 220 | 38 770 | 53 560 | 34 600 | 30.3 | 70.2 |
| 425 | 2 | 37 920 | 39 680 | 56 100 | 36 660 | 28.5 | 69.6 |
| 435 | 3 | 39 740 | 40 230 | 55 510 | 35 650 | 29.0 | 68.6 |
| 436 | 3 | 38 990 | 40 450 | 57 260 | 37 480 | 29.5 | 66.8 |
| 437 | 3 | 39 630 | 40 480 | 59 580 | 40 000 | 29.0 | 65.3 |
| 447 | 4 | 39 270 | 41 350 | 57 340 | 38 260 | 28.7 | 67.4 |
| 448 | 4 | 39 240 | 40 850 | 56 970 | 44 630 | 28.5 | 67.2 |
| 449 | 4 | 38 970 | 39 740 | 56 860 | 38 550 | 29.1 | 67.7 |
| 459 | 5 | 36 960 | 38 950 | 54 280 | 36 830 | 28.7 | 70.2 |
| 460 | 5 | 37 590 | 39 050 | 57 100 | 47 430 | 29.4 | 68.7 |
| 461 | 5 | 35 970 | 36 880 | 53 890 | 36 730 | 30.7 | 69.0 |
| 471 | 6 | 34 980 | 38 100 | 54 630 | 38 010 | 30.1 | 70.2 |
| 472 | 6 | 35 160 | 36 800 | 54 340 | 36 420 | 30.5 | 70.4 |
| 473 | 6 | 35 650 | 37 940 | 54 770 | 38 380 | 29.0 | 68.7 |
| 483 | 7 | 33 800 | 35 920 | 54 080 | 35 910 | 30.2 | 70.3 |
| 484 | 7 | 34 160 | 36 460 | 54 030 | 37 330 | 28.8 | 70.3 |
| 485 | 7 | 33 930 | 36 880 | 52 340 | 36 370 | 30.7 | 69.0 |
| 495 | 8 | 35 530 | 37 140 | 54 660 | 38 470 | 30.4 | 70.5 |
| 496 | 8 | 35 520 | 36 790 | 53 500 | 36 510 | 31.4 | 71.7 |
| 497 | 8 | 36 600 | 37 820 | 54 730 | 39 250 | 30.3 | 70.2 |

AGE OF BEAM, 52 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 426 | 2 | 37 160 | 38 890 | 56 200 | 37 090 | 31.5 | 69.9 |
| 427 | 2 | 36 720 | 38 480 | 54 030 | 35 930 | 30.8 | 69.7 |
| 428 | 2 | 38 290 | 37 760 | 55 730 | 36 220 | 31.5 | 71.4 |
| 438 | 3 | 39 230 | 40 290 | 58,190 | 36 740 | 28.3 | 66.0 |
| 439 | 3 | 39 860 | 40 850 | 56 300 | 37 870 | 31.2 | 70.7 |
| 440 | 3 | 39 410 | 41 040 | 56 690 | 36,140 | 29.2 | 68.8 |
| 450 | 4 | 40 520 | 41 630 | 58 350 | 38 040 | 29.6 | 66.8 |
| 451 | 4 | 39 690 | 41 050 | 59 750 | 40 030 | 29.9 | 67.5 |
| 452 | 4 | 39 590 | 40 610 | 58 600 | 38 190 | 28.4 | 65.7 |
| 462 | 5 | 35 930 | 37 420 | 54 720 | 36 240 | 29.2 | 70.7 |
| 463 | 5 | 35 570 | 37 460 | 55 200 | 36 810 | 30.0 | 70.0 |
| 464 | 5 | 35 760 | 38 800 | 55 390 | 36 590 | 28.4 | 70.0 |
| 474 | 6 | 33 120 | 36 710 | 60 390 | 40 120 | 28.4 | 64.5 |
| 475 | 6 | 34 300 | 38 770 | 56 800 | 37 830 | 30.6 | 67.7 |
| 476 | 6 | 34 620 | 37 400 | 56 100 | 38 860 | 31.0 | 69.2 |
| 486 | 7 | 34 080 | 37 620 | 53 660 | 37 020 | 30.3 | 68.9 |
| 487 | 7 | 34 150 | 37 230 | 53 160 | 37 120 | 30.9 | 70.2 |
| 488 | 7 | 34 220 | 37 230 | 53 010 | 34 670 | 31.3 | 71.1 |
| 498 | 8 | 35 940 | 37 760 | 54 980 | 36 880 | 30.1 | 69.4 |
| 499 | 8 | 36 530 | 38 620 | 54 880 | 38 070 | 29.0 | 70.0 |
| 500 | 8 | 35 750 | 37 760 | 55 100 | 36 770 | 29.1 | 68.4 |

Table 4.—Average Results of Tests on Reinforcement. One-Half Inch Round Bars—Continued

GRANITE AGGREGATE

AGE OF BEAM, 4 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 162 | 2 | 40 230 | 42 610 | 60 010 | 40 340 | 27.9 | 61.1 |
| 163 | 2 | 39 180 | 42 560 | 56 930 | 39 590 | 28.8 | 67.6 |
| 164 | 2 | 39 760 | 42 300 | 57 370 | 37 270 | 28.5 | 69.5 |
| 174 | 3 | 38 870 | 42 150 | 56 530 | 37 740 | 28.4 | 67.9 |
| 175 | 3 | 39 490 | 42 130 | 55 670 | 34 410 | 29.6 | 67.7 |
| 176 | 3 | 39 530 | 42 780 | 56 870 | 35 960 | 28.6 | 69.4 |
| 186 | 4 | 39 360 | 42 840 | 58 160 | 39 970 | 28.0 | 64.9 |
| 187 | 4 | 39 960 | 42 540 | 57 760 | 36 890 | 28.8 | 69.2 |
| 188 | 4 | 39 850 | 43 750 | 57 980 | 38 390 | 28.7 | 66.0 |
| 198 | 5 | 39 460 | 42 180 | 56 550 | 35 910 | 29.3 | 66.2 |
| 199 | 5 | 39 650 | 42 210 | 58 070 | 40 500 | 28.1 | 67.5 |
| 200 | 5 | 39 190 | 43 020 | 58 780 | 40 930 | 28.4 | 65.3 |
| 210 | 6 | 39 640 | 42 220 | 59 130 | 41 460 | 29.7 | 66.0 |
| 211 | 6 | (1) | ........... | ........... | ........... | ........... | ........... |
| 212 | 6 | (1) | ........... | ........... | ........... | ........... | ........... |
| 222 | 7 | 39 660 | 42 100 | 58 640 | 41 140 | 28.7 | 63.3 |
| 223 | 7 | 39 330 | 42 020 | 57 430 | 38 660 | 29.8 | 68.3 |
| 224 | 7 | 39 450 | 42 300 | 59 220 | 40 580 | 29.5 | 66.1 |
| 237 | 8 | 37 240 | 41 650 | 54 870 | 33 900 | 29.9 | 68.5 |
| 238 | 8 | 37 260 | 41 720 | 55 480 | 36 780 | 29.4 | 68.9 |
| 239 | 8 | 37 560 | 42 200 | 56 790 | 37 330 | 29.3 | 66.9 |

AGE OF BEAM, 13 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 165 | 2 | 39 460 | 42 230 | 56 020 | 37 400 | 28.2 | 70.8 |
| 166 | 2 | 39 180 | 42 200 | 57 740 | 41 420 | 29.4 | 67.3 |
| 167 | 2 | 39 350 | 41 910 | 56 330 | 37 160 | 29.4 | 69.6 |
| 177 | 3 | 39 520 | 41 940 | 58 430 | 37 900 | 29.9 | 65.6 |
| 178 | 3 | 38 900 | 43 390 | 55 860 | 41 110 | 29.8 | 69.9 |
| 179 | 3 | 39 580 | 43 470 | 58 150 | 37 860 | 28.1 | 66.8 |
| 189 | 4 | 38 920 | 41 960 | 56 040 | 35 940 | 30.0 | 70.7 |
| 190 | 4 | 39 680 | 42 480 | 58 910 | 39 010 | 28.9 | 66.8 |
| 191 | 4 | 39 440 | 40 670 | 58 780 | 43 150 | 27.6 | 63.5 |
| 201 | 5 | 39 680 | 40 920 | 60 530 | 42 320 | 28.8 | 63.4 |
| 202 | 5 | 39 820 | 41 460 | 60 140 | 44 730 | 28.5 | 61.6 |
| 203 | 5 | 39 820 | 40 410 | 59 760 | 42 390 | 29.5 | 64.0 |
| 213 | 6 | 39 840 | 41 460 | 59 010 | 40 860 | 29.5 | 65.3 |
| 214 | 6 | 39 970 | 41 230 | 58 780 | 44 260 | 30.4 | 64.2 |
| 215 | 6 | 39 310 | 41 080 | 56 630 | 37 620 | 29.9 | 65.4 |
| 225 | 7 | 38 920 | 41 180 | 61 650 | 45 820 | 28.2 | 61.1 |
| 226 | 7 | 39 290 | 42 110 | 60 200 | 46 050 | 28.1 | 64.5 |
| 227 | 7 | 39 120 | 40 750 | 60 520 | 42 200 | 29.8 | 63.5 |
| 243 | 8 | 37 580 | 41 790 | 57 740 | 38 400 | 29.2 | 67.7 |
| 244 | 8 | 37 480 | 41 780 | 56 860 | 37 240 | 28.9 | 67.9 |
| 245 | 8 | 37 300 | 41 400 | 55 470 | 36 040 | 29.8 | 67.4 |

[1] Tags of steel numbers mixed. The average elastic limit in these two beams was 39 000 to 40 000.

Table 4.—Average Results of Tests on Reinforcement. One-Half Inch Round Bars—Continued

GRANITE AGGREGATE—Continued

AGE OF BEAM, 26 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 168 | 2 | 39 290 | 43 160 | 59 560 | 43 730 | 26.9 | 56.9 |
| 169 | 2 | 39 700 | 42 810 | 57 620 | 39 330 | 29.4 | 69.8 |
| 170 | 2 | 39 460 | 42 520 | 60 080 | 40 650 | 26.6 | 65.1 |
| 180 | 3 | 39 750 | 42 700 | 56 920 | 38 390 | 29.2 | 68.3 |
| 181 | 3 | 39 300 | 41 320 | 56 860 | 43 320 | 28.4 | 68.9 |
| 182 | 3 | 39 480 | 43 730 | 58 650 | 43 750 | 27.0 | 65.7 |
| 192 | 4 | 40 320 | 42 570 | 59 440 | 41 440 | 28.5 | 66.4 |
| 193 | 4 | 38 670 | 41 350 | 56 720 | 35 810 | 30.2 | 69.1 |
| 194 | 4 | 39 420 | 42 800 | 59 460 | 38 680 | 29.1 | 66.7 |
| 204 | 5 | 39 840 | 41 380 | 61 510 | 46 450 | 27.8 | 63.2 |
| 205 | 5 | 39 720 | 42 700 | 64 040 | 49 830 | 26.7 | 60.4 |
| 206 | 5 | 39 630 | 41 340 | 61 420 | 49 420 | 28.5 | 61.2 |
| 216 | 6 | 40 000 | 41 680 | 59 020 | 44 340 | 28.8 | 65.3 |
| 217 | 6 | 39 450 | 41 930 | 59 690 | 40 500 | 29.0 | 66.1 |
| 218 | 6 | 39 190 | 41 420 | 58 350 | 42 380 | 28.7 | 66.6 |
| 231 | 7 | 37 040 | 40 960 | 55 740 | 36 620 | 28.5 | 69.0 |
| 232 | 7 | 37 990 | 40 450 | 55 330 | 38 110 | 29.0 | 67.3 |
| 233 | 7 | 37 230 | 40 610 | 55 370 | 40 850 | 29.7 | 67.9 |
| 240 | 8 | 37 880 | 42 170 | 56 190 | 37 620 | 28.9 | 68.9 |
| 241 | 8 | 37 070 | 40 760 | 55 270 | 36 700 | 29.5 | 69 3 |
| 242 | 8 | 37 430 | 42 400 | 55 950 | 37 420 | 29.6 | 69.1 |

AGE OF BEAM, 52 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 171 | 2 | 38 640 | 42 480 | 57 360 | 38 290 | 28.1 | 67.2 |
| 172 | 2 | 39 430 | 42 480 | 57 690 | 36 820 | 28.1 | 68.1 |
| 173 | 2 | 38 900 | 42 760 | 56 800 | 39 190 | 30.3 | 68.0 |
| 183 | 3 | 39 420 | 43 000 | 57 670 | 37 150 | 28.4 | 66.8 |
| 184 | 3 | 39 850 | 42 190 | 58 040 | 38 440 | 29.5 | 68.9 |
| 185 | 3 | 39 760 | 40 910 | 54 300 | 36 920 | 30.0 | 68.9 |
| 195 | 4 | 39 350 | 42 560 | 57 790 | 39 660 | 29.0 | 67.5 |
| 196 | 4 | 38 530 | 42 170 | 57 590 | 40 370 | 29.0 | 68.2 |
| 197 | 4 | 38 890 | 42 230 | 56 230 | 36 800 | 29.2 | 69.0 |
| 207 | 5 | 39 460 | 41 040 | 59 710 | 39 720 | 28.5 | 65.4 |
| 208 | 5 | 39 210 | 41 910 | 56 890 | 40 320 | 28.6 | 67.7 |
| 209 | 5 | 39 290 | 42 090 | 58 500 | 39 980 | 29.0 | 67.2 |
| 219 | 6 | 39 470 | 41 800 | 59 540 | 40 480 | 30.0 | 65.3 |
| 220 | 6 | 39 380 | 41 360 | 59 130 | 41 520 | 29.3 | 64.4 |
| 221 | 6 | 39 440 | 42 900 | 58 030 | 36 920 | 28.5 | 68.4 |
| 228 | 7 | 37 040 | 40 950 | 56 800 | 39 020 | 29.5 | 68.1 |
| 229 | 7 | 37 310 | 40 610 | 54 370 | 36 890 | 29.5 | 69.6 |
| 230 | 7 | 37 260 | 40 430 | 55 100 | 38 390 | 29.0 | 67.1 |
| 234 | 8 | 37 370 | 41 460 | 56 480 | 38 300 | 29.2 | 67.5 |
| 235 | 8 | 37 790 | 42 440 | 56 340 | 36 400 | 29.1 | 68.4 |
| 236 | 8 | 37 670 | 41 730 | 55 210 | 35 850 | 29.9 | 68.8 |

Table 4.—Average Results of Tests on Reinforcement One-half Inch Round Bars—Continued

GRAVEL AGGREGATE

AGE OF BEAM, 4 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 333 | 2 | 40 990 | 43 500 | 60 380 | 40 020 | 29.1 | 64.2 |
| 334 | 2 | 41 090 | 41 910 | 59 460 | 41 970 | 27.5 | 64.0 |
| 335 | 2 | 41 730 | 44 930 | 71 330 | 61 850 | 25.1 | 57.9 |
| 345 | 3 | 41 440 | 41 440 | 61 150 | 41 990 | 28.8 | 65.7 |
| 346 | 3 | 41 160 | 43 640 | 59 770 | 40 940 | 26.7 | 63.8 |
| 347 | 3 | 41 200 | 43 760 | 58 660 | 36 640 | 29.6 | 68.5 |
| 357 | 4 | 41 000 | 43 460 | 63 880 | 49 020 | 26.3 | 65.0 |
| 358 | 4 | 41 380 | 42 410 | 57 150 | 38 310 | 29.6 | 65.8 |
| 359 | 4 | 40 910 | 41 930 | 75 150 | 61 820 | 24.6 | 55.1 |
| 369 | 5 | 39 040 | 40 270 | 59 520 | 41 910 | 27.4 | 66.6 |
| 370 | 5 | 39 320 | 39 930 | 56 640 | 39 010 | 28.0 | 65.3 |
| 371 | 5 | 39 540 | 39 540 | 56 630 | 39 300 | 28.6 | 65.5 |
| 381 | 6 | 37 300 | 38 010 | 55 510 | 40 310 | 29.9 | 69.9 |
| 382 | 6 | 37 410 | 38 570 | 56 060 | 39 160 | 29.1 | 68.7 |
| 383 | 6 | 37 600 | 39 170 | 54 900 | 38 410 | 29.6 | 69.3 |
| 393 | 7 | 38 170 | 39 680 | 56 570 | 38 240 | 29.8 | 66.6 |
| 394 | 7 | 37 800 | 39 120 | 55 630 | 40 140 | 30.0 | 68.5 |
| 395 | 7 | 37 790 | 40 030 | 54 210 | 36 120 | 29.4 | 69.4 |
| 405 | 8 | 37 370 | 38 360 | 55 560 | 38 590 | 29.2 | 69.0 |
| 406 | 8 | 37 530 | 38 680 | 57 060 | 37 940 | 28.9 | 68.9 |
| 407 | 8 | 37 530 | 38 590 | 55 590 | 38 390 | 29.1 | 68.5 |

AGE OF BEAM, 13 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 336 | 2 | 40 860 | 42 590 | 59 390 | 39 030 | 28.9 | 64.3 |
| 337 | 2 | 40 570 | 41 530 | 61 150 | 46 120 | 26.9 | 65.5 |
| 338 | 2 | 41 170 | 42 370 | 60 300 | 44 140 | 28.8 | 63.6 |
| 348 | 3 | 40 650 | 42 010 | 57 510 | 39 660 | 28.0 | 68.1 |
| 349 | 3 | 40 120 | 41 330 | 56 870 | 37 920 | 29.2 | 67.9 |
| 350 | 3 | 41 250 | 43 390 | 59 760 | 40 500 | 26.6 | 64.2 |
| 360 | 4 | 41 080 | 43 310 | 60 350 | 46 490 | 28.7 | 65.4 |
| 361 | 4 | 39 520 | 39 830 | 57 540 | 37 230 | 29.3 | 68.0 |
| 362 | 4 | 39 050 | 40 040 | 57 930 | 38 840 | 29.3 | 66.2 |
| 372 | 5 | 39 090 | 39 510 | 56 680 | 38 280 | 28.9 | 68.6 |
| 373 | 5 | 39 460 | 39 900 | 57 640 | 43 030 | 28.4 | 67.5 |
| 374 | 5 | 38 920 | 39 830 | 57 710 | 38 620 | 29.4 | 67.7 |
| 384 | 6 | 37 270 | 37 950 | 56 160 | 37 650 | 29.0 | 67.4 |
| 385 | 6 | 37 280 | 37 470 | 55 230 | 39 160 | 30.6 | 69.9 |
| 386 | 6 | 37 330 | 38 050 | 56 190 | 38 710 | 29.8 | 69.0 |
| 396 | 7 | 37 420 | 38 080 | 55 450 | 37 590 | 29.9 | 69.7 |
| 397 | 7 | 37 820 | 41 020 | 57 420 | 42 160 | 28.8 | 68.8 |
| 398 | 7 | 37 820 | 38 920 | 57 910 | 40 590 | 29.4 | 67.7 |
| 408 | 8 | 37 400 | 38 940 | 55 960 | 37 610 | 29.1 | 66.8 |
| 409 | 8 | 37 590 | 38 630 | 55 660 | 37 490 | 29.0 | 66.4 |
| 410 | 8 | 37 240 | 38 110 | 55 780 | 37 420 | 29.8 | 67.6 |

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Table 4.—Average Results of Tests on Reinforcement. One-half Inch Round Bars—Continued

GRAVEL AGGREGATE—Continued

AGE OF BEAM, 26 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 339 | 2 | 42 160 | 42 160 | 62 510 | 48 650 | 26.9 | 57.8 |
| 340 | 2 | 41 530 | 45 220 | 71 680 | 63 720 | 21.9 | 45.9 |
| 341 | 2 | 40 700 | 40 700 | 58 350 | 40 560 | 31.6 | 66.3 |
| 351 | 3 | 41 120 | 42 110 | 60 100 | 41 810 | 29.0 | 63.4 |
| 352 | 3 | 41 360 | 43 960 | 64 690 | 55 330 | 24.5 | 60.5 |
| 353 | 3 | 40 990 | 43 140 | 58 880 | 45 470 | 30.0 | 67.5 |
| 363 | 4 | 39 280 | 39 400 | 56 830 | 39 140 | 28.3 | 68.3 |
| 364 | 4 | 39 400 | 40 310 | 58 440 | 43 720 | 28.3 | 66.0 |
| 365 | 4 | 39 230 | 39 680 | 57 790 | 41 560 | 28.6 | 68.7 |
| 375 | 5 | 39 090 | 39 850 | 57 840 | 39 030 | 28.0 | 68.3 |
| 376 | 5 | 39 000 | 39 660 | 57 840 | 40 590 | 28.9 | 67.9 |
| 377 | 5 | 38 960 | 39 680 | 57 430 | 41 050 | 28.0 | 68.4 |
| 387 | 6 | 37 100 | 38 400 | 56 010 | 38 030 | 29.1 | 69.2 |
| 388 | 6 | 37 340 | 38 120 | 57 670 | 38 830 | 28.2 | 68.0 |
| 389 | 6 | 37 390 | 38 540 | 55 820 | 38 930 | 29.4 | 67.9 |
| 399 | 7 | 37 460 | 39 050 | 55 790 | 39 180 | 28.8 | 67.9 |
| 400 | 7 | 37 120 | 38 250 | 57 750 | 38 700 | 30.0 | 68.7 |
| 401 | 7 | 37 740 | 38 740 | 55 990 | 41 190 | 29.4 | 67.7 |
| 411 | 8 | 37 630 | 38 120 | 55 620 | 36 550 | 30.1 | 68.4 |
| 412 | 8 | 37 290 | 38 240 | 55 580 | 36 740 | 29.2 | 69.1 |
| 413 | 8 | 37 420 | 38 620 | 56 080 | 36 890 | 28.7 | 68.1 |

AGE OF BEAM, 52 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 342 | 2 | 41 380 | 43 870 | 61 610 | 47 400 | 26.9 | 59.4 |
| 343 | 2 | 41 130 | 42 520 | 62 180 | 52 480 | 26.9 | 61.0 |
| 344 | 2 | 42 840 | 46 030 | 69 800 | 54 780 | 25.0 | 56.5 |
| 354 | 3 | 42 030 | 44 280 | 67 050 | 55 600 | 25.9 | 59.3 |
| 355 | 3 | 41 180 | 42 980 | 59 810 | 39 700 | 29.2 | 65.2 |
| 356 | 3 | 41 080 | 42 880 | 59 260 | 57 600 | 28.1 | 66.1 |
| 366 | 4 | 39 320 | 40 480 | 58 850 | 40 130 | 28.4 | 66.7 |
| 367 | 4 | 39 170 | 40 030 | 59 200 | 40 440 | 29.1 | 67.5 |
| 368 | 4 | 39 220 | 39 810 | 56 790 | 38 200 | 29.1 | 67.5 |
| 378 | 5 | 37 610 | 38 090 | 56 280 | 39 240 | 30.4 | 68.6 |
| 379 | 5 | 37 220 | 37 850 | 56 260 | 39 550 | 28.4 | 67.9 |
| 380 | 5 | 37 300 | 38 180 | 55 810 | 40 710 | 28.6 | 68.9 |
| 390 | 6 | 37 560 | 39 330 | 55 670 | 40 720 | 29.2 | 67.9 |
| 391 | 6 | 37 310 | 38 050 | 55 360 | 41 490 | 29.2 | 68.9 |
| 392 | 6 | 37 240 | 38 510 | 56 350 | 40 040 | 29.1 | 68.8 |
| 402 | 7 | 37 890 | 38 580 | 54 560 | 38 640 | 28.8 | 68.9 |
| 403 | 7 | 38 300 | 38 910 | 56 100 | 53 800 | 29.7 | 69.2 |
| 404 | 7 | 37 620 | 38 970 | 57 120 | 38 300 | 28.5 | 68.0 |
| 414 | 8 | 37 460 | 38 670 | 55 810 | 37 090 | 29.4 | 69.9 |
| 415 | 8 | 37 080 | 38 320 | 55 350 | 36 680 | 29.6 | 69.9 |
| 416 | 8 | 37 560 | 38 940 | 53 570 | 37 010 | 30.6 | 68.5 |

Table 4.—Average Results of Tests on Reinforcement. One-Half Inch Round Bars—Continued

LIMESTONE AGGREGATE

AGE OF BEAM, 4 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 255 | 2 | 37 770 | 42 350 | 55 920 | 35 030 | 30.3 | 68.1 |
| 256 | 2 | 38 120 | 41 200 | 59 300 | 40 490 | 29.7 | 65.7 |
| 257 | 2 | 37 320 | 41 410 | 53 590 | 31 470 | 30.0 | 70.6 |
| 261 | 3 | 37 530 | 40 720 | 55 260 | 33 940 | 28.7 | 70.5 |
| 262 | 3 | 37 780 | 41 080 | 56 190 | 34 140 | 29.0 | 70.9 |
| 263 | 3 | 36 810 | 41 330 | 56 750 | 35 770 | 30.2 | 67.0 |
| 273 | 4 | 37 570 | 40 720 | 61 020 | 45 640 | 28.2 | 63.3 |
| 274 | 4 | 37 720 | 40 280 | 57 970 | 41 570 | 29.4 | 62.8 |
| 275 | 4 | 37 550 | 41 370 | 59 360 | 39 790 | 28.9 | 62.9 |
| 285 | 5 | 38 200 | 42 550 | 58 900 | 41 520 | 29.3 | 66.0 |
| 286 | 5 | 37 790 | 41 850 | 55 540 | 35 570 | 30.5 | 68.8 |
| 287 | 5 | 37 350 | 41 030 | 59 360 | 42 210 | 28.6 | 65.4 |
| 297 | 6 | 35 450 | 40 330 | 54 490 | 38 060 | 27.2 | 68.5 |
| 298 | 6 | 35 870 | 40 790 | 55 620 | 37 390 | 30.0 | 68.7 |
| 299 | 6 | 35 850 | 40 660 | 54 780 | 36 030 | 30.9 | 69.3 |
| 318 | 7 | 35 690 | 42 620 | 62 560 | 48 830 | 27.7 | 63.9 |
| 319 | 7 | 35 570 | 39 740 | 55 560 | 39 530 | 30.1 | 64.9 |
| 320 | 7 | 35 760 | 40 900 | 55 460 | 38 030 | 29.7 | 68.2 |
| 321 | 8 | 35 900 | 39 210 | 55 270 | 39 150 | 29.5 | 68.2 |
| 322 | 8 | 35 920 | 37 140 | 53 680 | 38 550 | 30.1 | 68.8 |
| 323 | 8 | 35 790 | 37 760 | 55 370 | 38 770 | 28.8 | 68.7 |

AGE OF BEAM, 13 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 249 | 2 | 36 970 | 41 800 | 57 140 | 39 480 | 27.6 | 70.9 |
| 250 | 2 | 37 620 | 41 350 | 56 260 | 37 890 | 27.9 | 69.9 |
| 251 | 2 | 37 800 | 40 740 | 60 690 | 43 240 | 30.0 | 63.9 |
| 264 | 3 | 37 760 | 42 980 | 57 870 | 36 000 | 29.8 | 67.7 |
| 265 | 3 | 37 590 | 42 160 | 60 200 | 43 280 | 28.9 | 64.6 |
| 266 | 3 | 37 350 | 40 040 | 59 080 | 41 840 | 27.5 | 64.2 |
| 276 | 4 | 37 310 | 41 500 | 57 240 | 40 930 | 28.9 | 66.9 |
| 277 | 4 | 37 240 | 42 020 | 58 670 | 44 440 | 29.1 | 67.2 |
| 278 | 4 | 37 520 | 40 540 | 58 930 | 40 340 | 29.3 | 66.1 |
| 288 | 5 | 35 710 | 40 000 | 54 920 | 37 000 | 30.3 | 69.3 |
| 289 | 5 | 35 970 | 40 150 | 58 200 | 42 180 | 28.9 | 66.7 |
| 290 | 5 | 35 330 | 40 280 | 53 660 | 37 610 | 30.5 | 67.5 |
| 300 | 6 | 35 840 | 40 050 | 53 940 | 37 030 | 29.1 | 68.1 |
| 301 | 6 | 35 580 | 40 740 | 54 640 | 36 460 | 29.2 | 70.3 |
| 302 | 6 | 35 510 | 40 570 | 56 160 | 38 250 | 30.3 | 68.7 |
| 312 | 7 | 35 230 | 41 120 | 56 670 | 37 790 | 29.8 | 68.6 |
| 313 | 7 | 35 970 | 40 070 | 58 430 | 42 510 | 29.3 | 68.1 |
| 314 | 7 | 36 440 | 40 440 | 56 420 | 38 070 | 30.6 | 67.9 |
| 324 | 8 | 35 900 | 37 250 | 54 170 | 37 600 | 30.6 | 68.7 |
| 325 | 8 | 35 760 | 37 730 | 55 950 | 38 520 | 28.8 | 70.2 |
| 326 | 8 | 35 710 | 36 830 | 54 310 | 37 940 | 30.4 | 69.5 |

Table 4.—Average Results of Tests on Reinforcement. One-Half Inch Round Bars—Continued

LIMESTONE AGGREGATE—Continued

AGE OF BEAM, 26 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 252 | 2 | 37 560 | 40 750 | 53 140 | 34 680 | 29.4 | 73.4 |
| 253 | 2 | 37 450 | 41 650 | 56 020 | 36 140 | 31.3 | 70.1 |
| 254 | 2 | 37 830 | 40 290 | 57 620 | 41 020 | 30.7 | 68.2 |
| 267 | 3 | 37 270 | 40 680 | 56 480 | 37 750 | 26.9 | 66.6 |
| 268 | 3 | 37 580 | 40 750 | 58 940 | 42 460 | 28.3 | 63.6 |
| 269 | 3 | 37 310 | 40 710 | 53 090 | 36 350 | 29.2 | 71.4 |
| 279 | 4 | 37 250 | 41 040 | 58 230 | 41 320 | 29.7 | 65.1 |
| 280 | 4 | 38 130 | 40 990 | 58 140 | 37 360 | 31.6 | 67.4 |
| 281 | 4 | 37 530 | 41 090 | 58 890 | 42 650 | 30.3 | 65.6 |
| 291 | 5 | 35 840 | 39 800 | 53 780 | 37 110 | 29.5 | 66.9 |
| 292 | 5 | 35 820 | 39 990 | 54 090 | 38 090 | 30.5 | 68.7 |
| 293 | 5 | 35 980 | 40 300 | 55 150 | 37 410 | 30.2 | 69.2 |
| 303 | 6 | 34 940 | 41 890 | 58 350 | 39 730 | 30.0 | 66.3 |
| 304 | 6 | 36 080 | 41 350 | 53 810 | 37 590 | 30.0 | 68.0 |
| 305 | 6 | 35 920 | 41 060 | 54 590 | 36 140 | 30.0 | 69.7 |
| 315 | 7 | 35 460 | 39 600 | 54 550 | 37 510 | 30.3 | 68.6 |
| 316 | 7 | 35 530 | 37 530 | 54 410 | 40 300 | 29.1 | 67.4 |
| 317 | 7 | 35 900 | 39 870 | 54 940 | 39 600 | 30.0 | 65.8 |
| 327 | 8 | 35 740 | 36 730 | 54 990 | 38 000 | 30.0 | 69.8 |
| 328 | 8 | 35 960 | 37 140 | 54 440 | 37 460 | 30.5 | 69.3 |
| 329 | 8 | 35 910 | 36 900 | 55 220 | 33 240 | 29.7 | 69.7 |

AGE OF BEAM, 52 WEEKS

| Reinforcement used in Beam No. | No. of Bars | Elastic Limit (by Dividers) | Yield Point (Drop of Beam) | Maximum Unit Stress | Breaking Strength | Percentage Elongation in 8 Inches | Percentage Reduction in Area |
|---|---|---|---|---|---|---|---|
| 246 | 2 | 36 870 | 41 100 | 54 900 | 37 670 | 29.1 | 70.0 |
| 247 | 2 | 37 670 | 41 230 | 53 990 | 37 220 | 30.0 | 70.6 |
| 248 | 2 | 36 840 | 40 680 | 56 940 | 38 580 | 28.5 | 67.5 |
| 270 | 3 | 37 260 | 41 900 | 60 600 | 41 770 | 29.0 | 63.2 |
| 271 | 3 | 38 670 | 41 890 | 58 650 | 42 530 | 29.2 | 67.0 |
| 272 | 3 | 37 440 | 41 660 | 62 110 | 44 710 | 28.8 | 63.2 |
| 282 | 4 | 37 730 | 41 040 | 59 100 | 40 800 | 28.3 | 66.8 |
| 283 | 4 | 37 240 | 40 990 | 57 690 | 38 420 | 30.4 | 67.6 |
| 284 | 4 | 37 930 | 42 210 | 57 340 | 40 740 | 29.1 | 65.1 |
| 294 | 5 | 35 870 | 39 720 | 53 930 | 38 140 | 30.4 | 67.3 |
| 295 | 5 | 36 350 | 40 270 | 55 490 | 40 250 | 30.3 | 69.4 |
| 296 | 5 | 36 070 | 40 840 | 55 450 | 39 280 | 31.0 | 69.2 |
| 306 | 6 | 35 300 | 39 650 | 53 890 | 37 930 | 30.9 | 68.7 |
| 307 | 6 | 36 210 | 40 770 | 56 390 | 39 210 | 28.7 | 66.9 |
| 308 | 6 | 35 760 | 40 440 | 54 240 | 35 850 | 30.1 | 68.2 |
| 309 | 7 | 35 690 | 40 590 | 55 580 | 35 670 | 30.7 | 70.1 |
| 310 | 7 | 35 940 | 39 750 | 56 000 | 40 740 | 29.2 | 68.2 |
| 311 | 7 | 35 730 | 40 820 | 55 460 | 37 180 | 31.2 | 70.6 |
| 330 | 8 | 36 210 | 36 790 | 59 550 | 38 290 | 29.8 | 70.4 |
| 331 | 8 | 36 020 | 37 510 | 55 930 | 38 020 | 29.6 | 70.7 |
| 332 | 8 | 36 000 | 38 720 | 56 790 | 37 790 | 28.4 | 67.8 |

# SUMMARY OF TESTS ON REINFORCED CONCRETE BEAMS

## Table 6.—Granite Concrete Proportions, 1:2:4. Age, 4 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement: Number of ½″ round rods | Reinforcement: Nominal Per cent | Reinforcement: Effective Per cent | Reinforcement: Area, in sq. in. | First Crack: Applied Load, in lbs. | First Crack: Unit Elongation in Lower Fiber, inches per inch | Maximum Load: Applied Load, in lbs. | Maximum Load: Deflection, inches | Maximum Load: Unit Elongation in Steel, inches per inch | Maximum Load: Unit Stress of Steel, lbs. per sq. in. $S_1$ | Maximum Load: Yield Point of Steel, lbs. per sq. in. $S_2$ | Maximum Load: $\frac{S_1}{S_2}$ | Analysis: Applied Load, in lbs. | Analysis: Unit Elongation in Steel, inches per inch | Analysis: Unit Stress in Steel, lbs. per sq. in. | Analysis: KD, in inches | Analysis: D-.35KD in inches | Analysis: Resisting Moment, inch lbs., Mr | Analysis: Bending Moment, inch lbs., Mb | Analysis: $\frac{Mr}{Mb}$ | Analysis: Unit Deformation Upper Fiber, inches per inch | Unit Compressive Stress Upper Fiber, lbs. per sq. in.: $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 162 | 1170 | 145.4 | 2 | 0.49 | 0.49 | 0.393 | 3000 | 0.000137 | 5900 | (0.356) | (0.001100) | (33 000) | 42 610 | 0.77 | 5500 | 0.001014 | 30 400 | 3.18 | 8.89 | 106 100 | 151 900 | 0.70 | 0.000472 | 1780 | 845 | 1205 | 0.47 | 0.68 | 120 |
| 163 | 1200 | 145.5 | 2 | .49 | .49 | .393 | 2500 | .000124 | 7000 | .395 | (.001492) | (44 800) | 42 560 | 1.05 | 6750 | .001415 | 42 500 | 2.67 | 9.07 | 151 400 | 182 400 | .83 | .000516 | 1900 | 1405 | 1695 | .74 | .89 | 140 |
| 164 | 1230 | 151.9 | 2 | .49 | .49 | .393 | 3000 | .000150 | 6500 | (.340) | (.001240) | (37 200) | 42 300 | .88 | 6250 | .001200 | 36 000 | 2.53 | 9.11 | 128 800 | 170 900 | .75 | .000406 | 1600 | 1255 | 1675 | .78 | 1.05 | 131 |
| Average | | | | | | | | | 6470 | .364 | (.001277) | (38 300) | | .90 | | | | | | | | .76 | | | | | .66 | .87 | 130 |
| 174 | 1200 | 150.1 | 3 | .74 | .74 | .589 | 3000 | [1].000269 | 9300 | .415 | (.001135) | (34 100) | 42 150 | .81 | 9000 | .001068 | 32 000 | 3.83 | 8.66 | 163 300 | 236 400 | .69 | .000665 | 2230 | 1105 | 1600 | .50 | .72 | 125 |
| 175 | 1190 | 148.7 | 3 | .74 | .74 | .589 | 2500 | .000131 | 8900 | .445 | .001246 | 37 400 | 42 130 | .89 | 8750 | .001234 | 37 000 | 3.54 | 8.76 | 190 900 | 230 200 | .83 | .000677 | 2250 | 1365 | 1670 | .62 | .74 | 121 |
| 176 | 1200 | 150.3 | 3 | .74 | .74 | .589 | 2500 | .000124 | 9000 | (.430) | (.001431) | (42 900) | 42 780 | 1.00 | 8750 | .001332 | 40 000 | 3.50 | 8.78 | 206 900 | 230 400 | .90 | .000717 | 2320 | 1515 | 1685 | .65 | .73 | 120 |
| Average | | | | | | | | | 9070 | .430 | .001271 | 38 500 | | .90 | | | | | | | | .81 | | | | | .59 | .73 | 122 |
| 186 | 1210 | 146.6 | 4 | .98 | .98 | .785 | 2400 | .000095 | 13 280 | .460 | (.001340) | (40 200) | 42 840 | .94 | 13 000 | .001320 | 39 600 | 3.69 | 8.71 | 270 900 | 332 500 | .81 | .000772 | 2410 | 1895 | 2340 | .79 | .97 | 130 |
| 187 | 1190 | 146.2 | 4 | .98 | .98 | .785 | 2000 | .000086 | 11 650 | .450 | (.001369) | (41 100) | 42 540 | .97 | 11 000 | .001191 | 35 700 | 3.64 | 8.73 | 244 800 | 284 200 | .86 | .000682 | 2260 | 1735 | 2020 | .77 | .89 | 111 |
| 188 | 1210 | 145.2 | 4 | .98 | .98 | .785 | 4000 | [2].000223 | 12 460 | .465 | (.001409) | (42 300) | 43 750 | .97 | 12 000 | .001328 | 39 800 | 3.54 | 8.76 | 273 800 | 308 500 | .89 | .000727 | 2340 | 1985 | 2230 | .85 | .95 | 120 |
| Average | | | | | | | | | 12 460 | .458 | (.001373) | (41 200) | | .96 | | | | | | | | .85 | | | | | .80 | .94 | 120 |
| 198 | 1230 | 149.8 | 5 | 1.23 | 1.11 | .982 | 3000 | .000128 | 14 000 | (.487) | (.001429) | (42 900) | 42 180 | 1.02 | 13 500 | .001344 | 40 300 | 3.84 | 8.66 | 291 400 | 344 900 | .84 | .000839 | 2510 | 2095 | 2495 | .83 | .99 | 128 |
| 199 | 1230 | 150.4 | 5 | 1.23 | 1.11 | .982 | 3000 | .000139 | 14 000 | (.488) | (.001497) | (44 900) | 42 210 | 1.06 | 13 500 | .001390 | 41 700 | 3.80 | 8.67 | 301 900 | 344 900 | .88 | .000850 | [3] 2520 | 2190 | 2490 | .87 | .99 | 127 |
| 200 | 1230 | 147.9 | 5 | 1.23 | 1.11 | .982 | 3500 | [5].000155 | 13 750 | (.475) | (.001412) | (42 400) | 43 020 | .99 | 13 500 | .001386 | 41 600 | 3.75 | 8.69 | 302 200 | 344 900 | .88 | .000831 | 2500 | 2215 | 2515 | .89 | 1.01 | 127 |
| Average | | | | | | | | | 13 920 | (.483) | (.001446) | (43 400) | | 1.02 | | | | | | | | .87 | | | | | .86 | 1.00 | 127 |
| 210 | 1220 | 147.6 | 6 | 1.47 | 1.30 | 1.178 | 2500 | .000103 | 16 000 | .555 | (.001559) | (46 800) | 42 220 | 1.11 | 15 000 | .001282 | 38 500 | 4.06 | 8.58 | 314 500 | 387 000 | .83 | .000877 | [3] 2560 | 2195 | 2645 | .86 | 1.03 | 124 |
| 211 | 1210 | 144.0 | 6 | 1.47 | 1.30 | 1.178 | 2500 | .000110 | 15 500 | .535 | (.001538) | (46 100) | ([4]) | ...... | 14 000 | .001277 | 38 300 | 3.89 | 8.64 | 316 500 | 356 500 | .89 | .000814 | 2480 | 2290 | 2575 | .92 | 1.04 | 115 |
| 212 | 1200 | 146.9 | 6 | 1.47 | 1.30 | 1.178 | 2500 | .000117 | 15 100 | .635 | (.001687) | (50 600) | ([4]) | ...... | 14 000 | .001311 | 39 300 | 4.08 | 8.57 | 320 600 | 356 400 | .90 | .000901 | [3] 2590 | 2230 | 2480 | .86 | .96 | 117 |
| Average | | | | | | | | | 15 530 | .575 | (.001595) | (47 800) | | 1.11 | | | | | | | | .87 | | | | | .88 | 1.01 | 119 |
| 222 | 1240 | 150.4 | 7 | 1.72 | 1.54 | 1.375 | 3500 | .000157 | 18 000 | .600 | (.001679) | (50 400) | 42 100 | 1.20 | 17 500 | .001398 | 41 900 | 4.53 | 8.41 | 400 600 | 441 000 | .91 | .001159 | [3] 2810 | 2525 | 2775 | .90 | .99 | 123 |
| 223 | 1230 | 148.2 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000153 | 19 200 | .630 | (.001809) | (54 300) | 42 020 | 1.29 | 18 000 | .001465 | 44 000 | 4.31 | 8.49 | 426 800 | 452 900 | .94 | .001108 | [3] 2770 | 2600 | 2980 | 1.01 | 1.08 | 124 |
| 224 | 1220 | 146.8 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000146 | 18 450 | .650 | (.001933) | (58 000) | 42 300 | 1.37 | 17 000 | .001398 | 41 900 | 4.28 | 8.50 | 407 200 | 428 700 | .95 | .001045 | [3] 2720 | 2685 | 2828 | .99 | 1.04 | 117 |
| Average | | | | | | | | | 18 550 | .627 | (.001807) | (54 200) | | 1.29 | | | | | | | | .93 | | | | | .97 | 1.04 | 121 |
| 237 | 1220 | 146.8 | 8 | 1.96 | 1.72 | 1.571 | 3500 | .000117 | 19 650 | .640 | (.001474) | (44 200) | 41 650 | 1.06 | 19 000 | .001335 | 40 100 | 4.87 | 8.30 | 413 000 | 476 700 | .87 | .001268 | [3] 2860 | 2485 | 2855 | .87 | 1.00 | 123 |
| 238 | 1240 | 150.1 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000152 | 19 150 | .560 | (.001679) | (50 400) | 41 720 | 1.21 | 18 000 | .001344 | 40 300 | 4.38 | 8.47 | 429 800 | 453 000 | .95 | .001045 | [3] 2720 | 2815 | 2965 | 1.03 | 1.09 | 113 |
| 239 | 1240 | 147.2 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000176 | 19 920 | .625 | (.001774) | (53 200) | 42 200 | 1.26 | 19 000 | .001426 | 42 800 | 4.46 | 8.44 | 453 800 | 477 000 | .95 | .001148 | [3] 2800 | 2930 | 3085 | 1.05 | 1.10 | 119 |
| Average | | | | | | | | | 19 570 | .608 | (.001642) | (49 300) | | 1.18 | | | | | | | | .92 | | | | | .98 | 1.06 | 118 |
| Grand Ave | | 147.9 | | | | | 2900 | .000130 | | | | | | | | | | | | | | | | | | | | .95 | 122 |

[1] Beam was dropped when being placed in machine. [2] Accidentally loaded to 4000 lbs. before test. [3] Value taken from curve produced. [4] Steel was mixed. [5] Accidentally loaded to 3900 lbs. before test.

*Remarks.*—Average bond stress developed in beam=122 lbs. per square inch. Average ultimate bond stress from bond test pieces=489 lbs. per square inch. Ratio=4.0.

Note.—Values in parentheses are estimated.

## Table 7.—Granite Concrete Proportions, 1:2:4. Age, 13 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | First Crack: Applied Load, in lbs. | First Crack: Unit Elongation in Lower Fiber | Max. Load: Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel | Unit Stress of Steel $S_1$ | Yield Point of Steel $S_2$ | $\frac{S_1}{S_2}$ | Analysis: Applied Load, in lbs. | Unit Elongation in Steel | Unit Stress in Steel | KD, in inches | D-.35KD in inches | Resisting Moment, Mr | Bending Moment, Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber | $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 165 | 1200 | 149.1 | 2 | 0.49 | 0.49 | 0.393 | 2000 | 0.000072 | 6800 | 0.350 | 0.001138 | 34 100 | 42 230 | 0.81 | 6500 | 0.001015 | 30 500 | 3.06 | 8.93 | 107 000 | 176 400 | 0.61 | 0.000447 | 1890 | 880 | 1445 | 0.47 | 0.76 | 138 |
| 166 | 1190 | 147.7 | 2 | .49 | .49 | .393 | 3000 | .000105 | 6500 | .325 | .001176 | 35 300 | 42 200 | .84 | 6500 | .001176 | 35 300 | 2.62 | 9.08 | 125 900 | 176 200 | .72 | .000418 | 1780 | 1190 | 1655 | .67 | .93 | 135 |
| 167 | 1210 | 150.3 | 2 | .49 | .49 | .393 | 2500 | .000096 | 6600 | .345 | .001164 | 34 900 | 41 910 | .83 | 6500 | .001147 | 34 400 | 2.84 | 9.01 | 121 700 | 176 500 | .69 | .000454 | 1930 | 1070 | 1550 | .55 | .80 | 137 |
| Average | | | | | | | | | 6630 | .340 | .001159 | 34 800 | | .83 | | | | | | | | .67 | | | | | .56 | .83 | 137 |
| 177 | 1200 | 148.2 | 3 | .74 | .74 | .589 | 3000 | .000121 | 9210 | .410 | .001215 | 36 500 | 41 940 | .87 | 9000 | .001157 | 34 700 | 3.13 | 8.90 | 181 900 | 236 400 | .77 | .000527 | 2180 | 1470 | 1910 | .67 | .88 | 122 |
| 178 | 1200 | 146.6 | 3 | .74 | .74 | .589 | 3000 | .000109 | 10 000 | .410 | .001248 | 37 400 | 43 390 | .86 | 10 000 | .001248 | 37 400 | 3.10 | 8.92 | 196 500 | 260 400 | .75 | .000560 | 2300 | 1600 | 2135 | .70 | .93 | 133 |
| 179 | 1200 | 146.8 | 3 | .74 | .74 | .589 | 4000 | .000149 | 9840 | .390 | .001070 | 32 100 | 43 470 | .74 | 9000 | .000949 | 28 500 | 3.44 | 8.80 | 147 700 | 236 400 | .62 | .000498 | 2080 | 1100 | 1775 | .53 | .85 | 123 |
| Average | | | | | | | | | 9680 | .403 | .001178 | 35 300 | | .82 | | | | | | | | .71 | | | | | .63 | .89 | 126 |
| 189 | 1240 | 152.7 | 4 | .98 | .98 | .785 | 4000 | .000139 | 12 700 | .455 | .001226 | 36 800 | 41 950 | .88 | 12 000 | .001125 | 33 800 | 3.66 | 8.72 | 231 500 | 309 000 | .75 | .000650 | 2600 | 1630 | 2175 | .63 | .84 | 121 |
| 190 | 1190 | 146.2 | 4 | .98 | .98 | .785 | 3000 | .000094 | 12 560 | .475 | .001374 | 41 200 | 42 480 | .97 | 12 500 | .001344 | 40 300 | 3.37 | 8.82 | 279 200 | 320 200 | .87 | .000682 | 2690 | 2115 | 2430 | .79 | .90 | 124 |
| 191 | 1200 | 147.8 | 4 | .98 | .98 | .785 | 4000 | .000142 | 11 780 | .400 | .001176 | 35 300 | 40 670 | .87 | 11 000 | .001021 | 30 600 | 3.66 | 8.72 | 209 600 | 284 400 | .74 | .000588 | 2390 | 1475 | 1995 | .62 | .83 | 112 |
| Average | | | | | | | | | 12 350 | .443 | .001259 | 37 800 | | .91 | | | | | | | | .79 | | | | | .68 | .86 | 119 |
| 201 | 1210 | 146.2 | 5 | 1.23 | 1.11 | .982 | 4000 | .000125 | 13 000 | .430 | .001443 | 43 300 | 40 920 | 1.06 | 13 000 | .001164 | 34 900 | 3.61 | 8.74 | 255 600 | 332 500 | .77 | .000657 | 2610 | 1935 | 2515 | .74 | .96 | 121 |
| 202 | 1210 | 147.2 | 5 | 1.23 | 1.11 | .982 | 3000 | .000112 | 13 650 | .435 | .001323 | 39 700 | 41 460 | .96 | 13 000 | .001215 | 36 500 | 3.55 | 8.76 | 268 200 | 332 500 | .81 | .000670 | 2650 | 2060 | 2545 | .78 | .86 | 121 |
| 203 | 1210 | 148.1 | 5 | 1.23 | 1.11 | .982 | 4000 | .000143 | 14 180 | .465 | .001479 | 44 400 | 40 410 | 1.10 | 13 000 | .001166 | 35 000 | 3.53 | 8.76 | 257 300 | 332 500 | .77 | .000637 | 2550 | 1985 | 2580 | .78 | 1.01 | 121 |
| Average | | | | | | | | | 13 810 | .443 | .001415 | 42 500 | | 1.04 | | | | | | | | .78 | | | | | .77 | .98 | 121 |
| 213 | 1230 | 149.1 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000106 | 16 550 | .470 | .001321 | 39 600 | 41 460 | .96 | 16 000 | .001279 | 38 400 | 3.79 | 8.67 | 319 200 | 404 900 | .79 | .000782 | 2980 | 2360 | 2985 | .79 | 1.00 | 130 |
| 214 | 1210 | 147.3 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000103 | 16 800 | .525 | .001494 | 44 800 | 41 230 | 1.09 | 16 000 | .001321 | 39 600 | 3.78 | 8.68 | 329 600 | 404 500 | .81 | .000803 | 3040 | 2440 | 3010 | .80 | .99 | 129 |
| 215 | 1240 | 152.1 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000147 | 16 500 | .495 | .001422 | 42 700 | 41 080 | 1.04 | 16 000 | .001368 | 41 000 | 3.69 | 8.71 | 343 100 | 405 000 | .85 | .000799 | 3030 | 2595 | 3055 | .86 | 1.01 | 129 |
| Average | | | | | | | | | 16 620 | .497 | .001412 | 42 400 | | 1.03 | | | | | | | | .82 | | | | | .82 | 1.00 | 129 |
| 225 | 1220 | 147.7 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000096 | 18 250 | .510 | .001503 | 45 100 | 41 180 | 1.10 | 18 000 | .001354 | 40 600 | 4.03 | 8.59 | 400 900 | 452 700 | .89 | .000913 | 3330 | 2780 | 3125 | .83 | .94 | 122 |
| 226 | 1230 | 147.3 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000124 | 18 620 | .505 | .001694 | 50 800 | 42 110 | 1.21 | 18 000 | .001321 | 39 600 | 3.85 | 8.65 | 396 200 | 452 900 | .87 | .000827 | 3100 | 2850 | 3275 | .92 | 1.06 | 121 |
| 227 | 1240 | 150.4 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000133 | 18 780 | .495 | .001443 | 43 300 | 40 750 | 1.06 | 18 000 | .001308 | 39 200 | 3.94 | 8.62 | 389 200 | 453 000 | .86 | .000850 | 3170 | 2750 | 3200 | .87 | 1.01 | 121 |
| Average | | | | | | | | | 18 550 | .503 | .001547 | 46 400 | | 1.12 | | | | | | | | .87 | | | | | .87 | 1.00 | 121 |
| 243 | 1240 | 147.6 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000095 | 21 300 | .615 | .001706 | 51 200 | 41 790 | 1.23 | 19 000 | .001215 | 36 500 | 4.30 | 8.50 | 391 500 | 477 000 | .82 | 000917 | 3330 | 2605 | 3175 | .78 | .95 | 118 |
| 244 | 1260 | 149.8 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000113 | 21 280 | .530 | .001405 | 42 200 | 41 780 | 1.01 | 20 000 | .001252 | 37 600 | 4.07 | 8.58 | 409 600 | 501 400 | .82 | .000860 | 3200 | 2855 | 3480 | .89 | 1.09 | 122 |
| 245 | 1250 | 149.2 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000131 | 22 120 | .595 | .001831 | 54 900 | 41 400 | 1.33 | 19 000 | .001198 | 35 900 | 4.03 | 8.59 | 391 900 | 477 200 | .82 | .000809 | 3060 | 2755 | 3360 | .90 | 1.10 | 116 |
| Average | | | | | | | | | 21 570 | .580 | .001647 | 49 400 | | 1.19 | | | | | | | | .82 | | | | | .86 | 1.05 | 119 |
| Grand Ave | | 148.5 | | | | | 3400 | .000117 | | | | | | | | | | | | | | | | | | | | .94 | 125 |

*Remarks.*—Average bond stress developed in beam=125 pounds per square inch. Average ultimate bond stress from bond test pieces=611 pounds per square inch. Ratio=4.9.

## SUMMARY OF TESTS ON REINFORCED CONCRETE BEAMS—Continued

### Table 8.—Granite Concrete Proportions, 1:2:4. Age, 26 Weeks

| | | | Reinforcement | | | | First Crack | | Maximum Load | | | | | | Analysis of beam at Unit Elongation in Reinforcement Less than that at Yield Point | | | | | | | | | Unit Oppressive Stress Upper Fiber, lbs. per sq. in. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D-.35KD in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 169 | 1210 | 148.8 | 2 | .49 | .49 | .393 | 2500 | 0.000082 | 6810 | 0.340 | 0.001178 | 35 300 | 42 810 | .82 | 6500 | 0.001089 | 32 700 | 2.63 | 9.08 | 116 600 | 176 540 | 0.661 | 0.000389 | 1740 | 1100 | 1663 | 0.63 | 0.96 | 135 |
| 170 | 1210 | 147.4 | 2 | .49 | .49 | .393 | 2500 | .000083 | 6350 | .325 | .001044 | 31 300 | 42 520 | .74 | 6000 | .000887 | 26 600 | 2.80 | 9.02 | 94 200 | 164 540 | .573 | .000346 | 1550 | 840 | 1465 | .54 | .95 | 128 |
| Average | | | | | | | | | 6580 | .333 | .001111 | 33 300 | | .78 | | | | | | | | .617 | | | | | .59 | .96 | 132 |
| 180 | 1220 | 149.0 | 3 | .74 | .74 | .589 | 3000 | .000115 | 9820 | .380 | .001226 | 36 800 | 42 700 | .86 | 9000 | .001053 | 31 600 | 3.05 | 8.93 | 166 200 | 236 705 | .702 | .000462 | 2020 | 1375 | 1960 | .68 | .97 | 122 |
| 181 | 1220 | 148.9 | 3 | .74 | .74 | .589 | 2000 | .000063 | 10 780 | .425 | .001303 | 39 100 | 41 320 | .95 | 10 000 | .001178 | 35 300 | 3.01 | 8.95 | 186 100 | 260 705 | .714 | .000508 | 2190 | 1555 | 2180 | .71 | 1.00 | 133 |
| 182 | 1230 | 150.3 | 3 | .74 | .74 | .589 | 3000 | .000118 | 10 000 | .405 | .001241 | 37 200 | 43 730 | .85 | 10 000 | .001241 | 37 200 | 3.01 | 8.95 | 196 100 | 260 870 | .752 | .000533 | 2290 | 1640 | 2180 | .72 | .95 | 133 |
| Average | | | | | | | | | 10 200 | .403 | .001257 | 37 700 | | .89 | | | | | | | | .723 | | | | | .70 | .97 | 129 |
| 192 | 1190 | 146.5 | 4 | .98 | .98 | .785 | 3500 | .000126 | 12 360 | .425 | .001280 | 38 400 | 42 570 | .90 | 12 000 | .001181 | 35 400 | 3.47 | 8.79 | 244 400 | 308 210 | .793 | .000627 | 2620 | 1805 | 2275 | .69 | .87 | 120 |
| 193 | 1210 | 149.5 | 4 | .98 | .98 | .785 | 3000 | .000112 | 12 500 | .425 | .001210 | 36 300 | 41 350 | .88 | 12 000 | .001089 | 32 700 | 3.76 | 8.68 | 222 900 | 308 540 | .723 | .000656 | 2730 | 1535 | 2125 | .56 | .78 | 121 |
| 194 | 1210 | 145.6 | 4 | .98 | .98 | .785 | 4000 | .000126 | 12 530 | .415 | .001313 | 39 400 | 42 800 | .92 | 12 000 | .001173 | 35 200 | 3.20 | 8.88 | 245 500 | 308 540 | .796 | .000551 | 2350 | 1945 | 2445 | .83 | 1.04 | 119 |
| Average | | | | | | | | | 12 460 | .422 | .001268 | 38 000 | | .90 | | | | | | | | .771 | | | | | .69 | .90 | 120 |
| 204 | 1210 | 145.2 | 5 | 1.23 | 1.11 | .982 | 3000 | .000099 | 13 550 | .445 | .001267 | 38 000 | 41 380 | .92 | 13 000 | .001138 | 34 100 | 3.49 | 8.78 | 251 500 | 332 540 | .756 | .000610 | 2570 | 1960 | 2595 | .76 | 1.01 | 121 |
| 205 | 1240 | 150.3 | 5 | 1.23 | 1.11 | .982 | 3000 | .000116 | 14 730 | .540 | .001684 | 50 500 | 42 700 | 1.18 | 13 000 | .001137 | 34 100 | 3.39 | 8.81 | 252 600 | 333 035 | .759 | .000583 | 2470 | 2020 | 2660 | .82 | 1.08 | 120 |
| 206 | 1210 | 146.2 | 5 | 1.23 | 1.11 | .982 | 4000 | .000135 | 14 540 | .480 | .001393 | 41 800 | 41 340 | 1.01 | 14 000 | .001258 | 37 700 | 3.42 | 8.80 | 278 900 | 356 540 | .782 | .000655 | 2730 | 2215 | 2835 | .81 | 1.04 | 129 |
| Average | | | | | | | | | 14 270 | .488 | .001448 | 43 400 | | 1.04 | | | | | | | | .766 | | | | | .80 | 1.04 | 123 |
| 216 | 1220 | 147.6 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000086 | 16 000 | .480 | .001292 | 38 800 | 41 680 | .93 | 15 000 | .001077 | 32 300 | 3.97 | 8.61 | 265 400 | 380 705 | .697 | .000708 | 2920 | 1890 | 2710 | .65 | .93 | 124 |
| 217 | 1230 | 146.8 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000124 | 16 350 | .470 | .001224 | 36 700 | 41 930 | .88 | 16 000 | .001171 | 35 100 | 3.75 | 8.69 | 292 700 | 404 870 | .723 | .000703 | 2900 | 2185 | 3020 | .75 | 1.04 | 129 |
| 218 | 1240 | 150.3 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000098 | 16 300 | .480 | .001337 | 40 100 | 41 420 | .97 | 16 000 | .001251 | 37 500 | 3.63 | 8.73 | 315 000 | 405 035 | .778 | .000712 | 2930 | 2415 | 3105 | .82 | 1.06 | 128 |
| Average | | | | | | | | | 16 220 | .477 | .001284 | 38 500 | | .93 | | | | | | | | .733 | | | | | .74 | 1.01 | 127 |
| 231 | 1240 | 148.7 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000113 | 18 980 | .475 | .001309 | 39 300 | 40 960 | .96 | 18 000 | .001226 | 36 800 | 3.79 | 8.67 | 368 600 | 453 035 | .814 | .000746 | 3050 | 2695 | 3310 | .88 | 1.09 | 120 |
| 232 | 1240 | 147.6 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000119 | 19 570 | .511 | .001436 | 43 100 | 40 450 | 1.07 | 19 000 | .001313 | 39 400 | 3.78 | 8.68 | 395 100 | 477 035 | .828 | .000798 | 3220 | 2890 | 3490 | .90 | 1.08 | 126 |
| 233 | 1240 | 150.3 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000112 | 19 480 | .520 | .001474 | 44 200 | 40 610 | 1.09 | 18 000 | .001168 | 35 000 | 3.94 | 8.62 | 347 500 | 453 035 | .767 | .000759 | 3100 | 2455 | 3200 | .79 | 1.03 | 121 |
| Average | | | | | | | | | 19 340 | .502 | .001406 | 42 200 | | 1.04 | | | | | | | | .803 | | | | | .86 | 1.07 | 122 |
| 240 | 1240 | 147.9 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000107 | 21 620 | .550 | .001438 | 43 100 | 42 170 | 1.02 | 20 000 | .001219 | 36 600 | 4.13 | 8.55 | 396 500 | 501 035 | .791 | .000856 | 3370 | 2730 | 3450 | .81 | 1.02 | 123 |
| | | | 8 | 1.96 | 1.72 | 1.571 | | | | | | | | | | | | | | | | | | | | | | | |
| 242 | 1240 | 148.3 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000105 | 22 480 | .580 | .001619 | 48 600 | 42 400 | 1.15 | 21 000 | .001284 | 38 500 | 4.16 | 8.54 | 416 400 | 525 035 | .793 | .000913 | 3540 | 2850 | 3595 | .81 | 1.02 | 129 |
| Average | | | | | | | | | 22 050 | .565 | .001529 | 45 900 | | 1.09 | | | | | | | | .792 | | | | | .81 | 1.02 | 126 |
| Grand Ave. | | 148.2 | | | | | 3300 | .000107 | | | | | | | | | | | | | | | | | | | | 1.00 | 125 |

*Remarks.*—Average bond stress developed in beam=125 pounds per square inch. Average ultimate bond stress from bond test pieces=791 pounds per square inch. Ratio=6.3.

### Table 9.—Granite Concrete Proportions, 1:2:4. Age, 52 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D-.35KD in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 171 | 1190 | 144.3 | 2 | 0.49 | 0.49 | .393 | 3000 | 0.000092 | 7300 | 0.345 | 0.001347 | 40 400 | 42 480 | 0.95 | 7000 | .001144 | 34 300 | 2.50 | 9.12 | 122 900 | 188 200 | 0.653 | 0.000383 | 1850 | 1210 | 1855 | 0.65 | 1.00 | 143 |
| 172 | 1190 | 145.8 | 2 | .49 | .49 | .393 | 3000 | .000095 | 7000 | .305 | .001055 | 31 700 | 42 480 | .75 | 7000 | .001055 | 31 700 | 2.83 | 9.01 | 112 200 | 188 200 | .596 | .000415 | 1970 | 990 | 1660 | .50 | .84 | 145 |
| 173 | 1210 | 147.3 | 2 | .49 | .49 | .393 | 3000 | .000116 | 7200 | .345 | .001104 | 33 100 | 42 760 | .77 | 7000 | .001067 | 32 000 | 2.84 | 9.01 | 113 200 | 188 550 | .600 | .000424 | 2010 | 995 | 1660 | .50 | .83 | 145 |
| Average | | | | | | | | | 7170 | .332 | .001169 | 35 100 | | .82 | | | | | | | | .616 | | | | | .55 | .89 | 144 |
| 183 | 1210 | 146.6 | 3 | .74 | .74 | .589 | 2000 | .000075 | 10 750 | .430 | .001573 | 47 200 | 43 000 | 1.10 | 10 000 | .001313 | 39 400 | 2.86 | 9.00 | 208 900 | 260 550 | .802 | .000526 | 2430 | 1825 | 2275 | .75 | .94 | 132 |
| 184 | 1210 | 147.5 | 3 | .74 | .74 | .589 | 2000 | .000076 | 10 000 | .375 | .001280 | 38 400 | 42 190 | .91 | 9 000 | .001065 | 32 000 | 3.16 | 8.89 | 167 600 | 236 550 | .709 | .000493 | 2310 | 1340 | 1890 | .58 | .82 | 122 |
| 185 | 1220 | 146.1 | 3 | .74 | .74 | .589 | 2000 | .000063 | 10 670 | (.385) | .001115 | 33 500 | 40 910 | .82 | 10 000 | .001014 | 30 400 | 3.14 | 8.90 | 159 400 | 260 700 | .611 | .000464 | 2190 | 1285 | 2105 | .59 | .96 | 134 |
| Average | | | | | | | | | 10 470 | .397 | .001323 | 39 700 | | .94 | | | | | | | | .707 | | | | | .64 | .91 | 129 |
| 195 | 1180 | 142.1 | 4 | .98 | .98 | .785 | 3000 | .000089 | 13 670 | .445 | .001217 | 36 500 | 42 560 | .86 | 13 000 | .001135 | 34 100 | 3.51 | 8.77 | 234 700 | 332 050 | .707 | .000613 | 2800 | 1715 | 2425 | .61 | .87 | 129 |
| 196 | 1220 | 146.9 | 4 | .98 | .98 | .785 | 4000 | .000127 | 13 000 | .390 | .001214 | 36 400 | 42 170 | .86 | 13 000 | .001214 | 36 400 | 3.35 | 8.83 | 252 400 | 332 700 | .759 | .000612 | 2800 | 1920 | 2530 | .69 | .90 | 128 |
| 197 | 1220 | 148.3 | 4 | .98 | .98 | .785 | 3000 | .000095 | 13 100 | .415 | (.001200) | (36 000) | 42 230 | .85 | 13 000 | .001178 | 35 300 | 3.39 | 8.81 | 244 300 | 332 700 | .734 | .000605 | 2760 | 1840 | 2505 | .67 | .91 | 129 |
| Average | | | | | | | | | 13 260 | .417 | .001210 | 36 300 | | .86 | | | | | | | | .733 | | | | | .66 | .89 | 129 |
| 207 | 1220 | 147.3 | 5 | 1.23 | 1.11 | .982 | 4000 | .000140 | 14 500 | .430 | .001472 | 44 200 | 41 040 | 1.08 | 14 000 | .001253 | 37 600 | 3.52 | 8.77 | 276 900 | 356 700 | .776 | .000680 | 3060 | 2140 | 2760 | .70 | .90 | 129 |
| 208 | 1230 | 149.0 | 5 | 1.23 | 1.11 | .982 | 3000 | .000095 | 15 770 | .500 | .001518 | 45 500 | 41 910 | 1.09 | 15 000 | .001291 | 38 700 | 3.66 | 8.72 | 282 500 | 380 850 | .742 | .000745 | 3300 | 2115 | 2850 | .64 | .86 | 139 |
| 209 | 1240 | 148.6 | 5 | 1.23 | 1.11 | .982 | 3000 | .000100 | 15 380 | .465 | .001379 | 41 400 | 42 090 | .98 | 15 000 | .001318 | 39 500 | 3.42 | 8.80 | 292 200 | 381 050 | .767 | .000685 | 3090 | 2320 | 3025 | .75 | .98 | 137 |
| Average | | | | | | | | | 15 220 | .465 | .001456 | 43 700 | | 1.05 | | | | | | | | .762 | | | | | .70 | .91 | 135 |
| 219 | 1240 | 147.1 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000092 | 17 700 | .530 | .001639 | 49 200 | 41 800 | 1.18 | 16 000 | .001338 | 40 100 | 3.52 | 8.77 | 339 300 | 405 050 | .838 | .000727 | 3230 | 2670 | 3185 | .83 | .99 | 127 |
| 220 | 1230 | 145.8 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000097 | 16 600 | .535 | .001749 | 52 500 | 41 360 | 1.27 | 16 000 | .001248 | 37 400 | 3.64 | 8.73 | 314 100 | 404 900 | .776 | .000715 | 3190 | 2405 | 3100 | .75 | .97 | 128 |
| 221 | 1240 | 147.3 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000103 | 17 660 | .470 | .001438 | 43 100 | 42 900 | 1.00 | 17 000 | .001350 | 40 500 | 3.56 | 8.75 | 341 500 | 429 100 | .796 | .000746 | 3300 | 2665 | 3350 | .81 | 1.02 | 135 |
| Average | | | | | | | | | 17 320 | .512 | .001609 | 48 300 | | 1.15 | | | | | | | | .803 | | | | | .80 | .99 | 130 |
| 228 | 1240 | 148.9 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000146 | 20 650 | .560 | .001644 | 49 300 | 40 950 | 1.20 | 19 000 | .001320 | 39 600 | 3.91 | 8.63 | 393 800 | 477 050 | .826 | .000846 | 3650 | 2800 | 3390 | .77 | .93 | 127 |
| 229 | 1240 | 147.6 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000092 | 20 750 | .545 | .001585 | 47 600 | 40 610 | 1.17 | 20 000 | .001388 | 41 600 | 3.99 | 8.60 | 411 500 | 501 100 | .821 | .000893 | 3810 | 2880 | 3510 | .76 | .92 | 134 |
| 230 | 1240 | 148.2 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000136 | 21 000 | .535 | .001521 | 45 600 | 40 430 | 1.13 | 19 000 | .001331 | 39 900 | 3.69 | 8.71 | 402 100 | 477 600 | .842 | .000781 | 3430 | 3005 | 3570 | .88 | 1.04 | 126 |
| Average | | | | | | | | | 20 800 | .547 | .001583 | 47 500 | | 1.17 | | | | | | | | .830 | | | | | .80 | .96 | 129 |
| 234 | 1240 | 149.3 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000116 | 21 000 | .550 | .001607 | 48 200 | 41 460 | 1.16 | 20 000 | .001424 | 42 700 | 3.96 | 8.61 | 468 100 | 501 050 | .934 | .000932 | 3920 | 3340 | 3575 | .85 | .91 | 121 |
| 235 | 1240 | 148.2 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000096 | 22 100 | .620 | .001648 | 49 400 | 42 440 | 1.16 | 21 000 | .001390 | 41 700 | 4.14 | 8.55 | 451 800 | 525 050 | .860 | .000980 | 4060 | 3105 | 3010 | .77 | .89 | 128 |
| 236 | 1240 | 148.2 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000100 | 22 000 | .605 | .001790 | 53 700 | 41 730 | 1.29 | 20 000 | .001291 | 38 700 | 4.11 | 8.56 | 420 100 | 501 050 | .838 | .000901 | 3830 | 2905 | 3465 | .76 | .90 | 122 |
| Average | | | | | | | | | 21 700 | .592 | .001682 | 50 400 | | 1.20 | | | | | | | | .877 | | | | | .79 | .90 | 124 |
| Grand Av | | 147.2 | | | | | 3100 | .000102 | | | | | | | | | | | | | | | | | | | | .93 | 131 |

*Remarks.*—Average bond stress developed in beams =131 pounds per square inch. Average ultimate bond stress from bond test pieces=76 pounds per square inch. Ratio=5.9.

**Note.**—Values in parentheses are estimated.

## Table 10.—Limestone Concrete. Proportions, 1:2:4. Age, 4 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement: Number of ½″ round rods | Reinforcement: Nominal Per cent | Reinforcement: Effective Per cent | Reinforcement: Area, in sq. in. | First Crack: Applied Load, in lbs. | First Crack: Unit Elongation in Lower Fiber, inches per inch | Maximum Load: Applied Load, in lbs. | Maximum Load: Deflection, inches | Maximum Load: Unit Elongation in Steel, inches per inch | Maximum Load: Unit Stress of Steel, lbs. per sq. in. $S_1$ | Maximum Load: Yield Point of Steel, lbs. per sq. in. $S_2$ | Maximum Load: $\frac{S_1}{S_2}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 255 | 1200 | 146.5 | 2 | 0.49 | 0.49 | 0.393 | 2000 | 0.000103 | 5850 | 0.355 | (0.001107) | (33 200) | 42 350 | 0.78 |
| 256 | 1200 | 149.3 | 2 | .49 | .49 | .393 | 2000 | .000114 | 6350 | .405 | (.001321) | (39 600) | 41 200 | .96 |
| 257 | 1200 | 148.3 | 2 | .49 | .49 | .393 | 2000 | .000082 | 5900 | .350 | (.001111) | (33 300) | 41 410 | .80 |
| Average |  |  |  |  |  |  |  |  | 6030 | .370 | (.001180) | (35 400) |  | .85 |
| 261 | 1230 | 147.1 | 3 | .74 | .74 | .589 | 2000 | .000093 | 9420 | .425 | (.001233) | (37 000) | 40 720 | .91 |
| 262 | 1220 | 147.5 | 3 | .74 | .74 | .589 | 3000 | .000145 | 9320 | .420 | (.001451) | (43 500 | 41 080 | 1.06 |
| 263 | 1230 | 145.4 | 3 | .74 | .74 | .589 | 3500 | .000163 | 8470 | .385 | (.001314) | (39 400) | 41 330 | .95 |
| Average |  |  |  |  |  |  |  |  | 9070 | .410 | (.001333) | (40 000) |  | .97 |
| 273 | 1230 | 146.9 | 4 | .98 | .98 | .785 | 3000 | .000141 | 11 300 | .435 | (.001381) | (41 400) | 40 740 | 1.02 |
| 274 | 1230 | 144.7 | 4 | .98 | .98 | .785 | 3000 | .000133 | 10 800 | .350 | (.001269) | (38 100) | 40 280 | .95 |
| 275 | 1240 | 148.3 | 4 | .98 | .98 | .785 | 3000 | .000124 | 11 500 | .400 | (.001306) | (39 200) | 41 370 | .95 |
| Average |  |  |  |  |  |  |  |  | 11 200 | .395 | (.001319) | (39 600) |  | .97 |
| 285 | 1220 | 147.0 | 5 | 1.23 | 1.11 | .982 | 3000 | .000117 | 13 000 | .445 | .001400 | 42 000 | 42 550 | .99 |
| 286 | 1230 | 147.6 | 5 | 1.23 | 1.11 | .982 | 3500 | .000128 | 13 670 | .510 | (.001375) | (41 300) | 41 850 | .99 |
| 287 | 1240 | 144.4 | 5 | 1.23 | 1.11 | .982 | 3000 | .000123 | 13 100 | .500 | (.001504) | (45 100) | 41 030 | 1.10 |
| Average |  |  |  |  |  |  |  |  | 13 260 | .485 | (.001426) | (42 800) |  | 1.03 |
| 297 | 1220 | 144.4 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000145 | 14 860 | .525 | (.001527) | (45 800) | 40 330 | 1.14 |
| 298 | 1240 | 151.2 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000119 | 15 520 | .560 | (.001560) | (46 800) | 40 790 | 1.15 |
| 299 | 1220 | 144.5 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000133 | 15 100 | .585 | (.001615) | (48 500) | 40 660 | 1.19 |
| Average |  |  |  |  |  |  |  |  | 15 160 | .557 | (.001567) | (47 000) |  | 1.16 |
| 318 | 1240 | 146.8 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000125 | 17 650 | .595 | (.001566) | (47 000) | 42 620 | 1.10 |
| 319 | 1240 | 149.5 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000121 | 17 000 | .560 | (.001570) | (47 100) | 39 740 | 1.19 |
| 320 | 1230 | 147.1 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000143 | 16 600 | .590 | (.001713) | (51 400) | 40 900 | 1.26 |
| Average |  |  |  |  |  |  |  |  | 17 080 | .582 | (.001616) | (48 500) |  | 1.18 |
| 321 | 1240 | 147.8 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000128 | 18 870 | .620 | (.001808) | (54 200) | 39 210 | 1.38 |
| 322 | 1230 | 148.0 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000130 | 18 320 | .625 | (.001549) | (46 500) | 37 140 | 1.25 |
| 323 | 1230 | 145.9 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000130 | 18 960 | .595 | (.001635) | (49 100) | 37 760 | 1.30 |
| Average |  |  |  |  |  |  |  |  | 18 720 | .613 | (.001664) | (49 900) |  | 1.31 |
| Grand Ave |  | 147.1 |  |  |  |  | 2900 | .000126 |  |  |  |  |  |  |

| Beam Number | Analysis of beam at Unit Elongation in Reinforcement Less than that at Yield Point: Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D-.35KD in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | Unit Compressive Stress Upper Fiber, lbs. per sq. in.: $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 255 | 5500 | 0.001030 | 30 900 | 3.17 | 8.89 | 108 000 | 152 500 | 0.71 | 0.000478 | 1480 | 860 | 1210 | 0.58 | 0.82 | 120 |
| 256 | 6000 | .001239 | 37 200 | 3.01 | 8.95 | 131 000 | 164 500 | .80 | .000535 | 1590 | 1090 | 1365 | .69 | .86 | 128 |
| 257 | 5500 | .000973 | 29 200 | 3.28 | 8.85 | 101 500 | 152 500 | .67 | .000475 | 1470 | 785 | 1170 | .53 | .80 | 120 |
| Average |  |  |  |  |  |  |  | .73 |  |  |  |  | .60 | .83 | 123 |
| 261 | 9000 | .001169 | 35 100 | 3.34 | 8.83 | 182 500 | 237 000 | .77 | .000586 | 1660 | 1395 | 1810 | .84 | 1.09 | 123 |
| 262 | 9000 | .001376 | 41 300 | 3.05 | 8.93 | 217 500 | 237 000 | .92 | .000605 | 1690 | 1795 | 1950 | 1.06 | 1.15 | 121 |
| 263 | 8000 | .001162 | 34 900 | 3.05 | 8.93 | 183 500 | 213 000 | .86 | .000511 | 1540 | 1515 | 1760 | .98 | 1.14 | 110 |
| Average |  |  |  |  |  |  |  | .85 |  |  |  |  | .96 | 1.13 | 118 |
| 273 | 11 000 | .001251 | 37 500 | 3.57 | 8.75 | 258 000 | 285 000 | .91 | .000693 | 1810 | 1855 | 2040 | 1.02 | 1.13 | 111 |
| 274 | 10 000 | .001087 | 32 600 | 3.53 | 8.76 | 224 500 | 261 000 | .86 | .000593 | 1680 | 1630 | 1895 | .97 | 1.13 | 102 |
| 275 | 11 000 | .001214 | 36 400 | 3.60 | 8.74 | 250 000 | 285 000 | .88 | .000682 | 1800 | 1785 | 2030 | .99 | 1.13 | 111 |
| Average |  |  |  |  |  |  |  | .88 |  |  |  |  | .99 | 1.13 | 108 |
| 285 | 13 000 | .001400 | 42 000 | 3.65 | 8.72 | 306 500 | 332 500 | .92 | .000803 | 1890 | 2300 | 2500 | 1.22 | 1.32 | 122 |
| 286 | 13 000 | .001256 | 37 700 | 3.78 | 8.68 | 273 500 | 333 000 | .82 | .000764 | 1860 | 1990 | 2425 | 1.07 | 1.30 | 123 |
| 287 | 13 000 | .001348 | 40 400 | 3.76 | 8.68 | 293 000 | 333 000 | .88 | .000812 | 1890 | 2145 | 2440 | 1.13 | 1.29 | 123 |
| Average |  |  |  |  |  |  |  | .87 |  |  |  |  | 1.14 | 1.30 | 123 |
| 297 | 14 000 | .001373 | 41 200 | 3.97 | 8.61 | 338 500 | 356 500 | .95 | .000903 | [1] 2040 | 2410 | 2535 | 1.18 | 1.24 | 116 |
| 298 | 14 000 | .001307 | 39 200 | 4.18 | 8.54 | 318 000 | 357 000 | .89 | .000937 | [1] 2070 | 2165 | 2435 | 1.05 | 1.18 | 117 |
| 299 | 13 000 | .001176 | 35 300 | 4.27 | 8.51 | 284 500 | 332 500 | .85 | .000878 | 2020 | 1905 | 2240 | .94 | 1.11 | 110 |
| Average |  |  |  |  |  |  |  | .90 |  |  |  |  | 1.06 | 1.18 | 114 |
| 318 | 16 000 | .001294 | 38 800 | 4.59 | 8.39 | 369 500 | 405 000 | .91 | .001099 | [1] 2200 | 2305 | 2535 | 1.05 | 1.15 | 113 |
| 319 | 15 000 | .001168 | 35 000 | 4.55 | 8.41 | 334 500 | 381 000 | .88 | .000976 | [1] 2100 | 2100 | 2385 | 1.00 | 1.14 | 106 |
| 320 | 15 000 | .001270 | 38 100 | 4.47 | 8.44 | 366 000 | 381 000 | .96 | .001026 | [1] 2150 | 2330 | 2425 | 1.08 | 1.13 | 106 |
| Average |  |  |  |  |  |  |  | .92 |  |  |  |  | 1.04 | 1.14 | 108 |
| 321 | 17 000 | .001291 | 38 700 | 4.63 | 8.38 | 405 500 | 429 000 | .95 | .001114 | [1] 2210 | 2545 | 2680 | 1.15 | 1.21 | 109 |
| 322 | 17 000 | .001272 | 38 200 | 4.64 | 8.38 | 400 000 | 429 000 | .93 | .001103 | [1] 2200 | 2500 | 2690 | 1.14 | 1.22 | 109 |
| 323 | 18 000 | .001337 | 40 100 | 4.68 | 8.36 | 418 500 | 453 000 | .92 | .001177 | [1] 2260 | 2600 | 2825 | 1.15 | 1.25 | 115 |
| Average |  |  |  |  |  |  |  | .93 |  |  |  |  | 1.15 | 1.23 | 111 |
| Grand Ave |  |  |  |  |  |  |  |  |  |  |  |  |  | 1.13 | 115 |

[1] Value taken from curve produced

*Remarks.*—Average bond stress developed in beams=115 pounds per square inch. Average ultimate bond stress from bond test pieces=388 pounds per square inch. Ratio=3.4

**Note.**—Values in parentheses are estimated.

## Table 11.—Limestone Concrete. Proportions, 1:2:4. Age, 13 Weeks

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 249 | 1180 | 143.7 | 2 | 0.49 | 0.49 | 0.393 | 3000 | 0.000128 | 6000 | 0.305 | 0.000997 | 29 900 | 41 800 | 0.72 |
| 250 | 1190 | 145.0 | 2 | .49 | .49 | .393 | 3000 | .000113 | 6450 | .350 | .001091 | 32 700 | 41 350 | .79 |
| 251 | 1210 | 148.8 | 2 | .49 | .49 | .393 | 3000 | .000111 | 6000 | .290 | .000973 | 29 200 | 40 740 | .72 |
| Average |  |  |  |  |  |  |  |  | 6150 | .315 | .001021 | 30 600 |  | .74 |
| 264 | 1220 | 149.0 | 3 | .74 | .74 | .589 | 3000 | .000118 | 8780 | .385 | .001403 | 42 100 | 42 980 | .98 |
| 265 | 1210 | 147.9 | 3 | .74 | .74 | .589 | 3000 | .000122 | 8500 | .335 | .001101 | 33 000 | 42 160 | .78 |
| 266 | 1210 | 148.7 | 3 | .74 | .74 | .589 | 3500 | .000135 | 8630 | .390 | .001246 | 37 400 | 40 040 | ’93 |
| Average |  |  |  |  |  |  |  |  | 8640 | .370 | .001250 | 37 500 |  | .90 |
| 276 | 1200 | 147.5 | 4 | .98 | .98 | .785 | 3000 | .000096 | 11 930 | (.427) | .001168 | 35 000 | 41 500 | .84 |
| 277 | 1210 | 145.3 | 4 | .98 | .98 | .785 | 3000 | .000113 | 12 000 | .410 | .001297 | 38 900 | 42 020 | .93 |
| 278 | 1210 | 147.3 | 4 | .98 | .98 | .785 | 4000 | .000150 | 11 170 | .415 | .001202 | 36 100 | 40 540 | .89 |
| Average |  |  |  |  |  |  |  |  | 11 700 | .417 | .001222 | 36 700 |  | .89 |
| 288 | 1210 | 146.2 | 5 | 1.23 | 1.11 | .982 | 4000 | .000132 | 13 850 | .460 | .001397 | 41 900 | 40 000 | 1.05 |
| 289 | 1230 | 149.6 | 5 | 1.23 | 1.11 | .982 | 4000 | .000146 | 12 800 | .470 | .001542 | 46 300 | 40 150 | 1.15 |
| 290 | 1240 | 149.3 | 5 | 1.23 | 1.11 | .982 | 4000 | .000141 | 13 140 | .445 | .001352 | 40 600 | 40 280 | 1.01 |
| Average |  |  |  |  |  |  |  |  | 13 260 | .458 | .001430 | 42 900 |  | 1.07 |
| 300 | 1210 | 146.0 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000148 | 15 700 | .545 | .001644 | 49 300 | 40 050 | 1.23 |
| 301 | 1220 | 146.0 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000143 | 14 900 | .490 | .001557 | 46 700 | 40 740 | 1.15 |
| 302 | 1210 | 147.3 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000143 | 14 800 | .480 | .001426 | 42 800 | 40 570 | 1.05 |
| Average |  |  |  |  |  |  |  |  | 15 130 | .505 | .001542 | 46 300 |  | 1.14 |
| 312 | 1240 | 148.2 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000141 | 18 000 | .500 | .001487 | 44 600 | 41 120 | 1.08 |
| 313 | 1260 | 151.0 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000150 | 18 420 | .500 | .001345 | 40 400 | 40 070 | 1.01 |
| 314 | 1220 | 146.0 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000131 | 17 770 | .500 | .001325 | 39 800 | 40 440 | .98 |
| Average |  |  |  |  |  |  |  |  | 18 060 | .500 | .001386 | 41 600 |  | 1.02 |
| 324 | 1220 | 146.3 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000135 | 21 360 | .600 | .001603 | 48 100 | 37 250 | 1.29 |
| 325 | 1250 | 146.3 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000134 | 20 730 | .590 | .001528 | 45 800 | 37 730 | 1.21 |
| 326 | 1230 | 147.3 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000132 | 19 920 | .550 | .001564 | 46 900 | 36 830 | 1.27 |
| Average |  |  |  |  |  |  |  |  | 20 670 | .580 | .001565 | 46 900 |  | 1.26 |
| Grand Ave |  | 146.9 |  |  |  |  | 3600 | .000132 |  |  |  |  |  |  |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 249 | 6000 | 0.000997 | 29 900 | 3.06 | 8.93 | 104 900 | 164 000 | 0.64 | 0.000440 | 1620 | 865 | 1350 | 0.53 | 0.83 | 128 |
| 250 | 6000 | .000979 | 29 400 | 2.92 | 8.98 | 103 700 | 164 200 | .63 | .000404 | 1500 | 890 | 1415 | .59 | .94 | 128 |
| 251 | 6000 | .000973 | 29 200 | 2.73 | 9.04 | 103 700 | 164 500 | .63 | .000366 | 1360 | 945 | 1500 | .69 | 1.10 | 127 |
| Average |  |  |  |  |  |  |  | .63 |  |  |  |  | .60 | .96 | 128 |
| 264 | 8500 | .001183 | 35 500 | 2.98 | 8.96 | 187 400 | 224 700 | .83 | .000503 | 1820 | 1580 | 1905 | .87 | 1.05 | 115 |
| 265 | 8000 | .000988 | 29 600 | 3.20 | 8.88 | 154 800 | 212 500 | .73 | .000466 | 1700 | 1225 | 1680 | .72 | .99 | 110 |
| 266 | 8000 | .001043 | 31 300 | 3.19 | 8.88 | 163 700 | 212 500 | .77 | .000489 | 1770 | 1300 | 1690 | .73 | .95 | 110 |
| Average |  |  |  |  |  |  |  | .78 |  |  |  |  | .77 | 1.00 | 112 |
| 276 | 11 000 | .001050 | 31 500 | 3.61 | 8.74 | 216 200 | 284 400 | .76 | .000593 | 2080 | 1540 | 2025 | .74 | .97 | 111 |
| 277 | 12 000 | .001297 | 38 900 | 3.27 | 8.86 | 270 700 | 308 500 | .88 | .000629 | 2180 | 2100 | 2385 | .96 | 1.09 | 119 |
| 278 | 11 000 | .001138 | 34 100 | 3.48 | 8.78 | 235 500 | 284 500 | .83 | .000607 | 2110 | 1730 | 2085 | .82 | .99 | 111 |
| Average |  |  |  |  |  |  |  | .82 |  |  |  |  | .84 | 1.02 | 114 |
| 288 | 13 000 | .001262 | 37 900 | 3.75 | 8.69 | 275 300 | 332 500 | .83 | .000756 | 2490 | 2020 | 2435 | .81 | .98 | 122 |
| 289 | 12 000 | .001221 | 36 600 | 3.57 | 8.75 | 268 600 | 308 900 | .87 | .000678 | 2300 | 2055 | 2360 | .89 | 1.03 | 113 |
| 290 | 13 000 | .001320 | 39 600 | 3.59 | 8 74 | 290 200 | 333 000 | .87 | .000739 | 2450 | 2210 | 2540 | .90 | 1.04 | 122 |
| Average |  |  |  |  |  |  |  | .86 |  |  |  |  | .87 | 1.02 | 119 |
| 300 | 14 000 | .001193 | 35 800 | 3.91 | 8.63 | 295 300 | 356 500 | .83 | .000766 | 2510 | 2130 | 2565 | .85 | 1.02 | 115 |
| 301 | 14 500 | .001282 | 38 500 | 3.89 | 8.64 | 318 200 | 368 700 | .86 | .000816 | 2630 | 2300 | 2675 | .87 | 1.02 | 119 |
| 302 | 14 000 | .001142 | 34 300 | 4.10 | 8.57 | 279 700 | 356 500 | .78 | .000794 | 2590 | 1935 | 2480 | .75 | .96 | 117 |
| Average |  |  |  |  |  |  |  | .82 |  |  |  |  | .82 | 1.00 | 117 |
| 312 | 17 000 | .001268 | 38 000 | 4.10 | 8.57 | 373 800 | 429 000 | .87 | .000880 | 2780 | 2555 | 2935 | .92 | 1.06 | 116 |
| 313 | 18 000 | .001272 | 38 200 | 4.18 | 8.54 | 373 700 | 453 400 | .82 | .000914 | 2850 | 2515 | 3065 | .88 | 1.08 | 123 |
| 314 | 17 770 | .001325 | 39 800 | 4.15 | 8.55 | 390 200 | 447 200 | .87 | .000940 | 2900 | 2640 | 3030 | .87 | 1.04 | 121 |
| Average |  |  |  |  |  |  |  | .85 |  |  |  |  | .89 | 1.06 | 120 |
| 324 | 21 000 | .001419 | 42 600 | 4.37 | 8.47 | 454 500 | 524 700 | .87 | .001102 | 3200 | 2990 | 3435 | .93 | 1.07 | 130 |
| 325 | 20 000 | .001325 | 39 800 | 4.28 | 8.50 | 427 200 | 501 200 | .85 | .000990 | 3000 | 2855 | 3360 | .95 | 1.12 | 124 |
| 326 | 18 000 | .001212 | 36 400 | 4.36 | 8.47 | 388 400 | 452 900 | .86 | .000939 | 2900 | 2560 | 2975 | .88 | 1.03 | 113 |
| Average |  |  |  |  |  |  |  | .86 |  |  |  |  | .92 | 1.07 | 122 |
| Grand Ave |  |  |  |  |  |  |  |  |  |  |  |  |  | 1.01 | 119 |

*Remarks.*—Average bond stress developed in beam=119 pounds per square inch. Average ultimate bond stress from bond test pieces=466 pounds per square inch. Ratio=3.9

**Note.**—Values in parentheses are estimated.

## SUMMARY OF TESTS ON REINFORCED CONCRETE BEAMS—Continued

### Table 12.—Limestone Concrete. Proportions, 1:2:4. Age, 26 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement | | | | First Crack | | Maximum Load | | | | | | Analysis of Beam at Unit Elongation in Reinforcement Less than that at Yield Point | | | | | | | | | Unit Compressive Stress Upper Fiber, lbs. per sq. in. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Steel, Stress in lbs. per sq. in. | KD, in inches | D-35 KD, in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | $C_1$ from Cylinder Curve. | $C_2$ from Resisting Mement. | $C_3$ from Bending Moment. | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 252 | 1190 | 146.9 | 2 | 0.49 | 0.49 | 0.393 | 3000 | 0.000106 | 6310 | 0.335 | 0.001065 | 32 000 | 40 750 | 0.79 | 6000 | 0.000889 | 26 700 | 3.03 | 8.94 | 93 700 | 164 200 | 0.57 | 0.000387 | 1610 | 780 | 1370 | 0.48 | 0.85 | 128 |
| 253 | 1200 | 146.4 | 2 | .49 | .49 | .393 | 3000 | .000099 | 6000 | .290 | .000923 | 27 700 | 41 650 | .67 | 6000 | .000923 | 27 700 | 2.95 | 8.97 | 97 600 | 164 400 | .59 | .000385 | 1610 | 830 | 1405 | .52 | .87 | 128 |
| 254 | 1200 | 142.6 | 2 | .49 | .49 | .393 | 2000 | .000076 | 6000 | .285 | .001001 | 30 000 | 40 290 | .74 | 6000 | .001001 | 30 000 | 2.64 | 9.08 | 107 000 | 164 400 | .65 | .000359 | 1520 | 1005 | 1545 | .66 | 1.02 | 127 |
| Average | | | | | | | | | 6100 | .303 | .000996 | 29 900 | | .73 | | | | | | | | .60 | | | | | .55 | .91 | 128 |
| 267 | 1220 | 147.9 | 3 | .74 | .74 | .589 | 3500 | .000117 | 9110 | .380 | .001356 | 40 700 | 40 680 | 1.00 | 9000 | .001251 | 37 500 | 2.86 | 9.00 | 198 800 | 236 700 | .84 | .000502 | 2010 | 1740 | 2070 | .87 | 1.03 | 121 |
| 268 | 1210 | 146.1 | 3 | .74 | 74 | .589 | 4000 | .000134 | 9000 | .350 | .001072 | 32 200 | 40 750 | .79 | 9000 | .001072 | 32 200 | 3.03 | 8.94 | 169 600 | 236 500 | .72 | .000467 | 1890 | 1410 | 1960 | .75 | 1.04 | 121 |
| 269 | 1210 | 146.5 | 3 | .74 | .74 | .589 | 3000 | .000084 | 10 270 | .420 | .001284 | 38 500 | 40 710 | .95 | 10 000 | .001255 | 37 700 | 3.03 | 8.94 | 198 500 | 260 500 | .76 | .000545 | 2160 | 1650 | 2170 | .76 | 1.00 | 133 |
| Average | | | | | | | | | 9460 | .383 | .001237 | 37 100 | | .91 | | | | | | | | .77 | | | | | .79 | 1.02 | 125 |
| 279 | 1200 | 146.9 | 4 | .98 | .98 | .785 | 3000 | .000094 | 12 380 | .435 | .001325 | 39 800 | 41 040 | .97 | 12 000 | .001248 | 37 400 | 3.25 | 8.86 | 260 300 | 308 400 | .84 | .000602 | 2340 | 2035 | 2425 | .87 | 1.04 | 119 |
| 280 | 1220 | 147.0 | 4 | .98 | .98 | .785 | 4000 | .000120 | 11 430 | .415 | .001268 | 38 000 | 40 990 | .93 | 11 000 | .001115 | 33 500 | 3.21 | 8.88 | 233 600 | 284 700 | .82 | .000526 | 2100 | 1845 | 2250 | .88 | 1.07 | 110 |
| 281 | 1200 | 145.6 | 4 | .98 | .98 | .785 | 3500 | .000094 | 11 740 | .425 | .001215 | 36 500 | 41 090 | .89 | 11 000 | .001022 | 30 700 | 3.49 | 8.78 | 211 700 | 284 400 | .74 | .000549 | 2180 | 1555 | 2100 | .71 | .96 | 111 |
| Average | | | | | | | | | 11 850 | .425 | .001269 | 38 100 | | .93 | | | | | | | | .80 | | | | | .82 | 1.02 | 113 |
| 291 | 1220 | 146.5 | 5 | 1.23 | 1.11 | .982 | 4000 | .000116 | 13 220 | .460 | .001504 | 45 100 | 39 800 | 1.13 | 13 000 | .001277 | 38 300 | 3.27 | 8.86 | 285 900 | 332 700 | .86 | .000621 | 2400 | 2355 | 2740 | .98 | 1.14 | 119 |
| 292 | 1230 | 147.5 | 5 | 1.23 | 1.11 | .982 | 4000 | .000132 | 13 000 | .415 | .001296 | 38 900 | 39 990 | .97 | 12 000 | .001058 | 31 700 | 3.55 | 8.76 | 232 900 | 308 900 | .75 | .000583 | 2280 | 1790 | 2385 | .79 | 1.05 | 113 |
| 293 | 1240 | 148.7 | 5 | 1.23 | 1.11 | .982 | 4000 | .000114 | 13 600 | .475 | .001315 | 39 500 | 40 300 | .98 | 13 000 | .001147 | 34 400 | 3.61 | 8.74 | 251 900 | 333 000 | .76 | .000649 | 2480 | 1910 | 2515 | .77 | 1.01 | 122 |
| Average | | | | | | | | | 13 270 | .450 | .001372 | 41 200 | | 1.03 | | | | | | | | .79 | | | | | .85 | 1.07 | 118 |
| 303 | 1200 | 143.5 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000115 | 15 820 | .490 | .001549 | 46 500 | 41 890 | 1.11 | 15 000 | .001274 | 38 200 | 3.45 | 8.79 | 324 300 | 380 400 | .85 | .000671 | 2540 | 2600 | 3060 | 1.02 | 1.20 | 119 |
| 304 | 1200 | 143.4 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000133 | 15 710 | .490 | .001564 | 46 900 | 41 350 | 1.13 | 15 000 | .001285 | 38 600 | 3.53 | 8.76 | 326 000 | 380 400 | .86 | .000702 | 2630 | 2565 | 2985 | .98 | 1.13 | 120 |
| 305 | 1230 | 145.9 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000123 | 16 930 | .510 | .001503 | 45 100 | 41 060 | 1.10 | 16 000 | .001294 | 38 800 | 3.62 | 8.73 | 326 000 | 404 900 | .81 | .000736 | 2710 | 2505 | 3095 | .92 | 1.14 | 129 |
| Average | | | | | | | | | 16 150 | .497 | .001539 | 46 200 | | 1.11 | | | | | | | | .84 | | | | | .97 | 1.16 | 122 |
| 315 | 1230 | 146.2 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000121 | 18 940 | .505 | .001470 | 44 100 | 39 600 | 1.11 | 18 000 | .001260 | 37 800 | 3.94 | 8.62 | 375 300 | 452 900 | .89 | .000820 | 2920 | 2655 | 2985 | .91 | 1.02 | 121 |
| 316 | 1240 | 144.9 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000106 | 18 880 | .535 | .001561 | 46 800 | 37 530 | 1.25 | 18 000 | .001262 | 37 900 | 3.97 | 8.61 | 375 500 | 453 000 | .89 | .000831 | 2940 | 2635 | 2960 | .90 | 1.01 | 121 |
| 317 | 1250 | 147.7 | 7 | 1.72 | 1.54 | 1.375 | 5000 | .000159 | 18 000 | .465 | .001309 | 39 300 | 39 870 | .99 | 18 000 | .001309 | 39 300 | 3.82 | 8.66 | 392 800 | 453 200 | .87 | .000809 | 2900 | 2850 | 3275 | .98 | 1.13 | 120 |
| Average | | | | | | | | | 18 610 | .502 | .001447 | 43 400 | | 1.12 | | | | | | | | .88 | | | | | .93 | 1.05 | 121 |
| 327 | 1220 | 144.1 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000132 | 20 000 | .520 | .001597 | 47 900 | 36 730 | 1.30 | 18 000 | .001250 | 37 500 | 4.04 | 8.59 | 409 200 | 452 700 | .90 | .000847 | 2980 | 2870 | 3190 | .98 | 1.07 | 110 |
| 328 | 1220 | 144.0 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000127 | 20 420 | .585 | .001656 | 49 700 | 37 140 | 1.34 | 19 000 | .001267 | 38 000 | 4.22 | 8.52 | 409 300 | 476 700 | .86 | .000923 | 3150 | 2770 | 3220 | .88 | 1.02 | 117 |
| (1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Average | | | | | | | | | 20 210 | .553 | .001627 | 48 800 | | 1.32 | | | | | | | | .88 | | | | | .92 | 1.05 | 114 |
| Grand Ave | | 145.9 | | | | | 3500 | .000115 | | | | | | | | | | | | | | | | | | | | 1.04 | 120 |

[1] Sent to Jamestown.

*Remarks.*—Average bond stress developed in beam = 120 pounds per square inch. Average ultimate bond stress from bond test pieces = 604 pounds per square inch. Ratio = 5.0.

### Table 13.—Limestone Concrete. Proportions, 1:2:4. Age, 52 Weeks

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 246 | 1200 | 146.1 | 2 | 0.49 | 0.49 | 0.393 | 3000 | 0.000107 | 7000 | 0.350 | 0.001253 | 37 600 | 41 100 | 0.91 | 6000 | 0.000696 | 20 900 | 3.37 | 8.82 | 72 400 | 164 350 | 0.441 | 0.000353 | 1630 | 550 | 1245 | 0.34 | 0.76 | 130 |
| 247 | 1200 | 144.1 | 2 | .49 | .49 | .393 | 2000 | .000070 | 6800 | .355 | .001256 | 37 700 | 41 230 | .91 | 6000 | .001005 | 30 200 | 2.72 | 9.05 | 107 300 | 164 350 | .653 | .000375 | 1710 | 980 | 1500 | .57 | .88 | 127 |
| 248 | 1210 | 148.3 | 2 | .49 | .49 | .393 | 3000 | .000077 | 6380 | .320 | [1].000868 | 26 000 | 40 680 | .64 | 6000 | .000800 | 24 000 | 2.96 | 8.96 | 84 400 | 164 500 | .513 | .000336 | 1540 | 715 | 1395 | .46 | .91 | 128 |
| Average | | | | | | | | | 6730 | .342 | .001255 | 33 800 | | .82 | | | | | | | | .536 | | | | | .46 | .85 | 128 |
| 270 | 1230 | 147.6 | 3 | .74 | .74 | .589 | 3000 | .000081 | 9360 | .375 | .001258 | 37 700 | 41 900 | .90 | 9000 | .001156 | 34 700 | 2.58 | 9.10 | 186 000 | 236 860 | .785 | .000403 | 1820 | 1785 | 2275 | .98 | 1.25 | 119 |
| 271 | 1220 | 145.7 | 3 | .74 | .74 | .589 | 3000 | .000082 | 9000 | .340 | [1].000815 | 24 500 | 41 890 | .58 | 9000 | .000815 | 24 500 | 3.09 | 8.92 | 128 800 | 236 700 | .544 | .000365 | 1680 | 1050 | 1930 | .63 | 1.15 | 122 |
| 272 | 1230 | 146.8 | 3 | .74 | .74 | .589 | 3000 | .000112 | 9700 | .380 | .001115 | 33 500 | 41 660 | .80 | 9000 | .000974 | 29 200 | 2.69 | 9.06 | 155 900 | 236 850 | .658 | .000357 | 1640 | 1440 | 2190 | .88 | 1.34 | 120 |
| Average | | | | | | | | | 9350 | .365 | .001187 | 31 900 | | .76 | | | | | | | | .662 | | | | | .83 | 1.25 | 120 |
| 282 | 1230 | 147.1 | 4 | .98 | .98 | .785 | 3000 | .000097 | 12 000 | .380 | .001205 | 36 200 | 41 040 | .88 | 12 000 | .001205 | 36 200 | 3.00 | 8.95 | 254 500 | 308 850 | .824 | .000517 | 2230 | 2130 | 2585 | .96 | 1.16 | 118 |
| 283 | 1230 | 145.9 | 4 | .98 | .98 | .785 | 3000 | .000088 | 12 620 | .440 | .001303 | 39 100 | 40 990 | .95 | 12 000 | .001162 | 34 900 | 3.22 | 8.87 | 243 200 | 308 850 | .787 | .000553 | 2360 | 1915 | 2435 | .81 | 1.03 | 119 |
| 284 | 1220 | 147.7 | 4 | .98 | .98 | .785 | 3000 | .000107 | 12 200 | .435 | .001308 | 39 200 | 42 210 | .93 | 12 000 | .001198 | 35 900 | 3.14 | 8.90 | 250 900 | 308 700 | .813 | .000547 | 2330 | 2020 | 2485 | .87 | 1.07 | 118 |
| Average | | | | | | | | | 12 270 | .418 | .001272 | 38 200 | | .92 | | | | | | | | .808 | | | | | .88 | 1.09 | 118 |
| 294 | 1220 | 145.3 | 5 | 1.23 | 1.11 | .982 | 3000 | .000092 | 14 670 | .470 | .001487 | 44 600 | 39 720 | 1.12 | 14 000 | .001368 | 41 000 | 3.22 | 8.87 | 306 700 | 356 700 | .860 | .000651 | 2690 | 2565 | 2985 | .95 | 1.11 | 127 |
| 295 | 1240 | 146.4 | 5 | 1.23 | 1.11 | .982 | 3000 | .000095 | 14 380 | .460 | .001410 | 42 300 | 40 270 | 1.05 | 14 000 | .001289 | 38 700 | 3.25 | 8.86 | 289 000 | 357 000 | .810 | .000620 | 2590 | 2395 | 2955 | .92 | 1.14 | 128 |
| 296 | 1240 | 147.1 | 5 | 1 23 | 1.11 | .982 | 3000 | .000097 | 14 100 | .460 | .001453 | 43 600 | 40 840 | 1.07 | 14 000 | .001294 | 38 800 | 3.42 | 8.80 | 287 000 | 357 000 | .804 | .000671 | 2750 | 2275 | 2830 | .83 | 1.03 | 129 |
| Average | | | | | | | | | 14 380 | .463 | .001450 | 43 500 | | 1.08 | | | | | | | | .825 | | | | | .90 | 1.09 | 128 |
| 306 | 1230 | 149.6 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000104 | 16 450 | .550 | .001692 | 50 800 | 39 650 | 1.28 | 15 000 | .001272 | 38 200 | 3.77 | 8.68 | 318 000 | 380 900 | .835 | .000770 | 3050 | 2365 | 2830 | .78 | .93 | 122 |
| 307 | 1250 | 145.6 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000097 | 16 070 | (.458) | (.001728) | (51 800) | 40 770 | 1.27 | 15 000 | .001299 | 39 000 | 3.34 | 8.83 | 333 400 | 381 150 | .875 | .000652 | 2690 | 2750 | 3145 | 1.02 | 1.17 | 119 |
| 308 | 1230 | 147.2 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000065 | 16 000 | .460 | [1].000846 | [1] 25 400 | 40 440 | [1] .63 | 16 000 | .000846 | 25 400 | 3.18 | 8.89 | 219 300 | 404 900 | .542 | [1].000395 | 1790 | 1885 | 3480 | 1.05 | [1] 1.94 | 125 |
| Average | | | | | | | | | 16 170 | .489 | .001710 | 51 300 | | 1.28 | | | | | | | | .751 | | | | | .95 | 1.05 | 122 |
| 309 | 1220 | 145.1 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000147 | 18 800 | .500 | (.001328) | (39 800) | 40 590 | .98 | 18 000 | .001254 | 37 600 | 4.00 | 8.60 | 371 900 | 453 850 | .819 | .000835 | 3230 | 2595 | 3170 | .80 | .98 | 122 |
| 310 | 1220 | 146.5 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000131 | 19 000 | .535 | .001581 | 47 400 | 39 750 | 1.19 | 18 000 | .001369 | 41 100 | 3.98 | 8.61 | 407 200 | 452 700 | .900 | .000904 | 3410 | 2855 | 3170 | .84 | .93 | 121 |
| 311 | 1240 | 146.9 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000124 | 19 320 | .575 | (.001422) | (42 700) | 40 820 | 1.05 | 19 000 | .001344 | 40 300 | 4.03 | 8.59 | 398 000 | 478 200 | .832 | .000907 | 3420 | 2760 | 3315 | .81 | .97 | 128 |
| Average | | | | | | | | | 19 040 | .537 | .001444 | 43 300 | | 1.07 | | | | | | | | .850 | | | | | .82 | .96 | 124 |
| 330 | 1230 | 144.6 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000130 | 21 000 | .555 | .001574 | 47 200 | 36 790 | 1.28 | 20 000 | .001403 | 42 100 | 3.85 | 8.65 | 464 800 | 500 850 | .928 | .000878 | 3350 | 3395 | 3660 | 1.01 | 1.09 | 120 |
| 331 | 1250 | 149.5 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000114 | 21 580 | .530 | .001432 | 43 000 | 37 510 | 1.15 | 21 000 | .001374 | 41 200 | 4.16 | 8.54 | 445 700 | 525 200 | .849 | .000980 | 3590 | 3050 | 3595 | .85 | 1.00 | 129 |
| 332 | 1210 | 145.7 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000128 | 21 150 | (.548) | .001588 | 47 600 | 38 720 | 1.23 | 21 000 | .001422 | 42 700 | 4.14 | 8.55 | 462 700 | 524 500 | .882 | .001003 | 3640 | 3180 | 3170 | .87 | .87 | 128 |
| Average | | | | | | | | | 21 240 | .544 | .001531 | 45 900 | | 1.22 | | | | | | | | .886 | | | | | .91 | .99 | 126 |
| Grand Ave | | 146.6 | | | | | 3200 | .000101 | | | | | | | | | | | | | | | | | | | | 1.04 | 124 |

[1] Not used in average.

*Remarks.*—Average bond stress developed in beam = 124 pounds per square inch. Average ultimate bond stress from bond test pieces = 519 pounds per square inch. Ratio = 4.2.

Note.—Values in parentheses are estimated.

## Table 14.—Gravel Concrete. Proportions, 1:2:4. Age, 4 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement | | | | First Crack | | Maximum Load | | | | | | Analysis of beam at Unit Elongation in Reinforcement Less than that at Yield Point | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of ½" round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D-.35KD, in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | Unit Compressive Stress Upper Fiber, lbs. per sq. in.: $C_1$, from Cylinder Curve | $C_2$, from Resisting Moment | $C_3$, from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 333 | 1150 | 143.6 | 2 | 0.49 | 0.49 | 0.393 | 2000 | 0.000099 | 5800 | 0.325 | (.001289) | (38 700) | 43 500 | 0.89 | 5500 | 0.001104 | 33 100 | 2.77 | 9.03 | 117 500 | 151 600 | 0.78 | 0.000422 | 1780 | 1060 | 1360 | 0.60 | 0.76 | 117 |
| 334 | 1140 | 140.0 | 2 | .49 | .49 | .393 | 2000 | .000094 | 6000 | .350 | (.001253) | (37 600) | 41 910 | .90 | 5500 | .000949 | 28 500 | 3.02 | 8.94 | 100 000 | 151 400 | .66 | .000411 | 1750 | 830 | 1260 | .47 | .72 | 118 |
| 335 | 1170 | 141.8 | 2 | .49 | .49 | .393 | 2000 | .000085 | 6610 | .370 | (.001194) | (35 800) | 44 930 | .80 | 6500 | .001150 | 34 500 | 2.69 | 9.06 | 122 800 | 175 900 | .70 | .000424 | 1790 | 1130 | 1615 | .63 | .90 | 135 |
| Average | | | | | | | | | 6140 | .348 | (.001245) | (37 400) | | .86 | | | | | | | | .71 | | | | | .57 | .79 | 123 |
| 345 | 1180 | 145.8 | 3 | .74 | .74 | .589 | 2000 | .000095 | 9420 | .435 | (.001699) | [1](51 000) | 41 440 | 1.23 | 9000 | .001460 | 43 800 | 2.95 | 8.97 | 231 500 | 236 000 | .98 | .000609 | 2300 | 1970 | 2010 | .86 | .87 | 120 |
| 346 | 1170 | 144.6 | 3 | .74 | .74 | .589 | 2500 | .000116 | 9000 | .415 | .001328 | 39 800 | 43 640 | .91 | 8500 | .001156 | 34 700 | 3.26 | 8.86 | 181 000 | 223 900 | .81 | .000560 | 2180 | 1410 | 1740 | .65 | .80 | 116 |
| 347 | 1170 | 144.4 | 3 | .74 | .74 | .589 | 2500 | .000109 | 9250 | .425 | (.001263) | (37 900) | 43 760 | .87 | 9000 | .001185 | 35 550 | 3.34 | 8.83 | 184 900 | 235 900 | .78 | .000593 | 2270 | 1410 | 1810 | .62 | .80 | 122 |
| Average | | | | | | | | | 9220 | .425 | .001430 | 38 900 | | 1.00 | | | | | | | | .86 | | | | | .71 | .82 | 119 |
| 357 | 1170 | 143.7 | 4 | .98 | .98 | .785 | 3000 | .000118 | 13 000 | .470 | .001557 | 46 700 | 43 460 | 1.07 | 12 500 | .001408 | 42 200 | 3.45 | 8.79 | 291 600 | 319 900 | .91 | .000741 | 2610 | 2170 | 2385 | .83 | .91 | 128 |
| 358 | 1180 | 146.0 | 4 | .98 | .98 | .785 | 3000 | .000119 | 12 260 | .465 | (.001296) | (38 900) | 42 410 | .92 | 12 000 | .001241 | 37 200 | 3.46 | 8.79 | 257 000 | 308 000 | .83 | .000656 | 2420 | 1900 | 2290 | .79 | .95 | 119 |
| 359 | 1190 | 144.6 | 4 | .98 | .98 | .785 | 3000 | .000119 | 12 080 | .455 | (.001379) | (41 400) | [2] 41 930 | .99 | 12 000 | .001350 | 40 500 | 3.26 | 8.86 | 281 800 | 308 200 | .91 | .000652 | 2410 | 2200 | 2420 | .91 | 1.00 | 119 |
| Average | | | | | | | | | 12 450 | .463 | .001411 | 42 300 | | .99 | | | | | | | | .88 | | | | | .84 | .95 | 122 |
| 369 | 1170 | 141.8 | 5 | 1.23 | 1.11 | .982 | 2000 | .000080 | 14 000 | .500 | .001497 | 44 900 | 40 270 | 1.11 | 13 000 | .001308 | 39 200 | 3.81 | 8.67 | 283 900 | 331 900 | .86 | .000805 | [3] 2730 | 2060 | 2395 | .75 | .88 | 122 |
| 370 | 1160 | 141.6 | 5 | 1.23 | 1.11 | .982 | 2000 | .000078 | 13 400 | .515 | (.001704) | (51 100) | 39 930 | 1.28 | 12 000 | .001212 | 36 400 | 3.61 | 8.74 | 266 600 | 307 700 | .87 | .000685 | 2490 | 2020 | 2320 | .81 | .93 | 112 |
| 371 | 1160 | 145.3 | 5 | 1.23 | 1.11 | .982 | 2000 | .000095 | 13 870 | .540 | .001527 | 45 800 | 39 540 | 1.16 | 13 000 | .001356 | 40 700 | 3.69 | 8.71 | 296 700 | 331 700 | .89 | .000791 | 2710 | 2200 | 2470 | .81 | .91 | 121 |
| Average | | | | | | | | | 13 760 | .518 | .001576 | 47 300 | | 1.18 | | | | | | | | .87 | | | | | .79 | .91 | 118 |
| 381 | 1180 | 145.7 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000110 | 15 240 | .565 | (.001631) | (48 900) | 38 010 | 1.29 | 14 000 | .001234 | 37 000 | 4.11 | 8.56 | 301 300 | 356 000 | .85 | .000862 | [3] 2840 | 2080 | 2445 | .73 | .86 | 117 |
| 382 | 1190 | 143.6 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000118 | 15 300 | .555 | (.001621) | (48 600) | 38 570 | 1.26 | 15 000 | .001392 | 41 800 | 3.85 | 8.65 | 346 100 | 380 200 | .91 | .000870 | [3] 2850 | 2530 | 2780 | .89 | .98 | 122 |
| 383 | 1200 | 145.2 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000123 | 15 920 | .520 | (.001539) | (46 200) | 39 170 | 1.18 | 15 000 | .001362 | 40 900 | 3.65 | 8.72 | 343 000 | 380 400 | .90 | .000782 | 2690 | 2620 | 2910 | .97 | 1.08 | 121 |
| Average | | | | | | | | | 15 490 | .547 | (.001597) | (47 900) | | 1.24 | | | | | | | | .89 | | | | | .86 | .97 | 120 |
| 393 | 1210 | 147.4 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000105 | 17 510 | .535 | .001391 | 41 700 | 39 680 | 1.05 | 17 000 | .001326 | 39 800 | 4.11 | 8.56 | 390 900 | 428 500 | .91 | .000927 | [3] 2940 | 2670 | 2935 | .91 | 1.00 | 116 |
| 394 | 1190 | 145.5 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000117 | 18 240 | .585 | (.001626) | (48 800) | 39 120 | 1.25 | 17 000 | .001402 | 42 100 | 4.06 | 8.58 | 414 900 | 428 200 | .97 | .000959 | [3] 2980 | 2860 | 2950 | .96 | .99 | 115 |
| 395 | 1200 | 143.4 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000107 | 17 920 | .530 | (.001706) | (51 200) | 40 030 | 1.28 | 17 000 | .001344 | 40 300 | 3.93 | 8.62 | 400 200 | 428 400 | .93 | .000872 | [3] 2850 | 2840 | 3055 | 1.00 | 1.07 | 115 |
| Average | | | | | | | | | 17 890 | .550 | .001574 | 47 200 | | 1.19 | | | | | | | | .94 | | | | | .96 | 1.02 | 115 |
| 405 | 1200 | 146.3 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000093 | 19 950 | .580 | .001617 | 48 500 | 38 630 | 1.26 | 18 000 | .001214 | 36 400 | 4.45 | 8.44 | 386 100 | 452 400 | .85 | .000975 | [3] 3000 | 2500 | 2940 | .83 | .98 | 113 |
| 406 | 1220 | 147.8 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000105 | 19 800 | .585 | .001783 | 53 500 | 38 680 | 1.38 | 19 000 | .001393 | 41 800 | 4.11 | 8.56 | 453 700 | 476 800 | .95 | .000974 | [3] 3000 | 3140 | 3305 | 1.05 | 1.10 | 116 |
| 407 | 1210 | 147.3 | 8 | 1.96 | 1.72 | 1.571 | 2000 | .000071 | 20 450 | .630 | .001788 | 53 600 | 38 590 | 1.39 | 19 000 | .001366 | 41 000 | 4.18 | 8.53 | 443 300 | 476 500 | .93 | .000979 | [3] 3000 | 3020 | 3245 | 1.01 | 1.08 | 117 |
| Average | | | | | | | | | 20 070 | .598 | .001729 | 51 900 | | 1.34 | | | | | | | | .91 | | | | | .96 | 1.05 | 115 |
| Grand Ave | | 144.5 | | | | | 2500 | .000103 | | | | | | | | | | | | | | | | | | | | .93 | 119 |

[1] Not used in average. [2] Average of only 3 rods. [3] Value taken from average curve produced.

*Remarks.*—Average bond stress developed in beam=119 pounds per square inch. Average ultimate bond stress from bond test pieces=586 pounds per square inch. Ratio=4.9.

**Note.**—Values in parentheses are estimated.

## Table 15.—Gravel Concrete. Proportions, 1:2:4. Age, 13 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½" round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | First Crack: Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Max. Load: Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel $S_1$ | Yield Point of Steel $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel | Unit Stress in Steel | KD, in inches | D-.35KD, in inches | Mr | Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber | $C_1$ | $C_2$ | $C_3$ | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 336 | 1170 | 143.7 | 2 | 0.49 | 0.49 | 0.393 | 2500 | 0.000098 | 7350 | 0.365 | 0.001357 | 40 700 | 42 590 | 0.96 | 7000 | 0.001256 | 37 700 | 2.59 | 9.09 | 134 600 | 187 900 | 0.72 | 0.000439 | 1980 | 1290 | 1790 | 0.65 | 0.90 | 143 |
| 337 | 1170 | 141.7 | 2 | .49 | .49 | .393 | 2000 | .000076 | 6740 | .340 | .001241 | 37 200 | 41 530 | .90 | 6500 | .001162 | 34 900 | 2.55 | 9.11 | 124 900 | 175 900 | .71 | .000398 | 1800 | 1210 | 1705 | .67 | .95 | 134 |
| 338 | 1160 | 142.4 | 2 | .49 | .49 | .393 | 2000 | .000077 | | | | | 42 370 | | 5500 | .000797 | 23 900 | 2.97 | 8.96 | 84 100 | 151 700 | .55 | .000337 | 1540 | 710 | 1290 | .46 | .84 | 118 |
| Average | | | | | | | | | 7050 | .353 | .001299 | 39 000 | | .93 | | | | | | | | .66 | | | | | .59 | .90 | 132 |
| 348 | 1190 | 147.0 | 3 | .74 | .74 | .589 | 3000 | .000105 | 9620 | .390 | .001338 | 40 100 | 42 010 | .95 | 9000 | .001072 | 32 200 | 3.10 | 8.92 | 169 000 | 236 200 | .72 | .000481 | 2160 | 1380 | 1915 | .64 | .89 | 121 |
| 349 | 1200 | 145.7 | 3 | .74 | .74 | .589 | 3000 | .000102 | 11 050 | .465 | .001516 | 45 500 | 41 330 | 1.10 | 11 000 | .001467 | 44 000 | 2.73 | 9.04 | 234 300 | 284 400 | .82 | .000551 | 2440 | 2140 | 2610 | .88 | 1.07 | 143 |
| 350 | 1180 | 145.9 | 3 | .74 | .74 | .589 | 3000 | .000116 | 8800 | .345 | .001250 | 37 500 | 43 390 | .86 | 8000 | .000945 | 28 400 | 3.07 | 8.93 | 149 100 | 212 000 | .70 | .000418 | 1880 | 1220 | 1745 | .65 | .93 | 109 |
| Average | | | | | | | | | 9820 | .400 | .001368 | 41 000 | | .97 | | | | | | | | .75 | | | | | .72 | .96 | 124 |
| 360 | 1190 | 145.7 | 4 | .98 | .98 | .785 | 4000 | .000136 | 12 850 | .400 | .001362 | 40 900 | 43 310 | .94 | 12 000 | .001200 | 36 000 | 3.17 | 8.89 | 251 300 | 308 200 | .82 | .000556 | 2460 | 2010 | 2450 | .82 | 1.00 | 118 |
| 361 | 1200 | 143.0 | 4 | .98 | .98 | .785 | 3000 | .000094 | 12 450 | .390 | .001309 | 39 300 | 39 830 | .99 | 12 000 | .001188 | 35 600 | 3.05 | 8.93 | 249 700 | 308 400 | .81 | .000521 | 2320 | 2060 | 2595 | .89 | 1.10 | 118 |
| 362 | 1180 | 145.0 | 4 | .98 | .98 | .785 | 3000 | .000104 | 12 960 | .430 | .001468 | 44 000 | 40 040 | 1.10 | 12 000 | .001282 | 38 500 | 3.18 | 8.89 | 268 800 | 308 000 | .87 | .000597 | 2610 | 2140 | 2460 | .82 | .94 | 118 |
| Average | | | | | | | | | 12 750 | .407 | .001380 | 41 400 | | 1.01 | | | | | | | | .83 | | | | | .84 | 1.01 | 118 |
| 372 | 1210 | 147.1 | 5 | 1.23 | 1.11 | .982 | 3000 | .000109 | 14 870 | .470 | .001385 | 41 600 | 39 510 | 1.05 | 14 000 | .001248 | 37 400 | 3.48 | 8.78 | 275 800 | 356 500 | .77 | .000667 | 2860 | 2160 | 2805 | .76 | .98 | 130 |
| 373 | 1200 | 144.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000098 | 15 150 | .505 | .001376 | 41 300 | 39 900 | 1.04 | 15 000 | .001361 | 40 800 | 3.48 | 8.78 | 300 900 | 380 400 | .79 | .000725 | 3040 | 2350 | 2975 | .77 | .98 | 137 |
| 374 | 1210 | 147.4 | 5 | 1.23 | 1.11 | .982 | 3000 | .000112 | 14 550 | (.482) | .001458 | 43 700 | 39 830 | 1.10 | 14 000 | .001380 | 41 400 | 3.33 | 8.83 | 307 700 | 356 500 | .86 | .000690 | 2940 | 2500 | 2905 | .85 | .99 | 128 |
| Average | | | | | | | | | 14 860 | .486 | .001406 | 42 200 | | 1.06 | | | | | | | | .81 | | | | | .79 | .98 | 132 |
| 384 | 1190 | 143.1 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000103 | 16 840 | .520 | .001653 | 49 600 | 37 950 | 1.31 | 16 000 | .001345 | 40 400 | 3.45 | 8.79 | 342 500 | 404 200 | .85 | .000710 | 3000 | 2750 | 3235 | .92 | 1.08 | 127 |
| 385 | 1210 | 146.4 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000098 | 16 720 | .485 | .001559 | 46 800 | 37 470 | 1.25 | 15 000 | .001270 | 38 100 | 3.48 | 8.78 | 322 900 | 380 500 | .85 | .000678 | 2890 | 2570 | 3025 | .89 | 1.05 | 120 |
| 386 | 1200 | 145.9 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000103 | 16 000 | .465 | .001391 | 41 700 | 38 050 | 1.10 | 15 000 | .001241 | 37 200 | 3.64 | 8.73 | 312 400 | 380 400 | .82 | .000709 | 3000 | 2390 | 2915 | .80 | .97 | 121 |
| Average | | | | | | | | | 16 520 | .490 | .001534 | 46 000 | | 1.22 | | | | | | | | .84 | | | | | .87 | 1.03 | 123 |
| 396 | 1200 | 149.6 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000127 | 19 650 | .535 | .001602 | 48 100 | 38 080 | 1.26 | 18 630 | .001359 | 40 800 | 3.73 | 8.69 | 410 000 | 467 500 | .88 | .000807 | 3280 | 3040 | 3455 | .95 | 1.05 | 123 |
| 397 | 1200 | 143.3 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000113 | 19 960 | .555 | .001718 | 51 500 | 41 020 | 1.26 | 17 100 | .001231 | 36 900 | 3.66 | 8.72 | 372 500 | 430 800 | .86 | .000712 | 3000 | 2800 | 3255 | .93 | 1.08 | 113 |
| 398 | 1230 | 148.7 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000122 | 19 100 | .550 | .001655 | 49 700 | 38 920 | 1.28 | 18 000 | .001294 | 38 800 | 3.83 | 8.66 | 387 800 | 452 900 | .86 | .000803 | 3270 | 2810 | 3270 | .86 | 1.00 | 120 |
| Average | | | | | | | | | 19 570 | .547 | .001658 | 49 800 | | 1.27 | | | | | | | | .87 | | | | | .91 | 1.04 | 119 |
| 408 | 1230 | 147.4 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000117 | 22 000 | .540 | .001504 | 45 100 | 38 940 | 1.16 | 21 000 | .001385 | 41 600 | 3.98 | 8.61 | 455 100 | 524 900 | .87 | .000915 | 3540 | 3230 | 3715 | .91 | 1.05 | 127 |
| 409 | 1240 | 147.6 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000118 | 22 350 | .595 | .001826 | 54 800 | 38 630 | 1.42 | 21 000 | .001397 | 41 900 | 3.95 | 8.62 | 459 900 | 525 000 | .88 | .000914 | 3540 | 3280 | 3725 | .93 | 1.05 | 127 |
| 410 | 1200 | 142.8 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000122 | 21 690 | .575 | .001610 | 48 300 | 38 110 | 1.27 | 20 000 | .001349 | 40 500 | 4.00 | 8.60 | 442 900 | 500 400 | .89 | .000898 | 3500 | 3130 | 3515 | .89 | 1.00 | 121 |
| Average | | | | | | | | | 22 010 | .570 | .001647 | 49 400 | | 1.28 | | | | | | | | .88 | | | | | .91 | 1.03 | 125 |
| Grand Ave | | 145.2 | | | | | 3200 | .000107 | | | | | | | | | | | | | | | | | | | | .99 | 125 |

*Remarks.*—Average bond stress developed in beam=125 pounds per square inch. Average ultimate bond stress from bond test pieces=675 pounds per square inch. Ratio=5.4.

**Note.**—Values in parentheses are estimated.

# SUMMARY OF TESTS OF REINFORCED CONCRETE BEAMS—Continued

## Table 16.—Gravel Concrete. Proportions, 1:2:4. Age, 26 Weeks

| | | | Reinforcement | | | | First Crack | | Maximum Load | | | | | | Analysis of beam at Unit Elongation in Reinforcement Less than that at Yield Point | | | | | | | | | Unit Compressive Stress Upper Fiber, lbs. per sq. in. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D. 35 KD, in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | $C_1$ From Cylinder Curve. | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27a | 28 | 29 | 30 |
| 339 | 1170 | 143.4 | 2 | 0.49 | 0.49 | 0.393 | 2500 | 0.000087 | 6500 | 0.280 | 0.001127 | 33 800 | 42 160 | 0.80 | 6500 | 0.001127 | 33 800 | 2.60 | 9.09 | 120 700 | 175 900 | 0.69 | 0.000396 | 2030 | 1150 | 1665 | 0.57 | 0.82 | 134 |
| 340 | 1170 | 141.7 | 2 | .49 | .49 | .393 | 3000 | .000111 | 6500 | .290 | .001029 | 30 900 | 45 220 | .68 | 6500 | .001029 | 30 900 | 2.59 | 9.09 | 110 300 | 175 900 | .63 | .000361 | 1870 | 1060 | 1685 | .57 | .90 | 134 |
| 341 | 1170 | 144.3 | 2 | .49 | .49 | .393 | 2500 | .000091 | 6680 | .320 | .001212 | 36 400 | 40 700 | .89 | 6500 | .001144 | 34 300 | 2.52 | 9.12 | 122 900 | 175 900 | .70 | .000384 | 1980 | 1200 | 1715 | .61 | .87 | 134 |
| Average | | | | | | | | | 6560 | .297 | .001123 | 33 700 | | .79 | | | | | | | | .67 | | | | | .58 | .86 | 134 |
| 351 | 1180 | 143.1 | 3 | .74 | .74 | .589 | 3500 | .000110 | 10 000 | .370 | .001241 | 37 200 | 42 110 | .88 | 10 000 | .001241 | 37 200 | 2.95 | 8.97 | 196 600 | 260 000 | .76 | .000519 | 2570 | 1670 | 2195 | .65 | .85 | 132 |
| 352 | 1200 | 143.7 | 3 | .74 | .74 | .589 | 3000 | .000110 | 10 300 | .380 | .001220 | 36 600 | 43 960 | .83 | 10 000 | .001164 | 34 900 | 2.99 | 8.95 | 184 000 | 260 400 | .71 | .000497 | 2470 | 1550 | 2185 | .63 | .88 | 133 |
| 353 | 1180 | 143.9 | 3 | .74 | .74 | .589 | 3000 | .000098 | 9830 | .360 | .001078 | 32 300 | 43 140 | .75 | 9000 | .000950 | 28 500 | 3.16 | 8.89 | 149 200 | 236 000 | .63 | .000438 | 2220 | 1200 | 1905 | .54 | .86 | 121 |
| Average | | | | | | | | | 10 040 | .370 | .001180 | 35 400 | | .82 | | | | | | | | .70 | | | | | .61 | .86 | 129 |
| 363 | 1200 | 144.6 | 4 | .98 | .98 | .785 | 3000 | .000094 | 13 530 | .445 | .001429 | 42 900 | 39 400 | 1.09 | 13 000 | .001299 | 39 000 | 3.10 | 8.91 | 273 200 | 332 400 | .82 | .000583 | 2830 | 2220 | 2705 | .78 | .96 | 127 |
| 364 | 1180 | 140.4 | 4 | .98 | .98 | .785 | 3000 | .000097 | 13 100 | .430 | .001543 | 46 300 | 40 310 | 1.15 | 12 000 | .001229 | 36 900 | 2.95 | 8.97 | 260 000 | 308 000 | .84 | .000513 | 2550 | 2210 | 2630 | .87 | 1.03 | 117 |
| 365 | 1190 | 144.5 | 4 | .98 | .98 | .785 | 3000 | .000094 | 13 000 | .400 | .001239 | 37 200 | 39 680 | .94 | 13 000 | .001239 | 37 200 | 3.22 | 8.87 | 259 200 | 332 200 | .78 | .000588 | 2840 | 2040 | 2615 | .72 | .92 | 127 |
| Average | | | | | | | | | 13 210 | .425 | .001404 | 42 100 | | 1.06 | | | | | | | | .81 | | | | | .79 | .97 | 124 |
| 375 | 1180 | 141.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000094 | 15 780 | .500 | .001579 | 47 400 | 39 850 | 1.19 | 15 000 | .001415 | 42 450 | 3.26 | 8.87 | 317 000 | 380 000 | .83 | .000683 | 3210 | 2620 | 3155 | .82 | .98 | 136 |
| 376 | 1170 | 139.3 | 5 | 1.23 | 1.11 | .982 | 3000 | .000096 | 14 990 | .470 | .001328 | 39 800 | 39 660 | 1.00 | 14 000 | .001205 | 36 150 | 3.32 | 8.84 | 269 100 | 355 900 | .76 | .000599 | 2900 | 2190 | 2880 | .76 | .99 | 127 |
| 377 | 1170 | 140.9 | 5 | 1.23 | 1.11 | .982 | 4000 | .000140 | 15 360 | .490 | .001543 | 46 300 | 39 680 | 1.17 | 14 000 | .001267 | 38 000 | 3.31 | 8.84 | 282 900 | 355 900 | .79 | .000627 | 3000 | 2310 | 2925 | .79 | .98 | 127 |
| Average | | | | | | | | | 15 380 | .487 | .001483 | 44 500 | | 1.12 | | | | | | | | .79 | | | | | .79 | .98 | 130 |
| 387 | 1200 | 145.0 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000122 | 16 880 | .525 | .001607 | 48 200 | 38 400 | 1.26 | 16 000 | .001249 | 37 500 | 3.87 | 8.65 | 310 400 | 404 400 | .77 | .000788 | 3580 | 2260 | 2935 | .63 | .82 | 130 |
| 388 | 1190 | 141.4 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000121 | 17 000 | .485 | .001516 | 45 500 | 38 120 | 1.19 | 16 000 | .001340 | 40 200 | 3.37 | 8.82 | 343 000 | 404 200 | .85 | .000680 | 3200 | 2810 | 3305 | .88 | 1.03 | 126 |
| 389 | 1200 | 144.8 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000130 | 16 980 | .485 | .001463 | 43 900 | 38 540 | 1.14 | 16 000 | .001272 | 38 200 | 3.65 | 8.72 | 320 400 | 404 400 | .79 | .000731 | 3380 | 2450 | 3100 | .73 | .92 | 128 |
| Average | | | | | | | | | 16 950 | .498 | .001529 | 45 900 | | 1.20 | | | | | | | | .80 | | | | | .75 | .92 | 128 |
| 399 | 1200 | 144.0 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000119 | 19 650 | .495 | .001496 | 44 900 | 39 050 | 1.15 | 19 000 | .001338 | 40 100 | 3.82 | 8.66 | 400 800 | 476 400 | .84 | .000828 | 3700 | 2910 | 3465 | .79 | .94 | 126 |
| 400 | 1210 | 142.5 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000113 | 20 000 | .495 | .001415 | 42 500 | 38 250 | 1.11 | 19 000 | .001313 | 39 400 | 3.61 | 8.74 | 399 100 | 476 500 | .84 | .000741 | 3420 | 3040 | 3620 | .89 | 1.06 | 125 |
| 401 | 1200 | 144.5 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000124 | 19 880 | .505 | .001578 | 47 300 | 38 740 | 1.22 | 18 000 | .001290 | 38 700 | 3.64 | 8.73 | 391 300 | 452 400 | .87 | .000740 | 3420 | 2960 | 3400 | .87 | .99 | 119 |
| Average | | | | | | | | | 19 680 | .498 | .001496 | 44 900 | | 1.16 | | | | | | | | .85 | | | | | .85 | 1.00 | 123 |
| [1] 412 | 1200 | 141.9 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000118 | 22 000 | .530 | .001492 | 44 800 | 38 240 | 1.17 | 21 000 | .001383 | 41 500 | 3.75 | 8.69 | 461 400 | 524 400 | .88 | .000828 | 3700 | 3440 | 3710 | .93 | 1.06 | 125 |
| 413 | 1220 | 144.7 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000117 | 22 000 | .555 | .001550 | 46 500 | 38 620 | 1.20 | 21 000 | .001316 | 39 500 | 3.81 | 8.67 | 437 500 | 524 700 | .83 | .000810 | 3640 | 3220 | 3880 | .88 | 1.07 | 125 |
| Average | | | | | | | | | 22 000 | .543 | .001521 | 45 700 | | 1.19 | | | | | | | | .86 | | | | | .91 | 1.07 | 125 |
| Grand Ave | | 143.0 | | | | | 3400 | .000109 | | | | | | | | | | | | | | | | | | | | .95 | 128 |

[1] Sent to Jamestown.

*Remarks.*—Average bond stress developed in beam=128 pounds per square inch. Average ultimate bond stress from bond test pieces=738 pounds per square inch. Ratio=5.8.

## Table 17.—Gravel Concrete. Proportions, 1:2:4. Age, 52 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | First Crack Applied Load | First Crack Unit Elongation | Max. Applied Load | Deflection | Unit Elongation in Steel | $S_1$ | $S_2$ | $\frac{S_1}{S_2}$ | Applied Load | Unit Elongation in Steel | Unit Stress in Steel | KD | D. 35 KD | Mr | Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber | $C_1$ | $C_2$ | $C_3$ | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 342 | 1150 | 142.0 | 2 | 0.49 | 0.49 | 0.393 | 3000 | 0.000107 | 6280 | 0.250 | 0.001091 | 32 700 | 43 870 | 0.75 | 6000 | 0.000872 | 26 200 | 2.71 | 9.05 | 93 100 | 163 550 | 0.569 | 0.000325 | 1760 | 855 | 1500 | 0.49 | 0.85 | 126 |
| 343 | 1150 | 142.5 | 2 | .49 | .49 | .393 | 3000 | .000119 | 5800 | .265 | .000773 | 23 200 | 42 520 | .55 | 5500 | .000603 | 18 100 | 3.19 | 8.88 | 63 100 | 151 550 | .416 | .000282 | 1560 | 500 | 1200 | .32 | .77 | 120 |
| 344 | 1160 | 144.5 | 2 | .49 | .49 | .393 | 3000 | .000123 | 6800 | .365 | .001169 | 35 100 | 46 030 | .76 | 6500 | .001111 | 33 300 | 2.75 | 9.04 | 118 200 | 175 700 | .673 | .000420 | 2220 | 1070 | 1590 | .48 | .72 | 135 |
| Average | | | | | | | | | 6290 | .293 | .001011 | 30 300 | | .69 | | | | | | | | .553 | | | | | .43 | .78 | 127 |
| 354 | 1160 | 143.3 | 3 | .74 | .74 | .589 | 3000 | .000104 | 9600 | .370 | .001456 | 43 700 | 44 280 | .99 | 9000 | .001142 | 34 300 | 3.00 | 8.95 | 180 900 | 235 700 | .768 | .000488 | 2560 | 1515 | 1975 | .59 | .77 | 121 |
| 355 | 1160 | 142.2 | 3 | .74 | .74 | .589 | 3000 | .000097 | 10 450 | (.420) | .001444 | 43 300 | 42 980 | 1.01 | 10 000 | .001306 | 39 200 | 2.82 | 9.01 | 208 100 | 259 700 | .801 | .000513 | 2690 | 1845 | 2305 | .69 | .86 | 132 |
| 356 | 1150 | 141.0 | 3 | .74 | .74 | .589 | 3500 | .000118 | 9950 | .380 | .001431 | 42 900 | 42 880 | 1.00 | 9000 | .001123 | 33 700 | 2.98 | 8.96 | 177 900 | 235 550 | .755 | .000477 | 2500 | 1500 | 1985 | .60 | .79 | 120 |
| Average | | | | | | | | | 10 000 | .390 | .001444 | 43 300 | | 1.00 | | | | | | | | .775 | | | | | .63 | .81 | 124 |
| 366 | 1170 | 143.0 | 4 | .98 | .98 | .785 | 3000 | .000100 | 13 950 | .470 | .001562 | 46 900 | 40 480 | 1.16 | 13 000 | .001374 | 41 200 | 3.02 | 8.94 | 289 300 | 331 900 | .872 | .000596 | 3070 | 2410 | 2765 | .79 | .90 | 126 |
| 367 | 1190 | 144.2 | 4 | .98 | .98 | .785 | 3000 | .000098 | 13 870 | (.435) | .001439 | 43 200 | 40 030 | 1.08 | 13 000 | .001279 | 38 400 | 3.17 | 8.89 | 268 100 | 332 200 | .807 | .000595 | 3070 | 2140 | 2650 | .70 | .86 | 127 |
| 368 | 1180 | 144.6 | 4 | .98 | .98 | .785 | 3500 | .000092 | 13 890 | (.451) | .001390 | 41 700 | 39 810 | 1.05 | 13 000 | .001232 | 37 000 | 3.40 | 8.81 | 256 000 | 332 050 | .771 | .000635 | 3240 | 1925 | 2495 | .59 | .77 | 128 |
| Average | | | | | | | | | 13 900 | .452 | .001464 | 43 900 | | 1.10 | | | | | | | | .817 | | | | | .69 | .84 | 127 |
| 378 | 1170 | 144.5 | 5 | 1.23 | 1.11 | .982 | 3000 | .000112 | 14 230 | (.450) | (.001240) | (37 200) | 38 090 | .98 | 14 000 | .001210 | 36 300 | 3.49 | 8.78 | 267 700 | 357 050 | .750 | .000648 | 3300 | 2085 | 2780 | .63 | .84 | 129 |
| 379 | 1180 | 143.8 | 5 | 1.23 | 1.11 | .982 | 3000 | .000106 | 14 850 | .480 | .001364 | 40 900 | 37 850 | 1.08 | 14 000 | .001234 | 37 000 | 3.47 | 8.79 | 273 200 | 356 050 | .767 | .000657 | 3340 | 2140 | 2790 | .64 | .84 | 129 |
| 380 | 1160 | 141.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000106 | 14 000 | .460 | .001568 | 47 000 | 38 180 | 1.23 | 13 000 | .001224 | 36 700 | 3.32 | 8.84 | 273 100 | 331 700 | .823 | .000608 | 3120 | 2220 | 2700 | .71 | .87 | 119 |
| Average | | | | | | | | | 14 360 | .463 | .001391 | 41 700 | | 1.10 | | | | | | | | .780 | | | | | .66 | .85 | 126 |
| 390 | 1190 | 143.5 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000106 | 16 980 | (.470) | (.001190) | (35 700) | 39 330 | .91 | 16 000 | .001105 | 33 200 | 3.99 | 8.60 | 272 400 | 405 400 | .672 | .000733 | 3650 | 1930 | 2870 | .53 | .79 | 131 |
| 391 | 1200 | 143.1 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000114 | 17 440 | .490 | .001487 | 44 600 | 38 050 | 1.17 | 17 000 | .001391 | 41 700 | 3.54 | 8.76 | 352 200 | 428 400 | .822 | .000760 | 3750 | 2760 | 3360 | .74 | .90 | 135 |
| 392 | 1190 | 144.3 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000143 | 17 250 | .525 | .001668 | 50 000 | 38 510 | 1.30 | 16 000 | .001309 | 39 300 | 3.57 | 8.75 | 331 400 | 404 250 | .820 | .000728 | 3620 | 2580 | 3145 | .71 | .87 | 128 |
| Average | | | | | | | | | 17 220 | .495 | .001448 | 43 400 | | 1.13 | | | | | | | | .771 | | | | | .66 | .85 | 131 |
| 402 | 1200 | 144.1 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000105 | 19 920 | (.507) | (.001400) | (42 000) | 38 580 | 1.09 | 19 000 | .001295 | 38 900 | 3.89 | 8.64 | 387 500 | 477 500 | .812 | .000823 | 3970 | 2770 | 3410 | .70 | .86 | 127 |
| 403 | 1220 | 146.5 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000119 | 19 860 | (.555) | .001675 | 50 300 | 38 910 | 1.29 | 18 000 | .001345 | 40 400 | 3.70 | 8.71 | 407 100 | 452 700 | .899 | .000791 | 3860 | 3035 | 3375 | .79 | .87 | 119 |
| 404 | 1200 | 144.3 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000123 | 20 200 | (.539) | .001771 | 53 100 | 38 970 | 1.36 | 19 000 | .001374 | 41 200 | 3.75 | 8.69 | 413 800 | 476 400 | .869 | .000826 | 3990 | 3050 | 3510 | .76 | .88 | 126 |
| Average | | | | | | | | | 19 990 | (.534) | .001615 | 48 500 | | 1.25 | | | | | | | | .860 | | | | | .75 | .87 | 124 |
| 414 | 1190 | 143.7 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000119 | 21 410 | .585 | .001916 | 57 500 | 38 670 | 1.49 | 20 000 | .001315 | 39 500 | 3.96 | 8.61 | 433 000 | 500 250 | .866 | .000861 | 4110 | 3085 | 3560 | .75 | .87 | 121 |
| 415 | 1190 | 143.0 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000112 | 21 440 | (.516) | (.001589) | (47 700) | 38 320 | 1.24 | 20 000 | .001222 | 36 700 | 3.99 | 8.60 | 401 400 | 501 400 | .801 | .000810 | 3930 | 2845 | 3550 | .72 | .90 | 121 |
| 416 | 1190 | 143.5 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000127 | 21 000 | .560 | .001651 | 49 500 | 38 940 | 1.27 | 20 000 | .001366 | 41 000 | 3.98 | 8.61 | 449 200 | 500 250 | .898 | .000904 | 4240 | 3190 | 3550 | .75 | .84 | 121 |
| Average | | | | | | | | | 21 280 | .554 | .001719 | 51 600 | | 1.33 | | | | | | | | .855 | | | | | .74 | .87 | 121 |
| Grand Ave | | 143.5 | | | | | 3900 | .000112 | | | | | | | | | | | | | | | | | | | | .84 | 126 |

*Remarks.*—Average bond stress developed in beam=126 pounds per square inch. Average ultimate bond stress from bond test pieces=781 pounds per square inch. Ratio=6.2.

Note.—Values in parentheses are estimated.

4672°—12 (To face page 128.) No. 6

## Table 18.—Cinder Concrete. Proportions 1:2:4. Age, 4 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement: Number of ½″ round rods | Reinforcement: Nominal Per cent | Reinforcement: Effective Per cent | Reinforcement: Area, in sq. in. | First Crack: Applied Load, in lbs. | First Crack: Unit Elongation in Lower Fiber, inches per inch | Maximum Load: Applied Load, in lbs. | Maximum Load: Deflection, inches | Maximum Load: Unit Elongation in Steel, inches per inch | Maximum Load: Unit Stress of Steel, lbs. per sq. in. $S_1$ | Maximum Load: Yield Point of Steel, lbs. per sq. in. $S_2$ | Maximum Load: $\frac{S_1}{S_2}$ | Analysis: Applied Load, in lbs. | Analysis: Unit Elongation in Steel, inches per inch | Analysis: Unit Stress in Steel, lbs. per sq. in. | Analysis: KD, in inches | Analysis: D-35 KD, in inches | Analysis: Resisting Moment, inch lbs., Mr | Analysis: Bending Moment, inch lbs., Mb | Analysis: $\frac{Mr}{Mb}$ | Analysis: Unit Deformation Upper Fiber, inches per inch | Unit Compressive Stress Upper Fiber, lbs. per sq. in.: $C_1$ from Cylinder Curve | Unit Compressive Stress Upper Fiber: $C_2$ from Resisting Moment | Unit Compressive Stress Upper Fiber: $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 417 | 970 | 120.8 | 2 | 0.49 | 0.49 | 0.393 | 2000 | 0.000195 | 5900 | 0.440 | 0.001169 | 35 100 | 36 960 | 0.95 | 5500 | 0.001009 | 30 300 | 4.06 | 8.58 | 102 100 | 148 600 | 0.69 | 0.000688 | 940 | 660 | 925 | 0.70 | 1.02 | 120 |
| 418 | 980 | 121.4 | 2 | .49 | .49 | .393 | 1500 | .000133 | 5900 | .385 | .001132 | 34 000 | 37 720 | .90 | 5500 | .000976 | 29 300 | 4.08 | 8.57 | 98 600 | 148 700 | .66 | .000674 | 930 | 635 | 960 | .68 | 1.03 | 121 |
| 419 | 950 | 117.6 | 2 | .49 | .49 | .393 | 2000 | .000201 | 6390 | .445 | .001294 | 38 800 | 37 390 | 1.04 | 6000 | .001205 | 36 200 | 4.11 | 8.56 | 121 700 | 160 300 | .76 | .000840 | 1080 | 780 | 1025 | .72 | .95 | 130 |
| Average | | | | | | | | | 6060 | .423 | .001198 | 36 000 | | .96 | | | | | | | | .70 | | | | | .70 | 1.00 | 124 |
| 429 | 990 | 121.8 | 3 | .74 | .74 | .589 | 2000 | .000157 | 8700 | .520 | .001405 | 42 200 | 39 090 | 1.08 | 8500 | .001311 | 39 300 | 4.50 | 8.43 | 195 200 | 220 900 | .88 | .001073 | 1240 | 1160 | 1320 | .94 | 1.06 | 120 |
| 430 | 990 | 122.5 | 3 | .74 | .74 | .589 | 2000 | .000171 | 8760 | .520 | .001362 | 40 900 | 40 490 | 1.01 | 8500 | .001236 | 37 100 | 4.65 | 8.37 | 182 900 | 220 900 | .83 | .001072 | 1240 | 1060 | 1275 | .85 | 1.03 | 121 |
| 431 | 980 | 121.9 | 3 | .74 | 74 | .589 | 2500 | .000199 | 8940 | .505 | .001234 | 37 000 | 41 300 | .90 | 8500 | .001113 | 33 400 | 4.81 | 8.32 | 163 700 | 220 700 | .74 | .001032 | 1210 | 920 | 1245 | .76 | 1.03 | 121 |
| Average | | | | | | | | | 8800 | .515 | .001334 | 40 000 | | 1.00 | | | | | | | | .82 | | | | | .85 | 1.04 | 121 |
| 441 | 960 | 119.2 | 4 | .98 | .98 | .785 | 2000 | .000166 | 10 500 | .585 | .001414 | 42 400 | 40 520 | 1.05 | 10 000 | .001215 | 36 500 | 5.50 | 8.08 | 231 600 | 256 400 | .90 | .001487 | 1410 | 1175 | 1305 | .83 | .93 | 108 |
| 442 | 970 | 119.1 | 4 | .98 | .98 | .785 | 2000 | .000153 | 10 900 | .595 | (.001335) | (40 100) | 41 840 | .96 | 10 500 | .001186 | 35 600 | 5.54 | 8.06 | 225 300 | 268 600 | .84 | .001471 | 1400 | 1135 | 1350 | .81 | .96 | 113 |
| 443 | 970 | 118.3 | 4 | .98 | .98 | .785 | 3000 | .000249 | 11 470 | .625 | (.001458) | (43 700) | 41 150 | 1.06 | 10 000 | .001060 | 31 800 | 5.43 | 8.10 | 202 300 | 256 600 | .79 | .001258 | 1330 | 1035 | 1310 | .78 | .99 | 108 |
| Average | | | | | | | | | 10 960 | .602 | .001402 | (42 100) | | 1.02 | | | | | | | | .84 | | | | | .81 | .96 | 110 |
| 453 | 960 | 118.6 | 5 | 1.23 | 1.11 | .982 | 2000 | .000173 | 11 700 | .740 | .001684 | 50 500 | 40 330 | 1.25 | 11 000 | .001246 | 37 400 | 5.70 | 8.01 | 238 700 | 280 400 | .85 | .001654 | [1]1460 | 1245 | 1465 | .85 | 1.00 | 117 |
| 454 | 980 | 118.8 | 5 | 1.23 | 1.11 | .982 | 2000 | .000176 | 11 130 | .765 | .001655 | 49 700 | 38 210 | 1.30 | 10 000 | .001126 | 33 800 | 5.59 | 8.04 | 217 400 | 256 700 | .85 | .001431 | 1390 | 1155 | 1360 | .83 | .98 | 107 |
| 455 | 980 | 119.5 | 5 | 1.23 | 1.11 | .982 | 2000 | .000170 | 11 450 | .665 | .001508 | 45 200 | 39 750 | 1.14 | 10 000 | .001097 | 32 900 | 5.36 | 8.12 | 215 300 | 256 700 | .84 | .001268 | 1340 | 1180 | 1405 | .88 | 1.05 | 105 |
| Average | | | | | | | | | 11 430 | .723 | .001616 | 48 500 | | 1.23 | | | | | | | | .85 | | | | | .85 | 1.01 | 110 |
| 465 | 970 | 118.1 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000164 | 13 100 | (.760) | (.001660) | (49 800) | 36 980 | 1.35 | 12 000 | .001231 | 36 900 | 5.93 | 7.92 | 260 200 | 304 600 | .85 | .001790 | [1]1500 | 1345 | 1580 | .90 | 1.05 | 115 |
| 466 | 980 | 117.4 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000157 | 13 460 | .810 | (.001906) | (57 200) | 37 870 | 1.51 | 12 000 | .001176 | 35 300 | 5.71 | 8.00 | 254 200 | 304 700 | .83 | .001566 | [1]1440 | 1350 | 1625 | .94 | 1.13 | 113 |
| 467 | 980 | 119.6 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000153 | 14 100 | .845 | (.001762) | (52 900) | 37 350 | 1.42 | 13 500 | .001318 | 39 500 | 5.67 | 8.02 | 285 800 | 340 700 | .84 | .001726 | [1]1480 | 1530 | 1820 | 1.03 | 1.23 | 125 |
| Average | | | | | | | | | 13 550 | .805 | .001776 | (53 300) | | 1.43 | | | | | | | | .84 | | | | | .96 | 1.14 | 118 |
| 477 | 990 | 119.2 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000219 | 14 870 | .885 | .001925 | 57 800 | 36 730 | 1.57 | 13 000 | .001179 | 35 400 | 5.86 | 7.95 | 306 900 | 328 900 | .93 | .001668 | [1]1460 | 1580 | 1700 | 1.08 | 1.16 | 101 |
| 478 | 980 | 116.4 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000213 | 14 590 | .870 | .001701 | 51 000 | 35 790 | 1.42 | 13 000 | .001198 | 35 900 | 5.82 | 7.96 | 312 000 | 328 700 | .95 | .001669 | [1]1460 | 1615 | 1700 | 1.11 | 1.16 | 101 |
| 479 | 980 | 117.1 | 7 | 1.72 | 1.54 | 1.375 | 2000 | .000146 | 15 170 | .875 | (.001949) | (58 500) | 37 620 | 1.56 | 13 000 | .001097 | 32 900 | 5.93 | 7.92 | 283 100 | 328 700 | .86 | .001598 | [1]1440 | 1445 | 1680 | 1.00 | 1.17 | 102 |
| Average | | | | | | | | | 14 880 | .877 | .001858 | (55 800) | | 1.52 | | | | | | | | .91 | | | | | 1.06 | 1.16 | 101 |
| 489 | 990 | 118.9 | 8 | 1.96 | 1.72 | 1.571 | 2000 | .000148 | 15 750 | .980 | (.002046) | (61 400) | 38 020 | 1.61 | 13 000 | .001094 | 32 800 | 6.28 | 7.80 | 297 800 | 328 900 | .91 | .001844 | [1]1510 | 1475 | 1620 | .98 | 1.07 | 96 |
| 490 | 1000 | 117.5 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000219 | 16 000 | 1.005 | .001974 | 59 200 | 37 690 | 1.57 | 13 000 | .001055 | 31 700 | 6.09 | 7.87 | 293 700 | 329 100 | .89 | .001641 | [1]1460 | 1485 | 1670 | 1.02 | 1.14 | 95 |
| 491 | 1000 | 150.0 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000208 | 16 410 | 1.000 | (.001993) | (59 800) | 37 950 | 1.58 | 14 000 | .001145 | 34 400 | 6.06 | 7.88 | 319 600 | 353 100 | .90 | .001765 | [1]1490 | 1625 | 1805 | 1.09 | 1.21 | 101 |
| Average | | | | | | | | | 16 050 | .995 | .002004 | (60 100) | | 1.59 | | | | | | | | .90 | | | | | 1.03 | 1.14 | 97 |
| Grand Ave | | 119.0 | | | | | 2200 | .000180 | | | | | | | | | | | | | | | | | | | | 1.08 | 111 |

Note.—Values in parentheses are estimated.

[1] Values taken from average curve produced.

## Table 19.—Cinder Concrete. Proportions 1:2:4. Age, 13 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½″ round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | First Crack: Applied Load, in lbs. | First Crack: Unit Elongation in Lower Fiber | Maximum Load: Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel | $S_1$ | $S_2$ | $\frac{S_1}{S_2}$ | Analysis: Applied Load | Unit Elongation in Steel | Unit Stress in Steel | KD | D-35 KD | Mr | Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber | $C_1$ | $C_2$ | $C_3$ | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 420 | 960 | 119.2 | 2 | 0.49 | 0.49 | 0.393 | 1000 | 0.000094 | 6120 | 0.395 | 0.001265 | 38 000 | 38 400 | 0.99 | 6000 | 0.001085 | 32 600 | 3.83 | 8.66 | 110 900 | 160 400 | 0.69 | 0.000674 | 1160 | 750 | 1085 | 0.65 | 0.94 | 128 |
| 421 | 1000 | 122.4 | 2 | .49 | .49 | .393 | 2000 | .000163 | 5880 | .340 | .001044 | 31 300 | 39 220 | .80 | 6500 | .000875 | 26 300 | 3.83 | 8.66 | 89 400 | 149 100 | .60 | .000543 | 970 | 605 | 1010 | .62 | 1.04 | 120 |
| 422 | 980 | 120.7 | 2 | .49 | .49 | .393 | 2000 | .000174 | 5860 | .360 | .001197 | 35 900 | 40 010 | .90 | 5500 | .000959 | 28 800 | 3.83 | 8.66 | 97 900 | 148 700 | .66 | .000596 | 1040 | 665 | 1010 | .64 | .97 | 119 |
| Average | | | | | | | | | 5950 | .365 | .001169 | 35 100 | | .90 | | | | | | | | .65 | | | | | .64 | .98 | 122 |
| 432 | 1010 | 123.5 | 3 | .74 | .74 | .589 | 3000 | .000219 | 8810 | .420 | .001219 | 36 600 | 39 860 | .92 | 8730 | .001162 | 34 900 | 4.12 | 8.56 | 176 000 | 226 800 | .78 | .000815 | 1340 | 1125 | 1440 | .84 | 1.07 | 121 |
| 433 | 1020 | 123.4 | 3 | .74 | .74 | .589 | 2000 | .000144 | 9400 | .440 | .001214 | 36 400 | 39 550 | .92 | 9000 | .001101 | 33 000 | 4.14 | 8.55 | 166 200 | 233 400 | .71 | .000778 | 1300 | 1055 | 1485 | .81 | 1.14 | 125 |
| 434 | 990 | 119.5 | 3 | .74 | .74 | .589 | 3000 | .000211 | 9270 | .435 | .001200 | 36 000 | 40 520 | .89 | 9000 | .001065 | 32 000 | 4.42 | 8.45 | 159 300 | 232 900 | .68 | .000842 | 1380 | 960 | 1410 | .70 | 1.02 | 126 |
| Average | | | | | | | | | 9160 | .432 | .001211 | 36 300 | | .91 | | | | | | | | .72 | | | | | .78 | 1.08 | 124 |
| 444 | 1000 | 120.5 | 4 | .98 | .98 | .785 | 2000 | .000138 | 12 000 | .515 | .001285 | 38 600 | 39 900 | .97 | 12 000 | .001285 | 38 600 | 4.64 | 8.38 | 254 100 | 305 100 | .83 | .001111 | 1640 | 1470 | 1770 | .90 | 1.08 | 124 |
| 445 | 1000 | 118.1 | 4 | .98 | .98 | .785 | 3000 | .000205 | 11 750 | .525 | .001381 | 41 400 | 39 780 | 1.04 | 11 000 | .001164 | 34 900 | 4.44 | 8.45 | 231 600 | 281 100 | .82 | .000931 | 1480 | 1390 | 1695 | .94 | 1.15 | 113 |
| 446 | 1000 | 120.9 | 4 | .98 | .98 | .785 | 2000 | .000146 | 12 000 | .535 | .001482 | 44 500 | 41 670 | 1.07 | 11 000 | .001209 | 36 300 | 4.56 | 8.40 | 239 500 | 281 100 | .85 | .001014 | 1560 | 1405 | 1655 | .90 | 1.06 | 114 |
| Average | | | | | | | | | 11 920 | .525 | .001383 | 41 500 | | 1.03 | | | | | | | | .83 | | | | | .91 | 1.10 | 117 |
| 456 | 990 | 119.5 | 5 | 1.23 | 1.11 | .982 | 2000 | .000144 | 12 500 | .550 | .001482 | 44 500 | 38 780 | 1.15 | 12 000 | .001244 | 37 300 | 4.88 | 8.29 | 252 500 | 304 900 | .83 | .001184 | 1700 | 1490 | 1795 | .88 | 1.06 | 120 |
| 457 | 1020 | 122.5 | 5 | 1.23 | 1.11 | .982 | 3000 | .000193 | 14 000 | .615 | .001571 | 47 100 | 38 000 | 1.24 | 13 000 | .001320 | 39 600 | 4.72 | 8.35 | 271 100 | 329 400 | .82 | .001181 | 1700 | 1645 | 2005 | .97 | 1.18 | 128 |
| 458 | 1010 | 121.6 | 5 | 1.23 | 1.11 | .982 | 2000 | .000149 | 13 200 | .620 | .001610 | 48 300 | 40 810 | 1.18 | 12 000 | .001221 | 36 600 | 4.92 | 8.28 | 247 200 | 305 200 | .81 | .001183 | 1700 | 1450 | 1790 | .85 | 1.05 | 121 |
| Average | | | | | | | | | 13 230 | .595 | .001554 | 46 600 | | 1.19 | | | | | | | | .82 | | | | | .90 | 1.10 | 123 |
| 468 | 1000 | 120.5 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000122 | 14 560 | .585 | .001188 | 35 600 | 38 010 | .94 | 14 000 | .001128 | 33 800 | 5.39 | 8.11 | 250 300 | 353 100 | .71 | .001317 | 1800 | 1395 | 1965 | .78 | 1.09 | 127 |
| 469 | 1000 | 118.3 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000135 | 14 550 | (.595) | .001296 | 38 900 | 37 970 | 1.02 | 14 000 | .001209 | 36 300 | 5.29 | 8.15 | 271 200 | 353 100 | .77 | .001360 | 1820 | 1530 | 1985 | .84 | 1.09 | 126 |
| 470 | 990 | 118.6 | 6 | 1.47 | 1.30 | 1.178 | 2000 | .000144 | 15 000 | (.599) | .001747 | 52 400 | 37 630 | 1.39 | 14 000 | .001344 | 40 300 | 5.10 | 8.22 | 305 800 | 352 900 | .87 | .001399 | 1840 | 1775 | 2040 | .96 | 1.11 | 124 |
| Average | | | | | | | | | 14 700 | .593 | .001410 | 42 300 | | 1.12 | | | | | | | | .78 | | | | | .86 | 1.10 | 126 |
| 480 | 1010 | 120.4 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000194 | 16 650 | .645 | .001547 | 46 400 | 36 110 | 1.28 | 15 000 | .001125 | 33 800 | 5.36 | 8.12 | 304 800 | 377 200 | .81 | .001297 | 1780 | 1680 | 2075 | .94 | 1.17 | 111 |
| 481 | 1020 | 119.0 | 7 | 1.72 | 1.54 | 1.375 | 2000 | .000122 | 17 150 | [1].985 | [1].003130 | [1]93 900 | 36 260 | [1]2.59 | 15 000 | .001137 | 34 100 | 5.48 | 8.08 | 304 700 | 377 400 | .81 | .001377 | 1830 | 1650 | 2035 | .90 | 1.11 | 112 |
| 482 | 980 | 115.7 | 7 | 1.72 | 1.54 | 1.375 | 2000 | .000119 | 17 500 | (.735) | .001785 | 53 600 | 36 980 | 1.45 | 16 000 | .001183 | 35 500 | 5.61 | 8.04 | 314 100 | 400 700 | .78 | .001511 | 1910 | 1670 | 2140 | .87 | 1.12 | 120 |
| Average | | | | | | | | | 17 100 | .690 | .001666 | 50 000 | | 1.37 | | | | | | | | .80 | | | | | .90 | 1.13 | 114 |
| 492 | 1010 | 117.9 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000186 | 18 060 | .760 | .001726 | 51 800 | 37 210 | 1.39 | 16 000 | .001164 | 34 900 | 5.61 | 8.04 | 338 300 | 401 200 | .84 | .001487 | 1900 | 1820 | 2165 | .96 | 1.14 | 110 |
| 493 | 1030 | 118.4 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000232 | 17 850 | .785 | .001600 | 48 000 | 38 190 | 1.26 | 17 000 | .001224 | 36 700 | 5.66 | 8.02 | 354 100 | 425 600 | .83 | .001596 | 1950 | 1895 | 2285 | .97 | 1.17 | 117 |
| 494 | 1020 | 121.3 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000187 | 18 140 | .805 | .001807 | 54 200 | 36 440 | 1.49 | 16 000 | .001149 | 34 500 | 5.66 | 8.02 | 332 900 | 401 400 | .83 | .001501 | 1900 | 1780 | 2145 | .94 | 1.13 | 110 |
| Average | | | | | | | | | 18 020 | .783 | .001711 | 51 300 | | 1.38 | | | | | | | | .83 | | | | | .96 | 1.15 | 112 |
| Grand Ave | | 120.1 | | | | | 2400 | .000163 | | | | | | | | | | | | | | | | | | | | 1.09 | 120 |

[1] Not used in average.

*Remarks.*—Average bond stress developed in beam = 120 pounds per square inch. Average ultimate bond stress from bond test pieces = 547 pounds per square inch. Ratio = 4.5.

Note.—Values in parentheses are estimated.

## Table 20.—Cinder Concrete. Proportions, 1:2:4. Age, 26 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Reinforcement | | | | First Crack | | Maximum Load | | | | | | Analysis of beam at Unit Elongation in Reinforcement Less than that at Yield Point | | | | | | | | | Unit Compressive Stress Upper Fiber, lbs. per sq. in. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of ½" round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | Applied Load, in lbs. | Unit Elongation in Lower Fiber, inches per inch | Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel, inches per inch | Unit Stress of Steel, lbs. per sq. in. $S_1$ | Yield Point of Steel, lbs. per sq. in. $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel, inches per inch | Unit Stress in Steel, lbs. per sq. in. | KD, in inches | D-.35KD in inches | Resisting Moment, inch lbs., Mr | Bending Moment, inch lbs., Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber, inches per inch | $C_1$ from Cylinder Curve | $C_2$ from Resisting Moment | $C_3$ from Bending Moment | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress, lbs. per sq. in. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 423 | 1000 | 122.4 | 2 | 0.49 | 0.49 | 0.393 | 2000 | 0.000134 | 6610 | 0.360 | 0.001101 | 33 000 | 38 220 | 0.86 | 6500 | 0.000933 | 28 000 | 3.88 | 8.64 | 95 000 | 173 100 | 0.55 | 0.000591 | 1210 | 640 | 1165 | 0.53 | 0.96 | 139 |
| 424 | 990 | 121.0 | 2 | .49 | .49 | .393 | 2500 | .000156 | 6460 | .335 | .000945 | 28 400 | 38 770 | .73 | 6000 | .000848 | 25 400 | 3.82 | 8.66 | 86 400 | 160 900 | .54 | .000525 | 1090 | 585 | 1085 | .54 | 1.00 | 129 |
| 425 | 990 | 121.0 | 2 | .49 | .49 | .393 | 2500 | .000191 | 6320 | .330 | .001029 | 30 900 | 39 680 | .78 | 6000 | .000904 | 27 100 | 3.71 | 8.70 | 92 600 | 160 900 | .58 | .000534 | 1110 | 645 | 1110 | .58 | 1.00 | 128 |
| Average | | | | | | | | | 6460 | .342 | .001025 | 30 800 | | .79 | | | | | | | | .56 | | | | | .55 | .99 | 132 |
| 435 | 980 | 120.4 | 3 | .74 | .74 | .589 | 2500 | .000173 | 9500 | .420 | .001210 | 36 300 | 40 230 | .90 | 9000 | .001019 | 30 600 | 4.36 | 8.47 | 152 700 | 232 700 | .66 | .000786 | 1510 | 930 | 1410 | .62 | .93 | 125 |
| 436 | 1000 | 119.9 | 3 | .74 | .74 | .589 | 3000 | .000195 | 9300 | .410 | .001202 | 36 100 | 40 450 | .89 | 9000 | .001072 | 32 200 | 4.03 | 8.59 | 162 900 | 233 100 | .70 | .000724 | 1420 | 1060 | 1515 | .75 | 1.07 | 124 |
| 437 | 980 | 119.3 | 3 | .74 | .74 | .589 | 2500 | .000169 | 9550 | .435 | .001253 | 37 600 | 40 480 | .93 | 9000 | .001056 | 31 700 | 4.11 | 8.56 | 159 800 | 232 700 | .69 | .000738 | 1440 | 1020 | 1480 | .71 | 1.03 | 124 |
| Average | | | | | | | | | 9450 | .422 | .001222 | 36 700 | | .91 | | | | | | | | .68 | | | | | .69 | 1.01 | 124 |
| 447 | 970 | 116.5 | 4 | .98 | .98 | .785 | 3000 | .000179 | 12 600 | .500 | .001354 | 40 600 | 41 350 | .98 | 12 000 | .001096 | 32 900 | 4.74 | 8.34 | 215 500 | 304 600 | .71 | .000986 | 1780 | 1225 | 1725 | .69 | .97 | 124 |
| 448 | 990 | 117.4 | 4 | .98 | .98 | .785 | 3000 | .000169 | 12 830 | .515 | .001311 | 39 300 | 40 850 | .96 | 12 000 | .001120 | 33 600 | 4.50 | 8.43 | 222 500 | 304 900 | .73 | .000916 | 1690 | 1320 | 1810 | .78 | 1.07 | 123 |
| 449 | 990 | 118.5 | 4 | .98 | .98 | .785 | 4000 | .000241 | 13 000 | .510 | .001376 | 41 300 | 39 740 | 1.04 | 12 000 | .001109 | 33 300 | 4.60 | 8.39 | 219 400 | 304 900 | .72 | .000944 | 1730 | 1280 | 1780 | .74 | 1.03 | 123 |
| Average | | | | | | | | | 12 810 | .508 | .001347 | 40 400 | | .99 | | | | | | | | .72 | | | | | .74 | 1.02 | 123 |
| 459 | 990 | 117.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000179 | 13 730 | .525 | .001315 | 39 500 | 38 950 | 1.01 | 13 000 | .001195 | 35 900 | 4.74 | 8.34 | 245 300 | 328 900 | .75 | .001075 | 1880 | 1485 | 1980 | .79 | 1.05 | 128 |
| 460 | 990 | 116.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000174 | 13 980 | .530 | .001385 | 41 600 | 39 050 | 1.07 | 13 000 | .001234 | 37 000 | 4.49 | 8.43 | 257 000 | 328 900 | .78 | .001006 | 1800 | 1620 | 2075 | .90 | 1.15 | 126 |
| 461 | 980 | 118.9 | 5 | 1.23 | 1.11 | .982 | 3000 | .000182 | 13 100 | .570 | .001272 | 38 200 | 36 880 | 1.04 | 13 000 | .001221 | 36 600 | 4.78 | 8.33 | 249 600 | 328 700 | .76 | .001117 | 1930 | 1495 | 1965 | .77 | 1.02 | 128 |
| Average | | | | | | | | | 13 600 | .542 | .001324 | 39 800 | | 1.04 | | | | | | | | .76 | | | | | .82 | 1.07 | 127 |
| 471 | 990 | 118.0 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000172 | 15 400 | .585 | .001545 | 46 400 | 38 100 | 1.22 | 14 000 | .001109 | 33 300 | 5.16 | 8.19 | 251 200 | 352 900 | .71 | .001182 | 2000 | 1445 | 2035 | .72 | 1.02 | 124 |
| 472 | 990 | 117.1 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000176 | 15 570 | .640 | .001561 | 46 800 | 36 800 | 1.27 | 14 000 | .001156 | 34 700 | 4.92 | 8.28 | 267 000 | 352 900 | .76 | .001119 | 1930 | 1595 | 2100 | .83 | 1.09 | 122 |
| 473 | 990 | 118.5 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000174 | 15 000 | .590 | .001566 | 47 000 | 37 940 | 1.24 | 14 000 | .001195 | 35 900 | 4.90 | 8.29 | 276 700 | 352 900 | .78 | .001146 | 1960 | 1655 | 2120 | .84 | 1.08 | 122 |
| Average | | | | | | | | | 15 320 | .605 | .001557 | 46 700 | | 1.24 | | | | | | | | .75 | | | | | .80 | 1.06 | 123 |
| 483 | 1000 | 117.5 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000172 | 17 000 | .655 | .001638 | 49 100 | 35 920 | 1.37 | 16 000 | .001232 | 37 000 | 5.27 | 8.16 | 366 300 | 401 100 | .84 | .001371 | 2190 | 1875 | 2230 | .86 | 1.02 | 117 |
| 484 | 1020 | 119.4 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000166 | 17 550 | (.640) | .001540 | 46 200 | 36 460 | 1.27 | 17 000 | .001308 | 39 200 | 5.23 | 8.17 | 357 200 | 425 400 | .85 | .001433 | [1] 2240 | 2005 | 2360 | .90 | 1.05 | 124 |
| 485 | 1010 | 119.3 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000167 | 17 000 | .615 | .001482 | 44 500 | 36 880 | 1.21 | 15 000 | .001067 | 32 000 | 5.39 | 8.11 | 287 900 | 377 200 | .76 | .001249 | 2060 | 1580 | 2080 | .77 | 1.01 | 111 |
| Average | | | | | | | | | 17 180 | .637 | .001553 | 46 600 | | 1.28 | | | | | | | | .82 | | | | | .84 | 1.03 | 117 |
| 495 | 1000 | 117.2 | 8 | 1.96 | 1.72 | 1.571 | 3000 | .000154 | 19 730 | .680 | .001602 | 48 100 | 37 140 | 1.30 | 18 100 | .001174 | 35 200 | 5.64 | 8.03 | 340 400 | 451 500 | .75 | .001521 | [1] 2320 | 1825 | 2435 | .79 | 1.05 | 124 |
| 496 | 1030 | 120.4 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000212 | 19 700 | .690 | .001579 | 47 400 | 36 790 | 1.29 | 18 000 | .001217 | 36 500 | 5.34 | 8.13 | 361 900 | 449 600 | .81 | .001392 | 2200 | 2025 | 2500 | .92 | 1.14 | 120 |
| 497 | 1010 | 118.5 | 8 | 1.96 | 1.72 | 1.571 | 5000 | .000249 | 20 000 | .690 | .001385 | 41 600 | 37 820 | 1.10 | 19 000 | .001191 | 35 700 | 5.57 | 8.05 | 347 100 | 473 200 | .73 | .001499 | [1] 2300 | 1880 | 2575 | .82 | 1.12 | 129 |
| Average | | | | | | | | | 19 810 | .687 | .001522 | 45 700 | | 1.23 | | | | | | | | .76 | | | | | .84 | 1.10 | 124 |
| Grand Ave | | 118.9 | | | | | 3000 | .000180 | | | | | | | | | | | | | | | | | | | | 1.04 | 124 |

[1] Values taken from average curve produced.

*Remarks.*—Average bond stress developed in beam=124 pounds per square inch. Average ultimate bond stress from bond test pieces=397 pounds per square inch. Ratio=32.

**Note.—Values in parentheses are estimated.**

## Table 21.—Cinder Concrete. Proportions, 1:2:4. Age, 52 Weeks

| Beam Number | Total Weight of Beam, in lbs. | Weight per cu. ft., in lbs. | Number of ½" round rods | Nominal Per cent | Effective Per cent | Area, in sq. in. | First Crack Applied Load, in lbs. | First Crack Unit Elongation in Lower Fiber | Max. Applied Load, in lbs. | Deflection, inches | Unit Elongation in Steel | Unit Stress of Steel $S_1$ | Yield Point of Steel $S_2$ | $\frac{S_1}{S_2}$ | Applied Load, in lbs. | Unit Elongation in Steel | Unit Stress in Steel | KD, in inches | D-.35KD in inches | Resisting Moment, Mr | Bending Moment, Mb | $\frac{Mr}{Mb}$ | Unit Deformation Upper Fiber | $C_1$ | $C_2$ | $C_3$ | $\frac{C_2}{C_1}$ | $\frac{C_3}{C_1}$ | Unit Bond Stress |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 426 | 970 | 120.8 | 2 | 0.49 | 0.49 | 0.393 | 2500 | 0.000186 | 6460 | (0.343) | 0.001161 | 34 800 | 38 890 | 0.89 | 6000 | 0.000889 | 26 700 | 3.95 | 8.62 | 90 400 | 160 050 | .565 | 0.000579 | 1220 | 595 | 1055 | 0.49 | 0.86 | 129 |
| 427 | 960 | 120.2 | 2 | .49 | .49 | .393 | 2000 | .000151 | 6500 | .385 | [1].000926 | 27 800 | 38 480 | .72 | 6500 | .000926 | 27 800 | 4.24 | 8.52 | 93 000 | 172 400 | .539 | .000680 | 1400 | 580 | 1075 | .41 | .77 | 140 |
| 428 | 980 | 122.5 | 2 | .49 | .49 | .393 | 2000 | .000145 | 6400 | (.340) | [1].000949 | 28 500 | 37 660 | .76 | 6000 | .000809 | 24 300 | 4.20 | 8.53 | 81 400 | 160 950 | .506 | .000586 | 1238 | 570 | 1010 | .41 | .82 | 131 |
| Average | | | | | | | | | 6450 | .356 | .001161 | 30 370 | | .79 | | | | | | | | .537 | | | | | .44 | .82 | 133 |
| 438 | 930 | 115.2 | 3 | .74 | .74 | .589 | 2000 | .000143 | 9500 | (.459) | .001325 | 39 800 | 40 290 | .99 | 9000 | .001125 | 33 800 | 4.45 | 8.44 | 168 100 | 231 950 | .725 | .000901 | 1760 | 1005 | 1385 | .57 | .79 | 125 |
| 439 | 960 | 119.2 | 3 | .74 | .74 | .589 | 2500 | .000171 | 9930 | (.444) | .001174 | 35 200 | 40 850 | .86 | 9000 | .001009 | 30 300 | 4.47 | 8.44 | 150 700 | 232 400 | .648 | .000816 | 1630 | 900 | 1390 | .55 | .85 | 125 |
| 440 | 960 | 118.3 | 3 | .74 | .74 | .589 | 3000 | .000202 | 9850 | (.462) | (.001183) | 35 500 | 41 040 | .87 | 9000 | .001034 | 31 000 | 4.40 | 8.46 | 154 500 | 232 400 | .665 | .000813 | 1620 | 935 | 1405 | .58 | .87 | 125 |
| Average | | | | | | | | | 9760 | (.455) | .001227 | 36 830 | | .91 | | | | | | | | .679 | | | | | .57 | .84 | 125 |
| 450 | 960 | 118.3 | 4 | .98 | .98 | .785 | 3000 | .000181 | 12 000 | .500 | .001272 | 38 200 | 41 650 | .92 | 12 000 | .001272 | 38 200 | 4.69 | 8.37 | 251 100 | 304 450 | .825 | .001122 | 2060 | 1440 | 1745 | .70 | .85 | 123 |
| 451 | 960 | 115.0 | 4 | .98 | .98 | .785 | 2000 | .000126 | 12 000 | (.482) | .001297 | 38 900 | 41 050 | .95 | 11 000 | .001120 | 33 600 | 4.69 | 8.37 | 220 900 | 280 450 | .788 | .000987 | 1880 | 1265 | 1605 | .67 | .85 | 114 |
| 452 | 950 | 116.6 | 4 | .98 | .98 | .785 | 3000 | .000190 | 12 000 | .505 | .001227 | 36 800 | 40 610 | .91 | 12 000 | .001227 | 36 800 | 4.68 | 8.37 | 241 900 | 304 400 | .795 | .001079 | 2010 | 1390 | 1750 | .69 | .87 | 123 |
| Average | | | | | | | | | 12 000 | .496 | .001265 | 37 970 | | .93 | | | | | | | | .803 | | | | | .69 | .86 | 120 |
| 462 | 960 | 115.6 | 5 | 1.23 | 1.11 | .982 | 3000 | .000243 | 13 900 | (.558) | (.001314) | 39 400 | 37 420 | 1.05 | 13 000 | .001186 | 35 600 | 4.13 | 8.35 | 243 600 | 329 550 | .739 | .001065 | 1990 | 1475 | 1995 | .74 | 1.00 | 128 |
| 463 | 970 | 117.4 | 5 | 1.23 | 1.11 | .982 | 3000 | .000209 | 13 350 | (.534) | .001303 | 39 100 | 37 460 | 1.04 | 13 000 | .001226 | 36 800 | 4.72 | 8.35 | 251 900 | 328 600 | .767 | .001095 | 2030 | 1525 | 1990 | .75 | .98 | 128 |
| 464 | 960 | 117.4 | 5 | 1.23 | 1.11 | .982 | 2000 | .000133 | 13 250 | (.554) | .001379 | 41 400 | 38 800 | 1.07 | 13 000 | .001238 | 37 100 | 4.90 | 8.29 | 251 100 | 328 450 | .765 | .001187 | 2130 | 1475 | 1930 | .69 | .91 | 129 |
| Average | | | | | | | | | 13 500 | (.549) | .001332 | 39 970 | | 1.05 | | | | | | | | .757 | | | | | .73 | .96 | 128 |
| 474 | 970 | 117.9 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000257 | 14 480 | (.628) | (.001480) | 44 400 | 36 710 | 1.21 | 13 000 | .001150 | 34 500 | 5.06 | 8.23 | 262 500 | 329 750 | .796 | .001179 | 2130 | 1535 | 1930 | .72 | .91 | 115 |
| 475 | 990 | 117.8 | 6 | 1.47 | 1.30 | 1.178 | 4000 | .000230 | 15 250 | (.580) | .001285 | 38 600 | 38 770 | 1.00 | 15 000 | .001246 | 37 400 | 4.94 | 8.28 | 287 600 | 376 950 | .763 | .001217 | 2170 | 1710 | 2240 | .79 | 1.03 | 130 |
| 476 | 970 | 118.8 | 6 | 1.47 | 1.30 | 1.178 | 3000 | .000188 | 14 240 | (.607) | .001668 | 50 000 | 37 400 | 1.34 | 13 000 | .001215 | 36 500 | 5.02 | 8.25 | 278 900 | 328 600 | .849 | .001223 | 2180 | 1635 | 1925 | .75 | .88 | 114 |
| Average | | | | | | | | | 14 660 | (.605) | .001478 | 44 330 | | 1.18 | | | | | | | | .803 | | | | | .75 | .94 | 120 |
| 486 | 960 | 116.5 | 7 | 1.72 | 1.54 | 1.375 | 3000 | .000255 | 17 000 | .675 | .001572 | 47 200 | 37 620 | 1.25 | 15 000 | .001026 | 30 800 | 5.68 | 8.01 | 270 900 | 377 600 | .717 | .001347 | 2300 | 1430 | 1995 | .62 | .87 | 114 |
| 487 | 990 | 116.3 | 7 | 1.72 | 1.54 | 1.375 | 4000 | .000214 | 18 000 | .620 | .001350 | 40 500 | 37 230 | 1.09 | 17 000 | .001207 | 36 200 | 5.30 | 8.15 | 328 300 | 424 900 | .773 | .001360 | 2320 | 1825 | 2360 | .79 | 1.02 | 124 |
| 488 | 990 | 117.8 | 7 | 1.72 | 1.54 | 1.375 | 3500 | .000166 | 17 850 | (.660) | .001603 | 48 100 | 37 230 | 1.29 | 16 000 | .001174 | 35 200 | 5.25 | 8.17 | 320 500 | 400 900 | .799 | .001300 | 2260 | 1795 | 2245 | .79 | 1.99 | 117 |
| Average | | | | | | | | | 17 620 | .652 | .001508 | 45 270 | | 1.21 | | | | | | | | .763 | | | | | .73 | .96 | 118 |
| 498 | 1000 | 119.4 | 8 | 1.96 | 1.72 | 1.571 | 4100 | .000214 | 19 250 | (.696) | .001665 | 50 000 | 37 760 | 1.32 | 18 000 | .001256 | 37 700 | 5.59 | 8.04 | 365 900 | 449 100 | .815 | .001590 | 2520 | 1980 | 2430 | .79 | .96 | 122 |
| 499 | 1020 | 120.3 | 8 | 1.96 | 1.72 | 1.571 | 3100 | .000225 | 19 800 | (.700) | (.001708) | 51 200 | 38 620 | 1.33 | 18 000 | .001210 | 36 300 | 5.41 | 8.11 | 358 100 | 450 600 | .795 | .001426 | 2370 | 1985 | 2495 | .84 | 1.05 | 121 |
| 500 | 1000 | 118.9 | 8 | 1.96 | 1.72 | 1.571 | 4000 | .000209 | 19 760 | (.704) | .001658 | 49 700 | 37 760 | 1.32 | 18 000 | .001198 | 35 900 | 5.44 | 8.10 | 353 200 | 449 100 | .786 | .001428 | 2380 | 1950 | 2480 | .82 | 1.04 | 121 |
| Average | | | | | | | | | 19 600 | (.700) | .001677 | 50 300 | | 1.32 | | | | | | | | .799 | | | | | .82 | 1.02 | 121 |
| Grand Ave | | 118.1 | | | | | 2900 | .000192 | | | | | | | | | | | | | | | | | | | | .91 | 124 |

[1] Not used in average.

*Remarks.*—Average bond stress developed in beam=124 pounds per square inch. Average ultimate bond stress from bond test pieces=462 pounds per square inch. Ratio=3.7.

**Note.—Values in parentheses estimated.**

# Table 33.—Compression Tests on Granite Concrete of Medium Consistency Similar to that Used in Beams

**[Proportions 1 : 2 : 4 by volume, or 1 : 2.01 : 3.81 by weight]**

| Register number | Percentage of water | Cylinders | | | | | | Cubes | | | | Stress ratio of cylinders to cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | |
| | | Diameter, inches | Length, inches | | | | | Base, inches | Height, inches | | | |
| **AGE, 4 WEEKS** | | | | | | | | | | | | |
| 162 | 8.3 | 8.02 | 16.16 | 148.7 | 3083 | 4 200 000 | 900 | 6.04 x 5.99 | 6.02 | 148.8 | 3803 | ...... |
| 163 | 8.3 | 8.04 | 16.08 | 148.2 | 3521 | 4 100 000 | 900 | 6.03 x 6.03 | 6.07 | 144.9 | 4268 | ...... |
| 164 | 8.3 | 8.03 | 16.08 | 149.3 | 3120 | 3 900 000 | 1000 | 6.02 x 6.04 | 5.98 | 150.0 | 3880 | ...... |
| 174 | 8.3 | 7.98 | 16.02 | 148.8 | 3117 | 4 320 000 | 1000 | 6.01 x 6.01 | 6.09 | 147.3 | 4138 | ...... |
| 175 | 8.3 | 8.02 | 16.04 | 149.3 | 3045 | 4 080 000 | ....... | 6.03 x 6.02 | 6.03 | 146.0 | 3914 | ...... |
| 176 | 8.3 | 8.03 | 15.99 | 146.7 | 2772 | 4 240 000 | 1000 | 6.02 x 6.01 | 5.98 | 149.8 | 4076 | ...... |
| 186 | 8.3 | 7.99 | 15.75 | 149.3 | 3081 | 3 940 000 | 1000 | 6.03 x 6.03 | 5.98 | 145.1 | 3914 | ...... |
| 187 | 8.3 | 8.02 | 16.00 | 148.6 | 2784 | 4 000 000 | 1000 | 5.99 x 5.98 | 6.00 | 148.7 | 3349 | ...... |
| 188 | 8.3 | 8.00 | 16.25 | 147.5 | 2556 | 3 860 000 | 800 | 6.02 x 5.99 | 6.04 | 147.8 | 4060 | ...... |
| 198 | 8.3 | 7.98 | 15.75 | 151.4 | 3234 | 4 200 000 | 1000 | 6.04 x 5.94 | 6.09 | 148.3 | 2190 | ...... |
| 199 | 8.3 | 7.99 | 15.75 | 151.5 | 3311 | 3 920 000 | 1000 | 6.01 x 6.04 | 6.07 | 145.1 | 3657 | ...... |
| 200 | 8.3 | 7.94 | 16.00 | 151.3 | 2989 | 3 980 000 | 1000 | 6.01 x 6.01 | 5.98 | 150.0 | 4101 | ...... |
| 210 | 8.1 | 7.98 | 16.13 | 150.0 | 2879 | 4 200 000 | 800 | 6.00 x 6.00 | 6.14 | 148.5 | 3898 | ...... |
| 211 | 8.0 | 8.01 | 15.75 | 151.3 | 2480 | 3 930 000 | 1000 | 6.02 x 6.02 | 6.09 | 147.8 | 4063 | ...... |
| 212 | 8.0 | 8.02 | 16.00 | 148.0 | 2940 | 4 060 000 | 700 | 6.03 x 6.02 | 6.12 | 147.7 | 3581 | ...... |
| 222 | 8.1 | 8.02 | 15.88 | 152.2 | 3393 | 4 980 000 | 1000 | 6.02 x 6.02 | 6.14 | 145.6 | 3907 | ...... |
| 223 | 8.1 | 7.99 | 16.25 | 147.9 | 3312 | 4 380 000 | 1000 | 6.00 x 6.01 | 6.12 | 144.9 | 3674 | ...... |
| 224 | 8.1 | 8.00 | 16.13 | 149.2 | 3036 | 5 660 000 | 800 | 6.03 x 5.98 | 6.16 | 147.9 | 3981 | ...... |
| 237 | 8.1 | 7.99 | 15.75 | 152.6 | 3336 | 5 320 000 | 1000 | 6.03 x 6.03 | 6.07 | 146.8 | 4018 | ...... |
| 238 | 8.1 | 8.02 | 15.75 | 150.4 | 3041 | 4 520 000 | 800 | 5.99 x 6.00 | 6.04 | 143.3 | 3930 | ...... |
| 239 | 8.1 | 7.98 | 16.13 | 147.3 | 3097 | 4 230 000 | ....... | 5.98 x 6.09 | 6.03 | 145.6 | 3439 | ...... |
| Average. | | ....... | ....... | 149.4 | 3054 | 4 290 000 | 950 | ............ | ....... | ....... | 3802 | 0.803 |
| **AGE, 13 WEEKS** | | | | | | | | | | | | |
| 165 | 8.3 | 8.02 | 16.15 | 147.4 | [1] 3959 | 4 640 000 | 900 | 6.03 x 6.03 | 6.09 | 146.4 | 5274 | ...... |
| 166 | 8.3 | 8.00 | 16.04 | 149.5 | [1] 3979 | 4 760 000 | 1100 | 6.08 x 5.95 | 6.08 | 147.4 | 5130 | ...... |
| 167 | 8.3 | 8.06 | 16.07 | 147.0 | [1] 3920 | 4 280 000 | 1000 | 6.04 x 6.03 | 6.12 | 145.4 | 5200 | ...... |
| 177 | 8.3 | 8.01 | 16.03 | 148.1 | [1] 3969 | 4 540 000 | 1100 | 6.04 x 6.03 | 6.03 | 146.5 | 5349 | ...... |
| 178 | 8.3 | 8.00 | 16.00 | 148.0 | [1] 3979 | 4 480 000 | 1300 | 6.04 x 6.03 | 6.06 | 146.8 | 5036 | ...... |
| 179 | 8.3 | 8.02 | 16.02 | 147.1 | [1] 3957 | 4 540 000 | 1300 | 6.10 x 6.02 | 6.03 | 146.4 | 5178 | ...... |
| 189 | 8.3 | 8.01 | 16.01 | 149.1 | [1] 3969 | 4 580 000 | 1000 | 6.00 x 6.05 | 6.08 | 146.8 | 4599 | ...... |
| 190 | 8.3 | 8.05 | 16.07 | 147.9 | [1] 3930 | 3 930 000 | 1800 | 6.01 x 6.00 | 6.03 | 148.1 | 5026 | ...... |
| 191 | 8.3 | 8.00 | 16.08 | 148.0 | [1] 3979 | 4 440 000 | 1000 | 6.04 x 6.02 | 6.07 | 144.9 | 4753 | ...... |
| 201 | 8.3 | 7.99 | 16.03 | 147.8 | [1] 3989 | 4 540 000 | 800 | 6.03 x 6.00 | 6.11 | 146.6 | 5017 | ...... |
| 202 | 8.3 | 8.00 | 16.00 | 148.5 | [1] 3680 | 4 460 000 | 1200 | 6.05 x 6.09 | 6.12 | 143.8 | 4525 | ...... |
| 203 | 8.3 | 8.00 | 16.07 | 148.4 | [1] 3979 | 4 440 000 | 2000 | 6.03 x 6.18 | 6.13 | 143.7 | 5137 | ...... |
| 213 | 8.1 | 8.02 | 16.07 | 146.9 | [1] 3959 | 4 600 000 | 1000 | 6.02 x 6.02 | 1.15 | 145.8 | 5251 | ...... |
| 214 | 8.1 | 8.02 | 16.25 | 148.2 | [1] 3959 | 4 080 000 | 1900 | 6.00 x 6.19 | 6.06 | 145.9 | 5201 | ...... |
| 215 | 8.1 | 8.04 | 16.15 | 147.0 | [1] 3939 | 4 780 000 | 1900 | 6.02 x 6.00 | 6.15 | 147.4 | 5188 | ...... |
| 225 | 8.1 | 8.00 | 16.19 | 147.6 | [1] 3978 | 4 050 000 | 2700 | 6.04 x 6.04 | 6.00 | 148.0 | 5017 | ...... |
| 226 | 8.1 | 8.03 | 16.02 | 149.1 | [1] 3949 | 4 270 000 | 1100 | 6.02 x 6.00 | 6.07 | 147.9 | 5180 | ...... |
| 227 | 8.1 | 8.00 | 16.24 | 147.1 | [1] 3978 | 4 250 000 | 1800 | 6.08 x 6.03 | 6.02 | 146.8 | 4973 | ...... |
| 243 | 8.1 | 8.03 | 16.07 | 146.5 | [1] 3949 | 4 540 000 | 1000 | 6.02 x 6.06 | 6.01 | 147.8 | 4936 | ...... |
| 244 | 8.1 | 8.02 | 16.06 | 145.9 | [1] 3959 | 4 480 000 | 1300 | 6.04 x 6.09 | 5.98 | 147.4 | 4948 | ...... |
| 245 | 8.1 | 8.00 | 16.03 | 147.4 | [1] 3978 | 4 360 000 | 1200 | 6.00 x 6.02 | 6.10 | 145.1 | 4919 | ...... |
| Average. | | ....... | ....... | ....... | ....... | 4 430 000 | 1350 | ............ | ....... | ....... | 5040 | [1] 0.823 |

[1] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

Table 33.—Compression Tests on Granite Concrete of Medium Consistency Similar to that Used in Beams—Continued

AGE, 26 WEEKS

| Register number | Percentage of water | Cylinders | | | | | | Cubes | | | | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | |
| | | Diameter, inches | Length, inches | | | | | Base, inches | Height, inches | | | |
| 168 | 8.3 | 8.01 | 16.05 | 149.0 | [1] 3969 | 4 210 000 | 2400 | 6.00 x 6.02 | 6.08 | 146.5 | 5537 | ...... |
| 169 | 8.3 | 8.01 | 16.15 | 147.3 | [1] 3969 | 4 360 000 | 1700 | 6.02 x 6.02 | 5.98 | 151.5 | 5519 | ...... |
| 170 | 8.3 | 8.00 | 16.00 | 148.3 | [1] 3979 | 4 520 000 | 1700 | 6.02 x 6.02 | 5.96 | 149.0 | 5519 | ...... |
| 180 | 8.3 | 8.00 | 16.01 | 149.3 | [1] 3979 | 4 000 000 | 1900 | 6.02 x 6.02 | 6.01 | 148.8 | [1] 5519 | ...... |
| 181 | 8.3 | 8.05 | 16.02 | 148.4 | [1] 3930 | 4 640 000 | 1300 | 5.98 x 6.04 | 6.08 | 146.5 | [1] 5538 | ...... |
| 182 | 8.3 | 8.03 | 16.00 | 148.8 | [1] 3949 | 3 940 000 | 2400 | 6.01 x 6.05 | 6.10 | 144.1 | 5501 | ...... |
| 192 | 8.3 | 8.00 | 16.03 | 140.5 | [1] 3979 | 4 120 000 | 1200 | 6.00 x 6.00 | 6.00 | 147.0 | 4017 | ...... |
| 193 | 8.3 | 8.02 | 15.95 | 146.6 | [1] 3959 | 4 260 000 | 1000 | 6.00 x 6.00 | 6.00 | 148.0 | 4890 | ...... |
| 194 | 8.3 | 8.05 | 16.00 | 145.3 | [1] 3930 | 3 990 000 | 1800 | 6.00 x 6 00 | 6.00 | 148.0 | 5094 | ...... |
| 204 | 8.3 | 7.99 | 16.03 | 149.4 | [1] 4007 | 4 720 000 | 1200 | 6.08 x 6.00 | 6.00 | 148.0 | 5483 | ...... |
| 205 | 8.1 | 8.00 | 16.00 | 148.7 | [1] 3979 | 5 000 000 | 2000 | 6.03 x 5.99 | 6.00 | 148.0 | 5100 | ...... |
| 206 | 8.1 | 8.03 | 15.97 | 149.8 | [1] 3949 | 4 540 000 | 1700 | 5.97 x 6.12 | 6.00 | 149.4 | 5255 | ...... |
| 216 | 8.1 | 7.99 | 16.02 | 149.3 | [1] 3989 | 4 800 000 | 1800 | 6.13 x 5.98 | 6.00 | 147.8 | 4747 | ...... |
| 217 | 8.1 | 7.99 | 15.96 | 149.1 | [1] 3989 | 4 300 000 | 2800 | 6.09 x 5.98 | 6.00 | 148.3 | 5055 | ...... |
| 218 | 8.1 | 8.00 | 16.07 | 149.2 | [1] 3979 | 4 320 000 | 1700 | 6.04 x 6.03 | 6.00 | 148.3 | 5519 | ...... |
| 231 | 8.1 | 8.01 | 16.06 | 149.2 | [1] 3969 | 4 600 000 | 2000 | 5.98 x 6.03 | 6.06 | ...... | 5497 | ...... |
| 232 | 8.1 | 8.03 | 16.00 | 148.7 | [1] 3949 | 5 000 000 | 1100 | 6.00 x 6.00 | 6.02 | 146.5 | 5538 | ...... |
| 233 | 8.1 | 8.02 | 16.02 | 149.1 | [1] 3959 | 4 300 000 | 2200 | 6.03 x 5.98 | 6.08 | 150.3 | [1] 5546 | ...... |
| 240 | 8.1 | 8.00 | 16.02 | 149.7 | [1] 3979 | 4 900 000 | 1300 | 6.01 x 6.00 | 6.07 | 147.5 | 5091 | ...... |
| 241 | 8.1 | 8.01 | 16.00 | 147.5 | [1] 3969 | 4 920 000 | 1200 | 6.01 x 5.99 | 6.15 | 146.8 | 5507 | ...... |
| 242 | 8.1 | 8.00 | 16.02 | 148.3 | [1] 3979 | 4 540 000 | 1600 | 6.03 x 6.04 | 6.06 | 146.4 | 5439 | ...... |
| Average. | | ...... | ...... | ...... | ...... | 4 480 000 | 1700 | ...... | ...... | ...... | (5239) | [1] 0.849 |

AGE, 52 WEEKS

| Register number | Percentage of water | Diameter, inches | Length, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Base, inches | Height, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 171 | 8.3 | 8.04 | 16.01 | 148.8 | 5539 | 4 400 000 | 2300 | 6.01 x 6.09 | 6.02 | 147.5 | 6154 | ...... |
| 172 | 8.3 | 8.02 | 16.03 | 148.4 | 5838 | 4 760 000 | 1900 | 6.00 x 6.09 | 6.02 | 147.8 | 5176 | ...... |
| 173 | 8.3 | 7.99 | 15.98 | 149.1 | 5390 | 4 720 000 | 1900 | 6.00 x 6.00 | 6.00 | 149.0 | 5607 | ...... |
| 183 | 8.3 | 7.98 | 15.92 | 149.5 | 4716 | 4 740 000 | 1500 | 6.01 x 6.02 | 6.01 | 148.6 | 6362 | ...... |
| 184 | 8.3 | 8.00 | 16.04 | 148.9 | 5418 | 4 820 000 | 1200 | 6.03 x 6.00 | 6.00 | 149.3 | 6144 | ...... |
| 185 | 8.3 | 8.00 | 16.05 | 147.2 | 5271 | 5 080 000 | 2000 | 6.03 x 6.00 | 6.01 | 148.1 | 6142 | ...... |
| 195 | 8.3 | 8.02 | 16.00 | 149.9 | 5071 | 4 560 000 | 1700 | 6.02 x 5.99 | 6.00 | 147.8 | 4988 | ...... |
| 196 | 8.3 | 8.00 | 16.02 | 148.3 | 5197 | 4 320 000 | 1800 | 6.01 x 6.02 | 6.01 | 149.5 | 5076 | ...... |
| 197 | 8.3 | 7.98 | 16.00 | 148.9 | 4999 | 4 640 000 | 1600 | 6.04 x 6.02 | 6.01 | 147.3 | 5158 | ...... |
| 207 | 8.1 | 8.02 | 16.00 | 150.3 | 5305 | 4 880 000 | 1900 | 5.98 x 6.15 | 6.03 | 146.1 | 6580 | ...... |
| 208 | 8.1 | 8.00 | 15.98 | 149.5 | 5950 | 4 880 000 | 2300 | 6.02 x 6.08 | 6.01 | 148.3 | 6748 | ...... |
| 209 | 8.1 | 7.98 | 16.02 | 150.4 | 5299 | 4 880 000 | 1900 | 6.01 x 6.06 | 6.03 | 150.5 | 6168 | ...... |
| 219 | 8.1 | 8.00 | 16.12 | 148.7 | 5424 | 4 640 000 | 2100 | 6.00 x 6.07 | 6.01 | 149.0 | 6278 | ...... |
| 220 | 8.1 | 8.01 | 16.12 | 149.2 | 4961 | 5 160 000 | 1500 | 5.98 x 6.07 | 6.00 | 148.8 | 6572 | ...... |
| 221 | 8.1 | 7.98 | 16.08 | 149.8 | 5299 | 5 000 000 | 1800 | 6.01 x 6.09 | 6.01 | 148.3 | 6391 | ...... |
| 228 | 8.1 | 8.00 | 16.07 | 147.6 | 5968 | 5 200 000 | 1700 | 6.02 x 6.12 | 5.99 | 147.3 | 6432 | ...... |
| 229 | 8.1 | 8.01 | 16.13 | 148.8 | 5573 | 4 900 000 | 3100 | 6.04 x 6.17 | 6.01 | 146.6 | 5612 | ...... |
| 230 | 8.1 | 8.02 | 16.12 | 148.1 | 5065 | 4 700 000 | 2700 | 5.94 x 6.16 | 6.06 | 148.1 | 5426 | ...... |
| 234 | 8.1 | 7.99 | 16.05 | 148.8 | 4939 | 4 520 000 | 2300 | 5.99 x 6.09 | 6.01 | 147.8 | 6409 | ...... |
| 235 | 8.1 | 8.01 | 15.96 | 148.2 | 5058 | 4 640 000 | 2300 | 6.01 x 6.13 | 6.02 | 147.2 | 5774 | ...... |
| 236 | 8.1 | 8.00 | 15.98 | 147.7 | 4874 | 4 720 000 | 1700 | 6.02 x 6.09 | 6.03 | 146.6 | 6058 | ...... |
| Average. | | ...... | ...... | ...... | 5086 | 4 770 000 | 1962 | ...... | ...... | ...... | 5964 | .852 |

[1] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

## Table 34.—Compression Tests on Limestone Concrete of Medium Consistency Similar to that Used in Beams

**[Proportions 1:2:4 by volume, 1:2.01:3.91 by weight]**

**AGE, 4 WEEKS**

| | | Cylinders | | | | | | Cubes | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | | | | | Dimensions | | | | |
| Register number | Percentage of water | Diameter, inches | Length, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Base, inches | Height, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Stress ratio of cylinders to cubes |
| 255 | 10.0 | 8.00 | 16.21 | 145.5 | 2250 | 3 480 000 | 600 | 6.00 x 6.01 | 6.21 | 143.7 | 2896 | ...... |
| 256 | 10.0 | 8.01 | 16.20 | 145.2 | 2121 | 3 360 000 | 600 | 6.03 x 6.21 | 6.00 | 143.3 | 2935 | ...... |
| 257 | 10.0 | 8.00 | 16.20 | 146.1 | 1890 | 4 400 000 | 700 | 6.00 x 6.00 | 6.30 | 142.9 | 3518 | ...... |
| 261 | 10.0 | 7.99 | 16.01 | 146.4 | 2447 | 3 660 000 | 700 | 6.01 x 6.01 | 6.08 | ....... | 3216 | ...... |
| 262 | 10.0 | 8.01 | 16.00 | 146.5 | 2273 | 3 290 000 | 700 | 6.07 x 6.01 | 6.08 | ....... | 3015 | ...... |
| 263 | 10.0 | 8.02 | 16.00 | 145.4 | 1979 | 2 600 000 | 600 | 6.06 x 6.00 | 6.11 | ....... | 3086 | ...... |
| 273 | 10.0 | 8.01 | 16.12 | 146.5 | 2745 | 3 760 000 | 800 | 6.01 x 6.00 | 6.02 | 148.3 | 4116 | ...... |
| 274 | 10.0 | 8.01 | 16.00 | 145.7 | 2542 | 3 790 000 | 700 | 6.08 x 6.08 | 6.07 | 144.5 | 3420 | ...... |
| 275 | 10.0 | 7.99 | 16.13 | 146.1 | 2513 | 4 170 000 | 600 | 6.03 x 6.04 | 6.06 | 145.9 | 3664 | ...... |
| 285 | 10.0 | 8.05 | 16.15 | 146.1 | 3078 | 3 640 000 | 900 | 6.04 x 6.01 | 6.12 | 154.6 | 3554 | ...... |
| 286 | 10.0 | 8.08 | 16.10 | 146.0 | 2588 | 4 820 000 | 1300 | 6.06 x 6.04 | 6.01 | 145.3 | 4003 | ...... |
| 287 | 10.0 | 8.02 | 16.09 | 145.6 | 2679 | 3 800 000 | 1000 | 6.03 x 6.04 | 6.14 | 144.9 | 3655 | ...... |
| 297 | 10.0 | 8.03 | 16.06 | 145.2 | 2844 | 2 990 000 | 900 | 6.03 x 6.02 | 6.05 | 146.6 | 3446 | ...... |
| 298 | 10.0 | 8.01 | 16.11 | 145.3 | 2997 | 3 340 000 | 700 | 6.03 x 6.06 | 6.03 | 146.1 | 3293 | ...... |
| 299 | 10.0 | 8.02 | 16.12 | 144.9 | 2178 | 3 750 000 | 700 | 6.01 x 6.02 | 6.03 | 145.5 | 3015 | ...... |
| 318 | 10.0 | 8.01 | 16.01 | 147.2 | 2653 | 3 510 000 | 900 | 6.00 x 6.05 | 6.16 | 143.0 | 3581 | ...... |
| 319 | 10.0 | 8.04 | 16.14 | 145.8 | 2535 | 3 525 000 | 900 | 6.01 x 6.04 | 6.11 | 144.1 | 3325 | ...... |
| 320 | 10.0 | 8.08 | 16.04 | 143.9 | 1853 | 2 940 000 | 700 | 6.03 x 6.02 | 6.17 | 142.7 | 3085 | ...... |
| 321 | 10.0 | 7.98 | 16.11 | 146.6 | 2859 | 3 660 000 | 900 | 6.05 x 6.02 | 6.04 | 143.4 | 3405 | ...... |
| 322 | 10.0 | 8.01 | 16.11 | 147.1 | 2897 | 3 590 000 | 1000 | 6.05 x 6.25 | 6.00 | 139.0 | 3485 | ...... |
| 323 | 10.0 | 8.03 | 16.03 | 145.3 | 2419 | 3 230 000 | 800 | 6.01 x 6.05 | 5.99 | 143.9 | 3511 | ...... |
| Average. | | ....... | ....... | ....... | 2492 | 3 590 000 | 800 | ............ | ....... | ....... | 3392 | 0.735 |

**AGE, 13 WEEKS**

| Register number | Percentage of water | Diameter, inches | Length, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Base, inches | Height, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Stress ratio of cylinders to cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 249 | 10.0 | 8.01 | 16.04 | 146.4 | 3417 | 3 440 000 | 1700 | 6.01 x 6.00 | 6.13 | 144.6 | 4332 | ...... |
| 250 | 10.0 | 8.03 | 16.07 | 146.0 | 3483 | 4 160 000 | 800 | 6.02 x 6.03 | 6.12 | 145.9 | 4118 | ...... |
| 251 | 10.0 | 8.00 | 16.20 | 146.4 | 3481 | 3 900 000 | 1300 | 6.04 x 5.98 | 6.16 | 145.7 | 4489 | ...... |
| 264 | 10.0 | 8.02 | 16.10 | 144.5 | 3609 | 3 790 000 | 1100 | 6.02 x 6.04 | 6.03 | 143.9 | 4410 | ...... |
| 265 | 10.0 | 8.02 | 16.00 | 147.0 | 3569 | 3 930 000 | 2000 | 6.02 x 6.04 | 6.04 | 145.6 | 4368 | ...... |
| 266 | 10.0 | 8.02 | 16.25 | 144.2 | 3768 | 4 150 000 | 900 | 6.02 x 6.05 | 6.10 | 144.0 | 4397 | ...... |
| 276 | 10.0 | 8.01 | 16.02 | 146.6 | 3878 | 4 110 000 | 1500 | 6.02 x 6.09 | 6.03 | 142.7 | 5111 | ...... |
| 277 | 10.0 | 8.01 | 16.04 | 147.5 | [1] 3969 | 4 460 000 | 1100 | 6.01 x 6.11 | 6.02 | 144.6 | 4303 | ...... |
| 278 | 10.0 | 8.02 | 16.01 | 145.3 | 3959 | 3 900 000 | 1500 | 5.90 x 6.02 | 6.08 | 145.9 | 4541 | ...... |
| 288 | 10.0 | 8.00 | 16.08 | 147.0 | 3777 | 3 980 000 | 1200 | 6.01 x 6.05 | 6.15 | 142.9 | 5123 | ...... |
| 289 | 10.0 | ....... | ....... | ....... | ....... | ............ | ....... | 6.03 x 6.02 | 6.12 | 142.0 | 4905 | ...... |
| 290 | 10.0 | 8.01 | 16.11 | 146.3 | [1] 3969 | 4 260 000 | 900 | 6.05 x 6.00 | 6.14 | 143.5 | 4802 | ...... |
| 300 | 10.4 | 8.01 | 16.20 | 145.5 | 3494 | 2 400 000 | 2700 | 6.03 x 6.07 | 6.00 | 137.7 | 4025 | ...... |
| 301 | 10.0 | 8.03 | 16.03 | 144.7 | 3306 | 3 660 000 | 1400 | 6.04 x 6.17 | 6.03 | 134.6 | 3713 | ...... |
| 302 | 10.0 | 8.04 | 16.14 | 143.9 | 2826 | 3 990 000 | 1500 | 5.98 x 6.02 | 6.12 | 135.4 | 3815 | ...... |
| 312 | 10.2 | 7.99 | 16.09 | 146.7 | 3968 | 3 400 000 | 2000 | 6.03 x 6.13 | 6.03 | 135.7 | 4645 | ...... |
| 313 | 10.0 | 8.00 | 16.20 | 145.4 | 3562 | 3 885 000 | 1500 | 6.02 x 6.03 | 6.04 | 140.0 | 4083 | ...... |
| 314 | 10.0 | 8.00 | 16.08 | 145.4 | 3362 | 2 980 000 | 1500 | 6.01 x 6.03 | 6.01 | 140.8 | 4331 | ...... |
| 324 | 10.0 | 7.98 | 16.06 | 147.6 | 3826 | 4 180 000 | 1700 | 6.03 x 6.03 | 6.05 | 147.4 | 4300 | ...... |
| 325 | 10.0 | 7.99 | 16.08 | 147.1 | 3809 | 3 860 000 | 1200 | 6.02 x 6.02 | 6.06 | 145.6 | 4648 | ...... |
| 326 | 10.0 | 8.00 | 16.05 | 146.7 | 3700 | 3 790 000 | 1400 | 6.06 x 6.15 | 6.02 | 142.5 | 4387 | ...... |
| Average. | | ....... | ....... | ....... | 3600 | 3 810 000 | 1450 | ............ | ....... | ....... | 4421 | 0.814 |

[1] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

Table 34.—Compression Tests on Limestone Concrete of Medium Consistency Similar to that Used in Beams—Continued

AGE, 26 WEEKS

| Register number | Percentage of water | Cylinders | | | | | | Cubes | | | | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | |
| | | Diameter, inches | Length, inches | | | | | Base, inches | Height, inches | | | |
| 252 | 10.0 | 7.99 | 16.09 | 147.4 | 3636 | 4 400 000 | 1500 | 6.04 x 6.00 | 6.11 | 146.4 | 4228 | ...... |
| 253 | 10.0 | 8.00 | 16.09 | 147.6 | 3327 | 4 280 000 | 1600 | 6.06 x 6.01 | 6.11 | 144.6 | 4106 | ...... |
| 254 | 10.0 | 7.99 | 16.03 | 147.0 | 3577 | 4 120 000 | 1300 | 5.99 x 6.01 | 6.08 | 147.0 | 4115 | ...... |
| 267 | 10.0 | 7.99 | 16.10 | 148.1 | 3901 | 3 940 000 | 1400 | 5.98 x 6.02 | 6.12 | 145.6 | 4838 | ...... |
| 268 | 10.0 | 7.99 | 16.04 | 147.3 | 3761 | 4 040 000 | 1800 | 6.04 x 6.02 | 6.04 | 147.5 | 4903 | ...... |
| 269 | 9.8 | 8.00 | 16.04 | 147.6 | 3948 | 4 240 000 | 1800 | 6.03 x 6.02 | 6.05 | 148.7 | 5408 | ...... |
| 279 | 10.0 | 7.99 | 16.08 | 147.7 | 3690 | 4 000 000 | 1400 | 6.03 x 6.00 | 6.06 | 146.9 | 4875 | ...... |
| 280 | 10.0 | 8.02 | 16.06 | 146.5 | 3667 | 3 860 000 | 1500 | 6.0 x 6.00 | 6.08 | 147.6 | 4876 | ...... |
| 281 | 10.0 | 8.00 | 16.06 | 148.1 | 3956 | 4 360 000 | 1200 | 6.03 x 6.00 | 6.03 | 148.0 | 3606 | ...... |
| 291 | 10.0 | 8.00 | 16.06 | 148.5 | [1] 3979 | 4 500 000 | 1400 | 6.01 x 6.01 | 6.06 | 147.5 | 5056 | ...... |
| 292 | 10.0 | 7.99 | 16.13 | 148.0 | [1] 3989 | 4 780 000 | 1300 | 6.02 x 6.00 | 6.00 | 148.0 | 4927 | ...... |
| 293 | 10.0 | 7.99 | ...... | ...... | [1] 3989 | 4 160 000 | 1600 | 6.0 x 6.01 | 6.08 | 147.9 | 4113 | ...... |
| 303 | 10.0 | 7.99 | 16.01 | 148.0 | 3904 | 4 400 000 | 1300 | 5.99 x 6.02 | 6.08 | 147.9 | 4250 | ...... |
| 304 | 10.0 | 7.99 | 16.14 | 147.3 | 3690 | 4 500 000 | 1000 | 6.0 x 6.01 | 6.08 | 147.4 | 4331 | ...... |
| 305 | 10.2 | 7.99 | 16.10 | 147.8 | 3789 | 4 340 000 | 1400 | 6.04 x 6.00 | 6.12 | 146.0 | 4344 | ...... |
| 315 | 10.0 | 8.02 | 16.00 | 147.5 | 3781 | 4 500 000 | 1400 | 6.0 x 6.03 | 6.08 | 146.8 | 4000 | ...... |
| 316 | 10.0 | 8.00 | 16.00 | 147.5 | 3912 | 3 780 000 | 1500 | 5.97 x 5.96 | 6.07 | 149.5 | 4727 | ...... |
| 317 | 10.0 | 8.00 | 16.00 | 146.2 | 3803 | 4 400 000 | 1300 | 6.0 x 6.00 | 6.06 | 147.0 | 4503 | ...... |
| 327 | 10.0 | 7.99 | 16.03 | 147.8 | 3890 | 4 580 000 | 900 | 6.03 x 6.05 | 6.00 | 148.0 | 4839 | ...... |
| 328 | 10.0 | 8.00 | 16.14 | 147.5 | 3879 | 4 640 000 | 1300 | 6.02 x 6.05 | 6.00 | 148.3 | 4248 | ...... |
| 329 | 10.0 | 7.98 | 15.95 | 148.4 | 3899 | 4 780 000 | 1400 | 6.02 x 6.00 | 6.00 | 148.5 | 4271 | ...... |
| Average. | | ...... | ...... | ...... | 3778 | 4 310 000 | 1400 | ...... | ...... | ...... | 4503 | 0.839 |

AGE, 52 WEEKS

| Register number | Percentage of water | Diameter, inches | Length, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Base, inches | Height, inches | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 246 | 10.0 | 8.00 | 16.18 | 147.6 | 4101 | 4 280 000 | 1800 | 6.03 x 6.06 | 6.02 | 146.3 | 4659 | ...... |
| 247 | 10.0 | 8.01 | 16.15 | 146.7 | 4136 | 4 460 000 | 1700 | 6.03 x 6.15 | 5.99 | 147.3 | 4560 | ...... |
| 248 | 10.0 | 8.01 | 16.08 | 146.3 | 3969 | 4 040 000 | 1700 | 6.09 x 6.01 | 6.01 | 148.3 | 4652 | ...... |
| 270 | 9.8 | 8.00 | 16.10 | 147.4 | 4575 | 4 400 000 | 1600 | 6.03 x 6.00 | 6.00 | 147.3 | 5228 | ...... |
| 271 | 10.0 | 8.00 | 16.20 | 148.0 | 4600 | 4 760 000 | 1500 | 6.03 x 6.07 | 5.98 | 149.0 | 5111 | ...... |
| 272 | 10.0 | 8.01 | 16.04 | 148.8 | 4657 | 4 880 000 | 1700 | 6.09 x 6.00 | 5.99 | 147.5 | 5122 | ...... |
| 282 | 10.0 | 7.99 | 15.98 | 147.7 | 4265 | 4 680 000 | 1700 | 6.00 x 6.02 | 6.00 | 147.0 | 5498 | ...... |
| 283 | 10.0 | 7.99 | 16.03 | 147.8 | 4353 | 4 720 000 | 1700 | 6.08 x 6.03 | 5.97 | 147.0 | 4849 | ...... |
| 284 | 10.0 | 8.01 | 16.18 | 146.2 | 4463 | 4 540 000 | 1600 | 6.02 x 6.02 | 6.01 | 147.9 | 4560 | ...... |
| 294 | 10.0 | 7.99 | 16.10 | 149.0 | 4089 | 4 600 000 | 1800 | 6.00 x 6.08 | 6.00 | 147.5 | 4959 | ...... |
| 295 | 10.0 | 8.00 | 15.98 | 148.8 | 4641 | 4 720 000 | 1500 | 5.98 x 6.01 | 5.99 | 150.5 | 4786 | ...... |
| 296 | 10.0 | 7.98 | 16.06 | 149.5 | 5122 | 4 620 000 | 1600 | 5.96 x 6.10 | 6.00 | 150.0 | 5090 | ...... |
| 306 | 10.2 | 8.00 | 16.14 | 147.6 | 4151 | 4 240 000 | 1500 | 5.98 x 5.99 | 6.00 | 148.2 | 5179 | ...... |
| 307 | 10.0 | 8.01 | 16.12 | 148.0 | 4326 | 4 860 000 | 1500 | 6.00 x 6.03 | 6.00 | 150.3 | 5019 | ...... |
| 308 | 10.0 | 8.01 | 16.08 | 147.5 | 4526 | 4 580 000 | 1600 | 6.02 x 6.07 | 6.00 | 148.2 | 5282 | ...... |
| 309 | 10.0 | 8.03 | 16.06 | 145.3 | 4328 | 4 640 000 | 1500 | 5.99 x 6.09 | 6.00 | 146.5 | 4896 | ...... |
| 310 | 10.0 | 8.01 | 16.16 | 145.6 | 4366 | 4 160 000 | 2100 | 6.02 x 6.07 | 6.03 | 147.0 | 4779 | ...... |
| 311 | 10.2 | 8.02 | 16.10 | 145.3 | 4584 | 4 500 000 | 1700 | 5.92 x 6.02 | 6.03 | 148.7 | 4277 | ...... |
| 330 | 10.0 | 8.00 | 16.04 | 148.3 | 4626 | 4 840 000 | 1700 | 6.00 x 6.10 | 6.00 | 146.6 | 5682 | ...... |
| 331 | 10.0 | 8.01 | 16.20 | 146.5 | 3811 | 4 560 000 | 1700 | 6.05 x 6.01 | 6.02 | 147.5 | 5008 | ...... |
| 332 | 10.0 | 7.98 | 16.10 | 147.9 | 4252 | 4 560 000 | 1500 | 5.97 x 6.12 | 6.05 | 147.6 | 4592 | ...... |
| Average. | | ...... | ...... | ...... | 4378 | 4 550 000 | 1652 | ...... | ...... | ...... | 4942 | 0.886 |

[1] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

## Table 35.—Compression Tests on Gravel Concrete of Medium Consistency Similar to that Used in Beams

**[Proportions 1:2:4 by volume 1:2.01:4.10 by weight**

| Register number | Percentage of water | Cylinders | | | | | | Cubes | | | | Stress ratio of cylinders to cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | |
| | | Diameter, inches | Length, inches | | | | | Base, inches | Height, inches | | | |
| **AGE, 4 WEEKS** | | | | | | | | | | | | |
| 333 | 8.6 | 8.03 | 16.17 | 143.8 | 3626 | 5 040 000 | ...... | 6.07 x 6.04 | 6.11 | 141.8 | 3692 | ...... |
| 334 | 8.6 | 8.07 | 16.16 | 141.9 | 3646 | 4 940 000 | 1300 | 6.01 x 6.00 | 6.08 | 142.8 | 4243 | ...... |
| 335 | 9.0 | 7.99 | 16.07 | 144.5 | 3051 | 4 380 000 | 1200 | 6.04 x 6.05 | 6.12 | 140.1 | 4105 | ...... |
| 345 | 9.0 | 8.10 | 16.18 | 140.1 | 2939 | 4 620 000 | 800 | 6.01 x 6.01 | 6.15 | 142.9 | 4098 | ...... |
| 346 | 9.0 | 8.02 | 16.15 | 143.5 | 2573 | 4 360 000 | 900 | 6.18 x 5.97 | 6.15 | 139.9 | 3740 | ...... |
| 347 | 9.0 | 8.01 | 16.20 | 143.1 | 2719 | 4 440 000 | 900 | 6.03 x 6.11 | 6.13 | 141.5 | 4228 | ...... |
| 357 | 9.4 | 8.03 | 16.28 | 143.9 | 3735 | 4 720 000 | 1100 | 6.05 x 6.04 | 6.10 | 143.4 | 4576 | ...... |
| 358 | 9.4 | 8.00 | 16.24 | 145.0 | 3386 | 4 620 000 | 1100 | 6.06 x 6.11 | 6.17 | 139.9 | 4144 | ...... |
| 359 | 9.3 | 8.03 | 16.28 | 143.8 | 3199 | 4 740 000 | 1000 | 5.98 x 6.08 | 6.13 | 143.4 | 4106 | ...... |
| 369 | 9.3 | 8.03 | 16.06 | 143.4 | 3268 | 5 020 000 | 1000 | 6.05 x 6.02 | 6.11 | 141.7 | 3763 | ...... |
| 370 | 9.3 | 8.03 | 16.17 | 143.5 | 3092 | 4 620 000 | 1100 | 6.00 x 6.04 | 6.11 | 142.5 | 3804 | ...... |
| 371 | 9.4 | 8.03 | 16.11 | 143.2 | 3389 | 4 800 000 | 1000 | 6.01 x 6.01 | 6.11 | 143.9 | 3465 | ...... |
| 381 | 9.4 | 8.02 | 16.11 | 143.3 | 2652 | 3 880 000 | 900 | ........... | ...... | ...... | ....... | ...... |
| 382 | 9.4 | 7.98 | 16.12 | 146.3 | 3079 | 4 400 000 | 1000 | ........... | ...... | ...... | ....... | ...... |
| 383 | 9.4 | 8.02 | 16.05 | 144.6 | 3317 | 4 160 000 | 1100 | ........... | ...... | ...... | ....... | ...... |
| [1] 393 | 9.6 | 8.00 | 16.27 | 145.8 | 3232 | 4 000 000 | 600 | ........... | ...... | ...... | ....... | ...... |
| [1] 394 | 9.6 | 8.03 | 16.25 | 143.8 | 2861 | 4 410 000 | 1000 | ........... | ...... | ...... | ....... | ...... |
| [1] 395 | 9.8 | 8.01 | 16.10 | 144.1 | 2778 | 4 290 000 | 900 | ........... | ...... | ...... | ....... | ...... |
| [1] 405 | 9.8 | 8.00 | 16.13 | 147.1 | 3561 | 5 040 000 | 1200 | ........... | ...... | ...... | ....... | ...... |
| [1] 406 | 9.8 | 8.04 | 16.05 | 145.0 | 3211 | 5 720 000 | 1400 | ........... | ...... | ...... | ....... | ...... |
| [1] 407 | 9.8 | 8.03 | 16.11 | 145.1 | 3357 | 4 380 000 | 1200 | ........... | ...... | ...... | ....... | ...... |
| Average. | | ...... | ...... | ...... | 3175 | 4 600 000 | 1050 | ........... | ...... | ...... | 3997 | 0.794 |
| **AGE, 13 WEEKS** | | | | | | | | | | | | |
| 336 | 9.0 | 8.02 | 16.15 | 143.8 | [2] 3959 | 4 015 000 | 2900 | 6.04 x 6.04 | 6.10 | 147.7 | 4975 | ...... |
| 337 | 9.0 | 8.00 | 16.18 | 143.7 | [2] 3979 | 4 780 000 | 2700 | 6.16 x 6.00 | 6.03 | 140.5 | 4690 | ...... |
| 338 | 9.0 | 8.01 | 16.24 | 142.0 | [2] 3969 | 4 640 000 | 1500 | 6.07 x 6.03 | 5.98 | 144.1 | 4795 | ...... |
| 348 | 9.0 | 8.00 | 16.14 | 144.0 | [2] 3979 | 4 860 000 | 1600 | 6.00 x 6.02 | 6.18 | 142.3 | 4606 | ...... |
| 349 | 9.6 | 8.02 | 16.09 | 143.8 | [2] 3959 | 3 980 000 | 2700 | 6.00 x 6.00 | 6.08 | 145.1 | 4596 | ...... |
| 350 | 9.6 | 8.00 | 16.15 | 143.9 | [2] 3979 | 4 760 000 | 1600 | 6.00 x 6.04 | 6.04 | 143.1 | 4527 | ...... |
| 360 | 9.3 | 8.01 | 16.10 | 145.1 | [2] 3969 | 4 920 000 | 2000 | 6.02 x 6.01 | 6.08 | 143.4 | 4552 | ...... |
| 361 | 9.3 | 8.00 | 16.10 | 144.7 | [2] 3979 | 4 100 000 | 1800 | 6.05 x 6.09 | 6.15 | 139.2 | 4180 | ...... |
| 362 | 9.3 | 8.01 | 16.15 | 144.7 | [2] 3969 | •5 360 000 | 1200 | 6.01 x 6.01 | 6.00 | 145.5 | 4283 | ...... |
| 372 | 9.4 | 8.02 | 16.25 | 143.7 | [2] 3959 | 4 560 000 | 2300 | 6.05 x 6.03 | 6.14 | 141.8 | 5003 | ...... |
| 373 | 9.4 | 8.00 | 16.15 | 144.5 | [2] 3979 | 4 680 000 | 2200 | 6.06 x 6.00 | 6.10 | 149.0 | 5052 | ...... |
| 374 | 9.4 | 8.02 | 16.18 | 144.3 | [2] 3959 | 4 900 000 | 2100 | 6.02 x 6.07 | 6.03 | 144.2 | 4909 | ...... |
| 384 | 9.4 | 8.02 | 16.12 | 144.3 | [2] 3959 | 4 680 000 | 2400 | 6.02 x 6.03 | 6.07 | 144.2 | 5018 | ...... |
| 385 | 9.4 | 8.01 | 16.15 | 144.9 | [2] 3969 | 4 800 000 | 2200 | 6.04 x 5.98 | 6.13 | 143.5 | 5382 | ...... |
| 386 | 9.4 | 8.04 | 16.15 | 142.8 | [2] 3939 | 4 720 000 | 2000 | 6.03 x 5.98 | 6.09 | 143.6 | 4906 | ...... |
| [1] 396 | 9.8 | 8.02 | 16.00 | 144.6 | [2] 3959 | 4 740 000 | 1400 | 6.00 x 6.15 | 6.00 | 142.5 | 4808 | ...... |
| [1] 397 | 9.8 | 8.03 | 16.11 | 144.5 | 3929 | 4 680 000 | 2500 | 6.05 x 6.03 | 6.10 | 141.7 | 4863 | ...... |
| [1] 398 | 9.8 | 8.00 | 16.15 | 145.3 | 3780 | 4 540 000 | 2100 | 6.07 x 6.04 | 6.05 | 143.2 | 4655 | ...... |
| [1] 408 | 9.8 | 8.00 | 16.10 | 145.5 | [2] 3979 | 4 470 000 | 2900 | 6.10 x 6.03 | 6.04 | 144.0 | 4872 | ...... |
| [1] 409 | 9.8 | 8.00 | 16.14 | 143.0 | 3596 | 4 310 000 | 2400 | 6.13 x 6.03 | 6.00 | 143.2 | 4171 | ...... |
| [1] 410 | 9.8 | 8.00 | 16.12 | 145.3 | 3978 | 4 450 000 | 2100 | 6.11 x 6.07 | 6.05 | 141.6 | 4460 | ...... |
| Average. | | ...... | ...... | ...... | (3821) | 4 620 000 | 2100 | ........... | ...... | ...... | 4729 | 0.846 |

[1] Proportions 1:2:4 by volume. 1:2.01:3.99 by weight.
[2] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

Table 35.—Compression Tests on Gravel Concrete of Medium Consistency Similar to that Used in Beams—Continued

AGE, 26 WEEKS

| Register number | Percentage of water | Cylinders: Dimensions: Diameter, inches | Cylinders: Dimensions: Length, inches | Cylinders: Weight, lbs. per cu. ft. | Cylinders: Ultimate strength, lbs. per sq. in. | Cylinders: Initial modulus of elasticity | Cylinders: Yield point | Cubes: Dimensions: Base, inches | Cubes: Dimensions: Height, inches | Cubes: Weight, lbs. per cu. ft. | Cubes: Ultimate strength, lbs. per sq. in. | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 339 | 9.0 | 8.00 | 16.60 | 140.3 | [2] 3979 | 5 440 000 | 1600 | 6.00 x 6.03 | 6.01 | 143.6 | 5063 | ...... |
| 340 | 9.0 | 8.01 | 16.10 | 145.0 | [2] 3969 | 5 060 000 | 1300 | 6.01 x 6.08 | 6.02 | 143.4 | 5405 | ...... |
| 341 | 9.0 | 8.02 | 16.03 | 145.0 | [2] 3959 | 5 420 000 | 1600 | 6.03 x 6.00 | 6.00 | 145.8 | 5153 | ...... |
| 351 | 9.4 | 8.01 | 16.16 | 144.4 | [2] 3969 | 5 260 000 | 1600 | 6.03 x 6.05 | 6.03 | 144.9 | 5091 | ...... |
| 352 | 9.4 | 7.99 | 16.40 | 142.1 | [2] 3989 | 5 040 000 | 1600 | 6.07 x 6.02 | 6.03 | 145.1 | 5044 | ...... |
| 353 | 9.4 | 8.00 | 16.12 | 145.7 | [2] 3979 | 5 420 000 | 1500 | 6.02 x 6.04 | 5.99 | 146.3 | 5406 | ...... |
| 363 | 9.3 | 8.00 | 16.08 | 145.5 | [2] 3979 | 4 940 000 | 1600 | 6.01 x 6.05 | 6.00 | 144.5 | 4959 | ...... |
| 364 | 9.3 | 8.01 | 16.16 | 145.7 | [2] 3969 | 4 940 000 | 2500 | 6.06 x 6.09 | 5.97 | 144.6 | 5196 | ...... |
| 365 | 9.3 | 7.99 | 16.16 | 145.1 | [2] 3989 | 4 900 000 | 1800 | 6.02 x 6.06 | 6.04 | 145.1 | 4939 | ...... |
| 375 | 9.4 | 8.01 | 16.08 | 145.0 | [2] 3969 | 5 200 000 | 1500 | 6.01 x 6.11 | 6.02 | 144.2 | 5163 | ...... |
| 376 | 9.4 | 8.00 | 16.16 | 144.2 | [2] 3979 | 5 200 000 | 1500 | 6.00 x 6.06 | 6.00 | 145.1 | 5388 | ...... |
| 377 | 9.4 | 7.99 | 16.08 | 146.0 | [2] 3989 | 4 940 000 | 1500 | 6.07 x 6.01 | 6.04 | 146.1 | [2] 5483 | ...... |
| 387 | 9.4 | 8.02 | 16.14 | 145.0 | [2] 3959 | 5 080 000 | 1400 | 6.06 x 5.94 | 6.06 | 144.5 | 4648 | ...... |
| 388 | 9.4 | 7.99 | 16.10 | 145.3 | [2] 3989 | 5 500 000 | 1600 | 6.00 x 6.09 | 6.01 | 144.6 | 4803 | ...... |
| [1] 389 | 9.4 | 8.00 | 16.13 | 145.2 | [2] 3979 | 6 080 000 | 1200 | 6.03 x 6.05 | 6.01 | 146.3 | 5154 | ...... |
| [1] 399 | 9.8 | 8.00 | 16.13 | 145.6 | [2] 3979 | 4 940 000 | 1900 | 6.02 x 6.09 | 6.03 | 144.5 | 4148 | ...... |
| [1] 400 | 9.8 | 8.00 | 16.10 | 145.9 | [2] 3979 | 5 320 000 | 1200 | 6.03 x 6.10 | 6.03 | 145.1 | 4111 | ...... |
| [1] 401 | 9.8 | 7.99 | 16.17 | 146.1 | [2] 3989 | 4 960 000 | 1600 | 6.00 x 6.04 | 6.01 | ....... | 4813 | ...... |
| [1] 411 | 9.9 | 7.99 | 16.02 | 146.0 | [2] 3989 | 5 400 000 | 1400 | 6.00 x 6.05 | 6.04 | 143.8 | 3339 | ...... |
| [1] 412 | 9.9 | 8.00 | 16.12 | 145.8 | [2] 3979 | 5 480 000 | 1400 | 6.00 x 6.04 | 6.01 | 144.8 | 3994 | ...... |
| [1] 413 | 9.9 | 8.00 | 16.15 | 144.9 | [2] 3979 | 5 600 000 | 1400 | 6.02 x 6.01 | 6.03 | 144.5 | 3788 | ...... |
| Average. | | ...... | ...... | ...... | ...... | 5 240 000 | 1550 | ........... | ...... | ...... | 4830 | 0.88 |

AGE, 52 WEEKS

| Register number | Percentage of water | Cylinders: Dimensions: Diameter, inches | Cylinders: Dimensions: Length, inches | Cylinders: Weight, lbs. per cu. ft. | Cylinders: Ultimate strength, lbs. per sq. in. | Cylinders: Initial modulus of elasticity | Cylinders: Yield point | Cubes: Dimensions: Base, inches | Cubes: Dimensions: Height, inches | Cubes: Weight, lbs. per cu. ft. | Cubes: Ultimate strength, lbs. per sq. in. | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 342 | 9.0 | 8.00 | 16.12 | 145.5 | 5028 | 5 220 000 | 2100 | 6.11 x 5.97 | 6.03 | 144.4 | 5914 | ...... |
| 343 | 9.0 | 8.00 | 16.16 | 145.2 | 5073 | 5 600 000 | 2000 | 6.03 x 6.02 | 6.01 | 144.5 | 5762 | ...... |
| 344 | 9.0 | 8.00 | 16.06 | 145.0 | 5458 | 5 720 000 | 2200 | 6.01 x 6.13 | 6.01 | 143.5 | 5800 | ...... |
| 354 | 9.4 | 7.99 | 16.04 | 146.6 | 5086 | 5 600 000 | 2200 | 6.00 x 6.08 | 5.99 | 144.3 | 5857 | ...... |
| 355 | 9.4 | 8.00 | 16.24 | 145.3 | 4471 | 5 280 000 | 1800 | 6.00 x 6.12 | 6.00 | 144.2 | 5502 | ...... |
| 356 | 9.4 | 7.98 | 16.06 | 145.7 | 5341 | 5 600 000 | 1500 | 6.00 x 6.08 | 6.01 | 144.8 | 4709 | ...... |
| 366 | 9.3 | 7.99 | 16.12 | 145.7 | 5477 | 5 380 000 | 2100 | 6.13 x 6.02 | 6.01 | 143.7 | 5381 | ...... |
| 367 | 9.3 | 7.98 | 16.16 | 146.2 | 4999 | 4 800 000 | 2800 | 6.08 x 6.00 | 5.99 | 145.8 | 5433 | ...... |
| 368 | 9.3 | 7.99 | 16.18 | 146.0 | 5251 | 5 120 000 | 2400 | 6.01 x 6.09 | 6.04 | 145.7 | 5651 | ...... |
| 378 | 9.4 | 8.00 | 16.05 | 146.7 | 5667 | 5 500 000 | 1800 | 6.03 x 6.01 | 6.00 | 155.0 | 6512 | ...... |
| 379 | 9.4 | 8.01 | 16.13 | 145.1 | 5646 | 5 700 000 | 2300 | 6.00 x 6.05 | 6.00 | 156.7 | 6072 | ...... |
| 380 | 9.4 | 8.00 | 16.02 | 145.7 | 5636 | 5 120 000 | 2200 | 6.00 x 6.09 | 5.99 | 146.0 | 6240 | ...... |
| 390 | 9.4 | 8.00 | 16.07 | 145.9 | 5761 | 5 360 000 | 2200 | 5.99 x 6.10 | 6.03 | 144.2 | 5496 | ...... |
| 391 | 9.4 | 7.98 | 16.06 | 146.1 | 4933 | 4 860 000 | 2600 | 6.00 x 6.10 | 6.00 | 144.6 | 5290 | ...... |
| [1] 392 | 9.4 | 8.02 | 16.10 | 145.3 | 4949 | 5 860 000 | 1900 | 6.01 x 6.07 | 6.03 | 144.4 | 5456 | ...... |
| [1] 402 | 9.8 | 7.99 | 16.13 | 146.4 | 4886 | 5 740 000 | 2400 | 6.03 x 6.12 | 5.99 | 144.6 | 5759 | ...... |
| 403 | 9.8 | 7.98 | 16.07 | 147.3 | 5400 | 5 600 000 | 2200 | 6.00 x 6.12 | 6.02 | 145.7 | 5490 | ...... |
| 404 | 9.8 | 7.99 | 16.17 | 146.9 | 4687 | 5 260 000 | 1900 | 6.00 x 6.13 | 5.99 | 147.1 | 5822 | ...... |
| 414 | 9.9 | 8.00 | 16.10 | 145.6 | 5288 | 5 140 000 | 2400 | 6.02 x 6.04 | 6.00 | 144.5 | 4932 | ...... |
| 415 | 9.9 | 8.00 | 16.08 | 146.4 | 5552 | 5 560 000 | 2000 | 6.01 x 6.12 | 6.00 | 144.9 | 5672 | ...... |
| 416 | 9.9 | 8.00 | 16.10 | 146.0 | 5561 | 5 280 000 | 1700 | 6.00 x 6.04 | 6.01 | 145.9 | 5906 | ...... |
| Average. | | ...... | ...... | ...... | 5245 | 5 395 000 | 2129 | ........... | ...... | ...... | 5650 | .928 |

[1] Proportions 1:2:4 by volume. 1:2.01:3,99 by weight.
[2] Exceeded capacity of testing machine of 200 000 lbs., equivalent to given stress.

# Table 36.—Compression Tests on Cinder Concrete of Medium Consistency Similar to that Used in Beams

[Proportions 1 : 2 : 4 by volume. 1 : 2.01 : 1.97 by weight.]

AGE, 4 WEEKS

| Register number | Percentage of water | Cylinders: Dimensions: Diameter, inches | Cylinders: Dimensions: Length, inches | Cylinders: Weight, lbs. per cu. ft. | Cylinders: Ultimate strength, lbs. per sq. in. | Cylinders: Initial modulus of elasticity | Cylinders: Yield point | Cubes: Dimensions: Base, inches | Cubes: Dimensions: Height, inches | Cubes: Weight, lbs. per cu. ft. | Cubes: Ultimate strength, lbs. per sq. in. | Stress ratio of cylinders to cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 417 | 19.2 | 7.99 | 16.08 | 121.6 | 1499 | 2 320 000 | 500 | ... | ... | ... | ... | ... |
| 418 | 19.2 | 8.06 | 16.21 | 118.3 | 1835 | 1 690 000 | 500 | ... | ... | ... | ... | ... |
| 419 | 19.3 | 8.01 | 16.14 | 119.5 | 1554 | 1 180 000 | 600 | ... | ... | ... | ... | ... |
| 429 | 18.9 | 8.04 | 16.11 | 120.4 | 1891 | 1 760 000 | 500 | 6.06 x 6.13 | 5.98 | 117.7 | 2417 | ... |
| 430 | 18.9 | 8.07 | 16.11 | 120.1 | 1918 | 1 820 000 | 500 | 6.02 x 6.00 | 6.04 | 119.8 | 2486 | ... |
| 431 | 18.9 | 8.08 | 16.10 | 119.6 | 1964 | 1 690 000 | 400 | 6.02 x 6.16 | 6.04 | 118.7 | 2523 | ... |
| 441 | 18.9 | 8.10 | 16.00 | 115.3 | 1514 | 1 190 000 | 500 | 6.05 x 6.05 | 6.10 | 117.1 | 2161 | ... |
| 442 | 18.9 | 8.03 | 16.10 | 117.9 | 1575 | 1 620 000 | 500 | 6.05 x 6.05 | 6.13 | 115.6 | 2195 | ... |
| 443 | 18.8 | 8.00 | 15.95 | 119.6 | 1577 | 1 600 000 | 600 | 5.98 x 6.08 | 6.04 | 117.2 | 2258 | ... |
| 453 | 18.8 | 8.03 | 16.16 | 118.5 | 1593 | 1 615 000 | 500 | ... | ... | ... | ... | ... |
| 454 | 18.8 | 8.04 | 16.30 | 117.5 | 1576 | 1 645 000 | 300 | ... | ... | ... | ... | ... |
| 455 | 18.9 | 8.01 | 16.18 | 117.9 | 1620 | 1 640 000 | 500 | ... | ... | ... | ... | ... |
| 465 | 18.9 | 8.01 | 16.25 | 116.1 | 1572 | 1 535 000 | 400 | 6.01 x 6.02 | 6.11 | 117.3 | 2170 | ... |
| 466 | 18.9 | 8.00 | 16.31 | 116.7 | 1534 | 1 435 000 | 400 | 6.07 x 6.04 | 6.09 | 116.1 | 2046 | ... |
| 467 | 18.9 | 8.01 | 16.16 | 119.1 | 1532 | 1 660 000 | 400 | 6.03 x 6.05 | 6.07 | 117.1 | 2121 | ... |
| 477 | 18.9 | 8.04 | 16.05 | 118.5 | 1614 | 1 660 000 | 400 | 6.05 x 5.97 | 6.15 | 116.7 | 2139 | ... |
| 478 | 18.9 | 8.02 | 16.07 | 119.2 | 1682 | 1 460 000 | 500 | 6.07 x 6.09 | 6.15 | 112.2 | ... | ... |
| 479 | 18.9 | 8.05 | 16.23 | 115.8 | 1603 | 1 540 000 | 400 | 6.05 x 6.03 | 6.08 | 114.0 | 1990 | ... |
| 489 | 18.9 | 8.03 | 16.05 | 116.9 | 1629 | 1 530 000 | 500 | 6.02 x 6.02 | 6.09 | 117.5 | 1956 | ... |
| 490 | 18.9 | 8.03 | 16.04 | 118.1 | 1710 | 1 680 000 | 300 | 6.04 x 6.03 | 6.12 | 116.3 | 1850 | ... |
| 491 | 18.9 | 8.02 | 16.05 | 118.3 | 1589 | 1 620 000 | 500 | 6.01 x 6.07 | 6.10 | 115.5 | 1849 | ... |
| Average. | | ... | ... | ... | 1647 | 1 610 000 | 450 | ... | ... | ... | 2154 | 0.763 |

AGE, 13 WEEKS

| Register number | Percentage of water | Cylinders: Dimensions: Diameter, inches | Cylinders: Dimensions: Length, inches | Cylinders: Weight, lbs. per cu. ft. | Cylinders: Ultimate strength, lbs. per sq. in. | Cylinders: Initial modulus of elasticity | Cylinders: Yield point | Cubes: Dimensions: Base, inches | Cubes: Dimensions: Height, inches | Cubes: Weight, lbs. per cu. ft. | Cubes: Ultimate strength, lbs. per sq. in. | Stress ratio of cylinders to cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 420 | 19.3 | 8.01 | 16.05 | 118.8 | 2260 | 1 700 000 | 900 | 6.00 x 6.01 | 6.02 | 117.4 | 2773 | ... |
| 421 | 19.5 | 8.00 | 16.05 | 120.2 | 2399 | 1 930 000 | 700 | 6.07 x 6.02 | 6.10 | 119.2 | 2442 | ... |
| 422 | 19.5 | 8.00 | 16.13 | 119.4 | 2322 | 1 930 000 | 600 | 6.04 x 6.03 | 6.11 | 117.5 | 2843 | ... |
| 432 | 18.9 | 8.00 | 16.16 | 121.5 | 2445 | 1 880 000 | 1100 | 6.05 x 6.02 | 6.18 | 118.0 | 2965 | ... |
| 433 | 18.9 | 8.02 | 16.01 | 120.5 | 2426 | 1 800 000 | 1000 | 6.04 x 6.04 | 6.18 | 118.9 | 2784 | ... |
| 434 | 18.9 | 8.00 | 16.09 | 119.4 | 2259 | 1 790 000 | 700 | 6.02 x 6.05 | 6.07 | 119.1 | 2858 | ... |
| 444 | 18.8 | 8.01 | 16.09 | 119.2 | 2147 | 1 730 000 | 900 | 6.03 x 6.03 | 6.10 | 115.9 | 2676 | ... |
| 445 | 18.8 | 8.00 | 16.05 | 120.2 | 2110 | 1 720 000 | 900 | 6.05 x 6.00 | 6.07 | 116.7 | 2590 | ... |
| 446 | 18.8 | 8.02 | 16.11 | 118.6 | 1981 | 1 870 000 | 900 | 6.01 x 6.03 | 6.02 | 120.7 | 2667 | ... |
| 456 | 18.9 | 8.00 | 16.10 | 119.1 | 2306 | 1 810 000 | 800 | 6.13 x 6.03 | 6.04 | 114.2 | 2166 | ... |
| 457 | 18.9 | 7.99 | 16.23 | 121.6 | 2266 | 1 910 000 | 900 | 5.99 x 6.00 | 6.01 | 120.0 | 1842 | ... |
| 458 | 18.9 | 8.00 | 16.11 | 119.6 | 2185 | 1 820 000 | 900 | 6.04 x 6.04 | 6.01 | 121.2 | 2423 | ... |
| 468 | 18.9 | 8.02 | 16.06 | 117.9 | 2203 | 1 740 000 | 1000 | 6.02 x 6.00 | 6.04 | 117.8 | 2556 | ... |
| 469 | 18.9 | 8.01 | 16.23 | 118.6 | 2180 | 1 730 000 | 900 | 6.02 x 6.01 | 6.09 | 116.7 | 2419 | ... |
| 470 | 18.9 | 8.01 | 16.15 | 119.2 | 2201 | 1 920 000 | 500 | 6.01 x 6.03 | 6.02 | 119.8 | 2541 | ... |
| 480 | 18.9 | 8.01 | 16.03 | 118.2 | 2150 | 1 850 000 | 600 | 6.04 x 6.08 | 6.04 | 115.9 | 2568 | ... |
| 481 | 18.9 | 8.00 | 16.13 | 118.3 | 2108 | 1 800 000 | 700 | 6.05 x 5.99 | 5.98 | 118.7 | 2644 | ... |
| 482 | 18.9 | 8.01 | 16.18 | 118.2 | 2121 | 1 840 000 | 600 | 6.06 x 6.02 | 5.97 | 119.0 | 2452 | ... |
| 492 | 18.9 | 8.01 | 16.01 | 119.9 | 2107 | 1 760 000 | 600 | 6.01 x 6.00 | 6.10 | 116.9 | 2516 | ... |
| 493 | 18.9 | 8.00 | 16.10 | 120.1 | ... | 1 740 000 | 700 | 6.01 x 6.02 | 6.10 | 115.5 | 2531 | ... |
| 494 | 18.9 | 8.00 | 16.02 | 118.6 | 2169 | 1 920 000 | 800 | 5.98 x 6.01 | 6.05 | 117.3 | 2739 | ... |
| Average. | | ... | ... | ... | 2217 | 1 820 000 | 800 | ... | ... | ... | 2571 | 0.862 |

Table 36.—Compression Tests on Cinder Concrete of Medium Consistency Similar to that Used in Beams—Continued.

AGE, 26 WEEKS

| Register number | Percentage of water | Cylinders | | | | | | Cubes | | | | Stress of cylinders to Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | Initial modulus of elasticity | Yield point | Dimensions | | Weight, lbs. per cu. ft. | Ultimate strength, lbs. per sq. in. | |
| | | Diameter, inches | Length, inches | | | | | Base, inches | Height, inches | | | |
| 423 | 19.5 | 8.00 | 16.15 | 122.0 | 2792 | 2 240 000 | 800 | 6.01 x 6.08 | 6.00 | 120.2 | 2831 | ...... |
| 424 | 19.5 | 8.02 | 16.26 | 121.6 | 2746 | 2 300 000 | 900 | 6.00 x 6.05 | 6.00 | 124.1 | 3486 | ...... |
| 425 | 19.5 | 8.00 | 16.04 | 123.0 | 2586 | 2 200 000 | 1000 | 6.00 x 6.11 | 6.01 | 121.1 | 3021 | ...... |
| 435 | 18.9 | 8.01 | 16.16 | 120.0 | 2778 | 2 320 000 | 900 | 6.04 x 6.07 | 6.00 | 120.8 | 2403 | ...... |
| 436 | 18.9 | 8.00 | 16.14 | 121.0 | 2714 | 2 080 000 | 1000 | 6.05 x 5.93 | 6.09 | 121.0 | 2609 | ...... |
| 437 | 18.9 | 7.99 | 16.12 | 120.8 | 2546 | 2 080 000 | 800 | 6.02 x 6.06 | 6.03 | 119.8 | 2084 | ...... |
| 447 | 18.8 | 8.00 | 16.20 | 119.5 | 2359 | 2 060 000 | 1000 | 6.03 x 6.25 | 6.04 | 116.3 | 2778 | ...... |
| 448 | 18.8 | 8.01 | 16.32 | 119.5 | 2371 | 2 250 000 | 800 | 6.00 x 6.28 | 6.00 | 118.5 | 2857 | ...... |
| 449 | 18.8 | 8.02 | 16.12 | 120.0 | 2344 | 2 000 000 | 900 | 6.03 x 6.26 | 5.98 | 118.6 | 2443 | ...... |
| 459 | 18.9 | 8.00 | 16.42 | 115.8 | 2591 | 2 130 000 | 900 | 6.03 x 6.03 | 6.02 | 117.4 | 3210 | ...... |
| 460 | 18.9 | 8.01 | 16.38 | 117.1 | 2546 | 2 250 000 | 1100 | 6.03 x 6.11 | 6.01 | 119.5 | 2902 | ...... |
| 461 | 18.9 | 8.02 | 16.47 | 116.8 | 2486 | 2 380 000 | 1200 | 6.06 x 6.00 | 5.99 | 118.1 | 2866 | ...... |
| 471 | 18.9 | 7.99 | 16.02 | 119.0 | 2706 | 2 040 000 | 1000 | 6.08 x 6.02 | 6.03 | 117.5 | 2485 | ...... |
| 472 | 18.9 | 8.00 | 16.02 | 119.9 | 2615 | 1 880 000 | 900 | 6.03 x 6.05 | 6.02 | 118.5 | 2166 | ...... |
| 473 | 18.9 | 7.99 | 16.02 | 119.4 | 2595 | 1 830 000 | 900 | 6.00 x 6.00 | 6.01 | 114.3 | 1750 | ...... |
| 483 | 18.9 | 8.00 | 16.14 | 119.3 | 2284 | 2 120 000 | 900 | 6.02 x 5.98 | 6.04 | 117.3 | 2880 | ...... |
| 484 | 18.9 | 8.02 | 16.04 | 117.8 | 2344 | 2 080 000 | 900 | 6.02 x 6.04 | 6.02 | 118.4 | 2862 | ...... |
| 485 | 18.9 | 8.01 | 16.01 | 120.5 | 2187 | 2 040 000 | 700 | 6.06 x 6.04 | 6.08 | 117.5 | 2903 | ...... |
| 495 | 18.9 | 8.00 | 16.04 | 118.7 | 2563 | 1 990 000 | 900 | 6.00 x 6.08 | 6.00 | 118.4 | 2557 | ...... |
| 496 | 18.9 | 8.00 | 16.08 | 118.9 | 2388 | 1 960 000 | 1000 | 6.00 x 6.04 | 6.20 | 115.4 | 2775 | ...... |
| 497 | 18.9 | 8.02 | 16.04 | 118.5 | 2482 | 2 180 000 | 900 | 5.99 x 6.04 | 5.98 | 120.9 | 2879 | ...... |
| Average. | | ...... | ...... | ...... | 2525 | 2 120 000 | 900 | ........... | ...... | ...... | 2702 | 0.935 |
| AGE, 52 WEEKS | | | | | | | | | | | | |
| 426 | 19.5 | 8.00 | 16.04 | 122.7 | 2941 | 2 350 000 | 1000 | 6.01 x 6.02 | 6.03 | 119.8 | 3457 | ...... |
| 427 | 18.9 | 8.00 | 16.10 | 121.4 | 2945 | 2 020 000 | 1000 | 6.00 x 6.09 | 6.02 | 120.8 | 3040 | ...... |
| 428 | 18.9 | 8.00 | 16.12 | 120.2 | 2947 | 2 290 000 | 900 | 6.00 x 6.05 | 6.02 | 121.0 | 3054 | ...... |
| 438 | 18.9 | 8.00 | 16.16 | 119.1 | 2886 | 2 090 000 | 800 | 5.99 x 6.00 | 6.00 | 119.2 | 3454 | ...... |
| 439 | 18.9 | 8.00 | 16.16 | 118.6 | 2958 | 2 170 000 | 1100 | 5.99 x 6.10 | 6.00 | 118.7 | 3236 | ...... |
| 440 | 18.9 | 7.99 | 16.15 | 120.6 | 2838 | 2 000 000 | 1200 | 6.01 x 6.04 | 6.02 | 120.1 | 3269 | ...... |
| 450 | 18.8 | 8.00 | 16.11 | 119.8 | 2685 | 2 240 000 | 1200 | 6.25 x 6.03 | 5.97 | 118.1 | 2793 | ...... |
| 451 | 18.9 | 7.99 | 16.14 | 121.5 | 2493 | 2 080 000 | 1200 | 6.28 x 5.99 | 6.00 | 118.7 | 2637 | ...... |
| 452 | 18.9 | 8.00 | 16.10 | 119.6 | 2680 | 2 340 000 | 900 | 5.99 x 6.26 | 5.99 | 119.7 | 2669 | ...... |
| 462 | 18.9 | 8.02 | 16.08 | 118.7 | 2767 | 2 030 000 | 1100 | 6.01 x 6.01 | 5.96 | 117.9 | 3108 | ...... |
| 463 | 18.9 | 8.01 | 16.18 | 117.9 | 2610 | 1 980 000 | 1100 | 6.04 x 6.00 | 6.00 | 119.7 | 3158 | ...... |
| 464 | 18.9 | 7.98 | 16.11 | 118.6 | 2678 | 1 990 000 | ....... | 6.02 x 6.01 | 6.01 | 119.7 | 2948 | ...... |
| 474 | 18.9 | 8.00 | 16.12 | 119.7 | 2685 | 1 910 000 | 1400 | 5.99 x 6.07 | 6.03 | 115.3 | 3578 | ...... |
| 475 | 18.9 | 8.00 | 16.10 | 120.0 | 2783 | 2 170 000 | 1000 | 6.03 x 6.02 | 6.00 | 120.1 | 3269 | ...... |
| 476 | 18.9 | 8.01 | 16.14 | 119.0 | 2778 | 2 090 000 | 1000 | 5.97 x 6.10 | 5.99 | 118.9 | 2999 | ...... |
| 486 | 18.9 | 7.98 | 16.09 | 120.5 | 2766 | 2 060 000 | 1300 | 6.00 x 6.02 | 6.02 | 118.3 | 3214 | ...... |
| 487 | 18.9 | 7.98 | 16.11 | 120.4 | 2600 | 2 070 000 | 1200 | 6.00 x 6.05 | 6.01 | 116.8 | 2908 | ...... |
| 488 | 18.9 | 8.02 | 16.08 | 118.3 | 2655 | 2 080 000 | 800 | 6.00 x 6.02 | 5.98 | 119.0 | 2896 | ...... |
| 498 | 18.9 | 8.01 | 16.22 | 118.7 | 2877 | 2 150 000 | 1100 | 5.99 x 6.03 | 6.03 | 119.0 | 2912 | ...... |
| 499 | 18.9 | 8.02 | 16.17 | 120.6 | 2771 | 1 950 000 | 1200 | 5.98 x 6.05 | 6.00 | 120.5 | 3448 | ...... |
| 500 | 18.9 | 8.01 | 16.12 | 119.1 | 2640 | 2 180 000 | 1000 | 6.00 x 6.08 | 6.02 | 122.0 | 3407 | ...... |
| Average. | | ...... | ...... | ...... | 2761 | 2 114 000 | 1075 | ........... | ...... | ...... | 3117 | .886 |

## Appendix I—Log Sheets for one Representa-

**1:2:4 GRANITE CONCRETE**

| Total Load, lbs. | Cylinder No. 162 Granite 4 weeks | | Cylinder No. 244 Granite 13 weeks | | Cylinder No. 170 Granite 26 weeks | | Cylinder No. 173 Granite 52 weeks | |
|---|---|---|---|---|---|---|---|---|
| | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. |
| 250 | ........ | ........ | ........ | ........ | ........ | ........ | 5 | ........ |
| 5000 | 99 | 20 | 99 | 25 | 100 | 21 | 100 | 21 |
| 10 000 | 198 | 30 | 198 | 50 | 199 | 42 | 199 | 42 |
| 15 000 | 297 | 30 | 297 | 71 | 298 | 67 | 299 | 63 |
| 20 000 | 396 | 50 | 396 | 92 | 398 | 83 | 399 | 83 |
| 25 000 | 495 | 70 | 495 | 115 | 497 | 100 | 499 | 104 |
| 30 000 | 594 | 100 | 594 | 138 | 597 | 125 | 598 | 125 |
| 35 000 | 693 | 130 | 693 | 158 | 696 | 146 | 698 | 145 |
| 40 000 | 792 | 150 | 792 | 182 | 796 | 163 | 798 | 167 |
| 45 000 | 891 | 180 | 891 | 204 | 895 | 188 | 897 | 188 |
| 50 000 | 990 | 220 | 990 | 228 | 995 | 217 | 997 | 208 |
| 55 000 | 1089 | 240 | 1089 | 250 | 1094 | 238 | 1097 | 229 |
| 60 000 | 1188 | 270 | 1188 | 271 | 1194 | 258 | 1197 | 250 |
| 65 000 | 1287 | 300 | 1287 | 294 | 1293 | 283 | 1296 | 271 |
| 70 000 | 1386 | 330 | 1386 | 315 | 1392 | 304 | 1396 | 292 |
| 75 000 | 1485 | 370 | 1485 | 346 | 1492 | 333 | 1496 | 313 |
| 80 000 | 1584 | 400 | 1584 | 371 | 1591 | 354 | 1595 | 338 |
| 85 000 | 1683 | 430 | 1683 | 396 | 1691 | 375 | 1695 | 358 |
| 90 000 | 1782 | 480 | 1782 | 413 | 1790 | 400 | 1795 | 379 |
| 95 000 | 1881 | 530 | 1881 | 433 | 1890 | 425 | 1894 | 404 |
| 100 000 | 1980 | 580 | 1980 | 457 | 1989 | 450 | 1994 | 429 |
| 105 000 | 2079 | 650 | 2079 | 483 | 2089 | 483 | 2094 | 454 |
| 110 000 | 2178 | 710 | 2178 | 513 | 2188 | 508 | 2194 | 479 |
| 115 000 | 2276 | 760 | 2276 | 538 | 2288 | 538 | 2293 | 504 |
| 120 000 | 2375 | 830 | 2375 | 563 | 2387 | 563 | 2393 | 529 |
| 125 000 | 2474 | 920 | 2474 | 588 | 2487 | 592 | 2493 | 554 |
| 130 000 | | | 2573 | 611 | 2586 | 621 | 2592 | 579 |
| 135 000 | | | 2672 | 646 | 2686 | 654 | 2692 | 604 |
| 140 000 | | | 2771 | 675 | 2785 | 675 | 2792 | 629 |
| 145 000 | | | 2870 | 700 | 2885 | 713 | 2892 | 658 |
| 150 000 | | | 2969 | 738 | 2984 | 750 | 2991 | 688 |
| 155 000 | | | 3068 | 783 | 3084 | 779 | 3091 | 717 |
| 160 000 | | | 3167 | 817 | 3183 | 817 | 3191 | 742 |
| 165 000 | | | 3266 | 867 | 3283 | 854 | 3290 | 771 |
| 170 000 | | | 3365 | 896 | 3382 | 896 | 3390 | 804 |
| 175 000 | | | 3464 | 933 | 3482 | 933 | 3490 | 838 |
| 180 000 | | | 3563 | 988 | 3581 | 988 | 3590 | 871 |
| 185 000 | | | (1) | | (1) | | 3689 | 904 |
| 190 000 | | | | | | | 3789 | 938 |
| 195 000 | | | | | | | 3889 | 971 |
| 200 000 | | | | | | | 3988 | 1004 |
| 205 000 | | | | | | | 4088 | 1046 |
| 210 000 | | | | | | | 4188 | 1092 |
| 215 000 | | | | | | | 4288 | 1138 |
| 220 000 | | | | | | | 4387 | 1183 |
| 225 000 | | | | | | | 4487 | 1233 |
| 230 000 | | | | | | | 4587 | 1288 |
| 235 000 | | | | | | | 4686 | 1342 |
| 240 000 | | | | | | | 4786 | 1413 |
| 245 000 | | | | | | | 4886 | 1488 |

[1] **Ultimate load exceeded the capacity of the testing machine (200 000 lb.=3969 lb. per sq. in.).**

tive Cylinder for each Age and Aggregate

**1:2:4 GRAVEL CONCRETE**

| Cylinder No. 359 Gravel 4 weeks | | Cylinder No. 338 Gravel 13 weeks | | Cylinder No. 351 Gravel 26 weeks | | Cylinder No. 366 Gravel 52 weeks | | Total load, lbs. |
|---|---|---|---|---|---|---|---|---|
| Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | |
| .......... | .......... | .......... | .......... | 5 | .......... | 5 | .......... | 250 |
| 99 | 20 | 99 | 50 | 99 | 25 | 100 | 21 | 5000 |
| 197 | 30 | 198 | 79 | 198 | 42 | 199 | 38 | 10 000 |
| 296 | 50 | 298 | 108 | 298 | 63 | 299 | 50 | 15 000 |
| 395 | 80 | 397 | 138 | 397 | 83 | 399 | 67 | 20 000 |
| 494 | 100 | 496 | 154 | 496 | 100 | 499 | 88 | 25 000 |
| 592 | 130 | 595 | 171 | 595 | 121 | 598 | 104 | 30 000 |
| 691 | 140 | 695 | 196 | 695 | 142 | 698 | 125 | 35 000 |
| 790 | 160 | 794 | 208 | 794 | 154 | 798 | 146 | 40 000 |
| 889 | 180 | 893 | 233 | 893 | 171 | 897 | 163 | 45 000 |
| 987 | 210 | 992 | 254 | 992 | 192 | 997 | 179 | 50 000 |
| 1086 | 230 | 1092 | 267 | 1092 | 208 | 1097 | 192 | 55 000 |
| 1185 | 250 | 1191 | 296 | 1191 | 233 | 1197 | 213 | 60 000 |
| 1284 | 280 | 1290 | 317 | 1290 | 250 | 1296 | 235 | 65 000 |
| 1382 | 310 | 1389 | 338 | 1389 | 271 | 1396 | 254 | 70 000 |
| 1481 | 330 | 1488 | 358 | 1488 | 288 | 1496 | 275 | 75 000 |
| 1580 | 350 | 1588 | 379 | 1588 | 308 | 1595 | 288 | 80 000 |
| 1678 | 380 | 1687 | 404 | 1687 | 325 | 1695 | 304 | 85 000 |
| 1777 | 400 | 1786 | 425 | 1786 | 354 | 1795 | 321 | 90 000 |
| 1876 | 440 | 1885 | 450 | 1885 | 375 | 1894 | 346 | 95 000 |
| 1975 | 470 | 1984 | 475 | 1984 | 392 | 1994 | 367 | 100 000 |
| 2074 | 500 | 2084 | 500 | 2084 | 413 | 2094 | 388 | 105 000 |
| 2172 | 550 | 2183 | 525 | 2183 | 433 | 2194 | 408 | 110 000 |
| 2271 | 580 | 2282 | 550 | 2282 | 454 | 2293 | 429 | 115 000 |
| 2370 | 620 | 2381 | 575 | 2381 | 479 | 2393 | 450 | 120 000 |
| 2468 | 650 | 2481 | 600 | 2481 | 500 | 2493 | 467 | 125 000 |
| 2567 | 700 | 2580 | 633 | 2580 | 521 | 2592 | 488 | 130 000 |
| | | 2679 | 667 | 2679 | 546 | 2692 | 508 | 135 000 |
| | | 2778 | 700 | 2778 | 575 | 2792 | 533 | 140 000 |
| | | 2877 | 733 | 2877 | 600 | 2892 | 550 | 145 000 |
| | | 2977 | 767 | 2977 | 621 | 2991 | 571 | 150 000 |
| | | 3076 | 800 | 3076 | 650 | 3091 | 600 | 155 000 |
| | | 3175 | 833 | 3175 | 679 | 3191 | 625 | 160 000 |
| | | 3274 | 863 | 3274 | 708 | 3290 | 642 | 165 000 |
| | | 3374 | 896 | 3374 | 738 | 3390 | 671 | 170 000 |
| | | 3473 | 933 | 3473 | 771 | 3490 | 688 | 175 000 |
| | | 3572 | 983 | 3572 | 804 | 3590 | 708 | 180 000 |
| | | 3671 | 1038 | 3671 | 838 | 3689 | 733 | 185 000 |
| | | 3770 | 1104 | 3770 | 871 | 3789 | 754 | 190 000 |
| | | 3870 | 1225 | 3870 | 913 | 3889 | 775 | 195 000 |
| | | 3969 | 1375 | 3969 | 971 | 3988 | 804 | 200 000 |
| | | (1) | | (1) | | 4088 | 833 | 205 000 |
| | | | | | | 4188 | 863 | 210 000 |
| | | | | | | 4288 | 896 | 215 000 |
| | | | | | | 4387 | 925 | 220 000 |
| | | | | | | 4487 | 954 | 225 000 |
| | | | | | | 4587 | 983 | 230 000 |
| | | | | | | 4686 | 1021 | 235 000 |
| | | | | | | 4786 | 1058 | 240 000 |
| | | | | | | 4886 | 1092 | 245 000 |
| | | | | | | 4986 | 1142 | 250 000 |
| | | | | | | 5085 | 1192 | 255 000 |
| | | | | | | 5185 | 1267 | 260 000 |

[1] Ultimate load exceeded the capacity of the testing machine (200 000 lb.=3969 lb. per sq. in.).

Appendix I—Log Sheets for one Representative

1:2:4 LIMESTONE CONCRETE—Continued

| Total Load, lbs. | Cylinder No. 274 Limestone 4 weeks | | Cylinder No. 264 Limestone 13 weeks | | Cylinder No. 305 Limestone 26 weeks | | Cylinder No. 283 Limestone 52 weeks | |
|---|---|---|---|---|---|---|---|---|
| | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. | Unit Stress, lb. per sq. in. | Deformation, millionths of in. per in. |
| 250 | ........ | ........ | ........ | ........ | 5 | ........ | 5 | ........ |
| 5000 | 99 | ........ | 99 | 33 | 100 | 17 | 100 | 21 |
| 10 000 | 198 | 30 | 198 | 67 | 199 | 38 | 199 | 42 |
| 15 000 | 298 | 60 | 297 | 100 | 299 | 58 | 299 | 58 |
| 20 000 | 397 | 80 | 396 | 129 | 399 | 83 | 399 | 83 |
| 25 000 | 496 | 110 | 495 | 146 | 499 | 108 | 499 | 104 |
| 30 000 | 595 | 130 | 594 | 179 | 598 | 125 | 598 | 125 |
| 35 000 | 695 | 160 | 693 | 204 | 698 | 150 | 698 | 146 |
| 40 000 | 794 | 180 | 792 | 225 | 798 | 175 | 798 | 171 |
| 45 000 | 893 | 210 | 891 | 246 | 898 | 196 | 897 | 192 |
| 50 000 | 992 | 240 | 990 | 275 | 997 | 225 | 997 | 213 |
| 55 000 | 1092 | 270 | 1089 | 304 | 1097 | 246 | 1097 | 233 |
| 60 000 | 1191 | 310 | 1188 | 329 | 1197 | 275 | 1197 | 254 |
| 65 000 | 1290 | 340 | 1287 | 358 | 1296 | 292 | 1296 | 275 |
| 70 000 | 1389 | 350 | 1386 | 388 | 1396 | 317 | 1396 | 296 |
| 75 000 | 1488 | 380 | 1485 | 417 | 1496 | 350 | 1496 | 317 |
| 80 000 | 1587 | 430 | 1584 | 450 | 1595 | 379 | 1595 | 338 |
| 85 000 | 1687 | 480 | 1683 | 483 | 1695 | 408 | 1695 | 858 |
| 90 000 | 1786 | 520 | 1782 | 508 | 1795 | 433 | 1795 | 383 |
| 95 000 | 1885 | 560 | 1881 | 542 | 1895 | 463 | 1894 | 408 |
| 100 000 | 1985 | 600 | 1980 | 575 | 1994 | 492 | 1994 | 458 |
| 105 000 | | | 2079 | 608 | 2094 | 529 | 2094 | 463 |
| 110 000 | | | 2178 | 650 | 2194 | 554 | 2194 | 492 |
| 115 000 | | | 2276 | 688 | 2294 | 592 | 2293 | 521 |
| 120 000 | | | 2375 | 717 | 2393 | 621 | 2393 | 550 |
| 125 000 | | | 2474 | 750 | 2493 | 658 | 2493 | 575 |
| 130 000 | | | 2573 | 800 | 2593 | 696 | 2592 | 604 |
| 135 000 | | | 2672 | 842 | 2692 | 729 | 2692 | 633 |
| 140 000 | | | 2771 | 888 | 2792 | 767 | 2792 | 657 |
| 145 000 | | | 2870 | 942 | 2892 | 808 | 2892 | 700 |
| 150 000 | | | 2969 | 988 | 2992 | 854 | 2991 | 733 |
| 155 000 | | | 3068 | 1050 | 3191 | 896 | 3091 | 771 |
| 160 000 | | | 3167 | 1113 | 3211 | 950 | 3191 | 804 |
| 165 000 | | | 3266 | 1175 | 3291 | 1004 | 3290 | 842 |
| 170 000 | | | 3365 | 1242 | 3391 | 1063 | 3390 | 879 |
| 175 000 | | | | | 3490 | 1121 | 3490 | 921 |
| 180 000 | | | | | 3590 | 1179 | 3590 | 963 |
| 185 000 | | | | | 3690 | 1258 | 3689 | 1004 |
| 190 000 | | | | | 3789 | 1358 | 3789 | 1050 |
| 195 000 | | | | | | | 3889 | 1096 |
| 200 000 | | | | | | | 3988 | 1146 |
| 205 000 | | | | | | | 4088 | 1217 |

## Cylinder for each Age and Aggregate—Continued

1:2:4 CINDER CONCRETE—Continued

| Cylinder No. 455 Cinder 4 weeks | | Cylinder No. 456 Cinder 13 weeks | | Cylinder No. 459 Cinder 26 weeks | | Cylinder No. 475 Cinder 52 weeks | | Total load, lbs. |
|---|---|---|---|---|---|---|---|---|
| **Unit Stress, lb. per sq. in.** | **Deformation, millionths of in. per in.** | **Unit Stress, lb. per sq. in.** | **Deformation, millionths of in. per in.** | **Unit Stress, lb. per sq. in.** | **Deformation, millionths of in. per in.** | **Unit Stress, lb. per sq. in.** | **Deformation, millionths of in. per in.** | |
| ........ | ........ | ........ | ........ | 5 | ........ | 5 | ........ | 250 |
| 99 | 50 | 100 | 42 | 100 | 46 | 99 | 46 | 5000 |
| 198 | 110 | 199 | 83 | 199 | 88 | 199 | 88 | 10 000 |
| 298 | 170 | 298 | 133 | 298 | 133 | 298 | 133 | 15 000 |
| 397 | 240 | 398 | 188 | 398 | 175 | 398 | 183 | 20 000 |
| 496 | 300 | 497 | 246 | 497 | 217 | 497 | 225 | 25 000 |
| 595 | 380 | 597 | 308 | 597 | 267 | 597 | 271 | 30 000 |
| 695 | 460 | 696 | 354 | 696 | 313 | 696 | 313 | 35 000 |
| 794 | 570 | 796 | 429 | 796 | 363 | 796 | 363 | 40 000 |
| 893 | 700 | 895 | 483 | 895 | 413 | 895 | 408 | 45 000 |
| 992 | 770 | 995 | 538 | 995 | 463 | 995 | 458 | 50 000 |
| 1092 | 900 | 1094 | 592 | 1094 | 513 | 1094 | 504 | 55 000 |
| 1191 | 1050 | 1194 | 663 | 1194 | 567 | 1194 | 558 | 60 000 |
| 1290 | 1230 | 1293 | 738 | 1293 | 625 | 1293 | 617 | 65 000 |
| 1389 | 1600 | 1392 | 804 | 1392 | 683 | 1392 | 671 | 70 000 |
| | | 1492 | 892 | 1492 | 746 | 1492 | 725 | 75 000 |
| | | 1591 | 971 | 1591 | 808 | 1591 | 779 | 80 000 |
| | | 1691 | 1071 | 1691 | 879 | 1691 | 833 | 85 000 |
| | | 1790 | 1188 | 1790 | 950 | 1790 | 900 | 90 000 |
| | | 1890 | 1317 | 1890 | 1021 | 1890 | 963 | 95 000 |
| | | 1989 | 1463 | 1989 | 1108 | 1989 | 1029 | 100 000 |
| | | 2089 | 1650 | 2089 | 1196 | 2089 | 1104 | 105 000 |
| | | 2188 | 1908 | 2188 | 1288 | 2188 | 1188 | 110 000 |
| | | | | 2288 | 1396 | 2288 | 1275 | 115 000 |
| | | | | 2387 | 1529 | 2387 | 1367 | 120 000 |
| | | | | 2487 | 1671 | 2487 | 1483 | 125 000 |
| | | | | 2586 | 1904 | 2586 | 1613 | 130 000 |
| | | | | | | 2685 | 1775 | 135 000 |

## Appendix II—Log Sheets of Concrete Beams

**BEAM 162**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 30 | 24 | 55.3 | 0.005 |
| 500 | 39.85 | 48 | 39 | 55.4 | .015 |
| 1000 | 54.85 | 66 | 53 | 55.4 | .025 |
| 1500 | 69.85 | 82 | 65 | 55.9 | .030 |
| 2000 | 84.85 | 103 | 82 | 55.7 | .035 |
| 2500 | 99.85 | 127 | 94 | 57.5 | .050 |
| 2750 | 107.35 | 139 | 103 | 57.5 | .055 |
| 3000 | 114.85 | 150 | 111 | 57.5 | .060 |
| 3250 | 122.35 | 159 | 130 | 55.1 | .070 |
| 3500 | 129.85 | 178 | 166 | 51.8 | .075 |
| 3750 | 137.35 | 274 | 441 | 38.3 | .135 |
| 4000 | 144.85 | 307 | 528 | 36.7 | .165 |
| 4250 | 152.35 | 334 | 612 | 35.3 | .205 |
| 4500 | 159.85 | 369 | 704 | 34.4 | .235 |
| 5000 | 174.85 | 424 | 868 | 32.8 | .285 |
| 5500 | 189.85 | 472 | 1014 | 31.8 | .325 |
| 5900 | 201.85 | ........ | ........ | ........ | ........ |
| 5100 | 177.85 | ........ | 1561 | ........ | .425 |

**BEAM 163**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 29 | 31 | 48.3 | 0.015 |
| 500 | 40.47 | 47 | 41 | 53.6 | .025 |
| 1000 | 55.47 | 61 | 53 | 53.4 | .035 |
| 1500 | 70.47 | 75 | 70 | 51.8 | .045 |
| 2000 | 85.47 | 94 | 87 | 51.9 | .055 |
| 2500 | 100.47 | 110 | 103 | 51.6 | .065 |
| 3000 | 115.47 | 129 | 125 | 50.7 | .065 |
| 3250 | 122.97 | 144 | 140 | 50.7 | .075 |
| 3500 | 130.47 | 166 | 173 | 49.0 | .085 |
| 3750 | 137.97 | 225 | 369 | 37.8 | .125 |
| 4000 | 145.47 | 258 | 489 | 34.6 | .155 |
| 4250 | 152.97 | 281 | 583 | 32.5 | .165 |
| 4500 | 160.47 | 309 | 674 | 31.4 | .185 |
| 4750 | 167.97 | 330 | 769 | 30.0 | .215 |
| 5000 | 175.47 | 366 | 885 | 29.2 | .245 |
| 5250 | 182.97 | 392 | 956 | 29.1 | .255 |
| 5500 | 190.47 | 409 | 1019 | 28.7 | .265 |
| 5750 | 197.97 | 433 | 1085 | 28.5 | .285 |
| 6000 | 205.47 | 451 | 1156 | 28.1 | .325 |
| 6250 | 212.97 | 471 | 1238 | 27.6 | .345 |
| 6500 | 220.47 | 495 | 1313 | 27.4 | .355 |
| 6750 | 227.97 | 516 | 1415 | 26.7 | .385 |
| 7000 | 235.47 | ........ | 1492 | ........ | .395 |

**BEAM 164**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 23 | 21 | 52.5 | 0.005 |
| 500 | 41.09 | 36 | 41 | 46.6 | .015 |
| 1000 | 56.09 | 49 | 55 | 47.2 | .020 |
| 1500 | 71.09 | 62 | 70 | 46.8 | .025 |
| 2000 | 86.09 | 82 | 84 | 49.5 | .035 |
| 2500 | 101.09 | 95 | 99 | 48.9 | .040 |
| 3000 | 116.09 | 111 | 121 | 47.8 | .050 |
| 3250 | 123.59 | 122 | 137 | 47.1 | .055 |
| 3500 | 131.09 | 131 | 185 | 41.4 | .065 |
| 3750 | 138.59 | 163 | 256 | 38.9 | .085 |
| 4000 | 146.09 | 191 | 344 | 35.7 | .110 |
| 4250 | 153.59 | 243 | 550 | 30.6 | .145 |
| 4500 | 161.09 | 264 | 641 | 29.2 | .170 |
| 4750 | 168.59 | 285 | 737 | 27.9 | .195 |
| 5000 | 176.09 | 306 | 815 | 27.3 | .220 |
| 5250 | 183.59 | 326 | 896 | 26.7 | .245 |
| 5500 | 191.09 | 346 | 974 | 26.2 | .260 |
| 5750 | 198.59 | 368 | 1062 | 25.7 | .275 |
| 6000 | 206.09 | 389 | 1140 | 25.5 | .305 |
| 6250 | 213.59 | 406 | 1200 | 25.3 | .325 |
| 6500 | 221.09 | ........ | ........ | ........ | ........ |

**BEAM 174**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 61 | 50 | 54.8 | 0.015 |
| 500 | 40.47 | 77 | 72 | 51.8 | .025 |
| 1000 | 55.47 | 105 | 109 | 49.0 | .035 |
| 1500 | 70.47 | 129 | 137 | 48.6 | .045 |
| 2000 | 85.47 | 160 | 164 | 49.4 | .055 |
| 2500 | 100.47 | 193 | 193 | 50.0 | .065 |
| 3000 | 115.47 | 222 | 224 | 49.8 | .080 |
| 3500 | 130.47 | 249 | 260 | 49.0 | .095 |
| 4000 | 145.47 | 279 | 301 | 48.1 | .105 |
| 4500 | 160.47 | 314 | 359 | 46.6 | .115 |
| 5000 | 175.47 | 352 | 458 | 43.4 | .155 |
| 5500 | 190.47 | 388 | 540 | 41.8 | .175 |
| 6000 | 205.47 | 431 | 619 | 41.0 | .215 |
| 6500 | 220.47 | 467 | 691 | 40.3 | .245 |
| 7000 | 235.47 | 505 | 769 | 39.6 | .265 |
| 7500 | 250.47 | 544 | 845 | 39.1 | .295 |
| 8000 | 265.47 | 587 | 930 | 38.7 | .330 |
| 8500 | 280.47 | 626 | 997 | 38.6 | .360 |
| 9000 | 295.47 | 665 | 1068 | 38.4 | .385 |
| 9300 | 304.47 | ........ | (1135) | ........ | .415 |
| 7500 | 250.47 | 797 | 1979 | 28.7 | .465 |

**BEAM 175**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 37 | 27 | 58.0 | 0.010 |
| 800 | 49.26 | 62 | 53 | 53.8 | .015 |
| 1600 | 73.26 | 92 | 75 | 55.2 | .025 |
| 2000 | 85.26 | 109 | 87 | 55.6 | .035 |
| 2500 | 100.26 | 127 | 108 | 54.0 | .045 |
| 3000 | 115.26 | 147 | 130 | 53.0 | .065 |
| 3500 | 130.26 | 184 | 183 | 50.2 | .070 |
| 3750 | 137.76 | 245 | 321 | 43.3 | .095 |
| 4000 | 145.26 | 256 | 349 | 42.3 | .110 |
| 4250 | 152.76 | 285 | 402 | 41.5 | .125 |
| 4500 | 160.26 | 311 | 468 | 39.9 | .145 |
| 4750 | 167.76 | 333 | 504 | 39.8 | .165 |
| 5000 | 175.26 | 357 | 556 | 39.1 | .180 |
| 5250 | 182.76 | 375 | 602 | 38.4 | .195 |
| 5500 | 190.26 | 392 | 639 | 38.0 | .205 |
| 6000 | 205.26 | 437 | 750 | 36.8 | .240 |
| 6500 | 220.26 | 476 | 841 | 36.1 | .275 |
| 7000 | 235.26 | 521 | 930 | 35.9 | .295 |
| 7500 | 250.26 | 564 | 1026 | 35.5 | .335 |
| 8000 | 265.26 | 609 | 1109 | 35.4 | .365 |
| 8500 | 280.26 | 652 | 1198 | 35.2 | .405 |
| 8750 | 287.76 | 677 | 1234 | 35.4 | .425 |
| 8900 | 292.26 | ........ | ........ | ........ | .445 |

**BEAM 176**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 37 | 24 | 60.7 | 0.010 |
| 500 | 40.47 | 50 | 39 | 56.4 | .020 |
| 1000 | 55.47 | 69 | 53 | 56.6 | .030 |
| 1500 | 70.47 | 88 | 65 | 57.4 | .030 |
| 2000 | 85.47 | 105 | 82 | 56.2 | .040 |
| 2500 | 100.47 | 126 | 101 | 55.6 | .045 |
| 3000 | 115.47 | 146 | 121 | 54.7 | .055 |
| 3500 | 130.47 | 178 | 154 | 53.6 | .070 |
| 3750 | 137.97 | 193 | 191 | 50.3 | .080 |
| 4000 | 145.47 | 221 | 234 | 48.5 | .090 |
| 4250 | 152.97 | 254 | 309 | 45.1 | .100 |
| 4500 | 160.47 | 291 | 403 | 41.9 | .120 |
| 4750 | 167.97 | 331 | 453 | 42.2 | .140 |
| 5000 | 175.47 | 362 | 509 | 41.5 | .160 |
| 5500 | 190.47 | 407 | 602 | 40.4 | .190 |
| 6000 | 205.47 | 443 | 694 | 39.0 | .220 |
| 6500 | 220.47 | 500 | 786 | 38.9 | .260 |
| 7000 | 235.47 | 538 | 875 | 38.1 | .240 |
| 7500 | 250.47 | 581 | 962 | 37.7 | .300 |
| 8000 | 265.47 | 619 | 1065 | 36.8 | .330 |
| 8500 | 280.47 | 685 | 1212 | 36.1 | ........ |
| 8750 | 287.97 | 717 | 1332 | 35.0 | ........ |
| 9000 | 295.47 | ........ | 1431 | ........ | ........ |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 186**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 26 | 21 | 55.7 | 0.010 |
| 800 | 49.68 | 50 | 38 | 57.0 | .020 |
| 1600 | 73.68 | 75 | 56 | 57.1 | .030 |
| 2400 | 97.68 | 100 | 77 | 56.5 | .040 |
| 3200 | 121.68 | 130 | 101 | 56.2 | .050 |
| 3600 | 133.68 | 148 | 118 | 55.7 | .060 |
| 4000 | 145.68 | 173 | 150 | 53.6 | .070 |
| 4400 | 157.68 | 195 | 179 | 52.1 | .080 |
| 4800 | 169.68 | 232 | 234 | 49.8 | .090 |
| 5200 | 181.68 | 276 | 287 | 49.0 | .100 |
| 5600 | 193.68 | 303 | 349 | 46.4 | .130 |
| 6000 | 205.68 | 334 | 410 | 44.9 | .150 |
| 6500 | 220.68 | 371 | 479 | 43.6 | .160 |
| 7000 | 235.68 | 400 | 557 | 41.8 | .190 |
| 8000 | 265.68 | 466 | 670 | 41.0 | .230 |
| 9000 | 295.68 | 530 | 805 | 39.7 | .260 |
| 10 000 | 325.68 | 591 | 930 | 38.9 | .300 |
| 11 000 | 355.68 | 648 | 1065 | 37.8 | .350 |
| 11 500 | 370.68 | 681 | 1128 | 37.7 | .380 |
| 12 000 | 385.68 | 712 | 1190 | 37.4 | .395 |
| 12 500 | 400.68 | 744 | 1262 | 37.1 | .420 |
| 13 000 | 415.68 | 772 | 1320 | 36.9 | .440 |
| 13 280 | 424.08 | ........ | 1340 | ........ | .460 |

**BEAM 187**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.26 | 53 | 43 | 55.1 | .020 |
| 2000 | 85.26 | 88 | 70 | 55.7 | .030 |
| 3000 | 115.26 | 128 | 108 | 54.2 | .050 |
| 3500 | 130.26 | 154 | 133 | 53.7 | .060 |
| 4000 | 145.26 | 181 | 164 | 52.5 | .070 |
| 4500 | 160.26 | 217 | 222 | 49.4 | .080 |
| 5000 | 175.26 | 260 | 311 | 45.5 | .110 |
| 5500 | 190.26 | 297 | 386 | 43.5 | .130 |
| 6000 | 205.26 | 332 | 462 | 41.8 | .165 |
| 7000 | 235.26 | 400 | 621 | 39.2 | .210 |
| 8000 | 265.26 | 467 | 768 | 37.8 | .260 |
| 9000 | 295.26 | 533 | 930 | 36.4 | .310 |
| 10 000 | 325.26 | 607 | 1038 | 36.9 | .350 |
| 11 000 | 355.26 | 682 | 1191 | 36.4 | .400 |
| 11 650 | 374.76 | ........ | 1369 | ........ | .450 |
| 10 000 | 325.26 | 781 | 1701 | 30.5 | .470 |

**BEAM 188**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 34 | 31 | 52.5 | 0.005 |
| 1000 | 55.68 | 75 | 85 | 46.9 | .025 |
| 2000 | 85.68 | 105 | 109 | 49.0 | .035 |
| 3000 | 115.68 | 147 | 144 | 50.4 | .050 |
| 3500 | 130.68 | 165 | 159 | 51.0 | .060 |
| 4000 | 145.68 | 190 | 185 | 50.6 | .075 |
| 4500 | 160.68 | 215 | 224 | 49.0 | .085 |
| 5000 | 175.68 | 251 | 292 | 46.2 | .105 |
| 5500 | 190.68 | 284 | 378 | 42.9 | .125 |
| 6000 | 205.68 | 321 | 455 | 41.3 | .155 |
| 7000 | 235.68 | 389 | 597 | 39.5 | .205 |
| 8000 | 265.68 | 451 | 750 | 37.6 | .245 |
| 9000 | 295.68 | 515 | 903 | 36.3 | .295 |
| 10 000 | 325.68 | 581 | 1022 | 36.3 | .335 |
| 11 000 | 355.68 | 644 | 1157 | 35.8 | .395 |
| 11 500 | 370.68 | 681 | 1232 | 35.6 | .425 |
| 12 000 | 385.68 | 727 | 1328 | 35.4 | .445 |
| 12 460 | 399.48 | ........ | 1409 | ........ | .465 |
| 10 800 | 349.68 | 781 | 1821 | 30.0 | .495 |

**BEAM 198**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 39 | 24 | 62.0 | 0.010 |
| 1000 | 56.09 | 66 | 53 | 55.4 | .020 |
| 2000 | 86.09 | 100 | 75 | 57.1 | .030 |
| 3000 | 116.09 | 135 | 104 | 56.5 | .050 |
| 3500 | 131.09 | 159 | 126 | 55.8 | .060 |
| 4000 | 146.09 | 181 | 162 | 52.8 | .070 |
| 4500 | 161.09 | 206 | 200 | 50.8 | .080 |
| 5000 | 176.09 | 234 | 255 | 47.9 | .100 |
| 5500 | 191.09 | 277 | 335 | 45.2 | .120 |
| 6000 | 206.09 | 314 | 419 | 42.8 | .140 |
| 6500 | 221.09 | 350 | 491 | 41.6 | .160 |
| 7000 | 236.09 | 390 | 566 | 40.8 | .190 |
| 8000 | 266.09 | 450 | 689 | 39.5 | .230 |
| 9000 | 296.09 | 514 | 809 | 38.9 | .270 |
| 10 000 | 326.09 | 576 | 916 | 38.6 | .320 |
| 11 000 | 356.09 | 651 | 1043 | 38.4 | .360 |
| 12 000 | 386.09 | 720 | 1154 | 38.4 | .410 |
| 13 000 | 416.09 | 798 | 1280 | 38.4 | .450 |
| 13 500 | 431.09 | 839 | 1344 | 38.4 | .470 |
| 14 000 | 446.09 | ........ | 1429 | ........ | ........ |
| 11 900 | 383.09 | 889 | 1897 | 31.9 | .510 |
| 12 500 | 401.09 | 1038 | 2860 | 26.6 | .630 |

**BEAM 199**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 30 | 29 | 50.8 | 0.010 |
| 1000 | 56.09 | 62 | 56 | 52.5 | .020 |
| 2000 | 86.09 | 93 | 84 | 52.5 | .030 |
| 3000 | 116.09 | 127 | 115 | 52.5 | .050 |
| 3500 | 131.09 | 152 | 140 | 52.0 | .060 |
| 4000 | 146.09 | 169 | 169 | 50.0 | .070 |
| 4500 | 161.09 | 202 | 224 | 47.5 | .080 |
| 5000 | 176.09 | 230 | 263 | 46.6 | .095 |
| 5500 | 191.09 | 264 | 328 | 44.6 | .110 |
| 6000 | 206.09 | 300 | 405 | 42.6 | .140 |
| 6500 | 221.09 | 342 | 482 | 41.5 | .160 |
| 7000 | 236.09 | 376 | 545 | 40.8 | .180 |
| 8000 | 266.09 | 447 | 674 | 39.9 | .220 |
| 9000 | 296.09 | 508 | 798 | 38.9 | .260 |
| 10 000 | 326.09 | 581 | 920 | 38.7 | .300 |
| 11 000 | 356.09 | 651 | 1051 | 38.3 | .350 |
| 12 000 | 386.09 | 724 | 1178 | 38.1 | .400 |
| 13 000 | 416.09 | 799 | 1311 | 37.9 | .440 |
| 13 500 | 431.09 | 850 | 1390 | 37.9 | ........ |
| 14 000 | 446.09 | ........ | 1497 | ........ | ........ |
| 12 300 | 395.09 | 932 | 2041 | 31.3 | ........ |

**BEAM 200**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 37 | 27 | 58.0 | 0.015 |
| 1000 | 56.09 | 82 | 62 | 57.0 | .030 |
| 2000 | 86.09 | 116 | 84 | 58.0 | .045 |
| 3000 | 116.09 | 146 | 111 | 56.8 | .055 |
| 3500 | 131.09 | 163 | 126 | 56.5 | .065 |
| 4000 | 146.09 | 185 | 150 | 55.2 | .075 |
| 4500 | 161.09 | 211 | 188 | 52.9 | .085 |
| 5000 | 176.09 | 243 | 236 | 50.7 | .100 |
| 6000 | 206.09 | 317 | 379 | 45.5 | .135 |
| 7000 | 236.09 | 388 | 530 | 42.3 | .175 |
| 8000 | 266.09 | 463 | 653 | 41.5 | .205 |
| 9000 | 296.09 | 525 | 778 | 40.3 | .255 |
| 10 000 | 326.09 | 595 | 903 | 39.7 | .295 |
| 11 000 | 356.09 | 657 | 1022 | 39.1 | .345 |
| 12 000 | 386.09 | 723 | 1159 | 38.4 | .390 |
| 13 000 | 416.09 | 794 | 1308 | 37.8 | .445 |
| 13 500 | 431.09 | 831 | 1386 | 37.5 | .465 |
| 13 750 | 438.59 | ........ | 1412 | ........ | ........ |
| 13 300 | 425.09 | 854 | 1474 | 36.7 | ........ |
| 12 100 | 389.09 | 900 | 1921 | 31.9 | .525 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 210**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 26 | 21 | 55.7 | 0.005 |
| 1500 | 70.88 | 74 | 58 | 55.9 | .025 |
| 2500 | 100.88 | 105 | 84 | 55.7 | .035 |
| 3500 | 130.88 | 143 | 120 | 54.4 | .045 |
| 4000 | 145.88 | 168 | 149 | 53.0 | .060 |
| 4500 | 160.88 | 195 | 179 | 52.1 | .075 |
| 5000 | 175.88 | 225 | 212 | 51.5 | .085 |
| 5500 | 190.88 | 257 | 255 | 50.2 | .095 |
| 6000 | 205.88 | 293 | 311 | 48.5 | .115 |
| 7000 | 235.88 | 359 | 419 | 46.1 | .155 |
| 8000 | 265.88 | 421 | 521 | 44.7 | .195 |
| 9000 | 295.88 | 487 | 626 | 43.7 | .235 |
| 10 000 | 325.88 | 552 | 744 | 42.6 | .275 |
| 11 000 | 355.88 | 616 | 858 | 41.8 | .305 |
| 12 000 | 385.88 | 679 | 971 | 41.2 | .345 |
| 13 000 | 415.88 | 744 | 1080 | 40.8 | .375 |
| 14 000 | 445.88 | 798 | 1178 | 40.4 | .425 |
| 15 000 | 475.88 | 877 | 1282 | 40.6 | .465 |
| 15 500 | 490.88 | 927 | 1366 | 40.4 | .485 |
| 15 860 | 501.68 | ........ | 1477 | ........ | ........ |
| 16 000 | 505.88 | ........ | 1559 | ........ | .555 |
| 14 300 | 454.88 | 1050 | 2010 | 34.3 | .555 |

**BEAM 211**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 27 | 31 | 46.5 | 0.005 |
| 1500 | 70.68 | 75 | 65 | 53.6 | .015 |
| 2500 | 100.68 | 102 | 91 | 52.8 | .030 |
| 3500 | 130.68 | 138 | 123 | 52.9 | .045 |
| 4000 | 145.68 | 166 | 156 | 51.6 | .055 |
| 4500 | 160.68 | 188 | 191 | 49.6 | .065 |
| 5000 | 175.68 | 213 | 229 | 48.2 | .080 |
| 5500 | 190.68 | 254 | 284 | 47.2 | .095 |
| 6000 | 205.68 | 282 | 340 | 45.3 | .115 |
| 7000 | 235.68 | 337 | 458 | 42.4 | .155 |
| 8000 | 265.68 | 405 | 576 | 41.3 | .195 |
| 9000 | 295.68 | 465 | 687 | 40.3 | .235 |
| 10 000 | 325.68 | 530 | 807 | 39.6 | .275 |
| 11 000 | 355.68 | 602 | 923 | 39.5 | .315 |
| 12 000 | 385.68 | 661 | 1039 | 38.9 | .355 |
| 13 000 | 415.68 | 731 | 1161 | 38.6 | .405 |
| 14 000 | 445.68 | 814 | 1277 | 38.9 | .445 |
| 15 000 | 475.68 | 904 | 1462 | 38.2 | .495 |
| 15 500 | 490.58 | ........ | 1538 | ........ | .535 |
| 15 000 | 475.68 | 963 | 1617 | 37.3 | ........ |
| 15 400 | 487.68 | ........ | ........ | ........ | .555 |
| 14 900 | 472.68 | 1006 | 1773 | 36.2 | .565 |

**BEAM 212**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 34 | 27 | 55.8 | 0.015 |
| 1500 | 70.47 | 83 | 68 | 54.8 | .035 |
| 2500 | 100.47 | 119 | 96 | 55.3 | .050 |
| 3500 | 130.47 | 158 | 128 | 55.3 | .065 |
| 4000 | 145.47 | 188 | 156 | 54.7 | .075 |
| 4500 | 160.47 | 217 | 191 | 53.2 | .095 |
| 5000 | 175.47 | 252 | 239 | 51.3 | .105 |
| 5500 | 190.47 | 289 | 285 | 50.3 | .125 |
| 6000 | 205.47 | 329 | 335 | 49.6 | .145 |
| 6500 | 220.47 | 369 | 409 | 47.4 | .175 |
| 7000 | 235.47 | 405 | 470 | 46.3 | .205 |
| 8000 | 265.47 | 468 | 588 | 44.3 | .245 |
| 9000 | 295.47 | 534 | 709 | 43.0 | .285 |
| 10 000 | 325.47 | 612 | 824 | 42.6 | .335 |
| 11 000 | 355.47 | 671 | 944 | 41.5 | .365 |
| 12 000 | 385.47 | 740 | 1056 | 41.2 | .405 |
| 13 000 | 415.47 | 817 | 1171 | 41.1 | .455 |
| 14 000 | 445.47 | 901 | 1311 | 40.8 | .505 |
| 15 000 | 475.47 | 1056 | 1614 | 39.6 | .595 |
| 15 100 | 478.47 | ........ | 1687 | ........ | .635 |
| 13 600 | 433.47 | 1140 | 1964 | 36.7 | .655 |

**BEAM 222**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 37 | 32 | 53.9 | 0.010 |
| 1000 | 56.29 | 66 | 55 | 54.6 | .020 |
| 2000 | 86.29 | 101 | 87 | 53.8 | .030 |
| 3000 | 116.29 | 138 | 115 | 54.5 | .040 |
| 3500 | 131.29 | 158 | 128 | 55.3 | .050 |
| 4000 | 146.29 | 188 | 154 | 55.0 | .060 |
| 4500 | 161.29 | 211 | 183 | 53.5 | .070 |
| 5000 | 176.29 | 240 | 217 | 52.5 | .080 |
| 5500 | 191.29 | 270 | 253 | 51.6 | .090 |
| 6000 | 206.29 | 299 | 285 | 51.2 | .110 |
| 7000 | 236.29 | 361 | 393 | 47.9 | .140 |
| 8000 | 266.29 | 421 | 485 | 46.5 | .180 |
| 9000 | 296.29 | 488 | 585 | 45.5 | .210 |
| 10 000 | 326.29 | 552 | 670 | 45.2 | .250 |
| 11 000 | 356.29 | 627 | 769 | 44.9 | .280 |
| 12 000 | 386.29 | 688 | 853 | 44.6 | .320 |
| 13 000 | 416.29 | 772 | 930 | 45.4 | .350 |
| 14 000 | 446.29 | 837 | 1014 | 45.2 | .390 |
| 15 000 | 476.29 | 919 | 1115 | 45.2 | .420 |
| 16 000 | 506.29 | 1003 | 1214 | 45.2 | .460 |
| 17 000 | 536.29 | 1100 | 1332 | 45.2 | .515 |
| 17 500 | 551.29 | 1159 | 1398 | 45.3 | .540 |
| 17 820 | 560.89 | ........ | 1443 | ........ | .560 |
| 17 100 | 539.29 | 1217 | 1547 | 44.0 | .570 |
| 18 000 | 566.29 | ........ | 1679 | ........ | .600 |
| 16 250 | 513.79 | 1338 | 2009 | 40.0 | .620 |

**BEAM 223**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 45 | 44 | 50.8 | 0.005 |
| 2000 | 86.09 | 109 | 94 | 53.7 | .030 |
| 3000 | 116.09 | 139 | 126 | 52.5 | .000 |
| 4000 | 146.09 | 182 | 169 | 51.8 | .060 |
| 5000 | 176.09 | 237 | 231 | 50.7 | .090 |
| 6000 | 206.09 | 295 | 313 | 48.6 | .110 |
| 7000 | 236.09 | 354 | 419 | 45.8 | .150 |
| 8000 | 266.09 | 423 | 521 | 44.8 | .180 |
| 9000 | 296.09 | 478 | 605 | 44.1 | .210 |
| 10 000 | 326.09 | 542 | 703 | 43.5 | .250 |
| 11 000 | 356.09 | 608 | 790 | 43.5 | .290 |
| 12 000 | 386.09 | 671 | 884 | 43.1 | .320 |
| 13 000 | 416.09 | 745 | 997 | 42.8 | .360 |
| 14 000 | 446.09 | 805 | 1080 | 42.7 | .390 |
| 15 000 | 476.09 | 877 | 1179 | 42.7 | .430 |
| 16 000 | 506.09 | 938 | 1246 | 43.0 | .460 |
| 17 000 | 536.09 | 1030 | 1352 | 43.2 | .500 |
| 17 500 | 551.09 | 1071 | 1409 | 43.2 | .520 |
| 18 000 | 566.09 | 1108 | 1465 | 43.1 | .540 |
| 18 500 | 581.09 | ........ | 1521 | ........ | .570 |
| 18 000 | 566.09 | 1177 | 1600 | 42.4 | .575 |
| ........ | ........ | ........ | ........ | ........ | .600 |
| 19 000 | 596.09 | 1250 | 1716 | 42.1 | .610 |
| 19 200 | 602.09 | ........ | 1809 | ........ | .630 |
| 16 800 | 530.09 | 1336 | 2248 | 37.3 | .660 |

**BEAM 224**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 37 | 31 | 54.7 | 0.010 |
| 2000 | 85.88 | 94 | 91 | 50.9 | .040 |
| 3000 | 115.88 | 128 | 121 | 51.5 | .050 |
| 4000 | 145.88 | 174 | 171 | 50.5 | .070 |
| 5000 | 175.88 | 230 | 239 | 49.1 | .090 |
| 6000 | 205.88 | 287 | 328 | 46.6 | .120 |
| 7000 | 235.88 | 353 | 415 | 46.0 | .150 |
| 8000 | 265.88 | 414 | 508 | 44.9 | .190 |
| 9000 | 295.88 | 475 | 605 | 44.0 | .220 |
| 10 000 | 325.88 | 544 | 692 | 44.0 | .250 |
| 11 000 | 355.88 | 607 | 802 | 43.1 | .290 |
| 12 000 | 385.88 | 677 | 903 | 42.8 | .330 |
| 13 000 | 415.88 | 743 | 1005 | 42.5 | .370 |
| 14 000 | 445.88 | 807 | 1106 | 42.2 | .410 |
| 15 000 | 475.88 | 885 | 1197 | 42.5 | .440 |
| 16 000 | 505.88 | 955 | 1292 | 42.5 | .480 |
| 17 000 | 535.88 | 1045 | 1398 | 42.8 | .530 |
| 18 000 | 565.88 | 1143 | 1579 | 42.0 | .580 |
| 18 200 | 571.88 | ........ | 1733 | ........ | .610 |
| 18 450 | 579.38 | ........ | 1933 | ........ | .650 |
| 16 600 | 523.88 | 1310 | 2229 | 37.0 | .670 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 237**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 33 | 15 | 69.0 | 0.010 |
| 2000 | 85.88 | 106 | 65 | 61.9 | .040 |
| 3000 | 115.88 | 144 | 85 | 63.0 | .050 |
| 3500 | 130.88 | 180 | 91 | 66.4 | .050 |
| 4000 | 145.88 | 209 | 109 | 65.7 | .050 |
| 4500 | 160.88 | 241 | 133 | 64.4 | .050 |
| 5000 | 175.88 | 275 | 164 | 62.6 | .075 |
| 6000 | 205.88 | 338 | 241 | 58.4 | .100 |
| 7000 | 235.88 | 402 | 318 | 55.8 | .130 |
| 8000 | 265.88 | 470 | 398 | 54.2 | .170 |
| 9000 | 295.88 | 518 | 499 | 50.9 | .210 |
| 10 000 | 325.88 | 574 | 605 | 48.7 | .240 |
| 11 000 | 355.88 | 646 | 656 | 49.6 | .270 |
| 12 000 | 385.88 | 710 | 737 | 49.1 | .310 |
| 13 000 | 415.88 | 781 | 814 | 49.0 | .340 |
| 14 000 | 445.88 | 852 | 901 | 48.6 | .370 |
| 15 000 | 475.88 | 925 | 988 | 48.3 | .410 |
| 16 000 | 505.88 | 1003 | 1072 | 48.3 | .440 |
| 17 000 | 535.88 | 1079 | 1185 | 47.7 | .480 |
| 18 000 | 565.88 | 1159 | 1263 | 47.9 | .510 |
| 19 000 | 595.88 | 1268 | 1335 | 48.7 | .550 |
| 19 300 | 604.88 | ........ | 1361 | ........ | ........ |
| 19 400 | 607.88 | ........ | 1393 | ........ | ........ |
| 19 500 | 610.88 | 1383 | 1456 | 48.7 | .620 |
| 19 650 | 615.38 | ........ | 1474 | ........ | .640 |
| 17 600 | 553.88 | 1355 | 1400 | 49.2 | .650 |

**BEAM 238**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 42 | 44 | 49.0 | 0.010 |
| 2000 | 86.29 | 107 | 94 | 53.2 | .030 |
| 3000 | 116.29 | 143 | 125 | 53.4 | .040 |
| 4000 | 146.29 | 184 | 169 | 52.1 | .055 |
| 5000 | 176.29 | 228 | 232 | 49.6 | .080 |
| 6000 | 206.29 | 279 | 303 | 47.9 | .100 |
| 7000 | 236.29 | 332 | 383 | 46.4 | .130 |
| 8000 | 266.29 | 408 | 474 | 46.3 | .170 |
| 9000 | 296.29 | 461 | 557 | 45.3 | .195 |
| 10 000 | 326.29 | 546 | 634 | 46.3 | .230 |
| 11 000 | 356.29 | 612 | 725 | 45.8 | .260 |
| 12 000 | 386.29 | 672 | 807 | 45.4 | .290 |
| 13 000 | 416.29 | 734 | 882 | 45.4 | .310 |
| 14 000 | 446.29 | 785 | 968 | 44.0 | .340 |
| 15 000 | 476.29 | 842 | 1051 | 44.5 | .380 |
| 16 000 | 506.29 | 899 | 1132 | 44.3 | .410 |
| 17 000 | 536.29 | 972 | 1231 | 44.1 | .440 |
| 18 000 | 566.29 | 1045 | 1344 | 43.8 | .480 |
| 19 000 | 596.29 | 1187 | 1629 | 42.1 | .550 |
| 19 150 | 600.79 | ........ | 1679 | ........ | .560 |
| 17 500 | 551.29 | 1224 | 1947 | 38.6 | ........ |

**BEAM 239**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 38 | 34 | 52.5 | 0.005 |
| 2000 | 86.29 | 103 | 85 | 54.9 | .030 |
| 3000 | 116.29 | 135 | 113 | 54.5 | .040 |
| 4000 | 146.29 | 173 | 144 | 54.6 | .055 |
| 5000 | 176.29 | 217 | 191 | 53.2 | .070 |
| 6000 | 206.29 | 270 | 255 | 51.5 | .100 |
| 7000 | 236.29 | 337 | 340 | 49.8 | .120 |
| 8000 | 266.29 | 399 | 434 | 47.9 | .150 |
| 9000 | 296.29 | 451 | 521 | 46.4 | .180 |
| 10 000 | 326.29 | 518 | 609 | 46.0 | .210 |
| 11 000 | 356.29 | 589 | 691 | 46.0 | .245 |
| 12 000 | 386.29 | 642 | 778 | 45.2 | .280 |
| 13 000 | 416.29 | 702 | 860 | 44.9 | .320 |
| 14 000 | 446.29 | 765 | 944 | 44.7 | .350 |
| 15 000 | 476.29 | 833 | 1031 | 44.7 | .380 |
| 16 000 | 506.29 | 899 | 1120 | 44.5 | .420 |
| 17 000 | 536.29 | 990 | 1227 | 44.6 | .460 |
| 18 000 | 566.29 | 1065 | 1326 | 44.5 | .495 |
| 19 000 | 596.29 | 1148 | 1426 | 44.6 | .540 |
| 19 500 | 611.29 | ........ | 1485 | ........ | .590 |
| 19 630 | 615.19 | ........ | 1578 | ........ | .590 |
| 19 920 | 623.89 | ........ | 1774 | ........ | .625 |
| 18 000 | 566.29 | ........ | ........ | ........ | .640 |

**BEAM 165**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 26 | 14 | 65.0 | 0.005 |
| 1000 | 55.47 | 72 | 36 | 66.8 | .020 |
| 2000 | 85.47 | 104 | 56 | 65.0 | .030 |
| 3000 | 115.47 | 134 | 87 | 60.6 | .040 |
| 3500 | 130.47 | 155 | 106 | 59.4 | .050 |
| 4000 | 145.47 | 183 | 156 | 54.0 | .060 |
| 4500 | 160.47 | 258 | 325 | 44.3 | .110 |
| 5000 | 175.47 | 307 | 485 | 38.7 | .155 |
| 5500 | 190.47 | 351 | 643 | 35.3 | .200 |
| 6000 | 205.47 | 400 | 843 | 32.2 | .255 |
| 6500 | 220.47 | 447 | 1015 | 30.6 | .305 |
| 6800 | 229.47 | ........ | 1138 | ........ | .350 |
| 4900 | 172.47 | 384 | 1003 | 27.7 | .355 |

**BEAM 166**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 55.26 | 52 | 34 | 60.6 | .020 |
| 2000 | 85.26 | 82 | 60 | 57.8 | .030 |
| 3000 | 115.26 | 114 | 85 | 57.3 | .040 |
| 3500 | 130.26 | 135 | 104 | 56.5 | .050 |
| 4000 | 145.26 | 162 | 138 | 54.0 | .060 |
| 4500 | 160.26 | 257 | 448 | 36.5 | .130 |
| 5000 | 175.26 | 311 | 672 | 31.6 | .185 |
| 5500 | 190.26 | 346 | 839 | 29.2 | .240 |
| 6000 | 205.26 | 383 | 1027 | 27.2 | .285 |
| 6500 | 220.26 | 418 | 1176 | 26.2 | .325 |
| 5000 | 175.26 | 423 | 1634 | 20.6 | .350 |

**BEAM 167**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 26 | 17 | 60.6 | 0.010 |
| 1000 | 55.68 | 63 | 36 | 63.6 | .020 |
| 2000 | 85.68 | 92 | 62 | 59.7 | .030 |
| 2500 | 100.68 | 108 | 77 | 58.4 | .035 |
| 3000 | 115.68 | 127 | 92 | 58.0 | .045 |
| 3500 | 130.68 | 148 | 116 | 56.1 | .050 |
| 4000 | 145.68 | 193 | 238 | 44.7 | .075 |
| 4500 | 160.68 | 253 | 432 | 37.0 | .105 |
| 5000 | 175.68 | 336 | 740 | 31.2 | .190 |
| 5500 | 190.68 | 384 | 882 | 30.3 | .235 |
| 6000 | 205.68 | 416 | 1015 | 29.0 | .275 |
| 6500 | 220.68 | 454 | 1147 | 28.4 | .320 |
| 6600 | 223.68 | ........ | 1164 | ........ | .345 |
| 5200 | 181.68 | 408 | 1063 | 27.8 | .345 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 177** | | | | | |
| 0 | 25.47 | 24 | 19 | 56.0 | 0.010 |
| 1000 | 55.47 | 55 | 46 | 54.5 | .020 |
| 2000 | 85.47 | 85 | 74 | 53.4 | .030 |
| 3000 | 115.47 | 117 | 99 | 54.1 | .040 |
| 3500 | 130.47 | 134 | 121 | 52.5 | .050 |
| 4000 | 145.47 | 157 | 145 | 52.0 | .060 |
| 4500 | 160.47 | 192 | 226 | 45.9 | .080 |
| 5000 | 175.47 | 239 | 337 | 41.5 | .100 |
| 6000 | 205.47 | 331 | 617 | 34.9 | .180 |
| 7000 | 235.47 | 392 | 810 | 32.6 | .240 |
| 8000 | 265.47 | 457 | 976 | 31.9 | .310 |
| 8500 | 280.47 | 490 | 1063 | 31.5 | .340 |
| 9000 | 295.47 | 527 | 1157 | 31.3 | .370 |
| 9210 | 301.77 | ........ | 1215 | ........ | .410 |
| 7600 | 253.47 | 500 | 1116 | 30.9 | .410 |
| **BEAM 178** | | | | | |
| 0 | 25.47 | 19 | 22 | 46.4 | 0.010 |
| 1000 | 55.47 | 56 | 38 | 59.4 | .020 |
| 2000 | 85.47 | 81 | 62 | 56.7 | .035 |
| 3000 | 115.47 | 113 | 89 | 56.0 | .050 |
| 3500 | 130.47 | 132 | 106 | 55.4 | .055 |
| 4000 | 145.47 | 149 | 128 | 53.8 | .060 |
| 4500 | 160.47 | 174 | 171 | 50.5 | .075 |
| 5000 | 175.47 | 213 | 229 | 48.2 | .090 |
| 6000 | 205.47 | 315 | 497 | 38.8 | .160 |
| 7000 | 235.47 | 375 | 694 | 35.0 | .220 |
| 8000 | 265.47 | 434 | 867 | 33.4 | .280 |
| 9000 | 295.47 | 496 | 1046 | 32.2 | .345 |
| 10 000 | 325.47 | 560 | 1248 | 31.0 | .410 |
| 7700 | 256.47 | 507 | 817 | 38.3 | .410 |
| **BEAM 179** | | | | | |
| 0 | 25.47 | 28 | 21 | 57.6 | 0.010 |
| 1000 | 55.47 | 53 | 43 | 55.1 | .010 |
| 2000 | 85.47 | 79 | 67 | 54.2 | .020 |
| 3000 | 115.47 | 107 | 96 | 52.7 | .030 |
| 4000 | 145.47 | 138 | 123 | 52.9 | .040 |
| 4500 | 160.47 | 157 | 144 | 52.2 | .050 |
| 5000 | 175.47 | 184 | 178 | 50.8 | .060 |
| 5500 | 190.47 | 227 | 253 | 47.3 | .090 |
| 6000 | 205.47 | 276 | 369 | 42.8 | .130 |
| 7000 | 235.47 | 356 | 588 | 37.7 | .200 |
| 8000 | 265.47 | 413 | 776 | 34.8 | .260 |
| 9000 | 295.47 | 498 | 949 | 34.4 | .325 |
| 9840 | 320.67 | ........ | 1070 | ........ | .390 |
| 8200 | 271.47 | 501 | 974 | 34.0 | .400 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 189** | | | | | |
| 0 | 26.29 | 28 | 17 | 62.4 | 0.010 |
| 1000 | 56.29 | 58 | 36 | 61.6 | .020 |
| 2000 | 86.29 | 87 | 58 | 60.1 | .035 |
| 3000 | 116.29 | 118 | 82 | 59.0 | .045 |
| 4000 | 146.29 | 150 | 113 | 57.1 | .055 |
| 4500 | 161.29 | 171 | 137 | 55.6 | .070 |
| 5000 | 176.29 | 189 | 166 | 53.2 | .080 |
| 5500 | 191.29 | 217 | 214 | 50.3 | .100 |
| 6000 | 206.29 | 248 | 282 | 46.7 | .120 |
| 7000 | 236.29 | 328 | 460 | 41.7 | .165 |
| 8000 | 266.29 | 411 | 597 | 40.8 | .210 |
| 9000 | 296.29 | 462 | 726 | 38.9 | .260 |
| 10 000 | 326.29 | 522 | 858 | 37.8 | .305 |
| 11 000 | 356.29 | 592 | 988 | 37.5 | .350 |
| 12 000 | 386.29 | 650 | 1125 | 36.6 | .400 |
| 12 700 | 407.29 | ........ | 1226 | ........ | .455 |
| 10 100 | 329.29 | 706 | 1853 | 27.6 | .475 |
| **BEAM 190** | | | | | |
| 0 | 25.26 | 26 | 10 | 72.1 | 0.005 |
| 1000 | 55.26 | 62 | 21 | 74.7 | .025 |
| 2000 | 85.26 | 94 | 43 | 68.6 | .035 |
| 3000 | 115.26 | 126 | 74 | 63.0 | .045 |
| 4000 | 145.26 | 160 | 106 | 60.2 | .060 |
| 4500 | 160.26 | 181 | 128 | 58.6 | .070 |
| 5000 | 175.26 | 207 | 164 | 55.7 | .080 |
| 5500 | 190.26 | 234 | 209 | 52.8 | .085 |
| 6000 | 205.26 | 279 | 292 | 48.8 | .110 |
| 7000 | 235.26 | 357 | 477 | 42.8 | .165 |
| 8000 | 265.26 | 420 | 656 | 39.0 | .230 |
| 9000 | 295.26 | 489 | 814 | 37.5 | .275 |
| 10 000 | 325.26 | 531 | 979 | 35.2 | .320 |
| 11 000 | 355.26 | 590 | 1132 | 34.3 | .370 |
| 12 000 | 385.26 | 651 | 1277 | 33.7 | .415 |
| 12 500 | 400.26 | 682 | 1344 | 33.7 | .445 |
| 12 560 | 402.06 | ........ | 1374 | ........ | .475 |
| 9800 | 319.26 | 603 | 1150 | 34.4 | .475 |
| **BEAM 191** | | | | | |
| 0 | 25.47 | 21 | 21 | 50.1 | 0.010 |
| 1000 | 55.47 | 43 | 44 | 49.6 | .025 |
| 2000 | 85.47 | 72 | 68 | 51.4 | .035 |
| 3000 | 115.47 | 107 | 92 | 53.8 | .045 |
| 4000 | 145.47 | 145 | 116 | 55.6 | .055 |
| 4500 | 160.47 | 165 | 135 | 55.0 | .065 |
| 5000 | 175.47 | 190 | 159 | 54.5 | .075 |
| 5500 | 190.47 | 218 | 191 | 53.4 | .085 |
| 6000 | 205.47 | 261 | 244 | 51.7 | .100 |
| 7000 | 235.47 | 346 | 421 | 45.1 | .150 |
| 8000 | 265.47 | 411 | 588 | 41.1 | .205 |
| 9000 | 295.47 | 469 | 735 | 39.0 | .250 |
| 10 000 | 325.47 | 533 | 892 | 37.4 | .300 |
| 11 000 | 355.47 | 588 | 1021 | 36.6 | .345 |
| 11 780 | 378.87 | ........ | 1176 | ........ | .400 |
| 10 100 | 328.47 | 673 | 1561 | 30.1 | .420 |

## Appendix II—Log Sheets for Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches | Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | | | | Upper Fiber | Steel Fiber | | |
| **BEAM 201** | | | | | | **BEAM 213** | | | | | |
| 0 | 25.68 | 23 | 15 | 60.4 | 0.005 | 0 | 26.09 | 23 | 15 | 60.4 | 0.005 |
| 1000 | 55.68 | 50 | 32 | 61.0 | .015 | 1000 | 56.09 | 53 | 39 | 57.4 | .015 |
| 2000 | 85.68 | 79 | 55 | 58.9 | .025 | 2000 | 86.09 | 75 | 62 | 54.7 | .020 |
| 3000 | 115.68 | 112 | 77 | 59.4 | .035 | 3000 | 116.09 | 106 | 87 | 54.8 | .030 |
| 4000 | 145.68 | 142 | 101 | 58.5 | .045 | 4000 | 146.09 | 141 | 123 | 53.4 | .045 |
| 5000 | 175.68 | 186 | 152 | 55.0 | .060 | 5000 | 176.09 | 184 | 171 | 51.8 | .060 |
| 6000 | 205.68 | 236 | 250 | 48.6 | .085 | 6000 | 206.09 | 228 | 241 | 48.7 | .090 |
| 7000 | 235.68 | 311 | 405 | 43.4 | .135 | 7000 | 236.09 | 299 | 333 | 47.3 | .115 |
| 8000 | 265.68 | 372 | 542 | 40.7 | .175 | 8000 | 266.09 | 360 | 441 | 44.9 | .150 |
| 9000 | 295.68 | 429 | 682 | 38.6 | .215 | 9000 | 296.09 | 416 | 550 | 43.1 | .185 |
| 10 000 | 325.68 | 485 | 802 | 37.7 | .255 | 10 000 | 326.09 | 471 | 665 | 41.4 | .220 |
| 11 000 | 355.68 | 548 | 916 | 37.4 | .290 | 11 000 | 356.09 | 519 | 749 | 40.9 | .255 |
| 12 000 | 385.68 | 600 | 1045 | 36.5 | .325 | 12 000 | 386.09 | 572 | 856 | 40.1 | .290 |
| 13 000 | 415.68 | 657 | 1164 | 36.1 | .370 | 13 000 | 416.09 | 626 | 961 | 39.5 | .325 |
| 13 550 | 432.18 | ........ | 1301 | ........ | .410 | 14 000 | 446.09 | 670 | 1060 | 38.7 | .365 |
| 13 600 | 433.68 | ........ | 1443 | ........ | .430 | 15 000 | 476.09 | 723 | 1157 | 38.5 | .400 |
| 12 300 | 394.68 | 740 | 1680 | 30.6 | .440 | 16 000 | 506.09 | 782 | 1279 | 37.9 | .435 |
| | | | | | | 16 550 | 522.59 | ........ | 1321 | ........ | .470 |
| | | | | | | 14 800 | 470.09 | 777 | 1262 | 37.6 | .480 |
| **BEAM 202** | | | | | | **BEAM 214** | | | | | |
| 0 | 25.68 | 21 | 19 | 52.5 | 0.010 | 0 | 25.68 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 55.68 | 48 | 39 | 55.4 | .020 | 1000 | 55.68 | 53 | 38 | 58.0 | .020 |
| 2000 | 85.68 | 79 | 65 | 54.9 | .030 | 2000 | 85.68 | 79 | 60 | 56.8 | .030 |
| 3000 | 115.68 | 109 | 92 | 54.2 | .040 | 3000 | 115.68 | 107 | 84 | 55.9 | .040 |
| 4000 | 145.68 | 144 | 130 | 52.5 | .055 | 4000 | 145.68 | 141 | 115 | 55.0 | .055 |
| 5000 | 175.68 | 190 | 190 | 50.0 | .075 | 5000 | 175.68 | 185 | 161 | 53.5 | .075 |
| 6000 | 205.68 | 249 | 291 | 46.1 | .105 | 6000 | 205.68 | 238 | 217 | 52.3 | .100 |
| 7000 | 235.68 | 316 | 429 | 42.4 | .140 | 7000 | 235.68 | 298 | 313 | 48.7 | .130 |
| 8000 | 265.68 | 379 | 566 | 40.1 | .190 | 8000 | 265.68 | 363 | 434 | 45.5 | .165 |
| 9000 | 295.68 | 437 | 687 | 38.9 | .230 | 9000 | 295.68 | 420 | 556 | 43.0 | .210 |
| 10 000 | 325.68 | 477 | 815 | 36.9 | .270 | 10 000 | 325.68 | 469 | 665 | 41.3 | .240 |
| 11 000 | 355.68 | 549 | 957 | 36.5 | .310 | 11 000 | 355.68 | 523 | 781 | 40.1 | .275 |
| 12 000 | 385.68 | 604 | 1084 | 35.8 | .350 | 12 000 | 385.68 | 570 | 885 | 39.2 | .315 |
| 13 000 | 415.68 | 670 | 1215 | 35.6 | .395 | 13 000 | 415.68 | 621 | 991 | 38.5 | .355 |
| 13 650 | 435.18 | ........ | 1323 | ........ | .435 | 14 000 | 445.68 | 682 | 1094 | 38.4 | .390 |
| 12 450 | 399.18 | 740 | 1634 | 31.2 | .460 | 15 000 | 475.68 | 748 | 1202 | 38.3 | .430 |
| | | | | | | 16 000 | 505.68 | 803 | 1321 | 37.8 | .465 |
| | | | | | | 16 800 | 529.68 | ........ | 1494 | ........ | .525 |
| | | | | | | 14 600 | 463.68 | 877 | 1930 | 31.3 | .530 |
| **BEAM 203** | | | | | | **BEAM 215** | | | | | |
| 0 | 25.68 | 23 | 17 | 57.5 | 0.010 | 0 | 26.29 | 21 | 15 | 58.1 | 0.010 |
| 1000 | 55.68 | 55 | 44 | 55.5 | .025 | 1000 | 56.29 | 51 | 43 | 54.1 | .020 |
| 2000 | 85.68 | 77 | 67 | 53.5 | .035 | 2000 | 86.29 | 82 | 62 | 57.0 | .030 |
| 3000 | 115.68 | 106 | 91 | 53.8 | .045 | 3000 | 116.29 | 111 | 87 | 56.0 | .040 |
| 4000 | 145.68 | 136 | 118 | 53.5 | .055 | 4000 | 146.29 | 146 | 120 | 54.9 | .050 |
| 5000 | 175.68 | 174 | 173 | 50.2 | .070 | 5000 | 176.29 | 189 | 174 | 52.1 | .070 |
| 6000 | 205.68 | 233 | 255 | 47.8 | .100 | 6000 | 206.29 | 245 | 277 | 46.9 | .100 |
| 7000 | 235.68 | 296 | 391 | 43.1 | .140 | 7000 | 236.29 | 299 | 379 | 44.1 | .130 |
| 8000 | 265.68 | 363 | 532 | 40.5 | .185 | 8000 | 266.29 | 358 | 494 | 42.0 | .160 |
| 9000 | 295.68 | 418 | 662 | 38.7 | .225 | 9000 | 296.29 | 411 | 597 | 40.8 | .195 |
| 10 000 | 325.68 | 473 | 805 | 37.0 | .265 | 10 000 | 326.29 | 461 | 708 | 39.5 | .235 |
| 11 000 | 355.68 | 527 | 920 | 36.4 | .310 | 11 000 | 356.29 | 518 | 821 | 38.7 | .275 |
| 12 000 | 385.68 | 578 | 1043 | 35.7 | .345 | 12 000 | 386.29 | 567 | 932 | 37.8 | .305 |
| 13 000 | 415.68 | 637 | 1166 | 35.3 | .385 | 13 000 | 416.29 | 618 | 1038 | 37.3 | .345 |
| 14 000 | 445.68 | 713 | 1361 | 34.4 | .440 | 14 000 | 446.29 | 670 | 1144 | 36.9 | .380 |
| 14 180 | 451.08 | ........ | 1479 | ........ | .465 | 15 000 | 476.29 | 726 | 1250 | 36.7 | .425 |
| 12 600 | 403.68 | 772 | 1882 | 29.1 | .495 | 16 000 | 506.29 | 799 | 1368 | 36.9 | .470 |
| | | | | | | 16 500 | 521.29 | ........ | 1422 | ........ | .495 |
| | | | | | | 15 500 | 491.29 | 828 | 1540 | 34.9 | .510 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 225** | | | | | |
| 0 | 25.88 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 55.88 | 55 | 31 | 64.1 | .020 |
| 2000 | 85.88 | 84 | 55 | 60.4 | .030 |
| 3000 | 115.88 | 116 | 77 | 60.0 | .040 |
| 4000 | 145.88 | 145 | 108 | 57.3 | .050 |
| 5000 | 175.88 | 185 | 147 | 55.8 | .070 |
| 6000 | 205.88 | 229 | 205 | 52.7 | .090 |
| 7000 | 235.88 | 296 | 289 | 50.6 | .115 |
| 8000 | 265.88 | 355 | 379 | 48.3 | .145 |
| 9000 | 295.88 | 414 | 479 | 46.3 | .180 |
| 10 000 | 325.88 | 469 | 579 | 44.8 | .210 |
| 11 000 | 355.88 | 522 | 682 | 43.4 | .240 |
| 12 000 | 385.88 | 579 | 773 | 42.8 | .275 |
| 13 000 | 415.88 | 625 | 868 | 41.8 | .310 |
| 14 000 | 445.88 | 686 | 966 | 41.5 | .345 |
| 15 000 | 475.88 | 732 | 1055 | 41.0 | .375 |
| 16 000 | 505.88 | 788 | 1156 | 40.5 | .410 |
| 17 000 | 535.88 | 839 | 1236 | 40.4 | .440 |
| 18 000 | 565.88 | 913 | 1354 | 40.3 | .485 |
| 18 250 | 573.38 | ........ | 1503 | ........ | .510 |
| 17 250 | 543.38 | 1040 | 1926 | 35.1 | .560 |
| **BEAM 226** | | | | | |
| 0 | 26.09 | 19 | 12 | 60.7 | 0.005 |
| 1000 | 56.09 | 45 | 34 | 56.9 | .015 |
| 2000 | 86.09 | 73 | 55 | 57.2 | .025 |
| 3000 | 116.09 | 101 | 80 | 55.8 | .035 |
| 4000 | 146.09 | 130 | 101 | 56.2 | .045 |
| 5000 | 176.09 | 167 | 140 | 54.5 | .055 |
| 6000 | 206.09 | 205 | 190 | 51.9 | .075 |
| 7000 | 236.09 | 257 | 263 | 49.4 | .095 |
| 8000 | 266.09 | 313 | 356 | 46.8 | .125 |
| 9000 | 296.09 | 368 | 465 | 44.2 | .155 |
| 10 000 | 326.09 | 421 | 574 | 42.3 | .185 |
| 11 000 | 356.09 | 471 | 663 | 41.5 | .215 |
| 12 000 | 386.09 | 522 | 754 | 40.9 | .250 |
| 13 000 | 416.09 | 567 | 839 | 40.3 | .285 |
| 14 000 | 446.09 | 617 | 932 | 39.9 | .315 |
| 15 000 | 476.09 | 668 | 1021 | 39.5 | .345 |
| 16 000 | 506.09 | 713 | 1109 | 39.1 | .375 |
| 17 000 | 536.09 | 769 | 1205 | 38.9 | .405 |
| 18 000 | 566.09 | 827 | 1321 | 38.5 | .445 |
| 18 500 | 581.09 | ........ | 1480 | ........ | .480 |
| 18 620 | 584.69 | ........ | 1694 | ........ | .505 |
| 17 300 | 545.09 | 967 | 2075 | 31.8 | .535 |
| **BEAM 227** | | | | | |
| 0 | 26.29 | 19 | 17 | 52.5 | 0.005 |
| 1000 | 56.29 | 48 | 43 | 52.5 | .015 |
| 2000 | 86.29 | 72 | 63 | 53.2 | .025 |
| 3000 | 116.29 | 101 | 85 | 54.4 | .035 |
| 4000 | 146.29 | 132 | 109 | 54.8 | .045 |
| 5000 | 176.29 | 167 | 138 | 54.8 | .055 |
| 6000 | 206.29 | 215 | 193 | 52.7 | .075 |
| 7000 | 236.29 | 273 | 258 | 51.4 | .095 |
| 8000 | 266.29 | 331 | 349 | 48.7 | .125 |
| 9000 | 296.29 | 387 | 448 | 46.3 | .155 |
| 10 000 | 326.29 | 437 | 550 | 44.3 | .190 |
| 11 000 | 356.29 | 488 | 643 | 43.1 | .220 |
| 12 000 | 386.29 | 543 | 732 | 42.6 | .255 |
| 13 000 | 416.29 | 589 | 824 | 41.7 | .285 |
| 14 000 | 446.29 | 634 | 911 | 41.0 | .315 |
| 15 000 | 476.29 | 690 | 1007 | 40.7 | .345 |
| 16 000 | 506.29 | 742 | 1103 | 40.2 | .385 |
| 17 000 | 536.29 | 796 | 1197 | 39.9 | .415 |
| 18 000 | 566.29 | 850 | 1308 | 39.4 | .455 |
| 18 780 | 589.69 | ........ | 1443 | ........ | .495 |
| 17 400 | 548.29 | 906 | 1513 | 37.5 | .530 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 243** | | | | | |
| 0 | 26.29 | 26 | 17 | 60.6 | 0.010 |
| 1000 | 56.29 | 67 | 38 | 63.9 | .025 |
| 2000 | 86.29 | 91 | 53 | 63.2 | .035 |
| 3000 | 116.29 | 123 | 75 | 62.1 | .045 |
| 4000 | 146.29 | 153 | 101 | 60.2 | .060 |
| 5000 | 176.29 | 190 | 135 | 58.5 | .080 |
| 6000 | 206.29 | 230 | 179 | 56.3 | .100 |
| 7000 | 236.29 | 284 | 239 | 54.3 | .120 |
| 8000 | 266.29 | 341 | 306 | 52.7 | .140 |
| 9000 | 296.29 | 401 | 379 | 51.4 | .170 |
| 10 000 | 326.29 | 446 | 472 | 48.6 | .195 |
| 11 000 | 356.29 | 503 | 556 | 47.5 | .225 |
| 12 000 | 386.29 | 547 | 643 | 45.9 | .255 |
| 13 000 | 416.29 | 603 | 725 | 45.4 | .285 |
| 14 000 | 446.29 | 647 | 805 | 44.5 | .315 |
| 15 000 | 476.29 | 696 | 887 | 44.0 | .345 |
| 16 000 | 506.29 | 746 | 966 | 43.6 | .370 |
| 17 000 | 536.29 | 807 | 1039 | 43.7 | .400 |
| 18 000 | 566.29 | 850 | 1115 | 43.3 | .430 |
| 19 000 | 596.29 | 917 | 1215 | 43.0 | .470 |
| 20 000 | 626.29 | 981 | 1340 | 42.3 | .500 |
| 20 500 | 641.29 | 1038 | 1456 | 41.6 | .535 |
| 21 000 | 656.29 | 1082 | 1562 | 40.9 | .570 |
| 21 300 | 665.29 | ........ | 1706 | ........ | .615 |
| 19 400 | 608.29 | 1182 | 2038 | 36.7 | .630 |
| **BEAM 244** | | | | | |
| 0 | 26.71 | 28 | 17 | 62.4 | 0.010 |
| 1000 | 56.71 | 52 | 32 | 62.0 | .020 |
| 2000 | 86.71 | 79 | 53 | 59.7 | .025 |
| 3000 | 116.71 | 105 | 72 | 59.3 | .035 |
| 4000 | 146.71 | 129 | 91 | 58.6 | .045 |
| 5000 | 176.71 | 163 | 115 | 58.6 | .060 |
| 6000 | 206.71 | 196 | 156 | 55.6 | .070 |
| 7000 | 236.71 | 242 | 209 | 53.6 | .090 |
| 8000 | 266.71 | 293 | 275 | 51.6 | .110 |
| 9000 | 296.71 | 339 | 354 | 48.9 | .140 |
| 10 000 | 326.71 | 381 | 443 | 46.3 | .170 |
| 11 000 | 356.71 | 427 | 532 | 44.5 | .195 |
| 12 000 | 386.71 | 474 | 617 | 43.4 | .225 |
| 13 000 | 416.71 | 519 | 697 | 42.7 | .250 |
| 14 000 | 446.71 | 566 | 778 | 42.1 | .280 |
| 15 000 | 476.71 | 608 | 856 | 41.5 | .310 |
| 16 000 | 506.71 | 658 | 937 | 41.2 | .340 |
| 17 000 | 536.71 | 703 | 1014 | 40.9 | .365 |
| 18 000 | 566.71 | 750 | 1089 | 40.8 | .395 |
| 19 000 | 596.71 | 808 | 1173 | 40.8 | .430 |
| 20 000 | 626.71 | 860 | 1252 | 40.7 | .460 |
| 21 000 | 656.71 | 927 | 1379 | 40.2 | .510 |
| 21 280 | 665.11 | ........ | 1405 | ........ | .530 |
| 19 400 | 608.71 | 890 | 1294 | 40.8 | .540 |
| **BEAM 245** | | | | | |
| 0 | 26.50 | 23 | 19 | 54.9 | 0.010 |
| 1000 | 56.50 | 48 | 43 | 52.5 | .020 |
| 2000 | 86.50 | 74 | 63 | 54.0 | .030 |
| 3000 | 116.50 | 101 | 85 | 54.4 | .040 |
| 4000 | 146.50 | 127 | 108 | 54.0 | .050 |
| 5000 | 176.50 | 162 | 140 | 53.7 | .060 |
| 6000 | 206.50 | 197 | 181 | 52.1 | .075 |
| 7000 | 236.50 | 243 | 244 | 49.9 | .095 |
| 8000 | 266.50 | 293 | 304 | 49.1 | .120 |
| 9000 | 296.50 | 340 | 388 | 46.7 | .145 |
| 10 000 | 326.50 | 388 | 477 | 44.9 | .170 |
| 11 000 | 356.50 | 431 | 564 | 43.3 | .200 |
| 12 000 | 386.50 | 477 | 648 | 42.4 | .230 |
| 13 000 | 416.50 | 525 | 728 | 41.9 | .260 |
| 14 000 | 446.50 | 568 | 802 | 41.4 | .285 |
| 15 000 | 476.50 | 615 | 879 | 41.2 | .315 |
| 16 000 | 506.50 | 662 | 957 | 40.9 | .345 |
| 17 000 | 536.50 | 704 | 1034 | 40.5 | .370 |
| 18 000 | 566.50 | 753 | 1113 | 40.4 | .400 |
| 19 000 | 596.50 | 809 | 1198 | 40.3 | .430 |
| 20 000 | 626.50 | 870 | 1304 | 40.0 | .470 |
| 21 000 | 656.50 | 938 | 1439 | 39.5 | .510 |
| 22 000 | 686.50 | 1044 | 1720 | 37.8 | .570 |
| 22 120 | 690.10 | ........ | 1831 | ........ | .595 |
| 18 900 | 593.50 | 1108 | 2419 | 31.4 | .620 |

Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 169** | | | | | |
| 0 | 25.68 | 16 | 10 | 62.0 | 0.005 |
| 1000 | 55.68 | 35 | 32 | 52.5 | .020 |
| 2000 | 85.68 | 59 | 55 | 51.6 | .030 |
| 2500 | 100.68 | 70 | 68 | 50.7 | .035 |
| 3000 | 115.68 | 86 | 85 | 50.2 | .050 |
| 3500 | 130.68 | 115 | 133 | 46.5 | .060 |
| 4000 | 145.68 | 153 | 212 | 42.0 | .085 |
| 4500 | 160.68 | 202 | 421 | 32.4 | .140 |
| 5000 | 175.68 | 265 | 586 | 31.1 | .185 |
| 5500 | 190.68 | 307 | 766 | 28.6 | .230 |
| 6000 | 205.68 | 349 | 942 | 27.1 | .265 |
| 6500 | 220.68 | 389 | 1089 | 26.3 | .315 |
| 6810 | 229.98 | ........ | 1178 | ........ | .340 |
| 6050 | 207.18 | 385 | 1135 | 25.3 | .350 |
| **BEAM 170** | | | | | |
| 0 | 25.68 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 55.68 | 45 | 31 | 59.1 | .025 |
| 2000 | 85.68 | 66 | 56 | 54.1 | .035 |
| 2500 | 100.68 | 87 | 68 | 56.1 | .045 |
| 3000 | 115.68 | 100 | 84 | 54.4 | .055 |
| 3500 | 130.68 | 122 | 106 | 53.6 | .060 |
| 4000 | 145.68 | 175 | 238 | 42.3 | .095 |
| 4500 | 160.68 | 232 | 414 | 35.9 | .145 |
| 5000 | 175.68 | 278 | 605 | 31.5 | .190 |
| 5500 | 190.68 | 313 | 745 | 29.6 | .230 |
| 6000 | 205.68 | 346 | 887 | 28.0 | .270 |
| 6350 | 216.18 | ........ | 1044 | ........ | .325 |
| 5230 | 182.58 | 350 | 979 | 26.4 | .335 |
| **BEAM 180** | | | | | |
| 0 | 25.88 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.88 | 33 | 43 | 43.3 | .020 |
| 2000 | 85.88 | 59 | 67 | 47.0 | .030 |
| 3000 | 115.88 | 88 | 97 | 47.6 | .040 |
| 3500 | 130.88 | 109 | 126 | 46.3 | .050 |
| 4000 | 145.88 | 135 | 159 | 45.9 | .065 |
| 4500 | 160.88 | 163 | 222 | 42.4 | .080 |
| 5000 | 175.88 | 196 | 306 | 39.1 | .100 |
| 6000 | 205.88 | 270 | 499 | 35.2 | .150 |
| 7000 | 235.88 | 336 | 691 | 32.7 | .210 |
| 8000 | 265.88 | 396 | 870 | 31.3 | .265 |
| 9000 | 295.88 | 462 | 1053 | 30.5 | .320 |
| 9820 | 320.48 | ........ | 1226 | ........ | .380 |
| 8000 | 265.88 | 575 | 2391 | 19.4 | .470 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 181** | | | | | |
| 0 | 25.88 | 16 | 12 | 57.8 | 0.010 |
| 1000 | 55.88 | 32 | 32 | 50.2 | .020 |
| 2000 | 85.88 | 66 | 51 | 56.4 | .030 |
| 3000 | 115.88 | 100 | 84 | 54.4 | .050 |
| 3500 | 130.88 | 115 | 109 | 51.4 | .060 |
| 4000 | 145.88 | 137 | 135 | 50.3 | .070 |
| 4500 | 160.88 | 167 | 191 | 46.6 | .080 |
| 5000 | 175.88 | 202 | 258 | 43.9 | .105 |
| 5500 | 190.88 | 235 | 333 | 41.4 | .130 |
| 6000 | 205.88 | 274 | 444 | 38.2 | .160 |
| 7000 | 235.88 | 333 | 619 | 35.0 | .210 |
| 8000 | 265.88 | 395 | 815 | 32.7 | .270 |
| 9000 | 295.88 | 458 | 998 | 31.4 | .325 |
| 10 000 | 325.88 | 508 | 1178 | 30.1 | .380 |
| 10 780 | 349.28 | ........ | 1303 | ........ | .425 |
| 8100 | 268.88 | 470 | 1133 | 29.3 | .440 |
| **BEAM 182** | | | | | |
| 0 | 26.09 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 56.09 | 51 | 51 | 50.1 | .030 |
| 2000 | 86.09 | 70 | 70 | 50.0 | .040 |
| 3000 | 116.09 | 94 | 99 | 48.6 | .050 |
| 3500 | 131.09 | 120 | 123 | 49.4 | .060 |
| 4000 | 146.09 | 148 | 168 | 46.8 | .070 |
| 4500 | 161.09 | 179 | 222 | 44.6 | .090 |
| 5000 | 176.09 | 211 | 289 | 42.2 | .110 |
| 6000 | 206.09 | 294 | 528 | 35.8 | .170 |
| 7000 | 236.09 | 356 | 708 | 33.5 | .230 |
| 8000 | 266.09 | 414 | 891 | 31.7 | .290 |
| 9000 | 296.09 | 478 | 1074 | 30.8 | .350 |
| 10 000 | 326.09 | 533 | 1241 | 30.0 | .405 |
| 8250 | 273.09 | 481 | 1132 | 29.8 | .430 |
| **BEAM 192** | | | | | |
| 0 | 25.26 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 55.26 | 38 | 38 | 49.9 | .020 |
| 2000 | 85.26 | 62 | 62 | 50.1 | .030 |
| 3000 | 115.26 | 93 | 87 | 51.7 | .045 |
| 3500 | 130.26 | 114 | 104 | 52.3 | .050 |
| 4000 | 145.26 | 136 | 130 | 51.2 | .060 |
| 5000 | 175.26 | 183 | 197 | 48.2 | .080 |
| 6000 | 205.26 | 240 | 311 | 43.5 | .115 |
| 7000 | 235.26 | 315 | 475 | 39.8 | .160 |
| 8000 | 265.26 | 383 | 629 | 37.8 | .210 |
| 9000 | 295.26 | 449 | 774 | 36.7 | .250 |
| 10 000 | 325.26 | 505 | 913 | 35.6 | .300 |
| 11 000 | 355.26 | 568 | 1051 | 35.1 | .345 |
| 12 000 | 385.26 | 627 | 1181 | 34.7 | .390 |
| 12 360 | 396.06 | ........ | 1280 | ........ | .425 |
| 10 900 | 352.26 | 627 | 1309 | 32.4 | .430 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 193** | | | | | |
| 0 | 25.68 | 19 | 14 | 57.1 | 0.005 |
| 1000 | 55.68 | 45 | 41 | 52.5 | .015 |
| 2000 | 85.68 | 79 | 65 | 54.9 | .030 |
| 3000 | 115.68 | 111 | 92 | 54.7 | .045 |
| 4000 | 145.68 | 146 | 125 | 53.8 | .055 |
| 5000 | 175.68 | 201 | 190 | 51.3 | .080 |
| 6000 | 205.68 | 273 | 308 | 47.0 | .115 |
| 7000 | 235.68 | 337 | 456 | 42.5 | .155 |
| 8000 | 265.68 | 396 | 593 | 40.1 | .205 |
| 9000 | 295.68 | 462 | 727 | 38.9 | .250 |
| 10 000 | 325.68 | 518 | 841 | 38.1 | .290 |
| 11 000 | 355.68 | 585 | 962 | 37.8 | .335 |
| 12 000 | 385.68 | 656 | 1089 | 37.6 | .395 |
| 12 500 | 400.68 | ........ | 1210 | ........ | .425 |
| 10 500 | 340.68 | 749 | 1786 | 29.5 | .470 |
| **BEAM 194** | | | | | |
| 0 | 25.68 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.68 | 37 | 31 | 54.7 | .020 |
| 2000 | 85.68 | 61 | 50 | 54.8 | .030 |
| 3000 | 115.68 | 90 | 77 | 54.0 | .045 |
| 4000 | 145.68 | 122 | 103 | 54.3 | .055 |
| 5000 | 175.68 | 164 | 178 | 48.0 | .080 |
| 6000 | 205.68 | 213 | 250 | 46.0 | .105 |
| 7000 | 235.68 | 272 | 412 | 39.8 | .145 |
| 8000 | 265.68 | 338 | 605 | 35.9 | .195 |
| 9000 | 295.68 | 382 | 754 | 33.6 | .240 |
| 10 000 | 325.68 | 443 | 899 | 33.0 | 285 |
| 11 000 | 355.68 | 491 | 1034 | 32.2 | .325 |
| 12 000 | 385.68 | 551 | 1173 | 32.0 | .375 |
| 12 530 | 401.58 | ........ | 1313 | ........ | .415 |
| 10 700 | 346.68 | 590 | 1708 | 25.7 | .430 |
| **BEAM 204** | | | | | |
| 0 | 25.68 | 17 | 15 | 52.5 | 0.01 |
| 1000 | 55.68 | 37 | 32 | 53.9 | .02 |
| 2000 | 85.68 | 64 | 55 | 53.8 | .03 |
| 3000 | 115.68 | 91 | 82 | 52.5 | .04 |
| 4000 | 145.68 | 127 | 121 | 51.3 | .06 |
| 5000 | 175.68 | 175 | 191 | 47.9 | .085 |
| 6000 | 205.68 | 236 | 297 | 44.2 | .12 |
| 7000 | 235.68 | 294 | 421 | 41.1 | .16 |
| 8000 | 265.68 | 345 | 540 | 39.0 | .20 |
| 9000 | 295.68 | 398 | 667 | 37.4 | .24 |
| 10 000 | 325.68 | 455 | 791 | 36.5 | .28 |
| 11 000 | 355.68 | 500 | 887 | 36.1 | .32 |
| 12 000 | 385.68 | 558 | 1014 | 35.5 | .36 |
| 13 000 | 415.68 | 610 | 1138 | 34.9 | .405 |
| 13 550 | 432.18 | ........ | 1267 | ........ | .445 |
| 12 500 | 400.68 | 665 | 1485 | 30.9 | .455 |
| **BEAM 205** | | | | | |
| 0 | 26.29 | 19 | 19 | 49.9 | 0.010 |
| 1000 | 56.29 | 42 | 46 | 48.0 | .020 |
| 2000 | 86.29 | 63 | 68 | 47.9 | .030 |
| 3000 | 116.29 | 91 | 97 | 48.5 | .045 |
| 4000 | 146.29 | 122 | 132 | 48.0 | .060 |
| 5000 | 176.29 | 162 | 186 | 46.6 | .080 |
| 6000 | 206.29 | 213 | 279 | 43.2 | .110 |
| 7000 | 236.29 | 268 | 403 | 39.9 | .140 |
| 8000 | 266.29 | 328 | 533 | 38.1 | .180 |
| 9000 | 296.29 | 382 | 655 | 36.8 | .220 |
| 10 000 | 326.29 | 429 | 781 | 35.5 | .260 |
| 11 000 | 356.29 | 487 | 906 | 34.9 | .300 |
| 12 000 | 386.29 | 534 | 1024 | 34.3 | .340 |
| 13 000 | 416.29 | 583 | 1137 | 33.9 | .380 |
| 14 000 | 446.29 | 653 | 1333 | 32.9 | .440 |
| 14 730 | 468.19 | ........ | 1684 | ........ | .540 |
| 13 730 | 438.19 | 722 | 1651 | 30.4 | .555 |
| **BEAM 206** | | | | | |
| 0 | 25.68 | 19 | 21 | 47.5 | 0.010 |
| 1000 | 55.68 | 38 | 36 | 51.1 | .020 |
| 2000 | 85.68 | 68 | 55 | 55.3 | .030 |
| 3000 | 115.68 | 100 | 82 | 55.0 | .050 |
| 4000 | 145.68 | 133 | 111 | 54.6 | .065 |
| 5000 | 175.68 | 173 | 164 | 51.3 | .085 |
| 6000 | 205.68 | 229 | 248 | 48.0 | .120 |
| 7000 | 235.68 | 284 | 373 | 43.2 | .160 |
| 8000 | 265.68 | 346 | 503 | 40.8 | .200 |
| 9000 | 295.68 | 403 | 621 | 39.4 | .240 |
| 10 000 | 325.68 | 450 | 744 | 37.7 | .280 |
| 11 000 | 355.68 | 507 | 865 | 36.9 | .320 |
| 12 000 | 385.68 | 551 | 983 | 35.9 | .360 |
| 13 000 | 415.68 | 596 | 1096 | 35.2 | .400 |
| 14 000 | 445.68 | 655 | 1258 | 34.2 | .450 |
| 14 540 | 461.88 | ........ | 1393 | ........ | .480 |
| 12 800 | 409.68 | 717 | 1756 | 29.0 | .505 |
| **BEAM 216** | | | | | |
| 0 | 25.88 | 17 | 14 | 54.1 | 0.010 |
| 1000 | 55.88 | 45 | 31 | 59.1 | .020 |
| 2000 | 85.88 | 68 | 51 | 57.1 | .030 |
| 3000 | 115.88 | 92 | 70 | 56.8 | .040 |
| 4000 | 145.88 | 127 | 106 | 54.4 | .050 |
| 5000 | 175.88 | 168 | 154 | 52.2 | .070 |
| 6000 | 205.88 | 214 | 214 | 50.1 | .100 |
| 7000 | 235.88 | 274 | 294 | 48.3 | .130 |
| 8000 | 265.88 | 333 | 393 | 45.9 | .170 |
| 9000 | 295.88 | 386 | 496 | 43.8 | .200 |
| 10 000 | 325.88 | 443 | 603 | 42.4 | .240 |
| 11 000 | 355.88 | 498 | 704 | 41.4 | .270 |
| 12 000 | 385.88 | 547 | 802 | 40.6 | .310 |
| 13 000 | 415.88 | 594 | 872 | 40.5 | .345 |
| 14 000 | 445.88 | 660 | 978 | 40.3 | .380 |
| 15 000 | 475.88 | 708 | 1077 | 39.7 | .415 |
| 16 000 | 505.88 | 808 | 1292 | 38.5 | .480 |
| 14 500 | 460.88 | 853 | 1739 | 32.9 | .520 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 217**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 19 | 14 | 57.1 | 0.005 |
| 1000 | 56.09 | 43 | 29 | 59.5 | .02 |
| 2000 | 86.09 | 64 | 50 | 56.0 | .03 |
| 3000 | 116.09 | 92 | 74 | 55.5 | .04 |
| 4000 | 146.09 | 124 | 101 | 55.2 | .05 |
| 5000 | 176.09 | 160 | 147 | 52.2 | .07 |
| 6000 | 206.09 | 205 | 203 | 50.3 | .09 |
| 7000 | 236.09 | 252 | 274 | 47.9 | .125 |
| 8000 | 266.09 | 300 | 342 | 46.7 | .16 |
| 9000 | 296.09 | 350 | 439 | 44.4 | .19 |
| 10 000 | 326.09 | 404 | 542 | 42.7 | .23 |
| 11 000 | 356.09 | 445 | 633 | 41.3 | .26 |
| 12 000 | 386.09 | 493 | 733 | 40.2 | .295 |
| 13 000 | 416.09 | 544 | 829 | 39.6 | .33 |
| 14 000 | 446.09 | 592 | 930 | 38.9 | .365 |
| 15 000 | 476.09 | 643 | 1041 | 38.2 | .405 |
| 16 000 | 506.09 | 703 | 1171 | 37.5 | .445 |
| 16 350 | 516.59 | ........ | 1224 | ........ | .47 |
| 15 300 | 485.09 | 777 | 1735 | 30.9 | .515 |

**BEAM 218**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 16 | 15 | 50.9 | 0.005 |
| 1000 | 56.29 | 38 | 36 | 51.1 | .020 |
| 2000 | 86.29 | 56 | 55 | 50.2 | .030 |
| 3000 | 116.29 | 82 | 82 | 50.1 | .045 |
| 4000 | 146.29 | 112 | 116 | 49.2 | .060 |
| 5000 | 176.29 | 155 | 185 | 45.6 | .080 |
| 6000 | 206.29 | 197 | 255 | 43.5 | .100 |
| 7000 | 236.29 | 249 | 342 | 42.1 | .130 |
| 8000 | 266.29 | 304 | 415 | 42.3 | .160 |
| 9000 | 296.29 | 359 | 525 | 40.6 | .200 |
| 10 000 | 326.29 | 406 | 629 | 39.2 | .230 |
| 11 000 | 356.29 | 456 | 733 | 38.4 | .270 |
| 12 000 | 386.29 | 503 | 836 | 37.6 | .305 |
| 13 000 | 416.29 | 555 | 937 | 37.2 | .340 |
| 14 000 | 446.29 | 604 | 1015 | 37.3 | .375 |
| 15 000 | 476.29 | 653 | 1130 | 36.6 | .410 |
| 16 000 | 506.29 | 712 | 1251 | 36.3 | .450 |
| 16 300 | 515.29 | ........ | 1337 | ........ | .480 |
| 14 900 | 473.29 | 780 | 1802 | 30.2 | .510 |

**BEAM 231**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 21 | 15 | 58.1 | 0.005 |
| 1000 | 56.29 | 43 | 34 | 55.8 | .015 |
| 2000 | 86.29 | 66 | 51 | 56.3 | .025 |
| 3000 | 116.29 | 92 | 67 | 57.8 | .035 |
| 4000 | 146.29 | 124 | 91 | 57.6 | .045 |
| 5000 | 176.29 | 158 | 121 | 56.6 | .060 |
| 6000 | 206.29 | 194 | 171 | 53.2 | .080 |
| 7000 | 236.29 | 236 | 236 | 50.0 | .100 |
| 8000 | 266.29 | 283 | 323 | 46.7 | .130 |
| 9000 | 296.29 | 341 | 415 | 45.1 | .160 |
| 10 000 | 326.29 | 387 | 504 | 43.4 | .190 |
| 11 000 | 356.29 | 434 | 595 | 42.2 | .220 |
| 12 000 | 386.29 | 483 | 696 | 41.0 | .250 |
| 13 000 | 416.29 | 529 | 786 | 40.2 | .280 |
| 14 000 | 446.29 | 567 | 862 | 39.7 | .310 |
| 15 000 | 476.29 | 603 | 942 | 39.0 | .340 |
| 16 000 | 506.29 | 650 | 1034 | 38.6 | .370 |
| 17 000 | 536.29 | 700 | 1120 | 38.5 | .405 |
| 18 000 | 566.29 | 746 | 1226 | 37.9 | .440 |
| 18 980 | 595.69 | ........ | 1309 | ........ | .475 |
| 16 600 | 524.29 | 848 | 1896 | 30.9 | .510 |

**BEAM 232**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 56.29 | 42 | 36 | 53.8 | .020 |
| 2000 | 86.29 | 61 | 53 | 53.4 | .030 |
| 3000 | 116.29 | 93 | 72 | 56.4 | .040 |
| 4000 | 146.29 | 119 | 97 | 55.1 | .050 |
| 5000 | 176.29 | 149 | 133 | 52.9 | .065 |
| 6000 | 206.29 | 197 | 183 | 51.8 | .085 |
| 7000 | 236.29 | 238 | 248 | 49.0 | .110 |
| 8000 | 266.29 | 282 | 333 | 45.8 | .135 |
| 9000 | 296.29 | 330 | 426 | 43.6 | .165 |
| 10 000 | 326.29 | 376 | 503 | 42.8 | .195 |
| 11 000 | 356.29 | 425 | 605 | 41.2 | .225 |
| 12 000 | 386.29 | 465 | 689 | 40.3 | .250 |
| 13 000 | 416.29 | 506 | 786 | 39.1 | .280 |
| 14 000 | 446.29 | 546 | 872 | 38.5 | .310 |
| 15 000 | 476.29 | 558 | 961 | 38.0 | .340 |
| 16 000 | 506.29 | 631 | 1048 | 37.6 | .370 |
| 17 000 | 536.29 | 681 | 1140 | 37.4 | .405 |
| 18 000 | 566.29 | 725 | 1239 | 36.9 | .440 |
| 19 000 | 596.29 | 798 | 1313 | 37.8 | .480 |
| 19 570 | 613.39 | ........ | 1436 | ........ | ........ |
| 16 700 | 527.29 | 837 | 1586 | 34.5 | .570 |

**BEAM 233**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 13 | 14 | 48.8 | 0.005 |
| 1000 | 56.29 | 35 | 27 | 56.5 | .015 |
| 2000 | 86.29 | 58 | 46 | 55.9 | .030 |
| 3000 | 116.29 | 84 | 65 | 56.5 | .040 |
| 4000 | 146.29 | 118 | 91 | 56.6 | 050 |
| 5000 | 176.29 | 162 | 135 | 54.5 | .070 |
| 6000 | 206.29 | 199 | 195 | 50.5 | .085 |
| 7000 | 236.29 | 234 | 251 | 48.3 | .110 |
| 8000 | 266.29 | 278 | 320 | 46.5 | .135 |
| 9000 | 296.29 | 331 | 405 | 45.0 | .160 |
| 10 000 | 326.29 | 382 | 496 | 43.5 | .195 |
| 11 000 | 356.29 | 430 | 585 | 42.4 | .220 |
| 12 000 | 386.29 | 469 | 665 | 41.3 | .250 |
| 13 000 | 416.29 | 522 | 757 | 40.8 | .285 |
| 14 000 | 446.29 | 562 | 834 | 40.2 | .315 |
| 15 000 | 476.29 | 609 | 916 | 39.9 | .345 |
| 16 000 | 506.29 | 659 | 997 | 39.8 | .370 |
| 17 000 | 536.29 | 704 | 1072 | 39.6 | .405 |
| 18 000 | 566.29 | 759 | 1168 | 39.4 | .440 |
| 19 000 | 596.29 | 827 | 1299 | 38.9 | .480 |
| 19 480 | 610.69 | ........ | 1474 | ........ | .520 |
| 17 760 | 559.09 | 1011 | 2342 | 30.2 | .600 |

**BEAM 240**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 15 | 12 | 56.2 | 0.010 |
| 1000 | 56.29 | 39 | 29 | 57.6 | .020 |
| 2000 | 86.29 | 58 | 51 | 53.4 | .030 |
| 3000 | 116.29 | 85 | 70 | 54.8 | .040 |
| 4000 | 146.29 | 113 | 87 | 56.5 | .050 |
| 5000 | 176.29 | 145 | 116 | 55.6 | .060 |
| 6000 | 206.29 | 183 | 152 | 54.6 | .085 |
| 7000 | 236.29 | 232 | 214 | 52.1 | .100 |
| 8000 | 266.29 | 281 | 282 | 49.9 | .125 |
| 9000 | 296.29 | 328 | 354 | 48.1 | .150 |
| 10 000 | 326.29 | 378 | 436 | 46.4 | .175 |
| 11 000 | 356.29 | 423 | 525 | 44.6 | .210 |
| 12 000 | 386.29 | 468 | 602 | 43.8 | .235 |
| 13 000 | 416.29 | 515 | 680 | 43.1 | .260 |
| 14 000 | 446.29 | 558 | 756 | 42.5 | .290 |
| 15 000 | 476.29 | 607 | 834 | 42.1 | .320 |
| 16 000 | 506.29 | 652 | 913 | 41.7 | .350 |
| 17 000 | 536.29 | 700 | 1007 | 41.0 | .380 |
| 18 000 | 566.29 | 747 | 1065 | 41.2 | .405 |
| 19 000 | 596.29 | 801 | 1132 | 41.4 | .435 |
| 20 000 | 626.29 | 856 | 1219 | 41.2 | .465 |
| 21 000 | 656.29 | 916 | 1338 | 40.6 | .500 |
| 21 620 | 674.89 | ........ | 1438 | ........ | .550 |
| 18 900 | 593.29 | 923 | 1328 | 41.0 | .560 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 242**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 15 | 12 | 56.2 | 0.010 |
| 1000 | 56.29 | 45 | 29 | 60.6 | .020 |
| 2000 | 86.29 | 71 | 46 | 60.6 | .030 |
| 3000 | 116.29 | 95 | 62 | 60.5 | .035 |
| 4000 | 146.29 | 125 | 84 | 59.9 | .075 |
| 5000 | 176.29 | 159 | 121 | 56.8 | .090 |
| 6000 | 206.29 | 202 | 173 | 53.8 | .110 |
| 7000 | 236.29 | 238 | 229 | 51.0 | .130 |
| 8000 | 266.29 | 282 | 291 | 49.2 | .150 |
| 9000 | 296.29 | 323 | 362 | 47.2 | .175 |
| 10 000 | 326.29 | 374 | 439 | 46.0 | .200 |
| 11 000 | 356.29 | 425 | 518 | 45.1 | .230 |
| 12 000 | 386.29 | 480 | 590 | 44.8 | .260 |
| 13 000 | 416.29 | 527 | 644 | 45.0 | .280 |
| 14 000 | 446.29 | 572 | 738 | 43.6 | .310 |
| 15 000 | 476.29 | 628 | 815 | 43.5 | .340 |
| 16 000 | 506.29 | 679 | 891 | 43.2 | .370 |
| 17 000 | 536.29 | 720 | 959 | 42.9 | .400 |
| 18 000 | 566.29 | 770 | 1041 | 42.5 | .425 |
| 19 000 | 596.29 | 812 | 1126 | 41.9 | .455 |
| 20 000 | 626.29 | 855 | 1200 | 41.6 | .485 |
| 21 000 | 656.29 | 913 | 1284 | 41.6 | .515 |
| 22 000 | 686.29 | 1005 | 1494 | 40.2 | .570 |
| 22 480 | 700.69 | ........ | 1619 | ........ | .600 |
| 19 650 | 615.79 | 1071 | 2132 | 33.4 | .610 |

**BEAM 173**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 23 | 22 | 51.4 | 0.010 |
| 1000 | 55.68 | 48 | 39 | 55.4 | .020 |
| 2000 | 85.68 | 79 | 62 | 56.0 | .030 |
| 3000 | 115.68 | 107 | 96 | 52.7 | .040 |
| 4000 | 145.68 | 164 | 169 | 49.2 | .060 |
| 5000 | 175.68 | 270 | 503 | 34.9 | .135 |
| 6000 | 205.68 | 358 | 827 | 30.2 | .230 |
| 7000 | 235.68 | 424 | 1067 | 28.4 | .320 |
| 7200 | 241.68 | ........ | 1104 | ........ | .345 |
| 5200 | 181.68 | 374 | 949 | 28.3 | .350 |

**BEAM 171**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 21 | 14 | 59.7 | .010 |
| 1000 | 55.26 | 47 | 34 | 58.1 | .020 |
| 2000 | 85.26 | 73 | 53 | 58.0 | .030 |
| 3000 | 115.26 | 96 | 75 | 56.0 | .040 |
| 4000 | 145.26 | 124 | 97 | 56.1 | .050 |
| 5000 | 175.26 | 166 | 179 | 48.2 | .170 |
| 6000 | 205.26 | 320 | 812 | 28.2 | .200 |
| 7000 | 235.26 | 383 | 1144 | 25.0 | .280 |
| 7300 | 244.26 | ........ | 1347 | ........ | .345 |
| 5350 | 185.76 | 382 | 1846 | 17.1 | .350 |

**BEAM 183**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 13 | 14 | 54.1 | 0.010 |
| 1000 | 55.68 | 42 | 36 | 53.8 | .020 |
| 2000 | 85.68 | 70 | 62 | 52.9 | .030 |
| 3000 | 115.68 | 101 | 92 | 52.2 | .050 |
| 4000 | 145.68 | 139 | 144 | 49.1 | .065 |
| 5000 | 175.68 | 191 | 250 | 43.3 | .090 |
| 6000 | 205.68 | 269 | 468 | 36.5 | .130 |
| 7000 | 235.68 | 343 | 728 | 32.0 | .200 |
| 8000 | 265.68 | 411 | 940 | 30.5 | .255 |
| 9000 | 295.68 | 473 | 1118 | 29.7 | .305 |
| 10 000 | 325.68 | 526 | 1313 | 28.6 | .360 |
| 10 750 | 348.18 | ........ | 1573 | ........ | .430 |
| 8800 | 289.68 | 571 | 2085 | 21.5 | .430 |

**BEAM 172**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 21 | 14 | 59.7 | 0.010 |
| 1000 | 55.26 | 45 | 31 | 59.1 | .020 |
| 2000 | 85.26 | 69 | 55 | 55.7 | .030 |
| 3000 | 115.26 | 100 | 77 | 56.5 | .040 |
| 4000 | 145.26 | 123 | 111 | 52.5 | .055 |
| 5000 | 175.26 | 227 | 354 | 39.1 | .110 |
| 6000 | 205.26 | 339 | 761 | 30.8 | .220 |
| 7000 | 235.26 | 415 | 1055 | 28.3 | .305 |
| 5100 | 178.26 | 433 | 2072 | 17.3 | .405 |

**BEAM 184**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 55.68 | 47 | 41 | 53.6 | .020 |
| 2000 | 85.68 | 74 | 62 | 54.3 | .030 |
| 3000 | 115.68 | 104 | 92 | 53.0 | .045 |
| 4000 | 145.68 | 136 | 125 | 52.1 | .060 |
| 5000 | 175.68 | 183 | 193 | 48.6 | .075 |
| 6000 | 205.68 | 263 | 379 | 41.0 | .115 |
| 7000 | 235.68 | 353 | 639 | 35.6 | .185 |
| 8000 | 265.68 | 427 | 870 | 32.9 | .245 |
| 9000 | 295.68 | 493 | 1065 | 31.6 | .305 |
| 10 000 | 325.68 | (567) | 1280 | (30.7) | .375 |
| 7700 | 256.68 | 538 | 1885 | 22.2 | .385 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM** 185 | | | | | |
| 0 | 25.88 | 21 | 15 | 58.1 | 0.010 |
| 1000 | 55.88 | 47 | 34 | 58.1 | .020 |
| 2000 | 85.88 | 71 | 51 | 58.2 | .030 |
| 3000 | 115.88 | 100 | 79 | 55.9 | .045 |
| 4000 | 145.88 | 127 | 108 | 54.0 | .055 |
| 5000 | 175.88 | 165 | 150 | 52.3 | .075 |
| 6000 | 205.88 | 223 | 270 | 45.2 | .100 |
| 7000 | 235.88 | 303 | 494 | 38.0 | .170 |
| 8000 | 265.88 | 355 | 670 | 34.7 | .225 |
| 9000 | 295.88 | 410 | 858 | 32.4 | .285 |
| 10 000 | 325.88 | 464 | 1014 | 31.4 | .345 |
| 10 670 | 345.98 | ........ | 1115 | ........ | ........ |
| 7650 | 355.38 | 405 | 904 | 31.0 | .405 |
| **BEAM** 195 | | | | | |
| 0 | 25.06 | 21 | 19 | 52.5 | 0.010 |
| 1000 | 55.06 | 43 | 34 | 55.8 | .020 |
| 2000 | 85.06 | 73 | 53 | 58.0 | .030 |
| 3000 | 115.06 | 100 | 72 | 58.0 | .040 |
| 4000 | 145.06 | 129 | 94 | 57.9 | .050 |
| 5000 | 175.06 | 161 | 121 | 57.1 | .065 |
| 6000 | 205.06 | 205 | 183 | 52.9 | .085 |
| 7000 | 235.06 | 287 | 345 | 45.4 | .130 |
| 8000 | 265.06 | 352 | 511 | 40.8 | .180 |
| 9000 | 295.06 | 413 | 658 | 38.5 | .220 |
| 10 000 | 325.06 | 457 | 783 | 36.9 | .270 |
| 11 000 | 355.06 | 508 | 901 | 36.1 | .310 |
| 12 000 | 385.06 | 563 | 1022 | 35.5 | .355 |
| 13 000 | 415.06 | 613 | 1135 | 35.1 | .400 |
| 13 670 | 435.16 | ........ | 1217 | ........ | .445 |
| 11 100 | 358.06 | 562 | 1106 | 33.7 | .470 |
| **BEAM** 196 | | | | | |
| 0 | 25.88 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 55.88 | 47 | 39 | 54.8 | .020 |
| 2000 | 85.88 | 74 | 58 | 55.9 | .030 |
| 3000 | 115.88 | 100 | 82 | 55.0 | .040 |
| 4000 | 145.88 | 127 | 104 | 54.9 | .050 |
| 5000 | 175.88 | 160 | 138 | 53.7 | .065 |
| 6000 | 205.88 | 202 | 214 | 48.5 | .085 |
| 7000 | 235.88 | 270 | 347 | 43.7 | .120 |
| 8000 | 265.88 | 339 | 515 | 39.7 | .170 |
| 9000 | 295.88 | 393 | 668 | 37.0 | .210 |
| 10 000 | 325.88 | 444 | 812 | 35.3 | .260 |
| 11 000 | 355.88 | 511 | 950 | 35.0 | .300 |
| 12 000 | 385.88 | 567 | 1085 | 34.3 | .340 |
| 13 000 | 415.88 | 612 | 1214 | 33.5 | .390 |
| 10 500 | 340.88 | 657 | 2074 | 24.0 | .440 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM** 197 | | | | | |
| 0 | 25.88 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 55.88 | 50 | 36 | 58.3 | .020 |
| 2000 | 85.88 | 79 | 55 | 58.9 | .030 |
| 3000 | 115.88 | 106 | 77 | 58.0 | .040 |
| 4000 | 145.88 | 133 | 108 | 55.2 | .050 |
| 5000 | 175.88 | 172 | 147 | 53.9 | .065 |
| 6000 | 205.88 | 217 | 222 | 49.4 | .085 |
| 7000 | 235.88 | 283 | 364 | 43.8 | .125 |
| 8000 | 265.88 | 339 | 504 | 40.2 | .165 |
| 9000 | 295.88 | 399 | 648 | 38.1 | .210 |
| 10 000 | 325.88 | 452 | 785 | 36.5 | .255 |
| 11 000 | 355.88 | 500 | 918 | 35.3 | .295 |
| 12 000 | 385.88 | 560 | 1060 | 34.6 | .345 |
| 13 000 | 415.88 | 605 | 1178 | 33.9 | .385 |
| 13 100 | 418.88 | ........ | ........ | ........ | .415 |
| 10 650 | 345.38 | 565 | 1135 | 33.2 | .435 |
| **BEAM** 207 | | | | | |
| 0 | 25.88 | 21 | 15 | 58.1 | 0.005 |
| 1000 | 55.88 | 47 | 32 | 59.5 | .015 |
| 2000 | 85.88 | 77 | 58 | 57.0 | .025 |
| 3000 | 115.88 | 107 | 85 | 55.6 | .040 |
| 4000 | 145.88 | 136 | 115 | 54.1 | .050 |
| 5000 | 175.88 | 174 | 161 | 51.9 | .065 |
| 6000 | 205.88 | 225 | 239 | 48.5 | .090 |
| 7000 | 235.88 | 275 | 338 | 44.8 | .125 |
| 8000 | 265.88 | 345 | 482 | 41.7 | .165 |
| 9000 | 295.88 | 401 | 614 | 39.5 | .205 |
| 10 000 | 325.88 | 452 | 732 | 38.2 | .245 |
| 11 000 | 355.88 | 507 | 856 | 37.2 | .285 |
| 12 000 | 385.88 | 568 | 981 | 36.7 | .325 |
| 13 000 | 415.88 | 618 | 1111 | 35.8 | .360 |
| 14 000 | 445.88 | 680 | 1253 | 35.2 | .410 |
| 14 500 | 460.88 | ........ | 1472 | ........ | .430 |
| 12 400 | 397.88 | 746 | 1986 | 27.3 | .480 |
| **BEAM** 208 | | | | | |
| 0 | 26.09 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 56.09 | 50 | 36 | 58.3 | .020 |
| 2000 | 86.09 | 73 | 56 | 56.7 | .030 |
| 3000 | 116.09 | 106 | 77 | 58.0 | .040 |
| 4000 | 146.09 | 137 | 106 | 56.4 | .050 |
| 5000 | 176.09 | 172 | 142 | 54.7 | .070 |
| 6000 | 206.09 | 214 | 200 | 51.7 | .090 |
| 7000 | 236.09 | 273 | 301 | 47.5 | .120 |
| 8000 | 266.09 | 337 | 421 | 44.5 | .160 |
| 9000 | 296.09 | 405 | 552 | 42.3 | .200 |
| 10 000 | 326.09 | 462 | 680 | 40.5 | .240 |
| 11 000 | 356.09 | 519 | 807 | 39.2 | .280 |
| 12 000 | 386.09 | 576 | 928 | 38.3 | .320 |
| 13 000 | 416.09 | 628 | 1053 | 37.4 | .360 |
| 14 000 | 446.09 | 691 | 1173 | 37.2 | .400 |
| 15 000 | 476.09 | 745 | 1291 | 36.6 | .440 |
| 15 770 | 499.19 | ........ | 1518 | ........ | .500 |
| 12 900 | 413.09 | 836 | 2202 | 27.5 | .530 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 209**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 56.29 | 45 | 38 | 54.3 | .020 |
| 2000 | 86.29 | 69 | 60 | 53.7 | .030 |
| 3000 | 116.29 | 100 | 82 | 55.0 | .040 |
| 4000 | 146.29 | 133 | 108 | 55.2 | .055 |
| 5000 | 176.29 | 165 | 149 | 52.5 | .070 |
| 6000 | 206.29 | 204 | 219 | 48.2 | .090 |
| 7000 | 236.29 | 263 | 315 | 45.5 | .115 |
| 8000 | 266.29 | 324 | 453 | 41.7 | .155 |
| 9000 | 296.29 | 374 | 602 | 38.3 | .205 |
| 10 000 | 326.29 | 431 | 723 | 37.3 | .245 |
| 11 000 | 356.29 | 474 | 824 | 36.5 | .280 |
| 12 000 | 386.29 | 532 | 949 | 35.9 | .315 |
| 13 000 | 416.29 | 578 | 1065 | 35.2 | .355 |
| 14 000 | 446.29 | 635 | 1185 | 34.9 | .400 |
| 15 000 | 476.29 | 685 | 1318 | 34.2 | .435 |
| 15 380 | 487.69 | ........ | 1379 | ........ | .465 |
| 12 500 | 401.29 | 614 | 1243 | 33.1 | .485 |

**BEAM 219**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 23 | 21 | 52.5 | 0.010 |
| 1000 | 56.29 | 42 | 38 | 52.5 | .020 |
| 2000 | 86.29 | 68 | 58 | 54.1 | .030 |
| 3000 | 116.29 | 92 | 75 | 55.2 | .040 |
| 4000 | 146.29 | 119 | 97 | 55.1 | .050 |
| 5000 | 176.29 | 148 | 121 | 55.1 | .060 |
| 6000 | 206.29 | 195 | 190 | 50.7 | .080 |
| 7000 | 236.29 | 251 | 292 | 46.2 | .110 |
| 8000 | 266.29 | 311 | 402 | 43.6 | .145 |
| 9000 | 296.29 | 368 | 526 | 41.1 | .175 |
| 10 000 | 326.29 | 420 | 660 | 38.9 | .215 |
| 11 000 | 356.29 | 470 | 750 | 38.5 | .250 |
| 12 000 | 386.29 | 520 | 860 | 37.7 | .285 |
| 13 000 | 416.29 | 568 | 966 | 37.0 | .325 |
| 14 000 | 446.29 | 618 | 1072 | 36.5 | .350 |
| 15 000 | 476.29 | 669 | 1142 | 36.9 | .390 |
| 16 000 | 506.29 | 727 | 1338 | 35.2 | .430 |
| 17 000 | 536.29 | 789 | 1496 | 34.5 | .480 |
| 17 700 | 557.29 | ........ | 1639 | ........ | .530 |
| 15 350 | 486.79 | 810 | 1713 | 32.1 | .560 |

**BEAM 220**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 56.09 | 45 | 43 | 51.4 | .020 |
| 2000 | 86.09 | 69 | 58 | 54.5 | .030 |
| 3000 | 116.09 | 98 | 79 | 55.3 | .040 |
| 4000 | 146.09 | 122 | 104 | 54.0 | .055 |
| 5000 | 176.09 | 166 | 147 | 53.0 | .065 |
| 6000 | 206.09 | 214 | 210 | 50.5 | .085 |
| 7000 | 236.09 | 259 | 287 | 47.5 | .115 |
| 8000 | 266.09 | 315 | 379 | 45.4 | .145 |
| 9000 | 296.09 | 380 | 487 | 43.9 | .180 |
| 10 000 | 326.09 | 425 | 603 | 41.4 | .220 |
| 11 000 | 356.09 | 484 | 709 | 40.6 | .255 |
| 12 000 | 386.09 | 523 | 812 | 39.2 | .290 |
| 13 000 | 416.09 | 570 | 913 | 38.4 | .325 |
| 14 000 | 446.09 | 620 | 1019 | 37.8 | .365 |
| 15 000 | 476.09 | 663 | 1116 | 37.3 | .400 |
| 16 000 | 506.09 | 715 | 1248 | 36.4 | .435 |
| 16 600 | 524.09 | ........ | 1749 | ........ | .535 |
| 14 900 | 473.09 | 887 | 2632 | 25.2 | .600 |

**BEAM 221**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 19 | 21 | 47.5 | 0.005 |
| 1000 | 56.29 | 38 | 41 | 48.1 | .015 |
| 2000 | 86.29 | 64 | 60 | 51.7 | .020 |
| 3000 | 116.29 | 91 | 85 | 51.6 | .030 |
| 4000 | 146.29 | 117 | 111 | 51.4 | .040 |
| 5000 | 176.29 | 147 | 137 | 51.8 | .060 |
| 6000 | 206.29 | 179 | 185 | 49.2 | .080 |
| 7000 | 236.29 | 234 | 270 | 46.5 | .100 |
| 8000 | 266.29 | 286 | 368 | 43.7 | .130 |
| 9000 | 296.29 | 332 | 475 | 41.2 | .160 |
| 10 000 | 326.29 | 387 | 598 | 39.3 | .195 |
| 11 000 | 356.29 | 442 | 708 | 38.5 | .230 |
| 12 000 | 386.29 | 489 | 815 | 37.5 | .260 |
| 13 000 | 416.29 | 536 | 932 | 36.5 | .300 |
| 14 000 | 446.29 | 589 | 1036 | 36.3 | .335 |
| 15 000 | 476.29 | 639 | 1145 | 35.8 | .370 |
| 16 000 | 506.29 | 688 | 1241 | 35.6 | .405 |
| 17 000 | 536.29 | 746 | 1350 | 35.6 | .440 |
| 17 660 | 556.09 | ........ | 1438 | ........ | .470 |
| 15 300 | 485.29 | 805 | 2044 | 28.3 | .520 |

**BEAM 228**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 19 | 22 | 46.4 | 0.005 |
| 1000 | 56.29 | 43 | 43 | 50.2 | .020 |
| 2000 | 86.29 | 70 | 63 | 52.5 | .030 |
| 3000 | 116.29 | 99 | 94 | 51.2 | .040 |
| 4000 | 146.29 | 128 | 121 | 51.5 | .050 |
| 5000 | 176.29 | 160 | 144 | 52.7 | .060 |
| 6000 | 206.29 | 195 | 181 | 51.8 | .075 |
| 7000 | 236.29 | 246 | 246 | 50.0 | .100 |
| 8000 | 266.29 | 298 | 323 | 48.0 | .125 |
| 9000 | 296.29 | 351 | 409 | 46.2 | .150 |
| 10 000 | 326.29 | 402 | 492 | 44.9 | .180 |
| 11 000 | 356.29 | 442 | 586 | 43.0 | .210 |
| 12 000 | 386.29 | 502 | 685 | 42.3 | .245 |
| 13 000 | 416.29 | 546 | 771 | 41.4 | .275 |
| 14 000 | 446.29 | 590 | 850 | 41.0 | .305 |
| 15 000 | 476.29 | 648 | 947 | 40.6 | .335 |
| 16 000 | 506.29 | 693 | 1024 | 40.4 | .365 |
| 17 000 | 536.29 | 741 | 1121 | 39.8 | .400 |
| 18 000 | 566.29 | 800 | 1214 | 39.7 | .435 |
| 19 000 | 596.29 | 846 | 1320 | 39.1 | .470 |
| 20 000 | 626.29 | 908 | 1436 | 38.7 | .505 |
| 20 650 | 645.79 | ........ | 1644 | ........ | .560 |
| 17 850 | 561.79 | 1007 | 2178 | 31.6 | .585 |

**BEAM 229**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 56.29 | 47 | 31 | 60.2 | .020 |
| 2000 | 86.29 | 76 | 53 | 59.1 | .030 |
| 3000 | 116.29 | 105 | 74 | 58.6 | .040 |
| 4000 | 146.29 | 133 | 103 | 56.3 | .055 |
| 5000 | 176.29 | 172 | 144 | 54.4 | .065 |
| 6000 | 206.29 | 211 | 197 | 51.8 | .085 |
| 7000 | 236.29 | 258 | 262 | 49.6 | .105 |
| 8000 | 266.29 | 310 | 349 | 47.0 | .135 |
| 9000 | 296.29 | 361 | 436 | 45.3 | .165 |
| 10 000 | 326.29 | 407 | 513 | 44.2 | .190 |
| 11 000 | 356.29 | 458 | 607 | 43.0 | .220 |
| 12 000 | 386.29 | 508 | 694 | 42.3 | .250 |
| 13 000 | 416.29 | 551 | 778 | 41.5 | .280 |
| 14 000 | 446.29 | 593 | 862 | 40.7 | .310 |
| 15 000 | 476.29 | 644 | 952 | 40.3 | .345 |
| 16 000 | 506.29 | 689 | 1036 | 39.9 | .375 |
| 17 000 | 536.29 | 736 | 1123 | 39.6 | .405 |
| 18 000 | 566.29 | 791 | 1207 | 39.6 | .435 |
| 19 000 | 596.29 | 836 | 1294 | 39.3 | .465 |
| 20 000 | 626.29 | 893 | 1388 | 39.2 | .500 |
| 20 750 | 648.79 | ........ | 1585 | ........ | .545 |
| 17 400 | 548.29 | 988 | 2526 | 28.1 | .595 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 230**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 27.01 | 20 | 15 | 57.2 | 0.005 |
| 1000 | 57.01 | 46 | 38 | 54.7 | .015 |
| 2000 | 87.01 | 70 | 59 | 54.2 | .025 |
| 3000 | 117.01 | 96 | 87 | 52.5 | .035 |
| 4000 | 147.01 | 129 | 112 | 53.5 | .045 |
| 5000 | 177.01 | 160 | 145 | 52.3 | .055 |
| 6000 | 207.01 | 196 | 192 | 50.4 | .080 |
| 7000 | 237.01 | 238 | 260 | 47.8 | .100 |
| 8000 | 267.01 | 280 | 340 | 45.4 | .120 |
| 9000 | 297.01 | 330 | 427 | 43.5 | .160 |
| 10 000 | 327.01 | 375 | 525 | 41.6 | .180 |
| 11 000 | 357.01 | 417 | 611 | 40.5 | .215 |
| 12 000 | 387.01 | 465 | 707 | 39.6 | .240 |
| 13 000 | 417.01 | 508 | 795 | 38.9 | .270 |
| 14 000 | 447.01 | 556 | 880 | 38.7 | .305 |
| 15 000 | 477.01 | 600 | 975 | 38.1 | .335 |
| 16 000 | 507.01 | 640 | 1053 | 37.8 | .365 |
| 17 000 | 537.01 | 684 | 1150 | 37.3 | .395 |
| 18 000 | 567.01 | 733 | 1233 | 37.2 | .425 |
| 19 000 | 597.01 | 781 | 1331 | 36.9 | .460 |
| 20 000 | 627.01 | 830 | 1440 | 36.5 | .480 |
| 21 000 | 657.01 | 884 | 1580 | 35.8 | .535 |
| 17 400 | 549.01 | 792 | 1397 | 36.1 | .545 |

**BEAM 234**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 56.29 | 42 | 41 | 50.7 | .020 |
| 2000 | 86.29 | 67 | 68 | 49.5 | .030 |
| 3000 | 116.29 | 94 | 97 | 49.1 | .040 |
| 4000 | 146.29 | 124 | 132 | 48.4 | .050 |
| 5000 | 176.29 | 162 | 169 | 48.9 | .070 |
| 6000 | 206.29 | 207 | 227 | 47.7 | .090 |
| 7000 | 236.29 | 253 | 291 | 46.5 | .110 |
| 8000 | 266.29 | 308 | 366 | 45.7 | .140 |
| 9000 | 296.29 | 352 | 434 | 44.8 | .165 |
| 10 000 | 326.29 | 402 | 518 | 43.7 | .195 |
| 11 000 | 356.29 | 456 | 602 | 43.1 | .225 |
| 12 000 | 386.29 | 503 | 691 | 42.1 | .260 |
| 13 000 | 416.29 | 554 | 785 | 41.4 | .285 |
| 14 000 | 446.29 | 612 | 880 | 41.0 | .320 |
| 15 000 | 476.29 | 664 | 966 | 40.8 | .345 |
| 16 000 | 506.29 | 718 | 1058 | 40.4 | .380 |
| 17 000 | 536.29 | 767 | 1142 | 40.2 | .410 |
| 18 000 | 566.29 | 817 | 1229 | 39.9 | .440 |
| 19 000 | 596.29 | 885 | 1337 | 39.8 | .470 |
| 20 000 | 626.29 | 932 | 1424 | 39.6 | .510 |
| 21 000 | 656.29 | 1015 | 1607 | 38.7 | .550 |
| 18 950 | 594.79 | 1197 | 2562 | 31.8 | .650 |

**BEAM 235**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 19 | 19 | 49.9 | 0.015 |
| 1000 | 56.29 | 42 | 39 | 51.9 | .025 |
| 2000 | 86.29 | 79 | 56 | 58.4 | .035 |
| 3000 | 116.29 | 116 | 77 | 60.0 | .045 |
| 4000 | 146.29 | 148 | 108 | 57.8 | .055 |
| 5000 | 176.29 | 187 | 140 | 57.2 | .070 |
| 6000 | 206.29 | 230 | 183 | 55.8 | .090 |
| 7000 | 236.29 | 281 | 234 | 54.5 | .110 |
| 8000 | 266.29 | 328 | 297 | 52.5 | .140 |
| 9000 | 296.29 | 380 | 385 | 49.7 | .170 |
| 10 000 | 326.29 | 428 | 470 | 47.7 | .195 |
| 11 000 | 356.29 | 486 | 559 | 46.5 | .220 |
| 12 000 | 386.29 | 532 | 636 | 45.6 | .250 |
| 13 000 | 416.29 | 578 | 720 | 44.5 | .280 |
| 14 000 | 446.29 | 634 | 807 | 44.0 | .310 |
| 15 000 | 476.29 | 679 | 891 | 43.2 | .340 |
| 16 000 | 506.29 | 724 | 978 | 42.5 | .370 |
| 17 000 | 536.29 | 771 | 1056 | 42.2 | .400 |
| 18 000 | 566.29 | 824 | 1144 | 41.9 | .430 |
| 19 000 | 596.29 | 884 | 1229 | 41.8 | .465 |
| 20 000 | 626.29 | 930 | 1297 | 41.8 | .495 |
| 21 000 | 656.29 | 980 | 1390 | 41.4 | .525 |
| 22 000 | 686.29 | 1042 | 1489 | 41.2 | .570 |
| 22 100 | 689.29 | ...... | 1648 | ...... | .620 |
| 18 850 | 591.79 | 998 | 1494 | 40.1 | .625 |

**BEAM 236**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 19 | 21 | 47.5 | 0.010 |
| 1000 | 56.29 | 47 | 38 | 55.4 | .020 |
| 2000 | 86.29 | 75 | 56 | 57.1 | .025 |
| 3000 | 116.29 | 100 | 82 | 55.0 | .040 |
| 4000 | 146.29 | 132 | 113 | 53.9 | .055 |
| 5000 | 176.29 | 168 | 157 | 51.7 | .070 |
| 6000 | 206.29 | 206 | 214 | 49.0 | .090 |
| 7000 | 236.29 | 255 | 262 | 49.2 | .115 |
| 8000 | 266.29 | 312 | 342 | 47.7 | .135 |
| 9000 | 296.29 | 355 | 419 | 45.8 | .165 |
| 10 000 | 326.29 | 409 | 489 | 45.5 | .185 |
| 11 000 | 356.29 | 458 | 566 | 44.7 | .215 |
| 12 000 | 386.29 | 504 | 648 | 43.7 | .245 |
| 13 000 | 416.29 | 559 | 738 | 43.1 | .275 |
| 14 000 | 446.29 | 604 | 810 | 42.7 | .305 |
| 15 000 | 476.29 | 655 | 887 | 42.5 | .335 |
| 16 000 | 506.29 | 704 | 966 | 42.2 | .365 |
| 17 000 | 536.29 | 757 | 1044 | 42.0 | .395 |
| 18 000 | 566.29 | 802 | 1125 | 41.6 | .425 |
| 19 000 | 596.29 | 852 | 1209 | 41.3 | .455 |
| 20 000 | 626.29 | 901 | 1291 | 41.1 | .485 |
| 21 000 | 656.29 | 970 | 1458 | 40.0 | .525 |
| 22 000 | 686.29 | ...... | 1790 | ...... | .605 |
| 18 400 | 578.29 | 1092 | 2453 | 30.8 | .625 |

**BEAM 256**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 30 | 29 | 50.8 | .01 |
| 1000 | 55.47 | 60 | 63 | 48.8 | .02 |
| 2000 | 85.47 | 104 | 94 | 52.5 | .04 |
| 2500 | 100.47 | 119 | 113 | 51.2 | .05 |
| 3000 | 115.47 | 150 | 147 | 50.5 | .06 |
| 3250 | 122.97 | 208 | 301 | 40.9 | .095 |
| 3500 | 130.47 | 271 | 463 | 36.9 | .13 |
| 4000 | 145.47 | 326 | 653 | 33.3 | .18 |
| 4500 | 160.47 | 380 | 832 | 31.3 | .23 |
| 5000 | 175.47 | 444 | 990 | 30.9 | .275 |
| 5500 | 190.47 | 496 | 1121 | 30.7 | .32 |
| 6000 | 205.47 | 535 | 1239 | 30.1 | .37 |
| 6350 | 215.97 | ...... | (1321) | ...... | .405 |
| 4500 | 160.47 | 548 | 2007 | 21.4 | .44 |

**BEAM 257**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 37 | 17 | 68.3 | 0.01 |
| 1000 | 55.47 | 78 | 36 | 68.3 | .02 |
| 2000 | 85.47 | 122 | 63 | 66.0 | .03 |
| 2500 | 100.47 | 144 | 82 | 63.8 | .04 |
| 3000 | 115.47 | 174 | 108 | 61.7 | .05 |
| 3250 | 122.97 | 207 | 167 | 55.3 | .06 |
| 3500 | 130.47 | 251 | 272 | 48.0 | .085 |
| 4000 | 145.47 | 337 | 532 | 38.8 | .15 |
| 4500 | 160.47 | 388 | 673 | 36.6 | .21 |
| 5000 | 175.47 | 437 | 853 | 33.8 | .26 |
| 5500 | 190.47 | 475 | 973 | 32.8 | .305 |
| 5800 | 199.47 | ...... | (1031) | ...... | .33 |
| 5900 | 202.47 | ...... | (1111) | ...... | .35 |
| 4550 | 161.97 | 534 | 1614 | 24.9 | .37 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 261** | | | | | |
| 0 | 26.09 | 27 | 24 | 52.5 | 0.010 |
| 1000 | 56.09 | 50 | 48 | 51.0 | .020 |
| 2000 | 86.09 | 85 | 77 | 52.5 | .035 |
| 3000 | 116.09 | 123 | 109 | 52.9 | .045 |
| 3500 | 131.09 | 149 | 137 | 52.2 | .055 |
| 4000 | 146.09 | 182 | 185 | 49.6 | .075 |
| 4500 | 161.09 | 232 | 306 | 43.1 | .105 |
| 5000 | 176.09 | 289 | 439 | 39.7 | .155 |
| 6000 | 206.09 | 351 | 646 | 35.2 | .215 |
| 7000 | 236.09 | 432 | 824 | 34.4 | .275 |
| 8000 | 266.09 | 509 | 1009 | 33.5 | .335 |
| 9000 | 296.09 | 586 | 1169 | 33.4 | .395 |
| 9420 | 308.69 | ........ | (1233) | ........ | .425 |
| **BEAM 262** | | | | | |
| 0 | 25.88 | 25 | 27 | 47.7 | 0.010 |
| 1000 | 55.88 | 51 | 58 | 47.0 | .020 |
| 2000 | 85.88 | 80 | 87 | 48.0 | .035 |
| 3000 | 115.88 | 118 | 121 | 49.4 | .050 |
| 3500 | 130.88 | 143 | 150 | 48.7 | 060 |
| 4000 | 145.88 | 184 | 225 | 45.1 | .075 |
| 4500 | 160.88 | 257 | 446 | 36.6 | .120 |
| 5000 | 175.88 | 309 | 567 | 35.3 | .150 |
| 6000 | 205.88 | 377 | 774 | 32.7 | .220 |
| 7000 | 235.88 | 452 | 964 | 31.9 | .270 |
| 8000 | 265.88 | 533 | 1150 | 31.7 | .330 |
| 8500 | 280.88 | 567 | 1268 | 30.9 | .365 |
| 9000 | 295.88 | 605 | 1376 | 30.5 | .395 |
| 9320 | 305.48 | ........ | (1451) | ........ | .420 |
| **BEAM 263** | | | | | |
| 0 | 26.09 | 25 | 27 | 47.7 | 0.010 |
| 1000 | 56.09 | 52 | 59 | 46.6 | .025 |
| 2000 | 86.09 | 82 | 89 | 47.8 | .035 |
| 3000 | 116.09 | 114 | 121 | 48.5 | .045 |
| 3500 | 131.09 | 139 | 136 | 50.5 | .055 |
| 4000 | 146.09 | 164 | 183 | 47.3 | .065 |
| 4500 | 161.09 | 236 | 388 | 37.8 | .105 |
| 5000 | 176.09 | 288 | 519 | 35.7 | .145 |
| 6000 | 206.09 | 364 | 728 | 33.3 | .210 |
| 7000 | 236.09 | 439 | 919 | 32.3 | .275 |
| 8000 | 266.09 | 511 | 1162 | 30.5 | .340 |
| 8470 | 280.19 | ........ | (1314) | ........ | .385 |
| 7500 | 251.09 | 573 | 1870 | 23.5 | .415 |
| **BEAM 273** | | | | | |
| 0 | 26.09 | 28 | 27 | 50.7 | 0.010 |
| 1000 | 56.09 | 60 | 58 | 50.8 | .020 |
| 2000 | 86.09 | 92 | 87 | 51.4 | .040 |
| 3000 | 115.09 | 129 | 116 | 52.7 | .050 |
| 3500 | 131.09 | 148 | 136 | 52.1 | .060 |
| 4000 | 146.09 | 175 | 160 | 52.2 | .070 |
| 4500 | 161.09 | 205 | 208 | 49.6 | .080 |
| 5000 | 176.09 | 254 | 282 | 47.4 | .110 |
| 6000 | 206.09 | 335 | 471 | 41.6 | .155 |
| 7000 | 236.09 | 407 | 641 | 38.9 | .210 |
| 8000 | 266.09 | 473 | 791 | 37.4 | .255 |
| 9000 | 296.09 | 543 | 953 | 36.3 | .305 |
| 10 000 | 326.09 | 612 | 1100 | 35.7 | .350 |
| 11 000 | 356.09 | 693 | 1251 | 35.7 | .405 |
| 11 300 | 365.09 | ........ | (1381) | ........ | .435 |
| 10 300 | 335.09 | 739 | 1849 | 28.6 | .450 |
| **BEAM 274** | | | | | |
| 0 | 26.09 | 28 | 25 | 52.5 | 0.010 |
| 1000 | 56.09 | 56 | 47 | 54.4 | .015 |
| 2000 | 86.09 | 86 | 80 | 51.9 | .030 |
| 3000 | 116.09 | 122 | 110 | 52.5 | .040 |
| 3500 | 131.09 | 139 | 129 | 51.9 | .050 |
| 4000 | 146.09 | 161 | 148 | 52.2 | .060 |
| 4500 | 161.09 | 193 | 191 | 50.3 | .075 |
| 5000 | 176.09 | 230 | 247 | 48.2 | .080 |
| 6000 | 206.09 | 318 | 444 | 41.7 | .130 |
| 7000 | 236.09 | 383 | 615 | 38.4 | .185 |
| 8000 | 266.09 | 447 | 762 | 37.0 | .210 |
| 9000 | 296.09 | 524 | 921 | 36.3 | .255 |
| 10 000 | 326.09 | 593 | 1087 | 35.3 | .305 |
| 10 800 | 350.09 | ........ | (1269) | ........ | .350 |
| 10 100 | 329.09 | 714 | 1681 | 29.8 | .395 |
| **BEAM 275** | | | | | |
| 0 | 26.29 | 27 | 22 | 55.5 | 0.010 |
| 1000 | 56.29 | 57 | 49 | 53.9 | .020 |
| 2000 | 86.29 | 91 | 77 | 54.3 | .040 |
| 3000 | 116.29 | 128 | 101 | 56.0 | .050 |
| 3500 | 131.29 | 148 | 125 | 54.2 | .060 |
| 4000 | 146.29 | 176 | 148 | 54.4 | .070 |
| 4500 | 161.29 | 201 | 181 | 52.6 | .080 |
| 5000 | 176.29 | 244 | 237 | 50.7 | .100 |
| 6000 | 206.29 | 335 | 460 | 42.1 | .155 |
| 7000 | 236.29 | 402 | 613 | 39.6 | .205 |
| 8000 | 266.29 | 454 | 764 | 37.3 | .250 |
| 9000 | 296.29 | 529 | 894 | 37.2 | .290 |
| 10 000 | 326.29 | 604 | 1063 | 36.2 | .340 |
| 11 000 | 356.29 | 682 | 1214 | 36.0 | .370 |
| 11 500 | 371.29 | ........ | (1306) | ........ | .400 |
| 10 400 | 338.29 | 734 | 1507 | 32.8 | .410 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 285**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 27 | 20 | 57.8 | 0.010 |
| 1000 | 55.88 | 59 | 47 | 55.8 | .025 |
| 2000 | 85.88 | 93 | 68 | 57.8 | .035 |
| 3000 | 115.88 | 127 | 95 | 57.2 | .045 |
| 3500 | 130.88 | 149 | 114 | 56.7 | .055 |
| 4000 | 145.88 | 170 | 136 | 55.6 | .065 |
| 4500 | 160.88 | 198 | 177 | 52.8 | .075 |
| 5000 | 175.88 | 232 | 244 | 48.7 | .085 |
| 6000 | 205.88 | 308 | 384 | 44.5 | .125 |
| 7000 | 235.88 | 385 | 547 | 41.3 | .175 |
| 8000 | 265.88 | 455 | 685 | 39.9 | .215 |
| 9000 | 295.88 | 518 | 815 | 38.8 | .240 |
| 10 000 | 325.88 | 585 | 965 | 37.7 | .285 |
| 11 000 | 355.88 | 657 | 1078 | 37.9 | .335 |
| 12 000 | 385.88 | 739 | 1242 | 37.3 | .375 |
| 13 000 | 415.88 | ........ | (1394) | ........ | .430 |
| 13 000 | 415.88 | 803 | 1400 | 36.5 | .445 |
| 12 500 | 400.88 | ........ | ........ | ........ | .475 |

**BEAM 286**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 26 | 18 | 59.3 | 0.010 |
| 1000 | 56.09 | 60 | 40 | 60.0 | .020 |
| 2000 | 86.09 | 92 | 68 | 57.5 | .040 |
| 3000 | 116.09 | 127 | 90 | 58.5 | .050 |
| 3500 | 131.09 | 148 | 103 | 58.9 | .060 |
| 4000 | 146.09 | 171 | 122 | 58.3 | .065 |
| 4500 | 161.09 | 190 | 146 | 56.5 | .075 |
| 5000 | 176.09 | 228 | 192 | 54.3 | .090 |
| 6000 | 206.09 | 296 | 315 | 48.4 | .130 |
| 7000 | 236.09 | 372 | 474 | 44.0 | .175 |
| 8000 | 266.09 | 433 | 623 | 41.0 | .225 |
| 9000 | 296.09 | 489 | 753 | 39.4 | .265 |
| 10 000 | 326.09 | 552 | 880 | 38.5 | .305 |
| 11 000 | 356.09 | 613 | 994 | 38.2 | .350 |
| 12 000 | 386.09 | 688 | 1114 | 38.2 | .400 |
| 12 500 | 401.09 | 732 | 1196 | 38.0 | .425 |
| 13 000 | 416.09 | 764 | 1256 | 37.8 | .450 |
| 13 500 | 431.09 | 803 | 1334 | 37.6 | .480 |
| 13 670 | 436.19 | ........ | (1375) | ........ | .510 |
| 12 000 | 386.09 | ........ | ........ | ........ | .535 |

**BEAM 287**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 24 | 22 | 52.5 | 0.010 |
| 1000 | 56.29 | 53 | 48 | 52.5 | .020 |
| 2000 | 86.29 | 81 | 72 | 52.8 | .030 |
| 3000 | 116.29 | 115 | 101 | 53.2 | .050 |
| 3500 | 131.29 | 131 | 118 | 52.7 | .060 |
| 4000 | 146.29 | 153 | 138 | 52.5 | .065 |
| 4500 | 161.29 | 174 | 162 | 51.8 | .070 |
| 5000 | 176.29 | 209 | 210 | 49.9 | .090 |
| 6000 | 206.29 | 284 | 345 | 45.2 | .130 |
| 7000 | 236.29 | 360 | 482 | 42.8 | .170 |
| 8000 | 266.29 | 421 | 612 | 40.7 | .215 |
| 9000 | 296.29 | 497 | 760 | 39.5 | .265 |
| 10 000 | 326.29 | 562 | 887 | 38.8 | .320 |
| 11 000 | 356.29 | 640 | 1022 | 38.5 | .365 |
| 12 000 | 386.29 | 717 | 1172 | 37.9 | .410 |
| 12 500 | 401.29 | 772 | 1266 | 37.9 | .440 |
| 13 000 | 416.29 | 812 | 1348 | 37.6 | .465 |
| 13 100 | 419.29 | ........ | (1504) | ........ | .500 |
| 12 000 | 386.29 | 872 | 1723 | 33.6 | .510 |

**BEAM 257**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 31 | 28 | 52.5 | 0.010 |
| 1000 | 55.88 | 63 | 57 | 52.5 | .020 |
| 2000 | 85.88 | 97 | 88 | 52.5 | .035 |
| 3000 | 115.88 | 133 | 120 | 52.5 | .050 |
| 4000 | 145.88 | 173 | 158 | 52.2 | .060 |
| 5000 | 175.88 | 225 | 237 | 48.7 | .090 |
| 6000 | 205.88 | 305 | 373 | 45.0 | .120 |
| 7000 | 235.88 | 370 | 500 | 42.6 | .165 |
| 8000 | 265.88 | 440 | 623 | 41.4 | .205 |
| 9000 | 295.88 | 523 | 753 | 41.0 | .250 |
| 10 000 | 325.88 | 597 | 895 | 40.0 | .295 |
| 11 000 | 355.88 | 671 | 1014 | 39.8 | .335 |
| 12 000 | 385.88 | 743 | 1131 | 39.6 | .385 |
| 13 000 | 415.88 | 823 | 1243 | 39.8 | .420 |
| 14 000 | 445.88 | 903 | 1373 | 39.7 | .465 |
| 14 600 | 463.88 | ........ | (1460) | ........ | .505 |
| 14 860 | 471.68 | ........ | (1527) | ........ | .525 |
| 13 900 | 442.88 | 1045 | 1722 | 37.8 | .530 |

**BEAM 298**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 27 | 20 | 57.8 | 0.010 |
| 1000 | 56.29 | 56 | 41 | 57.7 | .025 |
| 2000 | 86.29 | 89 | 66 | 57.3 | .035 |
| 3000 | 116.29 | 125 | 97 | 56.3 | .050 |
| 4000 | 146.29 | 168 | 141 | 54.4 | .065 |
| 5000 | 176.29 | 236 | 229 | 50.8 | .095 |
| 6000 | 206.29 | 318 | 343 | 48.1 | .130 |
| 7000 | 236.29 | 394 | 471 | 45.6 | .175 |
| 8000 | 266.29 | 469 | 606 | 43.6 | .220 |
| 9000 | 296.29 | 541 | 719 | 42.9 | .260 |
| 10 000 | 326.29 | 610 | 827 | 42.4 | .300 |
| 11 000 | 356.29 | 689 | 940 | 42.3 | .345 |
| 12 000 | 386.29 | 762 | 1061 | 41.8 | .385 |
| 13 000 | 416.29 | 863 | 1191 | 42.0 | .430 |
| 14 000 | 446.29 | 937 | 1307 | 41.8 | .470 |
| 15 000 | 476.29 | 1054 | 1464 | 41.9 | .525 |
| 15 520 | 491.89 | ........ | (1560) | ........ | .560 |
| 13 700 | 437.29 | ........ | ........ | ........ | .575 |

**BEAM 299**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 38 | 24 | 61.4 | 0.010 |
| 1000 | 55.88 | 70 | 50 | 58.3 | .020 |
| 2000 | 85.88 | 107 | 77 | 58.2 | .035 |
| 3000 | 115.88 | 145 | 108 | 57.3 | .050 |
| 4000 | 145.88 | 187 | 149 | 55.6 | .070 |
| 5000 | 175.88 | 250 | 229 | 52.2 | .095 |
| 6000 | 205.88 | 326 | 328 | 49.8 | .135 |
| 7000 | 235.88 | 401 | 463 | 46.4 | .175 |
| 8000 | 265.88 | 479 | 588 | 44.9 | .220 |
| 9000 | 295.88 | 566 | 708 | 44.4 | .260 |
| 10 000 | 325.88 | 651 | 827 | 44.0 | .305 |
| 11 000 | 355.88 | 728 | 939 | 43.7 | .345 |
| 12 000 | 385.88 | 815 | 1058 | 43.5 | .395 |
| 13 000 | 415.88 | 878 | 1176 | 42.7 | .440 |
| 14 000 | 445.88 | 979 | 1328 | 42.4 | .485 |
| 14 500 | 460.88 | 1058 | 1415 | 42.8 | .520 |
| 15 000 | 475.88 | 1111 | 1508 | 42.4 | .545 |
| 15 100 | 478.88 | ........ | (1615) | ........ | .585 |
| 12 900 | 412.88 | 1241 | 2162 | 36.5 | .615 |

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## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 318** | | | | | |
| 0 | 26.29 | 33 | 22 | 59.8 | 0.015 |
| 1000 | 56.29 | 68 | 48 | 58.5 | .025 |
| 2000 | 86.29 | 102 | 75 | 57.6 | .040 |
| 3000 | 116.29 | 141 | 101 | 58.3 | .055 |
| 4000 | 146.29 | 184 | 133 | 58.0 | .070 |
| 5000 | 176.29 | 242 | 184 | 56.8 | .090 |
| 6000 | 206.29 | 313 | 284 | 52.4 | .120 |
| 7000 | 236.29 | 389 | 383 | 50.4 | .155 |
| 8000 | 266.29 | 463 | 494 | 48.4 | .190 |
| 9000 | 296.29 | 536 | 588 | 47.7 | .225 |
| 10 000 | 326.29 | 615 | 690 | 47.1 | .260 |
| 11 000 | 356.29 | 681 | 786 | 46.4 | .300 |
| 12 000 | 386.29 | 755 | 894 | 45.8 | .340 |
| 13 000 | 416.29 | 837 | 991 | 45.8 | .375 |
| 14 000 | 446.29 | 910 | 1085 | 45.6 | .415 |
| 15 000 | 476.29 | 1012 | 1190 | 46.0 | .460 |
| 16 000 | 506.29 | 1099 | 1294 | 45.9 | .500 |
| 17 000 | 536.29 | 1225 | 1413 | 46.4 | .550 |
| 17 500 | 551.29 | 1314 | 1530 | 46.2 | .580 |
| 17 650 | 555.79 | ........ | (1566) | ........ | .595 |
| 16 700 | 527.29 | 1406 | 1737 | 44.7 | .615 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 319** | | | | | |
| 0 | 26.29 | 31 | 23 | 57.2 | 0.010 |
| 2000 | 86.29 | 100 | 73 | 57.7 | .035 |
| 3000 | 116.29 | 136 | 98 | 58.1 | .050 |
| 4000 | 146.29 | 181 | 134 | 57.4 | .060 |
| 5000 | 176.29 | 233 | 189 | 55.2 | .085 |
| 6000 | 206.29 | 303 | 276 | 52.3 | .115 |
| 7000 | 236.29 | 379 | 375 | 50.2 | .150 |
| 8000 | 266.29 | 450 | 473 | 48.8 | .185 |
| 9000 | 296.29 | 517 | 577 | 47.2 | .220 |
| 10 000 | 326.29 | 588 | 678 | 46.5 | .255 |
| 11 000 | 356.29 | 658 | 767 | 46.2 | .290 |
| 12 000 | 386.29 | 726 | 862 | 45.7 | .330 |
| 13 000 | 416.29 | 823 | 963 | 46.1 | .370 |
| 14 000 | 446.29 | 890 | 1064 | 45.5 | .405 |
| 15 000 | 476.29 | 976 | 1168 | 45.5 | .445 |
| 16 000 | 506.29 | 1091 | 1298 | 45.7 | .495 |
| 17 000 | 536.29 | 1266 | 1570 | 44.6 | .560 |
| 16 000 | 506.29 | 1329 | 1811 | 42.3 | .640 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 320** | | | | | |
| 0 | 26.09 | 40 | 26 | 60.8 | 0.010 |
| 1000 | 56.09 | 72 | 57 | 56.0 | .020 |
| 2000 | 86.09 | 110 | 86 | 56.1 | .035 |
| 3000 | 116.09 | 149 | 117 | 56.1 | .050 |
| 4000 | 146.09 | 195 | 159 | 55.0 | .065 |
| 5000 | 176.09 | 256 | 231 | 52.6 | .090 |
| 6000 | 206.09 | 327 | 315 | 50.9 | .110 |
| 7000 | 236.09 | 399 | 414 | 49.1 | .160 |
| 8000 | 266.09 | 472 | 530 | 47.1 | .200 |
| 9000 | 296.09 | 546 | 638 | 46.1 | .240 |
| 10 000 | 326.09 | 607 | 734 | 45.3 | .270 |
| 11 000 | 356.09 | 677 | 852 | 44.3 | .310 |
| 12 000 | 386.09 | 752 | 959 | 43.9 | .350 |
| 13 000 | 416.09 | 841 | 1053 | 44.4 | .395 |
| 14 000 | 446.09 | 926 | 1154 | 44.5 | .435 |
| 15 000 | 476.09 | 1026 | 1270 | 44.7 | .455 |
| 16 000 | 506.09 | 1137 | 1404 | 44.7 | .520 |
| 16 500 | 521.09 | ........ | (1508) | ........ | .560 |
| 16 600 | 524.09 | ........ | (1713) | ........ | .590 |
| 15 400 | 488.09 | 1358 | 1910 | 41.5 | .600 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 321** | | | | | |
| 0 | 26.29 | 28 | 23 | 54.5 | 0.010 |
| 1000 | 56.29 | 57 | 50 | 53.4 | .020 |
| 2000 | 86.29 | 91 | 76 | 54.6 | .035 |
| 3000 | 116.29 | 128 | 105 | 54.9 | .045 |
| 4000 | 146.29 | 171 | 141 | 54.7 | .060 |
| 5000 | 176.29 | 224 | 204 | 52.4 | .080 |
| 6000 | 206.29 | 282 | 285 | 50.0 | .100 |
| 7000 | 236.29 | 358 | 375 | 48.8 | .140 |
| 8000 | 266.29 | 431 | 464 | 48.1 | .170 |
| 9000 | 296.29 | 502 | 556 | 47.4 | .205 |
| 10 000 | 326.29 | 566 | 649 | 46.6 | .235 |
| 11 000 | 356.29 | 639 | 743 | 46.2 | .270 |
| 12 000 | 386.29 | 702 | 835 | 45.7 | .305 |
| 13 000 | 416.29 | 780 | 920 | 45.9 | .340 |
| 14 000 | 446.29 | 851 | 1013 | 45.7 | .375 |
| 15 000 | 476.29 | 939 | 1100 | 46.0 | .415 |
| 16 000 | 506.29 | 1016 | 1196 | 45.9 | .450 |
| 17 000 | 536.29 | 1114 | 1291 | 46.3 | .490 |
| 17 620 | 554.89 | ........ | (1387) | ........ | .520 |
| 18 000 | 566.29 | 1254 | 1491 | 45.7 | .545 |
| 18 680 | 586.69 | ........ | (1669) | ........ | .595 |
| 18 870 | 592.39 | ........ | (1808) | ........ | .620 |
| 17 000 | 536.29 | 1557 | 2240 | 41.0 | .655 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 322** | | | | | |
| 0 | 26.09 | 30 | 24 | 55.3 | 0.010 |
| 1000 | 56.09 | 64 | 48 | 57.0 | .025 |
| 2000 | 86.09 | 98 | 77 | 55.9 | .035 |
| 3000 | 116.09 | 130 | 106 | 55.0 | .050 |
| 4000 | 146.09 | 167 | 140 | 54.5 | .065 |
| 5000 | 176.09 | 219 | 198 | 52.5 | .080 |
| 6000 | 206.09 | 279 | 279 | 50.0 | .115 |
| 7000 | 236.09 | 354 | 373 | 48.7 | .150 |
| 8000 | 266.09 | 431 | 467 | 48.0 | .180 |
| 9000 | 296.09 | 494 | 562 | 46.8 | .210 |
| 10 000 | 326.09 | 550 | 670 | 45.1 | .250 |
| 11 000 | 356.09 | 636 | 747 | 46.0 | .285 |
| 12 000 | 386.09 | 698 | 831 | 45.7 | .320 |
| 13 000 | 416.09 | 786 | 920 | 46.1 | .355 |
| 14 000 | 446.09 | 857 | 1002 | 46.1 | .390 |
| 15 000 | 476.09 | 941 | 1091 | 46.3 | .425 |
| 16 000 | 506.09 | 1015 | 1174 | 46.4 | .465 |
| 17 000 | 536.09 | 1103 | 1272 | 46.4 | .500 |
| 18 000 | 566.09 | 1241 | 1393 | 47.1 | .555 |
| 18 200 | 572.09 | ........ | (1484) | ........ | .605 |
| 18 320 | 575.69 | ........ | (1549) | ........ | .625 |
| 17 200 | 542.09 | ........ | ........ | ........ | .655 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 323** | | | | | |
| 0 | 26.09 | 28 | 23 | 54.5 | 0.010 |
| 1000 | 56.09 | 63 | 49 | 56.1 | .020 |
| 2000 | 86.09 | 91 | 76 | 54.6 | .030 |
| 3000 | 116.09 | 128 | 107 | 54.4 | .040 |
| 4000 | 146.09 | 168 | 141 | 54.4 | .045 |
| 5000 | 176.09 | 217 | 202 | 51.8 | .075 |
| 6000 | 206.08 | 280 | 285 | 49.6 | .100 |
| 7000 | 236.09 | 349 | 348 | 50.1 | .125 |
| 8000 | 266.09 | 414 | 459 | 47.4 | .155 |
| 9000 | 296.09 | 490 | 531 | 48.0 | .185 |
| 10 000 | 326.09 | 561 | 628 | 47.2 | .225 |
| 11 000 | 356.09 | 627 | 717 | 46.7 | .245 |
| 12 000 | 386.09 | 675 | 803 | 45.7 | .290 |
| 13 000 | 416.09 | 755 | 879 | 46.2 | .330 |
| 14 000 | 446.09 | 828 | 979 | 45.8 | .360 |
| 15 000 | 476.09 | 921 | 1057 | 46.6 | .400 |
| 16 000 | 506.09 | 1000 | 1146 | 46.6 | .435 |
| 17 000 | 536.09 | 1092 | 1249 | 46.6 | .475 |
| 18 000 | 566.09 | 1177 | 1337 | 46.8 | .515 |
| 18 400 | 578.09 | ........ | (1409) | ........ | .540 |
| 18 960 | 594.89 | ........ | (1635) | ........ | .595 |
| 17 000 | 536.09 | 1406 | 2059 | 40.6 | .625 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 249** | | | | | |
| 0 | 25.06 | 26 | 17 | 60.6 | 0.010 |
| 1000 | 55.06 | 63 | 41 | 60.7 | .025 |
| 2000 | 85.06 | 93 | 68 | 57.8 | .035 |
| 2500 | 100.06 | 111 | 84 | 56.9 | .035 |
| 3000 | 115.06 | 133 | 104 | 56.1 | .045 |
| 3500 | 130.06 | 152 | 120 | 55.8 | .055 |
| 4000 | 145.06 | 185 | 186 | 49.8 | .065 |
| 4500 | 160.06 | 306 | 578 | 34.6 | .165 |
| 5000 | 175.06 | 339 | 696 | 32.7 | .200 |
| 5500 | 190.06 | 396 | 862 | 31.5 | .245 |
| 6000 | 205.06 | 440 | 997 | 30.6 | .305 |
| 4800 | 169.06 | 408 | 913 | 30.9 | .320 |
| **BEAM 250** | | | | | |
| 0 | 25.26 | 21 | 19 | 52.5 | 0.005 |
| 1000 | 55.26 | 60 | 39 | 60.6 | .015 |
| 2000 | 85.26 | 90 | 65 | 58.0 | .025 |
| 3000 | 115.26 | 122 | 92 | 56.9 | .040 |
| 3500 | 130.26 | 143 | 111 | 56.2 | .050 |
| 4000 | 145.26 | 168 | 145 | 53.6 | .060 |
| 4500 | 160.26 | 270 | 485 | 35.7 | .140 |
| 5000 | 175.26 | 294 | 585 | 33.4 | .180 |
| 5500 | 190.26 | 370 | 846 | 30.4 | .250 |
| 6000 | 205.26 | 404 | 979 | 29.2 | .290 |
| 6450 | 218.76 | ........ | 1091 | ........ | .350 |
| 4900 | 172.26 | 431 | 1542 | 21.9 | .365 |
| **BEAM 251** | | | | | |
| 0 | 25.68 | 24 | 19 | 56.0 | 0.010 |
| 1000 | 55.68 | 51 | 41 | 55.2 | .020 |
| 2000 | 85.68 | 81 | 65 | 55.6 | .030 |
| 3000 | 115.68 | 109 | 91 | 54.5 | .040 |
| 3500 | 130.68 | 127 | 109 | 53.8 | .050 |
| 4000 | 145.68 | 152 | 149 | 50.5 | .060 |
| 4500 | 160.68 | 259 | 544 | 32.3 | .130 |
| 5000 | 175.68 | 294 | 670 | 30.5 | .185 |
| 5500 | 190.68 | 324 | 814 | 28.5 | .240 |
| 6000 | 205.68 | 366 | 973 | 27.3 | .290 |
| 5000 | 175.68 | 365 | 1344 | 21.4 | .320 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 264** | | | | | |
| 0 | 25.88 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 55.88 | 51 | 44 | 53.6 | .025 |
| 2000 | 85.88 | 85 | 70 | 54.8 | .035 |
| 3000 | 115.88 | 117 | 97 | 54.6 | .045 |
| 4000 | 145.88 | 152 | 135 | 53.0 | .060 |
| 4500 | 160.88 | 183 | 190 | 49.0 | .075 |
| 5000 | 175.88 | 227 | 313 | 42.0 | .105 |
| 5500 | 190.88 | 281 | 484 | 36.8 | .140 |
| 6000 | 205.88 | 326 | 621 | 34.4 | .180 |
| 7000 | 235.88 | 386 | 817 | 32.1 | .240 |
| 8000 | 265.88 | 460 | 1034 | 30.8 | .300 |
| 8500 | 280.88 | 503 | 1183 | 29.8 | .335 |
| 8750 | 288.38 | ........ | 1359 | ........ | .375 |
| 8780 | 289.28 | ........ | 1403 | ........ | .385 |
| 8000 | 265.88 | 521 | 1362 | 27.7 | .405 |
| **BEAM 265** | | | | | |
| 0 | 25.68 | 16 | 24 | 40.0 | 0.010 |
| 1000 | 55.68 | 49 | 48 | 50.4 | .020 |
| 2000 | 85.68 | 78 | 75 | 50.9 | .035 |
| 3000 | 115.68 | 107 | 101 | 51.5 | .045 |
| 4000 | 145.68 | 146 | 140 | 51.1 | .055 |
| 4500 | 160.68 | 172 | 185 | 48.0 | .070 |
| 5000 | 175.68 | 235 | 291 | 44.7 | .095 |
| 5500 | 190.68 | 286 | 422 | 40.4 | .135 |
| 6000 | 205.68 | 322 | 530 | 37.8 | .175 |
| 7000 | 235.68 | 394 | 752 | 34.4 | .235 |
| 8000 | 265.68 | 466 | 988 | 32.0 | .305 |
| 8500 | 280.68 | ........ | 1101 | ........ | .335 |
| 7500 | 250.68 | 515 | 1373 | 27.3 | .355 |
| **BEAM 266** | | | | | |
| 0 | 25.68 | 24 | 19 | 56.0 | 0.010 |
| 1000 | 55.68 | 55 | 44 | 55.5 | .025 |
| 2000 | 85.68 | 85 | 68 | 55.4 | .040 |
| 3000 | 115.68 | 119 | 96 | 55.3 | .050 |
| 3500 | 130.68 | 132 | 111 | 54.4 | .060 |
| 4000 | 145.68 | 159 | 133 | 54.4 | .070 |
| 4500 | 160.68 | 179 | 168 | 51.6 | .080 |
| 5000 | 175.68 | 256 | 349 | 42.3 | .110 |
| 5500 | 190.68 | 290 | 456 | 38.9 | .145 |
| 6000 | 205.68 | 327 | 579 | 36.1 | .180 |
| 7000 | 235.68 | 406 | 822 | 33.1 | .260 |
| 8000 | 265.68 | 489 | 1043 | 31.9 | .330 |
| 8630 | 284.58 | ........ | 1246 | ........ | .390 |
| 7600 | 253.68 | 549 | 1509 | 26.7 | .395 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM** 276 | | | | | |
| 0 | 25.47 | 21 | 17 | 55.1 | 0.015 |
| 1000 | 55.47 | 75 | 27 | 73.6 | .045 |
| 2000 | 85.47 | 107 | 53 | 66.9 | .055 |
| 3000 | 115.47 | 136 | 75 | 64.4 | .065 |
| 4000 | 145.47 | 168 | 104 | 61.7 | .080 |
| 4500 | 160.47 | 189 | 130 | 59.2 | .090 |
| 5000 | 175.47 | 208 | 159 | 56.7 | .100 |
| 5500 | 190.47 | 239 | 198 | 54.7 | .115 |
| 6000 | 205.47 | 278 | 274 | 50.3 | .135 |
| 7000 | 235.47 | 357 | 487 | 42.3 | .190 |
| 8000 | 265.47 | 426 | 627 | 40.4 | .245 |
| 9000 | 295.47 | 475 | 776 | 37.9 | .295 |
| 10 000 | 325.47 | 530 | 913 | 36.7 | .345 |
| 11 000 | 355.47 | 593 | 1050 | 36.1 | .395 |
| 11 910 | 382.77 | ........ | 1157 | ........ | .445 |
| 11 930 | 383.37 | ........ | 1168 | ........ | .455 |
| 10 500 | 340.47 | 601 | 1091 | 35.5 | .460 |
| **BEAM** 277 | | | | | |
| 0 | 25.68 | 21 | 21 | 50.1 | 0.005 |
| 1000 | 55.68 | 51 | 46 | 52.5 | .015 |
| 2000 | 85.68 | 83 | 70 | 54.1 | .025 |
| 3000 | 115.68 | 114 | 92 | 55.4 | .035 |
| 4000 | 145.68 | 146 | 118 | 55.3 | .050 |
| 4500 | 160.68 | 158 | 132 | 54.6 | .055 |
| 5000 | 175.68 | 181 | 161 | 52.9 | .065 |
| 5500 | 190.68 | 206 | 203 | 50.4 | .075 |
| 6000 | 205.68 | 258 | 280 | 47.9 | .095 |
| 7000 | 235.68 | 326 | 499 | 39.5 | .155 |
| 8000 | 265.68 | 389 | 685 | 36.2 | .205 |
| 9000 | 295.68 | 445 | 838 | 34.7 | .260 |
| 10 000 | 325.68 | 501 | 986 | 33.7 | .310 |
| 11 000 | 355.68 | 567 | 1137 | 33.3 | .355 |
| 12 000 | 385.68 | 629 | 1297 | 32.7 | .410 |
| 10 200 | 331.68 | 645 | 1730 | 27.1 | .435 |
| **BEAM** 278 | | | | | |
| 0 | 25.68 | 24 | 19 | 56.0 | 0.010 |
| 1000 | 55.68 | 53 | 48 | 52.5 | .020 |
| 2000 | 85.68 | 83 | 72 | 53.5 | .030 |
| 3000 | 115.68 | 115 | 97 | 54.2 | .040 |
| 4000 | 145.68 | 149 | 123 | 54.7 | .055 |
| 4500 | 160.68 | 167 | 142 | 54.1 | .060 |
| 5000 | 175.68 | 191 | 168 | 53.2 | .070 |
| 5500 | 190.68 | 218 | 200 | 52.1 | .085 |
| 6000 | 205.68 | 251 | 258 | 49.4 | .105 |
| 7000 | 235.68 | 348 | 489 | 41.6 | .170 |
| 8000 | 265.68 | 404 | 682 | 37.2 | .220 |
| 9000 | 295.68 | 476 | 838 | 36.2 | .275 |
| 10 000 | 325.68 | 534 | 983 | 35.2 | .320 |
| 11 000 | 355.68 | 607 | 1138 | 34.8 | .380 |
| 11 170 | 360.78 | ........ | 1202 | ........ | .415 |
| 10 700 | 346.68 | 617 | 1169 | 34.6 | .415 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM** 288 | | | | | |
| 0 | 25.68 | 24 | 19 | 56.0 | 0.005 |
| 1000 | 55.68 | 61 | 39 | 61.0 | .020 |
| 2000 | 85.68 | 95 | 65 | 59.4 | .030 |
| 3000 | 115.68 | 125 | 84 | 59.9 | .040 |
| 4000 | 145.68 | 157 | 106 | 59.7 | .050 |
| 5000 | 175.68 | 212 | 174 | 55.0 | .070 |
| 6000 | 205.68 | 296 | 318 | 48.2 | .110 |
| 7000 | 235.68 | 368 | 472 | 43.8 | .150 |
| 8000 | 265.68 | 431 | 617 | 41.1 | .200 |
| 9000 | 295.68 | 484 | 756 | 39.0 | .245 |
| 10 000 | 325.68 | 562 | 865 | 39.4 | .290 |
| 11 000 | 355.68 | 602 | 983 | 38.0 | .330 |
| 12 000 | 385.68 | 682 | 1099 | 38.3 | .370 |
| 13 000 | 415.68 | 756 | 1262 | 37.5 | .420 |
| 13 850 | 441.18 | ........ | 1397 | ........ | .460 |
| 12 300 | 394.68 | 797 | 1409 | 36.1 | .490 |
| **BEAM** 289 | | | | | |
| 0 | 26.09 | 28 | 15 | 65.2 | 0.005 |
| 1000 | 56.09 | 63 | 34 | 64.9 | .020 |
| 2000 | 86.09 | 93 | 60 | 60.7 | .030 |
| 3000 | 116.09 | 126 | 87 | 59.1 | .045 |
| 4000 | 146.09 | 159 | 118 | 57.4 | .055 |
| 5000 | 176.09 | 204 | 178 | 53.4 | .075 |
| 6000 | 206.09 | 271 | 291 | 48.2 | .105 |
| 7000 | 236.09 | 347 | 465 | 42.7 | .155 |
| 8000 | 266.09 | 416 | 619 | 40.2 | .200 |
| 9000 | 296.09 | 478 | 774 | 38.2 | .245 |
| 10 000 | 326.09 | 541 | 915 | 37.1 | .290 |
| 11 000 | 356.09 | 609 | 1068 | 36.3 | .340 |
| 12 000 | 386.09 | 678 | 1221 | 35.7 | .390 |
| 12 800 | 410.09 | ........ | 1542 | ........ | .470 |
| 12 000 | 386.09 | 784 | 1549 | 33.6 | .480 |
| **BEAM** 290 | | | | | |
| 0 | 26.29 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 56.29 | 56 | 38 | 59.4 | .020 |
| 2000 | 86.29 | 87 | 62 | 58.5 | .030 |
| 3000 | 116.29 | 119 | 87 | 57.8 | .045 |
| 4000 | 146.29 | 150 | 115 | 56.6 | .055 |
| 5000 | 176.29 | 197 | 178 | 52.5 | .075 |
| 6000 | 206.29 | 265 | 309 | 46.1 | .105 |
| 7000 | 236.29 | 339 | 463 | 42.3 | .155 |
| 8000 | 266.29 | 405 | 609 | 39.9 | .200 |
| 9000 | 296.29 | 471 | 742 | 38.8 | .240 |
| 10 000 | 326.29 | 528 | 877 | 37.6 | .285 |
| 11 000 | 356.29 | 591 | 1005 | 37.0 | .325 |
| 12 000 | 386.29 | 659 | 1138 | 36.7 | .380 |
| 13 000 | 416.29 | 739 | 1320 | 35.9 | .430 |
| 13 140 | 420.49 | ........ | 1352 | ........ | .445 |
| 11 500 | 371.29 | 709 | 1268 | 35.9 | .450 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 300** | | | | | |
| 0 | 25.68 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.68 | 51 | 41 | 55.2 | .015 |
| 2000 | 85.68 | 87 | 65 | 57.1 | .030 |
| 3000 | 115.68 | 111 | 91 | 55.0 | .040 |
| 4000 | 145.68 | 145 | 121 | 54.6 | .050 |
| 5000 | 175.68 | 186 | 166 | 52.8 | .070 |
| 6000 | 205.68 | 244 | 258 | 48.6 | .095 |
| 7000 | 235.68 | 305 | 361 | 45.8 | .130 |
| 8000 | 265.68 | 369 | 496 | 42.7 | .170 |
| 9000 | 295.68 | 436 | 634 | 40.8 | .215 |
| 10 000 | 325.68 | 502 | 752 | 40.0 | .260 |
| 11 000 | 355.68 | 562 | 863 | 39.4 | .290 |
| 12 000 | 385.68 | 611 | 956 | 39.0 | .330 |
| 13 000 | 415.68 | 683 | 1072 | 38.9 | .370 |
| 14 000 | 445.68 | 766 | 1193 | 39.1 | .415 |
| 14 780 | 469.08 | ........ | 1292 | ........ | .455 |
| 15 000 | 475.68 | 874 | 1436 | 37.9 | .475 |
| 15 600 | 493.68 | ........ | 1574 | ........ | .515 |
| 15 700 | 496.68 | ........ | 1644 | ........ | .545 |
| 13 700 | 436.68 | 997 | 2323 | 30.0 | .550 |
| **BEAM 301** | | | | | |
| 0 | 25.88 | 24 | 21 | 53.6 | 0.010 |
| 1000 | 55.88 | 56 | 43 | 56.5 | .020 |
| 2000 | 85.88 | 84 | 65 | 56.5 | .030 |
| 3000 | 115.88 | 114 | 87 | 56.7 | .040 |
| 4000 | 145.88 | 151 | 116 | 56.6 | .055 |
| 5000 | 175.88 | 192 | 164 | 53.9 | .070 |
| 6000 | 205.88 | 252 | 241 | 51.1 | .100 |
| 7000 | 235.88 | 318 | 338 | 48.5 | .130 |
| 8000 | 265.88 | 387 | 467 | 45.3 | .170 |
| 9000 | 295.88 | 447 | 600 | 42.7 | .210 |
| 10 000 | 325.88 | 507 | 709 | 41.7 | .250 |
| 11 000 | 355.88 | 566 | 817 | 40.9 | .290 |
| 12 000 | 385.88 | 628 | 938 | 40.1 | .330 |
| 13 000 | 415.88 | 692 | 1058 | 39.6 | .370 |
| 14 000 | 445.88 | 776 | 1198 | 39.3 | .410 |
| 14 500 | 460.88 | 816 | 1282 | 38.9 | .440 |
| 14 870 | 471.98 | ........ | 1371 | ........ | .460 |
| 14 870 | 471.98 | ........ | 1462 | ........ | .475 |
| 14 900 | 472.88 | ........ | 1557 | ........ | .490 |
| 13 800 | 439.88 | 956 | 1915 | 33.3 | .525 |
| **BEAM 302** | | | | | |
| 0 | 25.68 | 19 | 15 | 55.5 | 0.010 |
| 1000 | 55.68 | 60 | 38 | 61.2 | .020 |
| 2000 | 85.68 | 92 | 63 | 59.3 | .035 |
| 3000 | 115.68 | 126 | 89 | 58.6 | .045 |
| 4000 | 145.68 | 159 | 116 | 57.8 | .055 |
| 5000 | 175.68 | 209 | 164 | 56.0 | .075 |
| 6000 | 205.68 | 264 | 243 | 52.1 | .100 |
| 7000 | 235.68 | 340 | 338 | 50.1 | .135 |
| 8000 | 265.68 | 402 | 463 | 46.5 | .175 |
| 9000 | 295.68 | 470 | 597 | 44.1 | .215 |
| 10 000 | 325.68 | 531 | 692 | 43.4 | .260 |
| 11 000 | 355.68 | 595 | 805 | 42.5 | .300 |
| 12 000 | 385.68 | 654 | 911 | 41.8 | .340 |
| 13 000 | 415.68 | 724 | 1029 | 41.3 | .375 |
| 14 000 | 445.68 | 794 | 1142 | 41.0 | .420 |
| 14 800 | 469.68 | ........ | 1426 | ........ | .480 |
| 14 000 | 445.68 | 920 | 1585 | 36.7 | .490 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 312** | | | | | |
| 0 | 26.29 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 56.29 | 51 | 48 | 51.5 | .020 |
| 2000 | 86.29 | 75 | 68 | 52.5 | .030 |
| 3000 | 116.29 | 109 | 91 | 54.5 | .040 |
| 4000 | 146.29 | 141 | 115 | 55.0 | .050 |
| 5000 | 176.29 | 177 | 145 | 55.0 | .065 |
| 6000 | 206.29 | 219 | 197 | 52.6 | .080 |
| 7000 | 236.29 | 277 | 268 | 50.8 | .105 |
| 8000 | 266.29 | 340 | 376 | 47.5 | .140 |
| 9000 | 296.29 | 400 | 485 | 45.2 | .175 |
| 10 000 | 326.29 | 439 | 590 | 42.7 | .205 |
| 11 000 | 356.29 | 516 | 694 | 42.7 | .240 |
| 12 000 | 386.29 | 577 | 800 | 41.9 | .270 |
| 13 000 | 416.29 | 632 | 885 | 41.7 | .305 |
| 14 000 | 446.29 | 686 | 971 | 41.4 | .330 |
| 15 000 | 476.29 | 745 | 1060 | 41.3 | .365 |
| 16 000 | 506.29 | 814 | 1152 | 41.4 | .410 |
| 17 000 | 536.29 | 880 | 1268 | 41.0 | .430 |
| 18 000 | 566.29 | ........ | 1487 | ........ | .500 |
| 16 200 | 512.29 | 1008 | 1853 | 35.2 | .510 |
| **BEAM 313** | | | | | |
| 0 | 26.71 | 24 | 15 | 61.5 | 0.010 |
| 1000 | 56.71 | 56 | 46 | 54.9 | .020 |
| 2000 | 86.71 | 88 | 72 | 55.0 | .025 |
| 3000 | 116.71 | 117 | 96 | 54.8 | .040 |
| 4000 | 146.71 | 151 | 123 | 55.1 | .050 |
| 5000 | 176.71 | 190 | 156 | 55.0 | .060 |
| 6000 | 206.71 | 231 | 205 | 53.0 | .080 |
| 7000 | 236.71 | 284 | 272 | 51.1 | .100 |
| 8000 | 266.71 | 343 | 357 | 49.0 | .135 |
| 9000 | 296.71 | 400 | 451 | 47.0 | .165 |
| 10 000 | 326.71 | 455 | 550 | 45.3 | .200 |
| 11 000 | 356.71 | 508 | 646 | 44.0 | .235 |
| 12 000 | 386.71 | 567 | 745 | 43.2 | .270 |
| 13 000 | 416.71 | 614 | 827 | 42.6 | .300 |
| 14 000 | 446.71 | 665 | 918 | 42.0 | .330 |
| 15 000 | 476.71 | 718 | 1010 | 41.6 | .365 |
| 16 000 | 506.71 | 787 | 1103 | 41.6 | .400 |
| 17 000 | 536.71 | 844 | 1195 | 41.4 | .435 |
| 18 000 | 566.71 | 914 | 1272 | 41.8 | .475 |
| 18 420 | 579.31 | ........ | 1345 | ........ | .500 |
| 16 600 | 524.71 | 919 | 1277 | 41.8 | .520 |
| **BEAM 314** | | | | | |
| 0 | 25.88 | 21 | 15 | 58.1 | 0.005 |
| 1000 | 55.88 | 60 | 34 | 63.7 | .025 |
| 2000 | 85.88 | 86 | 58 | 59.8 | .035 |
| 3000 | 115.88 | 114 | 79 | 59.0 | .045 |
| 4000 | 145.88 | 148 | 106 | 58.2 | .055 |
| 5000 | 175.88 | 180 | 135 | 57.1 | .070 |
| 6000 | 205.88 | 225 | 179 | 55.7 | .085 |
| 7000 | 235.88 | 274 | 246 | 52.7 | .110 |
| 8000 | 265.88 | 330 | 335 | 49.6 | .140 |
| 9000 | 295.88 | 391 | 441 | 47.0 | .170 |
| 10 000 | 325.88 | 457 | 552 | 45.3 | .200 |
| 11 000 | 355.88 | 509 | 641 | 44.2 | .235 |
| 12 000 | 385.88 | 564 | 730 | 43.6 | 270 |
| 13 000 | 415.88 | 616 | 819 | 42.9 | .300 |
| 14 000 | 445.88 | 670 | 904 | 42.6 | .335 |
| 15 000 | 475.88 | 735 | 1003 | 42.3 | .370 |
| 16 000 | 505.88 | 805 | 1106 | 42.1 | .410 |
| 17 000 | 535.88 | 874 | 1222 | 41.7 | .450 |
| 17 770 | 558.98 | 940 | 1325 | 41.5 | .500 |
| 16 500 | 520.88 | 927 | 1274 | 42.1 | .525 |

## Appendix II—Log Sheets of Concrete Beams—Continued

### BEAM 324

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 24 | 17 | 58.6 | 0.010 |
| 1000 | 55.88 | 58 | 39 | 59.7 | .015 |
| 2000 | 85.88 | 86 | 63 | 57.8 | .025 |
| 3000 | 115.88 | 118 | 85 | 58.2 | .040 |
| 4000 | 145.88 | 148 | 109 | 57.6 | .050 |
| 5000 | 175.88 | 178 | 138 | 56.3 | .065 |
| 6000 | 205.88 | 231 | 195 | 54.3 | .085 |
| 7000 | 235.88 | 287 | 256 | 52.9 | .110 |
| 8000 | 265.88 | 341 | 323 | 51.4 | .130 |
| 9000 | 295.88 | 402 | 412 | 49.4 | .160 |
| 10 000 | 325.88 | 458 | 516 | 47.0 | .195 |
| 11 000 | 355.88 | 512 | 602 | 45.9 | .230 |
| 12 000 | 385.88 | 563 | 684 | 45.2 | .255 |
| 13 000 | 415.88 | 614 | 766 | 44.5 | .285 |
| 14 000 | 445.88 | 666 | 841 | 44.2 | .315 |
| 15 000 | 475.88 | 723 | 923 | 43.9 | .350 |
| 16 000 | 505.88 | 780 | 998 | 43.9 | .380 |
| 17 000 | 535.88 | 833 | 1074 | 43.7 | .410 |
| 18 000 | 565.88 | 890 | 1152 | 43.6 | .440 |
| 19 000 | 595.88 | 966 | 1241 | 43.8 | .475 |
| 20 000 | 625.88 | 1034 | 1330 | 43.7 | .510 |
| 21 000 | 655.88 | 1102 | 1419 | 43.7 | .545 |
| 21 350 | 666.38 | ........ | 1499 | ........ | .580 |
| 21 360 | 666.68 | ........ | 1603 | ........ | .600 |
| 18 300 | 574.88 | 1191 | 1949 | 37.9 | .615 |

### BEAM 252

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 16 | 17 | 47.9 | 0.005 |
| 1000 | 55.26 | 48 | 43 | 52.5 | .020 |
| 2000 | 85.26 | 70 | 62 | 52.9 | .035 |
| 2500 | 100.26 | 87 | 75 | 53.7 | .040 |
| 3000 | 115.26 | 100 | 87 | 53.6 | .045 |
| 3500 | 130.26 | 120 | 109 | 52.5 | .055 |
| 4000 | 145.26 | 181 | 262 | 40.9 | .085 |
| 4500 | 160.26 | 271 | 506 | 34.9 | .155 |
| 5000 | 175.26 | 305 | 631 | 32.6 | .195 |
| 5500 | 190.26 | 354 | 786 | 31.1 | .245 |
| 6000 | 205.26 | 387 | 889 | 30.3 | .285 |
| 6310 | 214.56 | ........ | 1065 | ........ | .335 |
| 4300 | 154.26 | 417 | 1474 | 22.1 | .355 |

### BEAM 325

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.50 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 56.50 | 56 | 43 | 56.5 | .025 |
| 2000 | 86.50 | 84 | 62 | 57.6 | .035 |
| 3000 | 116.50 | 116 | 84 | 58.0 | .050 |
| 4000 | 146.50 | 145 | 109 | 57.0 | .060 |
| 5000 | 176.50 | 184 | 142 | 56.5 | .075 |
| 6000 | 206.50 | 223 | 190 | 54.0 | .090 |
| 7000 | 236.50 | 282 | 260 | 52.0 | .120 |
| 8000 | 266.50 | 330 | 333 | 49.8 | .145 |
| 9000 | 296.50 | 384 | 410 | 48.3 | .175 |
| 10 000 | 326.50 | 440 | 506 | 46.5 | .200 |
| 11 000 | 356.50 | 488 | 598 | 45.0 | .235 |
| 12 000 | 386.50 | 538 | 677 | 44.3 | .260 |
| 13 000 | 416.50 | 588 | 757 | 43.7 | .295 |
| 14 000 | 446.50 | 640 | 838 | 43.3 | .325 |
| 15 000 | 476.50 | 687 | 913 | 42.9 | .355 |
| 16 000 | 506.50 | 742 | 991 | 42.8 | .385 |
| 17 000 | 536.50 | 797 | 1077 | 42.5 | .420 |
| 18 000 | 566.50 | 850 | 1154 | 42.4 | .450 |
| 19 000 | 596.50 | 919 | 1231 | 42.8 | .485 |
| 20 000 | 626.50 | 990 | 1325 | 42.8 | .525 |
| 20 200 | 632.50 | ........ | 1374 | ........ | .540 |
| 20 430 | 639.40 | ........ | 1458 | ........ | .560 |
| 20 730 | 648.40 | ........ | 1528 | ........ | .590 |
| 18 000 | 566.50 | 1130 | 2058 | 35.5 | .605 |

### BEAM 253

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 19 | 21 | 47.5 | 0.010 |
| 1000 | 55.47 | 49 | 43 | 53.0 | .025 |
| 2000 | 85.47 | 72 | 63 | 53.2 | .035 |
| 2500 | 100.47 | 90 | 72 | 55.6 | .040 |
| 3000 | 115.47 | 108 | 80 | 57.5 | .045 |
| 3500 | 130.47 | 126 | 99 | 56.1 | .055 |
| 4000 | 145.47 | 174 | 227 | 43.4 | .075 |
| 4500 | 160.47 | 233 | 378 | 38.1 | .120 |
| 5000 | 175.47 | 283 | 521 | 35.2 | .180 |
| 5500 | 190.47 | 345 | 742 | 31.8 | .240 |
| 6000 | 205.47 | 385 | 923 | 29.5 | .290 |
| 5050 | 176.97 | 425 | 1610 | 20.0 | .345 |

### BEAM 326

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 31 | 15 | 67.6 | 0.010 |
| 1000 | 56.09 | 67 | 38 | 63.9 | .020 |
| 2000 | 86.09 | 99 | 62 | 61.5 | .035 |
| 3000 | 116.09 | 131 | 84 | 60.9 | .045 |
| 4000 | 146.09 | 158 | 106 | 59.9 | .060 |
| 5000 | 176.09 | 202 | 140 | 59.1 | .070 |
| 6000 | 206.09 | 244 | 188 | 56.4 | .090 |
| 7000 | 236.09 | 305 | 258 | 54.2 | .115 |
| 8000 | 266.09 | 365 | 335 | 52.1 | .140 |
| 9000 | 296.09 | 430 | 441 | 49.3 | .170 |
| 10 000 | 326.09 | 481 | 528 | 47.7 | .200 |
| 11 000 | 356.09 | 546 | 627 | 46.5 | .235 |
| 12 000 | 386.09 | 591 | 709 | 45.5 | .260 |
| 13 000 | 416.09 | 651 | 795 | 45.0 | .295 |
| 14 000 | 446.09 | 701 | 872 | 44.5 | .325 |
| 15 000 | 476.09 | 756 | 959 | 44.1 | .355 |
| 16 000 | 506.09 | 821 | 1043 | 44.0 | .390 |
| 17 000 | 536.09 | 880 | 1132 | 43.7 | .420 |
| 18 000 | 566.09 | 939 | 1212 | 43.6 | .450 |
| 19 000 | 596.09 | 1029 | 1326 | 43.7 | .495 |
| 19 450 | 609.59 | ........ | 1397 | ........ | .520 |
| 19 650 | 615.59 | ........ | 1463 | ........ | .530 |
| 19 920 | 623.69 | ........ | 1564 | ........ | .550 |
| 17 900 | 563.09 | 1224 | 1901 | 39.2 | .590 |

### BEAM 254

| Applied Load, lbs. | M/bd² lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 17 | 19 | 46.9 | 0.010 |
| 1000 | 55.47 | 42 | 41 | 50.7 | .020 |
| 2000 | 85.47 | 70 | 63 | 52.5 | .035 |
| 2500 | 100.47 | 85 | 79 | 51.9 | .040 |
| 3000 | 115.47 | 102 | 97 | 51.2 | .050 |
| 3500 | 130.47 | 118 | 118 | 50.0 | .060 |
| 4000 | 145.47 | 165 | 191 | 46.3 | .080 |
| 4500 | 160.47 | 235 | 421 | 35.8 | .135 |
| 5000 | 175.47 | 282 | 591 | 32.3 | .190 |
| 5500 | 190.47 | 317 | 762 | 29.4 | .230 |
| 6000 | 205.47 | 359 | 1001 | 26.4 | .285 |
| 4950 | 173.97 | 396 | 1779 | 18.2 | .360 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 267** | | | | | |
| 0 | 25.88 | 16 | 17 | 47.9 | 0.005 |
| 1000 | 55.88 | 45 | 38 | 54.3 | .015 |
| 2000 | 85.88 | 68 | 60 | 53.3 | .030 |
| 3000 | 115.88 | 90 | 79 | 53.4 | .040 |
| 3500 | 130.88 | 113 | 96 | 54.2 | .050 |
| 4000 | 145.88 | 125 | 109 | 53.4 | .055 |
| 4500 | 160.88 | 152 | 147 | 50.8 | .065 |
| 5000 | 175.88 | 184 | 221 | 45.5 | .080 |
| 6000 | 205.88 | 289 | 573 | 33.5 | .155 |
| 7000 | 235.88 | 348 | 783 | 30.7 | .220 |
| 8000 | 265.88 | 420 | 974 | 30.1 | .280 |
| 9000 | 295.88 | 502 | 1251 | 28.6 | .350 |
| 9110 | 299.18 | ........ | 1356 | ........ | .380 |
| 7700 | 256.88 | 532 | 1718 | 23.6 | .390 |
| **BEAM 268** | | | | | |
| 0 | 25.68 | 16 | 22 | 41.9 | 0.010 |
| 1000 | 55.68 | 38 | 46 | 45.4 | .015 |
| 2000 | 85.68 | 62 | 67 | 48.3 | .030 |
| 3000 | 115.68 | 89 | 91 | 49.4 | .040 |
| 4000 | 145.68 | 120 | 111 | 51.9 | .050 |
| 4500 | 160.68 | 139 | 132 | 51.2 | .060 |
| 5000 | 175.68 | 167 | 181 | 48.1 | .075 |
| 5500 | 190.68 | 232 | 368 | 38.7 | .120 |
| 6000 | 205.68 | 274 | 480 | 36.3 | .150 |
| 7000 | 235.68 | 346 | 699 | 33.1 | .225 |
| 8000 | 265.68 | 404 | 882 | 31.4 | .285 |
| 9000 | 295.68 | 467 | 1072 | 30.3 | .350 |
| 7650 | 255.18 | 429 | 1010 | 29.8 | .380 |
| **BEAM 269** | | | | | |
| 0 | 25.68 | 17 | 14 | 54.1 | 0.010 |
| 1000 | 55.68 | ........ | ........ | ........ | ........ |
| 2000 | 85.68 | 66 | 48 | 57.8 | .030 |
| 3000 | 115.68 | 92 | 68 | 57.5 | .045 |
| 3500 | 130.68 | 107 | 84 | 55.9 | .050 |
| 4000 | 145.68 | 122 | 101 | 54.7 | .055 |
| 4500 | 160.68 | 136 | 125 | 52.1 | .065 |
| 5000 | 175.68 | 167 | 178 | 48.4 | .075 |
| 6000 | 205.68 | 268 | 462 | 36.8 | .135 |
| 7000 | 235.68 | 358 | 726 | 33.0 | .210 |
| 8000 | 265.68 | 423 | 923 | 31.4 | .275 |
| 9000 | 295.68 | 484 | 1092 | 30.7 | .330 |
| 10 000 | 325.68 | 545 | 1255 | 30.3 | .390 |
| 10 270 | 333.78 | ........ | 1284 | ........ | .420 |
| 7650 | 255.18 | 476 | 1104 | 30.1 | .425 |
| **BEAM 279** | | | | | |
| 0 | 25.47 | 19 | 15 | 55.5 | 0.010 |
| 1000 | 55.47 | 47 | 36 | 56.7 | .020 |
| 2000 | 85.47 | 69 | 53 | 56.6 | .030 |
| 3000 | 115.47 | 96 | 77 | 55.4 | .045 |
| 4000 | 145.47 | 130 | 106 | 55.0 | .055 |
| 4500 | 160.47 | 154 | 135 | 53.4 | .065 |
| 5000 | 175.47 | 178 | 168 | 51.5 | .080 |
| 5500 | 190.47 | 208 | 226 | 47.9 | .095 |
| 6000 | 205.47 | 246 | 294 | 45.6 | .115 |
| 7000 | 235.47 | 316 | 499 | 38.8 | .165 |
| 8000 | 265.47 | 379 | 674 | 36.0 | .215 |
| 9000 | 295.47 | 440 | 834 | 34.5 | .265 |
| 10 000 | 325.47 | 495 | 964 | 33.9 | .310 |
| 11 000 | 355.47 | 545 | 1094 | 33.3 | .350 |
| 12 000 | 385.47 | 602 | 1248 | 32.5 | .395 |
| 12 380 | 396.87 | ........ | 1325 | ........ | .435 |
| 10 100 | 328.47 | 574 | 1229 | 31.8 | .440 |
| **BEAM 280** | | | | | |
| 0 | 25.88 | 16 | 19 | 45.3 | 0.010 |
| 1000 | 55.88 | 30 | 32 | 48.5 | .020 |
| 2000 | 85.88 | 53 | 55 | 49.3 | .030 |
| 3000 | 115.88 | 82 | 77 | 51.6 | .040 |
| 4000 | 145.88 | 109 | 99 | 52.5 | .055 |
| 5000 | 175.88 | 152 | 150 | 50.3 | .075 |
| 5500 | 190.88 | 183 | 203 | 47.4 | .090 |
| 6000 | 205.88 | 217 | 270 | 44.6 | .110 |
| 7000 | 235.88 | 295 | 501 | 37.0 | .165 |
| 8000 | 265.88 | 361 | 672 | 34.9 | .220 |
| 9000 | 295.88 | 413 | 810 | 33.8 | .270 |
| 10 000 | 325.88 | 468 | 949 | 33.0 | .315 |
| 11 000 | 355.88 | 526 | 1115 | 32.1 | .370 |
| 11 430 | 368.78 | ........ | 1268 | ........ | .415 |
| 9950 | 324.38 | 584 | 1609 | 26.7 | .420 |
| **BEAM 281** | | | | | |
| 0 | 25.47 | 17 | 14 | 54.1 | 0.010 |
| 1000 | 55.47 | 43 | 31 | 57.9 | .020 |
| 2000 | 85.47 | 69 | 44 | 60.9 | .030 |
| 3000 | 115.47 | 99 | 65 | 60.4 | .045 |
| 3500 | 130.47 | 112 | 75 | 60.0 | .055 |
| 4000 | 145.47 | 124 | 94 | 56.9 | .060 |
| 4500 | 160.47 | 141 | 116 | 54.8 | .065 |
| 5000 | 175.47 | 160 | 135 | 54.2 | .075 |
| 6000 | 205.47 | 224 | 263 | 46.0 | .110 |
| 7000 | 235.47 | 317 | 485 | 39.5 | .170 |
| 8000 | 265.47 | 380 | 627 | 37.8 | .225 |
| 9000 | 295.47 | 433 | 752 | 36.6 | .265 |
| 10 000 | 325.47 | 495 | 891 | 35.7 | .315 |
| 11 000 | 355.47 | 549 | 1022 | 34.9 | .365 |
| 11 740 | 377.67 | ........ | 1215 | ........ | .425 |
| 10 200 | 331.47 | 681 | 1801 | 27.4 | .475 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 291** | | | | | |
| 0 | 25.88 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.88 | 42 | 32 | 56.6 | .015 |
| 2000 | 85.88 | 68 | 50 | 57.6 | .025 |
| 3000 | 115.88 | 93 | 72 | 56.4 | .035 |
| 4000 | 145.88 | 129 | 94 | 57.9 | .050 |
| 5000 | 175.88 | 160 | 132 | 54.7 | .060 |
| 6000 | 205.88 | 225 | 241 | 48.3 | .100 |
| 7000 | 235.88 | 301 | 414 | 42.1 | .145 |
| 8000 | 265.88 | 353 | 533 | 39.9 | .185 |
| 9000 | 295.88 | 411 | 675 | 37.9 | .230 |
| 10 000 | 325.88 | 469 | 815 | 36.5 | .270 |
| 11 000 | 355.88 | 517 | 945 | 35.4 | .310 |
| 12 000 | 385.88 | 566 | 1082 | 34.4 | .355 |
| 13 000 | 415.88 | 621 | 1277 | 32.7 | .410 |
| 13 220 | 422.48 | ........ | 1504 | ........ | .460 |
| 11 700 | 376.88 | 697 | 1853 | 27.3 | .470 |
| **BEAM 292** | | | | | |
| 0 | 26.09 | 14 | 17 | 44.3 | 0.010 |
| 1000 | 56.09 | 35 | 41 | 45.9 | .020 |
| 2000 | 86.09 | 57 | 63 | 47.5 | .030 |
| 3000 | 116.09 | 87 | 80 | 52.2 | .040 |
| 4000 | 146.09 | 117 | 109 | 51.8 | .050 |
| 5000 | 176.09 | 153 | 147 | 51.0 | .070 |
| 6000 | 206.09 | 200 | 214 | 48.3 | .090 |
| 7000 | 236.09 | 282 | 397 | 41.5 | .135 |
| 8000 | 266.09 | 354 | 542 | 39.5 | .180 |
| 9000 | 296.09 | 410 | 675 | 37.8 | .225 |
| 10 000 | 326.09 | 466 | 802 | 36.8 | .265 |
| 11 000 | 356.09 | 529 | 930 | 36.3 | .310 |
| 12 000 | 386.09 | 583 | 1058 | 35.5 | .355 |
| 13 000 | 416.09 | 666 | 1296 | 33.9 | .415 |
| 11 700 | 377.09 | 744 | 1945 | 27.7 | .465 |
| **BEAM 293** | | | | | |
| 0 | 26.29 | 17 | 17 | 49.5 | 0.010 |
| 1000 | 56.29 | 47 | 31 | 60.2 | .020 |
| 2000 | 86.29 | 69 | 50 | 58.0 | .030 |
| 3000 | 116.29 | 101 | 70 | 59.0 | .040 |
| 4000 | 146.29 | 127 | 92 | 58.0 | .055 |
| 5000 | 176.29 | 164 | 135 | 54.8 | .070 |
| 6000 | 206.29 | 213 | 227 | 48.4 | .095 |
| 7000 | 236.29 | 287 | 390 | 42.4 | .140 |
| 8000 | 266.29 | 355 | 532 | 40.0 | .185 |
| 9000 | 296.29 | 421 | 679 | 38.3 | .235 |
| 10 000 | 326,29 | 475 | 791 | 37.5 | .275 |
| 11 000 | 356.29 | 530 | 915 | 36.7 | .315 |
| 12 000 | 386.29 | 589 | 1029 | 36.4 | .365 |
| 13 000 | 416.29 | 649 | 1147 | 36.1 | .405 |
| 13 600 | 434.29 | ........ | 1315 | ........ | .475 |
| 11 700 | 377.29 | 752 | 1841 | 29.0 | .510 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 303** | | | | | |
| 0 | 25.47 | 19 | 17 | 52.5 | 0.005 |
| 1000 | 55.47 | 40 | 32 | 55.3 | .015 |
| 2000 | 85.47 | 64 | 53 | 54.6 | .030 |
| 3000 | 115.47 | 88 | 70 | 55.7 | .040 |
| 4000 | 145.47 | 120 | 94 | 56.0 | .050 |
| 5000 | 175.47 | 166 | 147 | 53.0 | .065 |
| 6000 | 205.47 | 221 | 234 | 48.5 | .095 |
| 7000 | 235.47 | 274 | 326 | 45.7 | .120 |
| 8000 | 265.47 | 341 | 467 | 42.2 | .170 |
| 9000 | 295.47 | 398 | 583 | 40.6 | .200 |
| 10 000 | 325.47 | 451 | 713 | 38.8 | .240 |
| 11 000 | 355.47 | 503 | 831 | 37.7 | .280 |
| 12 000 | 385.47 | 549 | 944 | 36.8 | .320 |
| 13 000 | 415.47 | 587 | 1039 | 36.1 | .350 |
| 14 000 | 445.47 | 635 | 1156 | 35.4 | .390 |
| 15 000 | 475.47 | 671 | 1274 | 34.5 | .430 |
| 15 820 | 500.07 | ........ | 1549 | ........ | .490 |
| 14 500 | 460.47 | 841 | 2291 | 26.9 | .575 |
| **BEAM 304** | | | | | |
| 0 | 25.47 | 23 | 24 | 49.3 | 0.010 |
| 1000 | 55.47 | 48 | 41 | 54.2 | .020 |
| 2000 | 85.47 | 75 | 62 | 54.7 | .030 |
| 3000 | 115.47 | 101 | 82 | 55.2 | .040 |
| 4000 | 145.47 | 128 | 109 | 54.0 | .050 |
| 5000 | 175.47 | 170 | 154 | 52.5 | .070 |
| 6000 | 205.47 | 223 | 243 | 47.9 | .090 |
| 7000 | 235.47 | 275 | 337 | 44.9 | .120 |
| 8000 | 265.47 | 340 | 484 | 41.3 | .160 |
| 9000 | 295.47 | 394 | 593 | 39.9 | .200 |
| 10 000 | 325.47 | 444 | 721 | 38.1 | .240 |
| 11 000 | 355.47 | 499 | 834 | 37.4 | .275 |
| 12 000 | 385.47 | 544 | 938 | 36.7 | .310 |
| 13 000 | 415.47 | 593 | 1044 | 36.2 | .350 |
| 14 000 | 445.47 | 644 | 1159 | 35.7 | .385 |
| 15 000 | 475.47 | 702 | 1285 | 35.3 | .430 |
| 15 710 | 496.77 | ........ | 1564 | ........ | .490 |
| 13 750 | 437.97 | 811 | 2050 | 28.3 | .520 |
| **BEAM 305** | | | | | |
| 0 | 26.09 | 21 | 14 | 59.7 | 0.005 |
| 1000 | 56.09 | 45 | 31 | 59.1 | .015 |
| 2000 | 86.09 | 71 | 55 | 56.5 | .025 |
| 3000 | 116.09 | 96 | 75 | 56.0 | .040 |
| 4000 | 146.09 | 122 | 101 | 54.7 | .050 |
| 5000 | 176.09 | 159 | 138 | 53.5 | .060 |
| 6000 | 206.09 | 203 | 193 | 51.2 | .080 |
| 7000 | 236.09 | 254 | 284 | 47.2 | .110 |
| 8000 | 266.09 | 308 | 407 | 43.1 | .140 |
| 9000 | 296.09 | 376 | 535 | 41.2 | .185 |
| 10 000 | 326.09 | 425 | 656 | 39.3 | .225 |
| 11 000 | 356.09 | 473 | 757 | 38.5 | .260 |
| 12 000 | 386.09 | 522 | 862 | 37.7 | .300 |
| 13 000 | 416.09 | 573 | 961 | 37.3 | .330 |
| 14 000 | 446.09 | 627 | 1067 | 37.0 | .370 |
| 15 000 | 476.09 | 675 | 1166 | 36.7 | .410 |
| 16 000 | 506.09 | 736 | 1294 | 36.2 | .450 |
| 16 930 | 533.99 | ........ | 1503 | ........ | .510 |
| 14 350 | 456.59 | 824 | 1834 | 31.0 | .540 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 315** | | | | | |
| 0 | 26.09 | 19 | 22 | 46.4 | 0.010 |
| 1000 | 56.09 | 40 | 39 | 50.6 | .020 |
| 2000 | 86.09 | 62 | 56 | 52.5 | .030 |
| 3000 | 116.09 | 93 | 80 | 53.7 | .040 |
| 4000 | 146.09 | 124 | 99 | 55.6 | .055 |
| 5000 | 176.09 | 156 | 132 | 54.2 | .070 |
| 6000 | 206.09 | 197 | 176 | 52.8 | .085 |
| 7000 | 236.09 | 252 | 250 | 50.2 | .110 |
| 8000 | 266.09 | 304 | 337 | 47.4 | .140 |
| 9000 | 296.09 | 360 | 436 | 45.2 | .170 |
| 10 000 | 326.09 | 406 | 530 | 43.4 | .200 |
| 11 000 | 356.09 | 462 | 639 | 42.0 | .235 |
| 12 000 | 386.09 | 506 | 728 | 41.0 | .265 |
| 13 000 | 416.09 | 558 | 819 | 40.5 | .295 |
| 14 000 | 446.09 | 609 | 911 | 40.1 | .330 |
| 15 000 | 476.09 | 661 | 1002 | 39.8 | .360 |
| 16 000 | 506.09 | 716 | 1082 | 39.8 | .395 |
| 17 000 | 536.09 | 771 | 1168 | 39.8 | .425 |
| 18 000 | 566.09 | 820 | 1260 | 39.4 | .455 |
| 18 940 | 594.29 | ........ | 1470 | ........ | .505 |
| 16 800 | 530.09 | 955 | 1945 | 32.9 | .545 |
| **BEAM 316** | | | | | |
| 0 | 26.29 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 56.29 | 42 | 29 | 58.9 | .020 |
| 2000 | 66.29 | 66 | 48 | 57.8 | .030 |
| 3000 | 116.29 | 92 | 63 | 59.3 | .040 |
| 4000 | 146.29 | 123 | 85 | 59.2 | .050 |
| 5000 | 176.29 | 151 | 118 | 56.2 | .065 |
| 6000 | 206.29 | 196 | 162 | 54.7 | .085 |
| 7000 | 236.29 | 250 | 238 | 51.3 | .105 |
| 8000 | 266.29 | 306 | 337 | 47.6 | .135 |
| 9000 | 296.29 | 365 | 444 | 45.2 | .170 |
| 10 000 | 326.29 | 416 | 538 | 43.6 | .205 |
| 11 000 | 356.29 | 467 | 639 | 42.2 | .240 |
| 12 000 | 386.29 | 515 | 733 | 41.3 | .270 |
| 13 000 | 416.29 | 563 | 824 | 40.6 | .305 |
| 14 000 | 446.29 | 613 | 915 | 40.1 | .335 |
| 15 000 | 476.29 | 664 | 1003 | 39.8 | .365 |
| 16 000 | 506.29 | 722 | 1089 | 39.8 | .400 |
| 17 000 | 536.29 | 771 | 1174 | 39.6 | .435 |
| 18 000 | 566.29 | 831 | 1262 | 39.7 | .465 |
| 18 880 | 592.69 | ........ | 1561 | ........ | .535 |
| 16 600 | 524.29 | 1017 | 2542 | 28.6 | .595 |
| **BEAM 317** | | | | | |
| 0 | 26.50 | 16 | 17 | 47.9 | 0.010 |
| 1000 | 56.50 | 43 | 41 | 51.3 | .020 |
| 2000 | 86.50 | 66 | 58 | 53.3 | .030 |
| 3000 | 116.50 | 93 | 80 | 53.7 | .040 |
| 4000 | 146.50 | 119 | 104 | 53.4 | .050 |
| 5000 | 176.50 | 156 | 130 | 54.6 | .060 |
| 6000 | 206.50 | 199 | 198 | 50.1 | .080 |
| 7000 | 236.50 | 245 | 272 | 47.4 | .110 |
| 8000 | 266.50 | 299 | 374 | 44.4 | .140 |
| 9000 | 296.50 | 344 | 463 | 42.7 | .160 |
| 10 000 | 326.50 | 398 | 559 | 41.6 | .190 |
| 11 000 | 356.50 | 443 | 662 | 40.1 | .235 |
| 12 000 | 386.50 | 488 | 752 | 39.4 | .270 |
| 13 000 | 416.50 | 537 | 839 | 39.0 | .300 |
| 14 000 | 446.50 | 589 | 926 | 38.9 | .330 |
| 15 000 | 476.50 | 639 | 1014 | 38.6 | .360 |
| 16 000 | 506.50 | 695 | 1106 | 38.6 | .395 |
| 17 000 | 536.50 | 753 | 1207 | 38.4 | .430 |
| 18 000 | 566.50 | 809 | 1309 | 38.2 | .465 |
| 16 900 | 533.50 | 962 | 2142 | 31.0 | .575 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 327** | | | | | |
| 0 | 25.88 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.88 | 45 | 41 | 52.5 | .020 |
| 2000 | 85.88 | 74 | 63 | 54.0 | .030 |
| 3000 | 115.88 | 103 | 85 | 54.9 | .040 |
| 4000 | 145.88 | 133 | 108 | 55.2 | .055 |
| 5000 | 175.88 | 171 | 137 | 55.6 | .070 |
| 6000 | 205.88 | 213 | 191 | 52.7 | .085 |
| 7000 | 235.88 | 260 | 253 | 50.6 | .100 |
| 8000 | 265.88 | 311 | 326 | 48.8 | .130 |
| 9000 | 295.88 | 368 | 424 | 46.4 | .160 |
| 10 000 | 325.88 | 416 | 520 | 44.4 | .185 |
| 11 000 | 355.88 | 474 | 631 | 42.9 | .220 |
| 12 000 | 385.88 | 522 | 715 | 42.2 | .245 |
| 13 000 | 415.88 | 584 | 805 | 42.1 | .280 |
| 14 000 | 445.88 | 629 | 880 | 41.7 | .305 |
| 15 000 | 475.88 | 681 | 974 | 41.1 | .340 |
| 16 000 | 505.88 | 730 | 1051 | 41.0 | .365 |
| 17 000 | 535.88 | 780 | 1142 | 40.6 | .400 |
| 18 000 | 565.88 | 847 | 1250 | 40.4 | .430 |
| 19 000 | 595.88 | 926 | 1398 | 39.8 | .475 |
| 20 000 | 625.88 | 1004 | 1597 | 38.6 | .520 |
| 18 000 | 565.88 | 1102 | 2275 | 32.6 | .590 |
| **BEAM 328** | | | | | |
| 0 | 25.88 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 55.88 | 43 | 38 | 53.1 | .020 |
| 2000 | 85.88 | 72 | 60 | 54.4 | .030 |
| 3000 | 115.88 | 100 | 79 | 55.9 | .045 |
| 4000 | 145.88 | 130 | 104 | 55.5 | .060 |
| 5000 | 175.88 | 164 | 128 | 56.1 | .070 |
| 6000 | 205.88 | 204 | 169 | 54.6 | .090 |
| 7000 | 235.88 | 253 | 221 | 53.3 | .110 |
| 8000 | 265.88 | 304 | 294 | 50.8 | .155 |
| 9000 | 295.88 | 368 | 391 | 48.5 | .165 |
| 10 000 | 325.88 | 427 | 496 | 46.3 | .200 |
| 11 000 | 355.88 | 479 | 585 | 45.0 | .230 |
| 12 000 | 385.88 | 532 | 670 | 44.3 | .260 |
| 13 000 | 415.88 | 585 | 759 | 43.5 | .290 |
| 14 000 | 445.88 | 635 | 838 | 43.1 | .320 |
| 15 000 | 475.88 | 689 | 916 | 42.9 | .355 |
| 16 000 | 505.88 | 750 | 1002 | 42.8 | .380 |
| 17 000 | 535.88 | 803 | 1079 | 42.7 | .415 |
| 18 000 | 565.88 | 862 | 1166 | 42.5 | .445 |
| 19 000 | 595.88 | 923 | 1267 | 42.2 | .480 |
| 20 000 | 625.88 | 1000 | 1397 | 41.7 | .520 |
| 20 420 | 638.48 | ........ | 1656 | ........ | .585 |
| 18 350 | 576.38 | 1054 | 1561 | 40.3 | .610 |
| **BEAM 246** | | | | | |
| 0 | 25.47 | 26 | 17 | 60.6 | 0.010 |
| 1000 | 55.47 | 58 | 41 | 58.6 | .020 |
| 2000 | 85.47 | 84 | 63 | 57.2 | .030 |
| 3000 | 115.47 | 114 | 87 | 56.7 | .040 |
| 4000 | 145.47 | 148 | 120 | 55.3 | .055 |
| 5000 | 175.47 | 234 | 342 | 40.6 | .100 |
| 6000 | 205.47 | 353 | 696 | 33.7 | .245 |
| 7000 | 235.47 | ........ | 1253 | ........ | .350 |
| 5400 | 187.47 | 486 | 2265 | 17.7 | .490 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 247** | | | | | |
| 0 | 25.47 | 24 | 15 | 61.5 | 0.010 |
| 1000 | 55.47 | 55 | 36 | 60.2 | .020 |
| 2000 | 85.47 | 82 | 56 | 59.4 | .030 |
| 3000 | 115.47 | 113 | 84 | 57.3 | .045 |
| 4000 | 145.47 | 143 | 113 | 55.8 | .055 |
| 5000 | 175.47 | 266 | 576 | 31.6 | .125 |
| 6000 | 205.47 | 375 | 1005 | 27.2 | .235 |
| 6800 | 229.47 | ........ | 1256 | ........ | .355 |
| 4700 | 166.47 | 468 | 2487 | 15.9 | .440 |
| **BEAM 248** | | | | | |
| 0 | 25.68 | 13 | 10 | 56.8 | 0.010 |
| 1000 | 55.68 | 35 | 22 | 61.3 | .025 |
| 2000 | 85.68 | 58 | 44 | 56.9 | .035 |
| 3000 | 115.68 | 88 | 62 | 58.5 | .045 |
| 4000 | 145.68 | 119 | 85 | 58.4 | .055 |
| 5000 | 175.68 | 249 | 484 | 33.9 | .150 |
| 6000 | 205.68 | 336 | 800 | 29.6 | .250 |
| 6380 | 217.08 | ........ | 868 | ........ | .320 |
| 5000 | 175.68 | 321 | 793 | 28.8 | .320 |
| **BEAM 270** | | | | | |
| 0 | 26.09 | 11 | 10 | 52.5 | 0.005 |
| 1000 | 56.09 | 26 | 22 | 54.6 | .015 |
| 2000 | 86.09 | 43 | 46 | 48.6 | .030 |
| 3000 | 116.09 | 65 | 68 | 48.7 | .040 |
| 4000 | 146.09 | 86 | 96 | 47.3 | .055 |
| 5000 | 176.09 | 138 | 214 | 39.1 | .080 |
| 6000 | 206.09 | 215 | 424 | 33.6 | .135 |
| 7000 | 236.09 | 291 | 716 | 28.9 | .210 |
| 8000 | 266.09 | 345 | 911 | 27.5 | .265 |
| 9000 | 296.09 | 403 | 1156 | 25.8 | .320 |
| 9360 | 306.89 | ........ | 1258 | ........ | .375 |
| 7750 | 258.59 | 433 | 1578 | 21.6 | .380 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 271** | | | | | |
| 0 | 25.88 | 15 | 9 | 62.8 | 0.010 |
| 1000 | 55.88 | 35 | 27 | 56.5 | .020 |
| 2000 | 85.88 | 55 | 44 | 55.5 | .030 |
| 3000 | 115.88 | 72 | 68 | 51.4 | .040 |
| 4000 | 145.88 | 97 | 96 | 50.2 | .050 |
| 5000 | 175.88 | 137 | 145 | 48.6 | .070 |
| 6000 | 205.88 | 210 | 379 | 35.7 | .130 |
| 7000 | 235.88 | 265 | 588 | 31.0 | .190 |
| 8000 | 265.88 | 320 | 769 | 29.3 | .260 |
| 9000 | 295.88 | 365 | 815 | 30.9 | .340 |
| 8310 | 275.18 | 375 | 827 | 31.2 | .480 |
| **BEAM 272** | | | | | |
| 0 | 26.09 | 11 | 14 | 44.6 | 0.010 |
| 1000 | 56.09 | 27 | 31 | 46.5 | .020 |
| 2000 | 86.09 | 42 | 72 | 36.7 | .030 |
| 3000 | 116.09 | 64 | 96 | 40.0 | .040 |
| 4000 | 146.09 | 99 | 109 | 47.7 | .050 |
| 5000 | 176.09 | 129 | 137 | 48.6 | .060 |
| 6000 | 206.09 | 214 | 338 | 38.7 | .105 |
| 7000 | 236.09 | 295 | 544 | 35.2 | .180 |
| 8000 | 266.09 | 305 | 781 | 28.1 | .250 |
| 9000 | 296.09 | 357 | 971 | 26.9 | .300 |
| 9700 | 317.09 | ........ | 1115 | ........ | .380 |
| 7550 | 252.59 | 435 | 1595 | 21.4 | .390 |
| **BEAM 282** | | | | | |
| 0 | 26.09 | 16 | 15 | 50.9 | 0.010 |
| 1000 | 56.09 | 30 | 38 | 44.5 | .020 |
| 2000 | 86.09 | 48 | 60 | 44.7 | .030 |
| 3000 | 116.09 | 73 | 82 | 47.0 | .040 |
| 4000 | 146.09 | 94 | 106 | 47.0 | .050 |
| 5000 | 176.09 | 122 | 133 | 47.8 | .060 |
| 6000 | 206.09 | 165 | 195 | 45.8 | .080 |
| 7000 | 236.09 | 236 | 379 | 38.3 | .130 |
| 8000 | 266.09 | 304 | 583 | 34.3 | .185 |
| 9000 | 296.09 | 356 | 744 | 32.4 | .230 |
| 10 000 | 326.09 | 409 | 896 | 31.4 | .280 |
| 11 000 | 356.09 | 459 | 1022 | 31.0 | .330 |
| 12 000 | 386.09 | 517 | 1205 | 30.0 | .380 |
| 10 650 | 345.59 | 605 | 2241 | 21.2 | .470 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 283** | | | | | |
| 0 | 26.09 | 15 | 10 | 60.4 | 0.010 |
| 1000 | 56.09 | 39 | 29 | 57.6 | .020 |
| 2000 | 86.09 | 61 | 50 | 54.8 | .030 |
| 3000 | 116.09 | 88 | 72 | 55.0 | .040 |
| 4000 | 146.09 | 114 | 97 | 53.9 | .050 |
| 5000 | 176.09 | 141 | 123 | 53.4 | .065 |
| 6000 | 206.09 | 189 | 179 | 51.4 | .085 |
| 7000 | 236.09 | 240 | 359 | 40.1 | .130 |
| 8000 | 266.09 | 329 | 550 | 37.4 | .180 |
| 9000 | 296.09 | 393 | 706 | 35.8 | .240 |
| 10 000 | 326.09 | 444 | 850 | 34.3 | .280 |
| 11 000 | 356.09 | 497 | 997 | 33.3 | .330 |
| 12 000 | 386.09 | 553 | 1162 | 32.2 | .380 |
| 12 620 | 404.69 | ........ | 1303 | ........ | .440 |
| 10 300 | 335.09 | 606 | 1815 | 25.0 | .440 |
| **BEAM 284** | | | | | |
| 0 | 25.88 | 14 | 22 | 38.5 | 0.010 |
| 1000 | 55.88 | 31 | 48 | 39.2 | .020 |
| 2000 | 85.88 | 50 | 68 | 42.3 | .035 |
| 3000 | 115.88 | 73 | 91 | 44.6 | .045 |
| 4000 | 145.88 | 100 | 116 | 46.2 | .055 |
| 5000 | 175.88 | 129 | 152 | 45.9 | .065 |
| 6000 | 205.88 | 168 | 209 | 44.5 | .085 |
| 7000 | 235.88 | 239 | 393 | 37.8 | .135 |
| 8000 | 265.88 | 314 | 602 | 34.3 | .195 |
| 9000 | 295.88 | 367 | 756 | 32.7 | .255 |
| 10 000 | 325.88 | 429 | 901 | 32.2 | .285 |
| 11 000 | 355.88 | 476 | 1046 | 31.3 | .330 |
| 12 000 | 385.88 | 547 | 1198 | 31.4 | .385 |
| 12 200 | 391.88 | ........ | 1308 | ........ | .435 |
| 10 400 | 337.88 | 583 | 1708 | 25.4 | .435 |
| **BEAM 294** | | | | | |
| 0 | 25.88 | 19 | 15 | 55.5 | 0.010 |
| 1000 | 55.88 | 43 | 34 | 55.8 | .020 |
| 2000 | 85.88 | 69 | 53 | 56.6 | .030 |
| 3000 | 115.88 | 98 | 75 | 56.6 | .040 |
| 4000 | 145.88 | 122 | 97 | 55.7 | .050 |
| 5000 | 175.88 | 152 | 125 | 54.8 | .070 |
| 6000 | 205.88 | 191 | 176 | 52.1 | .090 |
| 7000 | 235.88 | 263 | 325 | 44.8 | .130 |
| 8000 | 265.88 | 323 | 496 | 39.4 | .170 |
| 9000 | 295.88 | 377 | 639 | 37.1 | .220 |
| 10 000 | 325.88 | 441 | 821 | 34.9 | .265 |
| 11 000 | 355.88 | 491 | 945 | 34.2 | .300 |
| 12 000 | 385.88 | 545 | 1106 | 33.0 | .350 |
| 13 000 | 415.88 | 593 | 1197 | 33.1 | .380 |
| 14 000 | 445.88 | 651 | 1368 | 32.2 | .455 |
| 14 670 | 465.98 | ........ | 1487 | ........ | .470 |
| 12 170 | 390.98 | 707 | 2072 | 25.4 | .490 |
| **BEAM 295** | | | | | |
| 0 | 26.29 | 24 | 14 | 63.1 | 0.010 |
| 1000 | 56.29 | 47 | 32 | 59.5 | .020 |
| 2000 | 86.29 | 71 | 55 | 56.5 | .030 |
| 3000 | 116.29 | 101 | 77 | 56.7 | .040 |
| 4000 | 146.29 | 126 | 103 | 55.1 | .050 |
| 5000 | 176.29 | 152 | 128 | 54.3 | .060 |
| 6000 | 206.29 | 192 | 186 | 50.8 | .080 |
| 7000 | 236.29 | 265 | 356 | 42.7 | .120 |
| 8000 | 266.29 | 321 | 494 | 39.4 | .160 |
| 9000 | 296.29 | 373 | 622 | 37.5 | .200 |
| 10 000 | 326.29 | 417 | 773 | 35.0 | .250 |
| 11 000 | 356.29 | 458 | 891 | 34.0 | .280 |
| 12 000 | 386,29 | 512 | 1014 | 33.6 | .320 |
| 13 000 | 416.29 | 556 | 1130 | 33.0 | .360 |
| 14 000 | 446.29 | 620 | 1289 | 32.5 | .410 |
| 14 380 | 457.69 | ........ | 1410 | ........ | .460 |
| 12 200 | 392.29 | 679 | 2140 | 24.1 | .475 |
| **BEAM 296** | | | | | |
| 0 | 26.29 | 24 | 17 | 58.6 | 0.010 |
| 1000 | 56.29 | 48 | 34 | 58.6 | .020 |
| 2000 | 86.29 | 73 | 56 | 56.7 | .030 |
| 3000 | 116.29 | 101 | 79 | 56.1 | .040 |
| 4000 | 146.29 | 128 | 106 | 54.6 | .050 |
| 5000 | 176.29 | 162 | 142 | 53.3 | .060 |
| 6000 | 206.29 | 198 | 188 | 51.3 | .080 |
| 7000 | 236.29 | 275 | 311 | 47.0 | .120 |
| 8000 | 266.29 | 344 | 458 | 42.9 | .160 |
| 9000 | 296.29 | 402 | 607 | 39.9 | .210 |
| 10 000 | 326.29 | 462 | 745 | 38.3 | .250 |
| 11 000 | 356.29 | 514 | 877 | 36.9 | .290 |
| 12 000 | 386.29 | 562 | 1005 | 35.9 | .330 |
| 13 000 | 416.29 | 613 | 1126 | 35.2 | .370 |
| 14 000 | 446.29 | 671 | 1294 | 34.2 | .420 |
| 14 100 | 449.29 | ........ | 1453 | ........ | .460 |
| 12 000 | 386.29 | 691 | 1923 | 26.5 | .470 |
| **BEAM 306** | | | | | |
| 0 | 26.09 | 24 | 17 | 58.6 | 0.010 |
| 1000 | 56.09 | 47 | 38 | 55.4 | .020 |
| 2000 | 86.09 | 75 | 60 | 55.5 | .030 |
| 3000 | 116.09 | 106 | 85 | 55.4 | .040 |
| 4000 | 146.09 | 133 | 111 | 54.5 | .050 |
| 5000 | 176.09 | 168 | 145 | 53.6 | .070 |
| 6000 | 206.09 | 202 | 186 | 52.1 | .085 |
| 7000 | 236.09 | 272 | 292 | 48.2 | .110 |
| 8000 | 256.09 | 340 | 410 | 45.4 | .150 |
| 9000 | 296.09 | 403 | 544 | 42.6 | .190 |
| 10 000 | 326.09 | 463 | 662 | 41.2 | .230 |
| 11 000 | 356.09 | 532 | 800 | 39.9 | .270 |
| 12 000 | 386.09 | 588 | 906 | 39.3 | .310 |
| 13 000 | 416.09 | 638 | 1005 | 38.8 | .345 |
| 14 000 | 446.09 | 706 | 1126 | 38.5 | .390 |
| 15 000 | 476.09 | 770 | 1272 | 37.7 | .430 |
| 16 000 | 506.09 | 862 | 1538 | 35.9 | .490 |
| 16 450 | 519.59 | ........ | 1692 | ........ | .550 |
| 13 450 | 429.59 | 956 | 2393 | 28.5 | .570 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 307** | | | | | |
| 0 | 26.50 | 24 | 15 | 61.5 | 0.010 |
| 1000 | 56.50 | 53 | 39 | 57.4 | .020 |
| 2000 | 86.50 | 77 | 58 | 57.0 | .030 |
| 3000 | 116.50 | 98 | 79 | 55.3 | .040 |
| 4000 | 146.50 | 124 | 103 | 54.7 | .050 |
| 5000 | 176.50 | 154 | 128 | 54.6 | .060 |
| 6000 | 206.50 | 184 | 171 | 51.8 | .075 |
| 7000 | 236.50 | 226 | 243 | 48.2 | .095 |
| 8000 | 266.50 | 283 | 340 | 44.7 | .125 |
| 9000 | 296.50 | 341 | 489 | 41.0 | .160 |
| 10 000 | 326.50 | 388 | 624 | 38.3 | .200 |
| 11 000 | 356.50 | 441 | 769 | 36.5 | .240 |
| 12 000 | 386.50 | 491 | 896 | 35.4 | .275 |
| 13 000 | 416.50 | 541 | 1014 | 34.8 | .310 |
| 14 000 | 446.50 | 593 | 1149 | 34.0 | .350 |
| 15 000 | 476.50 | 652 | 1299 | 33.4 | .395 |
| 16 000 | 506.50 | 715 | 1547 | 31.6 | .450 |
| 16 070 | 508.60 | | 1728 | | |
| 14 450 | 460.00 | 823 | 2528 | 24.6 | .600 |
| **BEAM 308** | | | | | |
| 0 | 26.09 | 10 | 09 | 52.5 | 0.005 |
| 1000 | 56.09 | 24 | 21 | 53.6 | .015 |
| 2000 | 86.09 | 37 | 31 | 54.7 | .025 |
| 3000 | 116.09 | 53 | 39 | 57.4 | .035 |
| 4000 | 146.09 | 66 | 53 | 55.4 | .045 |
| 5000 | 176.09 | 83 | 70 | 54.1 | .060 |
| 6000 | 206.09 | 99 | 92 | 51.7 | .075 |
| 7000 | 236.09 | 130 | 142 | 47.7 | .100 |
| 8000 | 266.09 | 156 | 205 | 43.2 | .130 |
| 9000 | 296.09 | 188 | 287 | 39.5 | .175 |
| 10 000 | 326.09 | 215 | 373 | 36.6 | .215 |
| 11 000 | 356.09 | 243 | 443 | 35.5 | .255 |
| 12 000 | 386.09 | 266 | 506 | 34.4 | .290 |
| 13 000 | 416.09 | 294 | 574 | 33.9 | .325 |
| 14 000 | 446.09 | 328 | 651 | 33.5 | .365 |
| 15 000 | 476.09 | 357 | 723 | 33.1 | .405 |
| 16 000 | 506.09 | 395 | 846 | 31.8 | .460 |
| 13 800 | 440.09 | 552 | 2364 | 19.0 | .555 |
| **BEAM 309** | | | | | |
| 0 | 27.31 | 40 | 42 | 48.8 | 0.020 |
| 1000 | 57.31 | 60 | 58 | 50.8 | .030 |
| 2000 | 87.31 | 93 | 89 | 51.1 | .045 |
| 3000 | 117.31 | 126 | 122 | 50.9 | .065 |
| 4000 | 147.31 | 165 | 163 | 50.2 | .080 |
| 5000 | 177.31 | 205 | 211 | 49.3 | .100 |
| 6000 | 207.31 | 240 | 251 | 48.9 | .110 |
| 7000 | 237.31 | 278 | 299 | 48.2 | .125 |
| 8000 | 267.31 | 320 | 352 | 47.6 | .145 |
| 9000 | 297.31 | 363 | 425 | 46.0 | .165 |
| 10 000 | 327.31 | 417 | 525 | 44.3 | .200 |
| 11 000 | 357.31 | 474 | 622 | 43.2 | .230 |
| 12 000 | 387.31 | 526 | 732 | 41.8 | .270 |
| 13 000 | 417.31 | 575 | 814 | 41.4 | .300 |
| 14 000 | 447.31 | 625 | 898 | 41.0 | .330 |
| 15 000 | 477.31 | 677 | 982 | 40.8 | .360 |
| 16 000 | 507.31 | 726 | 1070 | 40.4 | .390 |
| 17 000 | 537.31 | 777 | 1166 | 40.0 | .420 |
| 18 000 | 567.31 | 835 | 1254 | 40.0 | .460 |
| 18 800 | 591.31 | | | | .500 |
| 15 650 | 496.81 | 802 | 1202 | 40.0 | .510 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 310** | | | | | |
| 0 | 25.88 | 26 | 19 | 58.0 | 0.010 |
| 1000 | 55.88 | 55 | 41 | 57.2 | .020 |
| 2000 | 85.88 | 84 | 60 | 58.4 | .030 |
| 3000 | 115.88 | 114 | 85 | 57.3 | .040 |
| 4000 | 145.88 | 145 | 106 | 57.7 | .050 |
| 5000 | 175.88 | 174 | 133 | 56.7 | .060 |
| 6000 | 205.88 | 212 | 176 | 54.7 | .070 |
| 7000 | 235.88 | 263 | 246 | 51.7 | .095 |
| 8000 | 265.88 | 319 | 326 | 49.5 | .130 |
| 9000 | 295.88 | 385 | 429 | 47.3 | .155 |
| 10 000 | 325.88 | 446 | 566 | 44.0 | .200 |
| 11 000 | 355.88 | 505 | 675 | 42.8 | .230 |
| 12 000 | 385.88 | 558 | 779 | 41.7 | .270 |
| 13 000 | 415.88 | 615 | 880 | 41.1 | .310 |
| 14 000 | 445.88 | 670 | 976 | 40.7 | .340 |
| 15 000 | 475.88 | 721 | 1072 | 40.2 | .370 |
| 16 000 | 505.88 | 787 | 1174 | 40.1 | .405 |
| 17 000 | 535.88 | 843 | 1270 | 39.9 | .440 |
| 18 000 | 565.88 | 904 | 1369 | 39.8 | .480 |
| 19 000 | 595.88 | 997 | 1581 | 38.7 | .535 |
| 15 650 | 495.38 | 923 | 1484 | 38.4 | .580 |
| **BEAM 311** | | | | | |
| 0 | 27.72 | 33 | 19 | 63.0 | 0.010 |
| 1000 | 57.72 | 51 | 39 | 56.9 | .020 |
| 2000 | 87.72 | 75 | 62 | 54.7 | .030 |
| 3000 | 117.72 | 105 | 78 | 57.4 | .040 |
| 4000 | 147.72 | 134 | 101 | 57.0 | .050 |
| 5000 | 177.72 | 168 | 125 | 57.3 | .065 |
| 6000 | 207.72 | 206 | 157 | 56.6 | .080 |
| 7000 | 237.72 | 255 | 242 | 51.4 | .100 |
| 8000 | 267.72 | 310 | 305 | 50.4 | .130 |
| 9000 | 297.72 | 359 | 401 | 47.2 | .160 |
| 10 000 | 327.72 | 398 | 519 | 43.4 | .190 |
| 11 000 | 357.72 | 461 | 601 | 43.4 | .230 |
| 12 000 | 387.72 | 517 | 698 | 42.5 | .260 |
| 13 000 | 417.72 | 566 | 778 | 42.1 | .290 |
| 14 000 | 447.72 | 622 | 856 | 42.1 | .330 |
| 15 000 | 477.72 | 674 | 938 | 41.8 | .360 |
| 16 000 | 507.72 | 727 | 1028 | 41.4 | .390 |
| 17 000 | 537.72 | 783 | 1113 | 41.3 | .430 |
| 18 000 | 567.72 | 833 | 1195 | 41.1 | .460 |
| 19 000 | 597.72 | 907 | 1344 | 40.3 | .505 |
| 19 320 | 607.32 | | | | .575 |
| 16 000 | 507.72 | 1059 | 2044 | 34.1 | .590 |
| **BEAM 330** | | | | | |
| 0 | 26.09 | 26 | 21 | 55.7 | 0.010 |
| 1000 | 56.09 | 51 | 39 | 56.4 | .020 |
| 2000 | 86.09 | 81 | 62 | 56.7 | .030 |
| 3000 | 116.09 | 110 | 79 | 58.3 | .040 |
| 4000 | 146.09 | 135 | 106 | 56.0 | .050 |
| 5000 | 176.09 | 164 | 130 | 55.7 | .065 |
| 6000 | 206.09 | 197 | 171 | 53.6 | .080 |
| 7000 | 236.09 | 249 | 250 | 49.9 | .100 |
| 8000 | 266.09 | 294 | 321 | 47.8 | .125 |
| 9000 | 296.09 | 338 | 402 | 45.1 | .150 |
| 10 000 | 326.09 | 401 | 503 | 44.4 | .180 |
| 11 000 | 356.09 | 453 | 607 | 42.7 | .210 |
| 12 000 | 386.09 | 491 | 691 | 41.5 | .240 |
| 13 000 | 416.09 | 537 | 797 | 40.2 | .270 |
| 14 000 | 446.09 | 588 | 875 | 40.2 | .305 |
| 15 000 | 476.09 | 628 | 956 | 39.7 | .330 |
| 16 000 | 506.09 | 676 | 1043 | 39.3 | .360 |
| 17 000 | 536.09 | 729 | 1137 | 39.1 | .400 |
| 18 000 | 566.09 | 777 | 1219 | 38.9 | .420 |
| 19 000 | 596.09 | 817 | 1299 | 38.6 | .455 |
| 20 000 | 626.09 | 878 | 1403 | 38.5 | .490 |
| 20 760 | 648.89 | | 1513 | | .520 |
| 21 000 | 656.09 | 958 | 1574 | 37.9 | .555 |
| 18 350 | 576.59 | 896 | 1468 | 37.9 | .590 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 331** | | | | | |
| 0 | 26.50 | 19 | 12 | 60.7 | 0.010 |
| 1000 | 56.50 | 48 | 27 | 63.9 | .020 |
| 2000 | 86.50 | 74 | 53 | 58.4 | .030 |
| 3000 | 116.50 | 105 | 68 | 60.6 | .040 |
| 4000 | 146.50 | 137 | 91 | 60.2 | .050 |
| 5000 | 176.50 | 166 | 116 | 58.9 | .060 |
| 6000 | 206.50 | 203 | 154 | 56.8 | .080 |
| 7000 | 236.50 | 249 | 214 | 53.8 | .100 |
| 8000 | 266.50 | 299 | 275 | 52.1 | .120 |
| 9000 | 296.50 | 353 | 357 | 49.8 | .150 |
| 10 000 | 326.50 | 404 | 439 | 47.9 | .170 |
| 11 000 | 356.50 | 459 | 521 | 46.8 | .200 |
| 12 000 | 386.50 | 509 | 617 | 45.2 | .230 |
| 13 050 | 418.00 | 567 | 718 | 44.1 | .270 |
| 14 000 | 446.50 | 612 | 791 | 43.6 | .295 |
| 15 000 | 476.50 | 663 | 877 | 43.1 | .320 |
| 16 000 | 506.50 | 718 | 968 | 42.6 | .360 |
| 17 000 | 536.50 | 773 | 1048 | 42.4 | .390 |
| 18 000 | 566.50 | 818 | 1123 | 42.1 | .415 |
| 19 000 | 596.50 | 868 | 1205 | 41.9 | .450 |
| 20 000 | 626.50 | 917 | 1287 | 41.6 | .480 |
| 21 000 | 656.50 | 980 | 1374 | 41.6 | .510 |
| 21 580 | 673.90 | ........ | 1432 | ........ | .530 |
| 19 000 | 596.50 | 1087 | 2306 | 32.1 | .600 |
| **BEAM 332** | | | | | |
| 0 | 25.68 | 20 | 9 | 69.5 | 0.010 |
| 1000 | 55.68 | 53 | 39 | 57.4 | .025 |
| 2000 | 85.68 | 81 | 56 | 59.1 | .035 |
| 3000 | 115.68 | 113 | 82 | 57.9 | .045 |
| 4000 | 145.68 | 142 | 103 | 58.0 | .055 |
| 5000 | 175.68 | 177 | 132 | 57.4 | .065 |
| 6000 | 205.68 | 217 | 174 | 55.4 | .085 |
| 7000 | 235.68 | 271 | 224 | 54.7 | .105 |
| 8000 | 265.68 | 332 | 292 | 53.2 | .135 |
| 9000 | 295.68 | 375 | 381 | 49.6 | .160 |
| 10 000 | ........ | ........ | ........ | ........ | ........ |
| 11 000 | 355.68 | 478 | 564 | 45.9 | .225 |
| 12 000 | 385.68 | 523 | 643 | 44.9 | .255 |
| 13 000 | 415.68 | 573 | 728 | 44.0 | .285 |
| 14 000 | 445.68 | 619 | 812 | 43.2 | .315 |
| 15 000 | 475.68 | 669 | 908 | 42.4 | .345 |
| 16 000 | 505.68 | 727 | 988 | 42.4 | .375 |
| 17 000 | 535.68 | 766 | 1058 | 42.0 | .405 |
| 18 000 | 565.68 | 824 | 1149 | 41.8 | .445 |
| 19 000 | 595.68 | 877 | 1236 | 41.5 | .475 |
| 20 000 | 625.68 | 940 | 1326 | 41.5 | .505 |
| 21 000 | 655.68 | 1003 | 1422 | 41.4 | .545 |
| 21 150 | 660.18 | ........ | 1588 | ........ | ........ |
| 19 000 | 595.68 | 1127 | 2285 | 33.0 | .625 |
| **BEAM 333** | | | | | |
| 0 | 24.44 | 28 | 24 | 53.5 | 0.010 |
| 1000 | 54.44 | 57 | 51 | 53.0 | .020 |
| 2000 | 84.44 | 89 | 82 | 51.9 | .030 |
| 2500 | 99.44 | 116 | 118 | 49.5 | .040 |
| 2750 | 106.94 | 131 | 145 | 47.4 | .045 |
| 3000 | 114.44 | 157 | 231 | 40.5 | .065 |
| 3500 | 129.44 | 213 | 404 | 34.5 | .115 |
| 4000 | 144.44 | 265 | 569 | 37.2 | .160 |
| 4500 | 159.44 | 328 | 768 | 29.9 | .210 |
| 5000 | 174.44 | 364 | 935 | 28.0 | .235 |
| 5500 | 189.44 | 422 | 1104 | 27.7 | .285 |
| 5800 | 198.44 | ........ | (1289) | ........ | .325 |
| 5000 | 174.44 | 447 | 1382 | 24.4 | .330 |
| **BEAM 334** | | | | | |
| 0 | 24.23 | 27 | 22 | 55.5 | 0.010 |
| 2000 | 84.23 | 94 | 77 | 54.8 | .035 |
| 2500 | 99.23 | 115 | 101 | 53.2 | .050 |
| 2750 | 106.73 | 126 | 121 | 51.1 | .055 |
| 3000 | 114.23 | 148 | 152 | 49.3 | .065 |
| 3250 | 121.73 | 188 | 236 | 44.4 | .090 |
| 3500 | 129.23 | 222 | 330 | 40.2 | .110 |
| 4000 | 144.23 | 273 | 504 | 35.1 | .155 |
| 4500 | 159.23 | 327 | 720 | 31.3 | .200 |
| 5000 | 174.23 | 365 | 826 | 30.6 | .250 |
| 5500 | 189.23 | 411 | 949 | 30.2 | .290 |
| 6000 | 204.23 | ........ | (1253) | ........ | .350 |
| 5000 | 174.23 | 472 | 1470 | 24.3 | .365 |
| **BEAM 335** | | | | | |
| 0 | 24.85 | 22 | 20 | 52.5 | 0.010 |
| 1000 | 54.85 | 49 | 44 | 52.5 | .020 |
| 2000 | 84.85 | 78 | 70 | 52.8 | .035 |
| 2500 | 99.85 | 96 | 92 | 51.2 | .040 |
| 2750 | 107.35 | 106 | 105 | 50.1 | .045 |
| 3000 | 114.85 | 116 | 117 | 49.7 | .050 |
| 3250 | 122.35 | 135 | 145 | 48.2 | .065 |
| 3500 | 129.85 | 173 | 227 | 43.2 | .080 |
| 4000 | 144.85 | 234 | 430 | 35.3 | .125 |
| 4500 | 159.85 | 267 | 576 | 31.7 | .170 |
| 5000 | 174.85 | 302 | 711 | 29.8 | .210 |
| 5500 | 189.85 | 341 | 844 | 28.8 | .255 |
| 6000 | 204.85 | 382 | 972 | 28.2 | .295 |
| 6500 | 219.85 | 424 | 1150 | 26.9 | .355 |
| 6610 | 223.15 | ........ | (1194) | ........ | .370 |
| **BEAM 345** | | | | | |
| 0 | 25.06 | 21 | 21 | 50.4 | 0.010 |
| 1000 | 55.06 | 56 | 50 | 53.3 | .020 |
| 2000 | 85.06 | 85 | 79 | 52.0 | .030 |
| 2500 | 100.06 | 104 | 99 | 51.2 | .040 |
| 3000 | 115.06 | 128 | 123 | 50.8 | .055 |
| 3500 | 130.06 | 157 | 176 | 47.1 | .070 |
| 4000 | 145.06 | 203 | 296 | 40.7 | .090 |
| 4500 | 160.06 | 248 | 419 | 37.3 | .125 |
| 5000 | 175.06 | 289 | 532 | 35.2 | .155 |
| 6000 | 205.06 | 356 | 750 | 32.2 | .215 |
| 7000 | 235.06 | 447 | 973 | 31.5 | .275 |
| 8000 | 265.06 | 517 | 1185 | 30.4 | .340 |
| 8500 | 280.06 | 566 | 1309 | 30.2 | .360 |
| 9000 | 295.06 | 609 | 1460 | 29.5 | .385 |
| 9420 | 307.66 | ........ | (1699) | ........ | .435 |
| 8000 | 265.06 | 663 | 2084 | 24.2 | .445 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 346**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 27 | 27 | 49.3 | 0.010 |
| 1000 | 54.85 | 64 | 51 | 55.5 | .020 |
| 2000 | 84.85 | 101 | 77 | 56.8 | .035 |
| 2500 | 99.85 | 122 | 94 | 56.5 | .040 |
| 3000 | 114.85 | 143 | 118 | 54.8 | .055 |
| 3500 | 129.85 | 182 | 176 | 50.8 | .070 |
| 4000 | 144.85 | 227 | 280 | 44.8 | .100 |
| 4500 | 159.85 | 283 | 417 | 40.4 | .135 |
| 5000 | 174.85 | 327 | 523 | 38.4 | .165 |
| 6000 | 204.85 | 388 | 711 | 35.3 | .220 |
| 7000 | 234.85 | 454 | 902 | 33.5 | .285 |
| 8000 | 264.85 | 518 | 1073 | 32.5 | .340 |
| 8500 | 279.85 | 560 | 1156 | 32.6 | .370 |
| 9000 | 294.85 | 612 | 1328 | 31.5 | .415 |
| 8200 | 270.85 | 635 | 1596 | 28.4 | .435 |

**BEAM 347**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 23 | 19 | 54.6 | 0.010 |
| 1000 | 54.85 | 56 | 46 | 55.0 | .020 |
| 2000 | 84.85 | 88 | 72 | 55.2 | .030 |
| 2500 | 99.85 | 107 | 89 | 54.7 | .040 |
| 3000 | 114.85 | 127 | 113 | 52.9 | .050 |
| 3500 | 129.85 | 161 | 156 | 50.9 | .060 |
| 4000 | 144.85 | 208 | 260 | 44.5 | .085 |
| 4500 | 159.85 | 264 | 379 | 41.1 | .120 |
| 5000 | 174.85 | 302 | 485 | 38.4 | .155 |
| 6000 | 204.85 | 375 | 672 | 35.9 | .215 |
| 7000 | 234.85 | 448 | 846 | 34.6 | .275 |
| 8000 | 264.85 | 516 | 1019 | 33.6 | .330 |
| 8500 | 279.85 | 555 | 1094 | 33.6 | .360 |
| 9000 | 294.85 | 593 | 1185 | 33.4 | .395 |
| 9250 | 302.35 | ........ | (1263) | ........ | .425 |
| 7800 | 258.85 | 612 | 1643 | 27.1 | .440 |

**BEAM 357**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 21 | 21 | 50.4 | 0.010 |
| 1000 | 54.85 | 51 | 44 | 53.4 | .020 |
| 2000 | 84.85 | 82 | 70 | 53.6 | .030 |
| 3000 | 114.85 | 117 | 97 | 54.5 | .040 |
| 3500 | 129.85 | 138 | 130 | 51.5 | .050 |
| 4000 | 144.85 | 167 | 173 | 49.2 | .060 |
| 4500 | 159.85 | 203 | 238 | 46.1 | .080 |
| 5000 | 174.85 | 243 | 335 | 42.0 | .105 |
| 6000 | 204.85 | 310 | 492 | 38.7 | .140 |
| 7000 | 234.85 | 377 | 638 | 37.2 | .185 |
| 8000 | 264.85 | 437 | 781 | 35.9 | .230 |
| 9000 | 294.85 | 500 | 923 | 35.1 | .280 |
| 10 000 | 324.85 | 560 | 1063 | 34.5 | .325 |
| 11 000 | 354.85 | 623 | 1200 | 34.2 | .360 |
| 11 500 | 369.85 | 658 | 1267 | 34.2 | .385 |
| 12 000 | 384.85 | 695 | 1338 | 34.2 | .410 |
| 12 500 | 399.85 | 741 | 1408 | 34.5 | .435 |
| 13 000 | 414.85 | 793 | 1557 | 33.7 | .470 |
| 11 250 | 362.35 | 833 | 2012 | 29.3 | .505 |

**BEAM 358**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 21 | 19 | 52.5 | 0.010 |
| 1000 | 55.06 | 45 | 43 | 51.5 | .020 |
| 2000 | 85.06 | 75 | 70 | 51.9 | .030 |
| 3000 | 115.06 | 104 | 99 | 51.2 | .040 |
| 3500 | 130.06 | 121 | 123 | 49.7 | .050 |
| 4000 | 145.06 | 147 | 157 | 48.3 | .060 |
| 4500 | 160.06 | 179 | 217 | 45.2 | .080 |
| 5000 | 175.06 | 216 | 287 | 43.0 | .105 |
| 6000 | 205.06 | 283 | 450 | 38.6 | .150 |
| 7000 | 235.06 | 343 | 583 | 37.1 | .195 |
| 8000 | 265.06 | 401 | 716 | 35.9 | .245 |
| 9000 | 295.06 | 458 | 846 | 35.1 | .295 |
| 10 000 | 325.06 | 518 | 968 | 34.9 | .340 |
| 11 000 | 355.06 | 588 | 1097 | 34.9 | .390 |
| 12 000 | 385.06 | 656 | 1241 | 34.6 | .440 |
| 12 260 | 392.86 | ........ | (1296) | ........ | .456 |
| 10 000 | 325.06 | 712 | 1831 | 28.0 | .495 |

**BEAM 359**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 17 | 19 | 47.8 | 0.005 |
| 1000 | 55.26 | 44 | 48 | 47.8 | .010 |
| 2000 | 85.26 | 74 | 70 | 51.5 | .020 |
| 3000 | 115.26 | 102 | 99 | 50.8 | .035 |
| 3500 | 130.26 | 123 | 120 | 50.7 | .045 |
| 4000 | 145.26 | 150 | 156 | 49.1 | .055 |
| 4500 | 160.26 | 180 | 207 | 46.5 | .075 |
| 5000 | 175.26 | 222 | 313 | 41.5 | .095 |
| 6000 | 205.26 | 287 | 487 | 37.0 | .150 |
| 7000 | 235.26 | 306 | 660 | 31.7 | .195 |
| 8000 | 265.26 | 375 | 805 | 31.8 | .245 |
| 9000 | 295.26 | 435 | 944 | 31.5 | .290 |
| 10 000 | 325.26 | 501 | 1073 | 31.8 | .335 |
| 11 000 | 355.26 | 559 | 1214 | 31.5 | .385 |
| 11 500 | 370.26 | 600 | 1291 | 31.8 | .410 |
| 12 000 | 385.26 | 652 | 1350 | 32.6 | .435 |
| 12 080 | 387.66 | ........ | (1379) | ........ | .455 |
| 10 520 | 340.86 | 612 | 1265 | 32.6 | .475 |

**BEAM 369**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 26 | 19 | 58.2 | 0.010 |
| 1000 | 54.85 | 58 | 39 | 59.5 | .020 |
| 2000 | 84.85 | 90 | 65 | 58.0 | .030 |
| 3000 | 114.85 | 127 | 103 | 55.5 | .045 |
| 3500 | 129.85 | 155 | 137 | 53.1 | .055 |
| 4000 | 144.85 | 182 | 174 | 51.1 | .060 |
| 4500 | 159.85 | 213 | 224 | 48.8 | .080 |
| 5000 | 174.85 | 253 | 282 | 47.2 | .100 |
| 6000 | 204.85 | 321 | 421 | 43.3 | .140 |
| 7000 | 234.85 | 385 | 549 | 41.2 | .185 |
| 8000 | 264.85 | 449 | 679 | 39.8 | .225 |
| 9000 | 294.85 | 514 | 809 | 38.9 | .265 |
| 10 000 | 324.85 | 579 | 921 | 38.6 | .305 |
| 11 000 | 354.85 | 641 | 1043 | 38.1 | .350 |
| 12 000 | 384.85 | 715 | 1178 | 37.8 | .395 |
| 13 000 | 414.85 | 805 | 1308 | 38.1 | .440 |
| 14 000 | 444.85 | 862 | 1497 | 36.5 | .500 |
| 12 300 | 393.85 | 889 | 1916 | 31.7 | .535 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bc^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 370** | | | | | |
| 0 | 24.64 | 23 | 14 | 62.0 | 0.005 |
| 2000 | 84.64 | 86 | 63 | 57.7 | .025 |
| 3000 | 114.64 | 124 | 104 | 54.5 | .040 |
| 3500 | 129.64 | 152 | 138 | 52.2 | .055 |
| 4000 | 144.64 | 180 | 183 | 49.7 | .065 |
| 4500 | 159.64 | 213 | 232 | 47.9 | .085 |
| 5000 | 174.64 | 247 | 299 | 45.3 | .100 |
| 6000 | 204.64 | 312 | 432 | 41.9 | .145 |
| 7000 | 234.64 | 377 | 568 | 39.9 | .190 |
| 8000 | 264.64 | 440 | 697 | 38.7 | .235 |
| 9000 | 294.64 | 495 | 834 | 37.3 | .285 |
| 10 000 | 324.64 | 545 | 959 | 36.3 | .325 |
| 11 000 | 354.64 | 608 | 1085 | 35.9 | .370 |
| 12 000 | 384.64 | 685 | 1212 | 36.1 | .415 |
| 13 000 | 414.64 | 794 | 1499 | 34.6 | .470 |
| 13 400 | 426.64 | ........ | (1704) | ........ | .515 |
| 12 100 | 387.64 | 890 | 1969 | 31.1 | .535 |
| **BEAM 371** | | | | | |
| 0 | 24.64 | 21 | 22 | 48.5 | 0.010 |
| 1000 | 54.64 | 44 | 53 | 45.5 | .020 |
| 2000 | 84.64 | 78 | 79 | 49.8 | .030 |
| 3000 | 114.64 | 114 | 115 | 49.9 | .045 |
| 3500 | 129.64 | 137 | 145 | 48.6 | .055 |
| 4000 | 144.64 | 165 | 191 | 46.3 | .070 |
| 5000 | 174.64 | 237 | 308 | 43.6 | .110 |
| 6000 | 204.64 | 308 | 450 | 40.7 | .150 |
| 7000 | 234.64 | 371 | 590 | 38.6 | .195 |
| 8000 | 264.64 | 423 | 725 | 36.9 | .240 |
| 9000 | 294.64 | 482 | 860 | 35.9 | .280 |
| 10 000 | 324.64 | 570 | 991 | 36.5 | .325 |
| 11 000 | 354.64 | 640 | 1120 | 36.4 | .370 |
| 12 000 | 384.64 | 712 | 1229 | 36.7 | .415 |
| 13 000 | 414.64 | 791 | 1356 | 36.9 | .465 |
| 13 500 | 429.64 | 838 | 1461 | 36.4 | .495 |
| 13 870 | 440.74 | 859 | 1527 | 36.0 | .540 |
| 12 300 | 393.64 | 825 | 1446 | 36.3 | .555 |
| **BEAM 381** | | | | | |
| 0 | 25.06 | 23 | 14 | 62.0 | 0.010 |
| 1000 | 55.06 | 55 | 39 | 58.0 | 020 |
| 2000 | 85.06 | 82 | 62 | 57.3 | .035 |
| 3000 | 115.06 | 118 | 89 | 57.0 | .045 |
| 3500 | 130.06 | 149 | 111 | 55.6 | .055 |
| 4000 | 145.06 | 166 | 145 | 53.3 | .065 |
| 4500 | 160.06 | 197 | 186 | 51.4 | .080 |
| 5000 | 175.06 | 228 | 239 | 48.8 | .095 |
| 6000 | 205.06 | 292 | 342 | 46.0 | .130 |
| 7000 | 235.06 | 354 | 462 | 43.4 | .175 |
| 8000 | 265.06 | 418 | 583 | 41.7 | .210 |
| 9000 | 295.06 | 480 | 689 | 41.1 | .250 |
| 10 000 | 325.06 | 544 | 793 | 40.7 | .290 |
| 11 000 | 355.06 | 611 | 909 | 40.2 | .325 |
| 12 000 | 385.06 | 677 | 1003 | 40.3 | .370 |
| 13 000 | 415.06 | 753 | 1115 | 40.3 | .410 |
| 14 000 | 445.06 | 862 | 1234 | 41.1 | .455 |
| 15 000 | 475.06 | 938 | 1409 | 40.0 | .505 |
| 15 240 | 482.26 | ........ | (1631) | ........ | .565 |
| 13 610 | 433.36 | 1064 | 1998 | 34.8 | .580 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 382** | | | | | |
| 0 | 25.26 | 24 | 19 | 56.5 | 0.005 |
| 1000 | 55.26 | 58 | 41 | 58.5 | .020 |
| 2000 | 85.26 | 91 | 67 | 57.6 | .030 |
| 3000 | 115.26 | 119 | 97 | 54.9 | .040 |
| 4000 | 145.26 | 168 | 156 | 52.0 | .060 |
| 5000 | 175.26 | 227 | 244 | 48.2 | .090 |
| 6000 | 205.26 | 292 | 354 | 45.2 | .125 |
| 7000 | 235.26 | 355 | 480 | 42.5 | .165 |
| 8000 | 265.26 | 417 | 602 | 40.9 | .205 |
| 9000 | 295.26 | 478 | 704 | 40.4 | .240 |
| 10 000 | 325.26 | 537 | 805 | 40.0 | .280 |
| 11 000 | 355.26 | 598 | 935 | 39.0 | .320 |
| 12 000 | 385.26 | 666 | 1041 | 39.0 | .360 |
| 13 000 | 415.26 | 738 | 1164 | 38.8 | .405 |
| 14 000 | 445.26 | 802 | 1274 | 38.6 | .440 |
| 15 000 | 475.26 | 870 | 1392 | 38.5 | .490 |
| 15 270 | 483.36 | ........ | (1468) | ........ | .525 |
| 15 300 | 484.26 | ........ | (1621) | ........ | .555 |
| 13 900 | 442.26 | 973 | 2005 | 32.7 | .570 |
| **BEAM 383** | | | | | |
| 0 | 25.47 | 24 | 22 | 52.5 | 0.010 |
| 1000 | 55.47 | 55 | 48 | 53.3 | .015 |
| 2000 | 85.47 | 82 | 70 | 53.6 | .025 |
| 3000 | 115.47 | 115 | 101 | 53.2 | .040 |
| 4000 | 145.47 | 158 | 154 | 50.6 | .055 |
| 5000 | 175.47 | 210 | 234 | 47.3 | .080 |
| 6000 | 205.47 | 269 | 337 | 44.5 | .115 |
| 7000 | 235.47 | 324 | 462 | 41.3 | .150 |
| 8000 | 265.47 | 379 | 566 | 40.1 | .190 |
| 9000 | 295.47 | 434 | 694 | 38.5 | .225 |
| 10 000 | 325.47 | 486 | 809 | 37.5 | .265 |
| 11 000 | 355.47 | 541 | 921 | 37.0 | .305 |
| 12 000 | 385.47 | 602 | 1034 | 36.8 | .340 |
| 13 000 | 415.47 | 659 | 1139 | 36.7 | .380 |
| 14 000 | 445.47 | 713 | 1236 | 36.6 | .425 |
| 15 000 | 475.47 | 782 | 1362 | 36.5 | .465 |
| 15 920 | 503.07 | ........ | (1539) | ........ | .520 |
| 13 900 | 442.47 | 914 | 1662 | 35.5 | .555 |
| **BEAM 393** | | | | | |
| 0 | 25.68 | 28 | 14 | 67.0 | 0.010 |
| 1000 | 55.68 | 50 | 36 | 58.4 | .020 |
| 2000 | 85.68 | 86 | 60 | 59.0 | .035 |
| 3000 | 115.68 | 118 | 85 | 58.2 | .045 |
| 4000 | 145.68 | 156 | 116 | 57.2 | .060 |
| 5000 | 175.68 | 207 | 178 | 53.8 | .080 |
| 6000 | 205.68 | 265 | 260 | 50.5 | .105 |
| 7000 | 235.68 | 335 | 354 | 48.7 | .140 |
| 8000 | 265.68 | 382 | 460 | 45.4 | .175 |
| 9000 | 295.68 | 434 | 542 | 44.4 | .205 |
| 10 000 | 325.68 | 493 | 644 | 43.3 | .245 |
| 11 000 | 355.68 | 549 | 745 | 42.4 | .275 |
| 12 000 | 385.68 | 600 | 844 | 41.6 | .310 |
| 13 000 | 415.68 | 658 | 933 | 41.3 | .345 |
| 14 000 | 445.68 | 722 | 1038 | 41.0 | .385 |
| 15 000 | 475.68 | 775 | 1132 | 40.7 | .420 |
| 16 000 | 505.68 | 848 | 1224 | 41.0 | .455 |
| 17 000 | 535.68 | 927 | 1326 | 41.1 | .495 |
| 17 300 | 544.68 | ........ | 1366 | ........ | .510 |
| 17 510 | 550.98 | ........ | 1391 | ........ | .535 |
| 16 000 | 505.68 | 927 | 1321 | 41.3 | .570 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 394**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 26 | 14 | 65.0 | 0.005 |
| 1000 | 55.26 | 53 | 39 | 57.4 | .015 |
| 2000 | 85.26 | 87 | 65 | 57.1 | .030 |
| 3000 | 115.26 | 119 | 96 | 55.3 | .040 |
| 4000 | 145.26 | 160 | 144 | 52.7 | .055 |
| 5000 | 175.26 | 212 | 222 | 48.8 | .080 |
| 6000 | 205.26 | 275 | 311 | 47.0 | .105 |
| 7000 | 235.26 | 341 | 414 | 45.1 | .145 |
| 8000 | 265.26 | 408 | 523 | 43.8 | .175 |
| 9000 | 295.26 | 462 | 629 | 42.3 | .210 |
| 10 000 | 325.26 | 518 | 733 | 41.4 | .245 |
| 11 000 | 355.26 | 579 | 836 | 40.9 | .285 |
| 12 000 | 385.26 | 627 | 915 | 40.7 | .310 |
| 13 000 | 415.26 | 687 | 1015 | 40.4 | .350 |
| 14 000 | 445.26 | 747 | 1103 | 40.4 | .385 |
| 15 000 | 475.26 | 805 | 1207 | 40.0 | .420 |
| 16 000 | 505.26 | 877 | 1308 | 40.1 | .460 |
| 17 000 | 535.26 | 959 | 1402 | 40.6 | .500 |
| 17 480 | 549.66 | ........ | 1451 | ........ | .535 |
| 18 000 | 565.26 | 1043 | 1561 | 40.1 | .565 |
| 18 240 | 572.46 | ........ | 1626 | ........ | .585 |
| 15 600 | 493.26 | 1020 | 1494 | 40.6 | .620 |

**BEAM 395**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 21 | 19 | 52.5 | 0.005 |
| 1000 | 55.47 | 50 | 38 | 57.0 | .015 |
| 2000 | 85.47 | 84 | 63 | 57.1 | .025 |
| 3000 | 115.47 | 113 | 87 | 56.5 | .035 |
| 4000 | 145.47 | 148 | 118 | 55.7 | .050 |
| 5000 | 175.47 | 195 | 186 | 51.2 | .070 |
| 6000 | 205.47 | 253 | 274 | 48.1 | .095 |
| 7000 | 235.47 | 312 | 386 | 44.7 | .125 |
| 8000 | 265.47 | 364 | 516 | 41.3 | .165 |
| 9000 | 295.47 | 420 | 602 | 41.1 | .195 |
| 10 000 | 325.47 | 467 | 684 | 40.5 | .225 |
| 11 000 | 355.47 | 525 | 776 | 40.3 | .255 |
| 12 000 | 385.47 | 578 | 867 | 40.0 | .295 |
| 13 000 | 415.47 | 632 | 961 | 39.7 | .325 |
| 14 000 | 445.47 | 691 | 1039 | 40.0 | .360 |
| 15 000 | 475.47 | 740 | 1140 | 39.4 | .390 |
| 16 000 | 505.47 | 794 | 1239 | 39.1 | .425 |
| 17 000 | 535.47 | 872 | 1344 | 39.3 | .465 |
| 17 430 | 548.37 | ........ | 1429 | ........ | .485 |
| 17 920 | 563.07 | ........ | 1706 | ........ | .530 |
| 16 400 | 517.47 | 1058 | 2126 | 33.2 | .585 |

**BEAM 405**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 21 | 14 | 59.7 | 0.005 |
| 1000 | 55.47 | 52 | 29 | 64.2 | .010 |
| 2000 | 85.47 | 84 | 50 | 62.6 | .020 |
| 3000 | 115.47 | 118 | 74 | 61.4 | .035 |
| 4000 | 145.47 | 155 | 108 | 59.0 | .045 |
| 5000 | 175.47 | 206 | 159 | 56.5 | .065 |
| 6000 | 205.47 | 255 | 224 | 53.2 | .090 |
| 7000 | 235.47 | 315 | 313 | 50.2 | .120 |
| 8000 | 265.47 | 371 | 385 | 49.1 | .145 |
| 9000 | 295.47 | 436 | 489 | 47.1 | .165 |
| 10 000 | 325.47 | 486 | 566 | 46.2 | .210 |
| 11 000 | 355.47 | 547 | 651 | 45.7 | .245 |
| 12 000 | 385.47 | 611 | 737 | 45.3 | .275 |
| 13 000 | 415.47 | 660 | 814 | 44.8 | .305 |
| 14 000 | 445.47 | 721 | 886 | 44.9 | .330 |
| 15 000 | 475.47 | 779 | 966 | 44.6 | .360 |
| 16 000 | 505.47 | 832 | 1046 | 44.3 | .390 |
| 17 000 | 535.47 | 904 | 1128 | 44.5 | .425 |
| 18 000 | 565.47 | 975 | 1214 | 44.5 | .465 |
| 19 000 | 595.47 | 1077 | 1380 | 43.8 | .515 |
| 19 720 | 617.07 | ........ | 1532 | ........ | .555 |
| 19 950 | 623.97 | ........ | 1617 | ........ | .580 |
| 18 000 | 565.47 | 1302 | 2002 | 39.4 | .605 |

**BEAM 406**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 24 | 15 | 61.5 | 0.010 |
| 1000 | 55.88 | 50 | 39 | 56.4 | .020 |
| 2000 | 85.88 | 79 | 63 | 55.7 | .030 |
| 3000 | 115.88 | 109 | 85 | 56.1 | .040 |
| 4000 | 145.88 | 149 | 126 | 54.1 | .045 |
| 5000 | 175.88 | 197 | 188 | 51.2 | .075 |
| 6000 | 205.88 | 248 | 267 | 48.1 | .100 |
| 7000 | 235.88 | 303 | 359 | 45.8 | .130 |
| 8000 | 265.88 | 374 | 458 | 44.9 | .155 |
| 9000 | 295.88 | 409 | 532 | 43.5 | .190 |
| 10 000 | 325.88 | 466 | 622 | 42.9 | .220 |
| 11 000 | 355.88 | 521 | 708 | 42.4 | .250 |
| 12 000 | 385.88 | 572 | 798 | 41.7 | .280 |
| 13 000 | 415.88 | 622 | 879 | 41.4 | .315 |
| 14 000 | 445.88 | 686 | 966 | 41.5 | .345 |
| 15 000 | 475.88 | 735 | 1044 | 41.3 | .375 |
| 16 000 | 505.88 | 793 | 1132 | 41.2 | .405 |
| 17 000 | 535.88 | 856 | 1221 | 41.2 | .440 |
| 18 000 | 565.88 | 911 | 1302 | 41.1 | .480 |
| 19 000 | 595.88 | 974 | 1393 | 41.1 | .510 |
| 19 800 | 619.88 | 1125 | 1783 | 38.7 | .585 |
| 18 800 | 574.88 | 1228 | 2328 | 34.5 | .635 |

**BEAM 407**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 24 | 19 | 56.0 | 0.010 |
| 1000 | 55.68 | 48 | 36 | 57.3 | .020 |
| 2000 | 85.68 | 75 | 58 | 56.3 | .030 |
| 3000 | 115.68 | 107 | 92 | 53.8 | .045 |
| 4000 | 145.68 | 151 | 133 | 53.2 | .060 |
| 5000 | 175.68 | 195 | 176 | 52.5 | .075 |
| 6000 | 205.68 | 246 | 248 | 49.8 | .100 |
| 7000 | 235.68 | 298 | 323 | 48.0 | .130 |
| 8000 | 265.68 | 351 | 405 | 46.4 | .155 |
| 9000 | 295.68 | 403 | 499 | 44.7 | .185 |
| 10 000 | 325.68 | 455 | 586 | 43.7 | .220 |
| 11 000 | 355.68 | 513 | 684 | 42.8 | .250 |
| 12 000 | 385.68 | 563 | 768 | 42.3 | .280 |
| 13 000 | 415.68 | 619 | 853 | 42.0 | .310 |
| 14 000 | 445.68 | 683 | 937 | 42.2 | .345 |
| 15 000 | 475.68 | 731 | 1014 | 41.9 | .375 |
| 16 000 | 505.68 | 793 | 1097 | 42.0 | .405 |
| 17 000 | 535.68 | 852 | 1192 | 41.7 | .445 |
| 18 000 | 565.68 | 912 | 1277 | 41.7 | .480 |
| 19 000 | 595.68 | 979 | 1366 | 41.8 | .515 |
| 20 000 | 625.68 | 1077 | 1520 | 41.5 | .565 |
| 20 280 | 634.08 | ........ | 1572 | ........ | .580 |
| 20 410 | 637.98 | ........ | 1662 | ........ | .600 |
| 20 450 | 639.18 | ........ | 1788 | ........ | .630 |
| 18 400 | 577.68 | 1250 | 2169 | 36.6 | .655 |

**BEAM 336**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 19 | 17 | 52.5 | 0.005 |
| 1000 | 54.85 | 55 | 39 | 58.4 | .015 |
| 2000 | 84.85 | 81 | 67 | 54.9 | .025 |
| 2500 | 99.85 | 96 | 80 | 54.5 | .035 |
| 3000 | 114.85 | 112 | 99 | 53.0 | .040 |
| 3500 | 129.85 | 136 | 133 | 50.6 | .050 |
| 4000 | 144.85 | 174 | 217 | 44.4 | .065 |
| 4500 | 159.85 | 217 | 369 | 37.1 | .105 |
| 5000 | 174.85 | 278 | 610 | 31.3 | .165 |
| 5500 | 189.85 | 329 | 809 | 28.9 | .205 |
| 6000 | 204.85 | 371 | 990 | 27.3 | .255 |
| 6500 | 219.85 | 404 | 1116 | 26.6 | .295 |
| 7000 | 234.85 | 439 | 1256 | 25.9 | .335 |
| 7350 | 245.35 | ........ | 1357 | ........ | .365 |
| 5700 | 195.85 | 444 | 1783 | 20.0 | .375 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 337**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 17 | 21 | 44.6 | 0.010 |
| 1000 | 54.85 | 48 | 44 | 52.0 | .020 |
| 2000 | 84.85 | 66 | 63 | 51.3 | .030 |
| 3000 | 114.85 | 112 | 115 | 49.4 | .050 |
| 3500 | 129.85 | 138 | 156 | 46.9 | .060 |
| 4000 | 144.85 | 172 | 236 | 42.2 | .080 |
| 4500 | 159.85 | 237 | 472 | 33.5 | .130 |
| 5000 | 174.85 | 282 | 639 | 30.6 | .170 |
| 5500 | 189.85 | 319 | 815 | 28.1 | .215 |
| 6000 | 204.85 | 359 | 993 | 26.5 | .270 |
| 6500 | 219.85 | 398 | 1162 | 25.5 | .310 |
| 6740 | 227.05 | ........ | 1241 | ........ | .340 |
| 5600 | 192.85 | 491 | 1154 | 29.9 | .340 |

**BEAM 338**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.64 | 21 | 19 | 52.5 | 0.010 |
| 1000 | 54.64 | 51 | 43 | 54.1 | .025 |
| 2000 | 84.64 | 75 | 63 | 54.3 | .035 |
| 3000 | 114.64 | 115 | 109 | 51.4 | .055 |
| 3500 | 129.64 | 142 | 140 | 50.4 | .060 |
| 4000 | 144.64 | 182 | 217 | 45.6 | .085 |
| 4500 | 159.64 | 235 | 373 | 38.6 | .120 |
| 5000 | 174.64 | 286 | 566 | 33.5 | .170 |
| 5500 | 189.64 | 337 | 797 | 29.7 | .225 |
| ........ | ........ | ........ | ........ | ........ | ........ |
| 5000 | 174.64 | 411 | 1684 | 19.6 | .330 |

**BEAM 348**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 55.26 | 53 | 38 | 58.0 | .025 |
| 2000 | 85.26 | 77 | 56 | 57.8 | .035 |
| 3000 | 115.26 | 113 | 85 | 57.0 | .050 |
| 3500 | 130.26 | 126 | 103 | 55.1 | .055 |
| 4000 | 145.26 | 146 | 127 | 53.4 | .060 |
| 4500 | 160.26 | 167 | 168 | 49.8 | .070 |
| 5000 | 175.26 | 209 | 253 | 45.3 | .100 |
| 5500 | 190.26 | 257 | 362 | 41.5 | .120 |
| 6000 | 205.26 | 293 | 472 | 38.3 | .150 |
| 7000 | 235.26 | 357 | 656 | 35.2 | .210 |
| 8000 | 265.26 | 421 | 865 | 32.8 | .270 |
| 9000 | 295.26 | 481 | 1072 | 31.0 | .330 |
| 9370 | 306.36 | ........ | 1154 | ........ | .355 |
| 9620 | 313.86 | ........ | 1338 | ........ | .390 |
| 8000 | 265.26 | 534 | 1726 | 23.7 | .395 |

**BEAM 349**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 13 | 15 | 47.2 | 0.010 |
| 1000 | 55.47 | 42 | 39 | 51.9 | .020 |
| 2000 | 85.47 | 64 | 60 | 51.7 | .040 |
| 3000 | 115.47 | 93 | 84 | 52.5 | .050 |
| 4000 | 145.47 | 117 | 111 | 51.4 | .065 |
| 4500 | 160.47 | 145 | 149 | 49.3 | .080 |
| 5000 | 175.47 | 171 | 207 | 45.2 | .100 |
| 5500 | 190.47 | 217 | 321 | 40.3 | .120 |
| 6000 | 205.47 | 257 | 456 | 36.0 | .150 |
| 7000 | 235.47 | 321 | 706 | 31.3 | .220 |
| 8000 | 265.47 | 380 | 913 | 29.4 | .280 |
| 9000 | 295.47 | 433 | 1087 | 28.5 | .330 |
| 9500 | 310.47 | 464 | 1197 | 27.9 | .360 |
| 10 000 | 325.47 | 489 | 1294 | 27.4 | .390 |
| 10 500 | 340.47 | 516 | 1378 | 27.2 | .415 |
| 11 000 | 355.47 | 551 | 1467 | 27.3 | .440 |
| 11 050 | 356.97 | ........ | 1516 | ........ | .465 |
| 9300 | 304.47 | 548 | 1981 | 21.7 | .475 |

**BEAM 350**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 19 | 21 | 47.5 | 0.005 |
| 1000 | 55.06 | 43 | 46 | 48.6 | .020 |
| 2000 | 85.06 | 70 | 68 | 49.6 | .030 |
| 3000 | 115.06 | 102 | 96 | 51.5 | .040 |
| 4000 | 145.06 | 133 | 130 | 50.6 | .050 |
| 4500 | 160.06 | 160 | 169 | 48.7 | .060 |
| 5000 | 175.06 | 198 | 248 | 44.4 | .080 |
| 5500 | 190.06 | 244 | 390 | 38.5 | .115 |
| 6000 | 205.06 | 289 | 533 | 35.2 | .150 |
| 7000 | 235.06 | 360 | 754 | 32.3 | .210 |
| 8000 | 265.06 | 418 | 945 | 30.7 | .265 |
| 8800 | 289.06 | ........ | 1250 | ........ | .345 |
| 7500 | 250.06 | 498 | 1597 | 23.8 | .355 |

**BEAM 360**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 23 | 17 | 57.5 | 0.010 |
| 1000 | 55.26 | 56 | 43 | 56.5 | .015 |
| 2000 | 85.26 | 84 | 65 | 56.5 | .025 |
| 3000 | 115.26 | 107 | 87 | 55.1 | .035 |
| 4000 | 145.26 | 135 | 111 | 54.9 | .045 |
| 4500 | 160.26 | 158 | 130 | 54.9 | .050 |
| 5000 | 175.26 | 181 | 162 | 52.8 | .060 |
| 5500 | 190.26 | 206 | 222 | 48.2 | .080 |
| 6000 | 205.26 | 246 | 330 | 42.7 | .100 |
| 7000 | 235.26 | 309 | 508 | 37.8 | .150 |
| 8000 | 265.26 | 358 | 643 | 35.8 | .190 |
| 9000 | 295.26 | 409 | 786 | 34.2 | .230 |
| 10 000 | 325.26 | 455 | 938 | 32.6 | .275 |
| 11 000 | 355.26 | 508 | 1068 | 32.2 | .320 |
| 12 000 | 385.26 | 556 | 1200 | 31.7 | .360 |
| 12 850 | 410.76 | ........ | 1362 | ........ | .400 |
| 10 700 | 346.26 | 626 | 1921 | 24.6 | .430 |

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## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 361**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 17 | 14 | 54.1 | 0.010 |
| 1000 | 55.47 | 45 | 34 | 55.9 | .015 |
| 2000 | 85.47 | 68 | 53 | 56.2 | .030 |
| 3000 | 115.47 | 92 | 77 | 54.6 | .035 |
| 4000 | 145.47 | 119 | 103 | 53.6 | .050 |
| 4500 | 160.47 | 134 | 123 | 52.1 | .055 |
| 5000 | 175.47 | 152 | 154 | 49.7 | .065 |
| 5500 | 190.47 | 184 | 209 | 46.8 | .075 |
| 6000 | 205.47 | 222 | 309 | 41.8 | .105 |
| 7000 | 235.47 | 282 | 486 | 36.8 | .150 |
| 8000 | 265.47 | 338 | 636 | 34.7 | .195 |
| 9000 | 295.47 | 384 | 769 | 33.3 | .235 |
| 10 000 | 325.47 | 429 | 904 | 32.2 | .275 |
| 11 000 | 355.47 | 478 | 1039 | 31.5 | .320 |
| 12 000 | 385.47 | 521 | 1188 | 30.5 | .360 |
| 12 450 | 398.97 | ........ | 1309 | ........ | .390 |
| 11 500 | 370.47 | 537 | 1484 | 36.6 | .395 |

**BEAM 362**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.06 | 48 | 39 | 55.4 | .015 |
| 2000 | 85.06 | 75 | 56 | 57.1 | .025 |
| 3000 | 115.06 | 106 | 85 | 55.4 | .040 |
| 4000 | 145.06 | 138 | 118 | 53.9 | .050 |
| 4500 | 160.06 | 157 | 144 | 52.2 | .060 |
| 5000 | 175.06 | 183 | 190 | 49.0 | .070 |
| 5500 | 190.06 | 215 | 268 | 44.5 | .090 |
| 6000 | 205.06 | 257 | 362 | 41.5 | .110 |
| 7000 | 235.06 | 320 | 545 | 37.0 | .160 |
| 8000 | 265.06 | 381 | 716 | 34.7 | .205 |
| 9000 | 295.06 | 449 | 906 | 33.1 | .260 |
| 10 000 | 325.06 | 484 | 998 | 32.7 | .290 |
| 11 000 | 355.06 | 545 | 1145 | 32.2 | .335 |
| 12 000 | 385.06 | 597 | 1282 | 31.8 | .380 |
| 12 960 | 413.86 | ........ | 1468 | ........ | .430 |
| 11 100 | 358.06 | 651 | 1896 | 25.5 | .440 |

**BEAM 372**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 21 | 19 | 52.5 | 0.010 |
| 1000 | 55.68 | 53 | 41 | 56.2 | .020 |
| 2000 | 85.68 | 82 | 65 | 55.9 | .030 |
| 3000 | 115.68 | 111 | 89 | 55.5 | .040 |
| 4000 | 145.68 | 143 | 125 | 53.4 | .055 |
| 5000 | 175.68 | 190 | 195 | 49.4 | .075 |
| 6000 | 205.68 | 246 | 299 | 45.2 | .110 |
| 7000 | 235.68 | 304 | 429 | 41.4 | .145 |
| 8000 | 265.68 | 359 | 562 | 39.0 | .190 |
| 9000 | 295.68 | 413 | 668 | 38.2 | .230 |
| 10 000 | 325.68 | 460 | 786 | 36.9 | .265 |
| 11 000 | 355.68 | 514 | 901 | 36.3 | .310 |
| 12 000 | 385.68 | 561 | 1026 | 35.4 | .345 |
| 13 000 | 415.68 | 618 | 1138 | 35.2 | .390 |
| 14 000 | 445.68 | 667 | 1248 | 34.8 | .430 |
| 14 650 | 465.18 | ........ | 1325 | ........ | .455 |
| 14 870 | 471.78 | ........ | 1385 | ........ | .470 |
| 12 850 | 411.18 | 752 | 1921 | 28.2 | .505 |

**BEAM 373**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 55.47 | 50 | 34 | 59.6 | .020 |
| 2000 | 85.47 | 81 | 58 | 58.3 | .035 |
| 3000 | 115.47 | 108 | 79 | 57.8 | .055 |
| 4000 | 145.47 | 139 | 106 | 56.8 | .075 |
| 5000 | 175.47 | 188 | 161 | 53.9 | .100 |
| 6000 | 205.47 | 253 | 284 | 47.1 | .140 |
| 7000 | 235.47 | 310 | 417 | 42.7 | .175 |
| 8000 | 265.47 | 366 | 559 | 39.6 | .220 |
| 9000 | 295.47 | 417 | 684 | 37.9 | .255 |
| 10 000 | 325.47 | 471 | 807 | 36.8 | ........ |
| 11 000 | 355.47 | 523 | 918 | 36.3 | .340 |
| 12 000 | 385.47 | 574 | 1027 | 35.9 | .380 |
| 13 000 | 415.47 | 620 | 1137 | 35.3 | .420 |
| 14 000 | 445.47 | 676 | 1241 | 35.3 | .455 |
| 15 000 | 475.47 | 725 | 1361 | 34.8 | .495 |
| 15 150 | 479.97 | ........ | 1376 | ........ | .505 |
| 12 850 | 410.97 | 740 | 1916 | 27.9 | .525 |

**BEAM 374**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 21 | 19 | 52.5 | 0.010 |
| 1000 | 55.68 | 49 | 44 | 52.5 | ........ |
| 2000 | 85.68 | 77 | 65 | 54.3 | .020 |
| 3000 | 115.68 | 107 | 92 | 53.8 | .030 |
| 4000 | 145.68 | 139 | 128 | 52.1 | .040 |
| 5000 | 175.68 | 188 | 210 | 47.2 | .060 |
| 6000 | 205.68 | 250 | 325 | 43.5 | .095 |
| 7000 | 235.68 | 313 | 470 | 40.0 | .140 |
| 8000 | 265.68 | 364 | 597 | 37.9 | .175 |
| 9000 | 295.68 | 419 | 728 | 36.5 | .220 |
| 10 000 | 325.68 | 473 | 856 | 35.6 | .260 |
| 11 000 | 355.68 | 523 | 980 | 34.8 | .300 |
| 12 000 | 385.68 | 573 | 1106 | 34.1 | .340 |
| 13 000 | 415.68 | 631 | 1238 | 33.7 | .380 |
| 14 000 | 445.68 | 690 | 1380 | 33.3 | .430 |
| 14 550 | 462.18 | ........ | 1458 | ........ | .455 |
| 12 750 | 408.18 | 742 | 1858 | 28.5 | .475 |

**BEAM 384**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 21 | 14 | 59.7 | 0.010 |
| 1000 | 55.26 | 47 | 32 | 59.5 | .020 |
| 2000 | 85.26 | 75 | 58 | 56.3 | .030 |
| 3000 | 115.26 | 103 | 84 | 55.2 | .040 |
| 4000 | 145.26 | 130 | 108 | 54.6 | .050 |
| 5000 | 175.26 | 170 | 159 | 51.7 | .070 |
| 6000 | 205.26 | 220 | 236 | 48.2 | .090 |
| 7000 | 235.26 | 276 | 357 | 43.6 | .120 |
| 8000 | 265.26 | 332 | 489 | 40.4 | .155 |
| 9000 | 295.26 | 380 | 610 | 38.3 | .195 |
| 10 000 | 325.26 | 423 | 716 | 37.1 | .230 |
| 11 000 | 355.26 | 477 | 829 | 36.5 | .270 |
| 12 000 | 385.26 | 521 | 935 | 35.8 | .300 |
| 13 000 | 415.26 | 565 | 1038 | 35.3 | .335 |
| 14 000 | 445.26 | 610 | 1137 | 34.9 | .370 |
| 15 000 | 475.26 | 661 | 1231 | 34.9 | .405 |
| 16 000 | 505.26 | 710 | 1345 | 34.5 | .445 |
| 16 660 | 525.06 | ........ | 1455 | ........ | .480 |
| 16 700 | 526.06 | ........ | 1480 | ........ | .490 |
| 16 750 | 527.76 | ........ | 1540 | ........ | .500 |
| 16 840 | 530.46 | ........ | 1653 | ........ | .520 |
| 14 300 | 454.26 | 815 | 2089 | 28.1 | .550 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 385**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 21 | 15 | 58.1 | 0.010 |
| 1000 | 55.68 | 48 | 36 | 57.3 | .020 |
| 2000 | 85.68 | 77 | 58 | 56.9 | .030 |
| 3000 | 115.68 | 103 | 80 | 56.3 | .040 |
| 4000 | 145.68 | 132 | 111 | 54.3 | .050 |
| 5000 | 175.68 | 176 | 159 | 52.5 | .070 |
| 6000 | 205.68 | 223 | 231 | 49.1 | .090 |
| 7000 | 235.68 | 275 | 345 | 44.4 | .125 |
| 8000 | 265.68 | 333 | 480 | 40.9 | .160 |
| 9000 | 295.68 | 386 | 603 | 39.1 | .200 |
| 10 000 | 325.68 | 436 | 721 | 37.7 | .230 |
| 11 000 | 355.68 | 485 | 831 | 36.8 | .270 |
| 12 000 | 385.68 | 537 | 952 | 36.0 | .300 |
| 13 000 | 415.68 | 583 | 1053 | 35.6 | .340 |
| 14 000 | 445.68 | 634 | 1169 | 35.2 | .370 |
| 15 000 | 475.68 | 678 | 1270 | 34.8 | .410 |
| 16 000 | 505.68 | 746 | 1415 | 34.5 | .450 |
| 16 120 | 509.28 | ........ | 1441 | ........ | .460 |
| 16 720 | 527.28 | ........ | 1559 | ........ | .485 |
| 14 300 | 454.68 | 849 | 2186 | 28.0 | .525 |

**BEAM 386**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 19 | 17 | 52.5 | 0.005 |
| 1000 | 55.47 | 48 | 39 | 55.4 | .015 |
| 2000 | 85.47 | 75 | 62 | 54.7 | .025 |
| 3000 | 115.47 | 107 | 84 | 55.9 | .035 |
| 4000 | 145.47 | 138 | 113 | 54.9 | .050 |
| 5000 | 175.47 | 172 | 157 | 52.3 | .065 |
| 6000 | 205.47 | 228 | 238 | 49.0 | .085 |
| 7000 | 235.47 | 306 | 359 | 46.0 | .130 |
| 8000 | 265.47 | 352 | 467 | 43.0 | .165 |
| 9000 | 295.47 | 403 | 585 | 40.8 | .205 |
| 10 000 | 325.47 | 450 | 692 | 39.9 | .240 |
| 11 000 | 355.47 | 506 | 798 | 38.8 | .275 |
| 12 000 | 385.47 | 552 | 911 | 37.7 | .315 |
| 13 000 | 415.47 | 608 | 1033 | 37.1 | .350 |
| 14 000 | 445.47 | 653 | 1125 | 36.7 | .380 |
| 15 000 | 475.47 | 709 | 1241 | 36.4 | .415 |
| 16 000 | 505.47 | 775 | 1391 | 35.8 | .465 |
| 14 000 | 445.47 | 822 | 1974 | 29.4 | .510 |

**BEAM 396**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 19 | 21 | 47.5 | 0.010 |
| 1000 | 55.47 | 45 | 41 | 52.5 | .020 |
| 2000 | 85.47 | 68 | 60 | 53.3 | .030 |
| 3000 | 115.47 | 98 | 82 | 54.4 | .040 |
| 4000 | 145.47 | 128 | 104 | 55.1 | .050 |
| 5000 | 175.47 | 160 | 138 | 53.7 | .065 |
| 6000 | 205.47 | 208 | 195 | 51.6 | .080 |
| 7000 | 235.47 | 250 | 273 | 47.8 | .105 |
| 8000 | 265.47 | 308 | 376 | 45.0 | .135 |
| 9000 | 295.47 | 358 | 475 | 42.9 | .170 |
| 10 000 | 325.47 | 401 | 574 | 41.1 | .195 |
| 11 000 | 355.47 | 446 | 670 | 39.9 | .230 |
| 12 000 | 385.47 | 488 | 756 | 39.2 | .255 |
| 13 000 | 415.47 | 534 | 841 | 38.8 | .295 |
| 14 000 | 445.47 | 578 | 920 | 38.6 | .320 |
| 15 100 | 478.47 | 627 | 1019 | 38.1 | .355 |
| 16 000 | 505.47 | 666 | 1091 | 37.9 | .380 |
| 17 000 | 535.47 | 716 | 1186 | 37.6 | .410 |
| 18 000 | 565.47 | 764 | 1284 | 37.3 | .440 |
| 18 630 | 584.37 | 807 | 1359 | 37.3 | .475 |
| 19 000 | 595.47 | 834 | 1443 | 36.6 | .485 |
| 19 650 | 614.97 | ........ | 1602 | ........ | .535 |
| 17 000 | 535.47 | 911 | 2128 | 30.0 | .550 |

**BEAM 397**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 21 | 15 | 58.1 | 0.010 |
| 1000 | 55.47 | 52 | 31 | 62.7 | .020 |
| 2000 | 85.47 | 78 | 50 | 61.1 | .030 |
| 3000 | 115.47 | 106 | 70 | 60.2 | .040 |
| 4000 | 145.47 | 132 | 91 | 59.2 | .050 |
| 5000 | 175.47 | 168 | 120 | 58.4 | .065 |
| 6000 | 205.47 | 207 | 169 | 55.0 | .080 |
| 7000 | 235.47 | 257 | 258 | 49.9 | .105 |
| 8000 | 265.47 | 304 | 371 | 45.0 | .135 |
| 9000 | 295.47 | 349 | 477 | 42.3 | .165 |
| 10 000 | 325.47 | 398 | 574 | 40.9 | .195 |
| 11 000 | 355.47 | 441 | 667 | 39.8 | .225 |
| 12 000 | 385.47 | 484 | 747 | 39.3 | .255 |
| 13 000 | 415.47 | 528 | 836 | 38.7 | .290 |
| 14 000 | 445.47 | 569 | 930 | 38.0 | .320 |
| 15 000 | 475.47 | 612 | 1019 | 37.5 | .350 |
| 16 000 | 505.47 | 656 | 1113 | 37.1 | .380 |
| 17 100 | 538.47 | 712 | 1231 | 36.6 | .420 |
| 18 000 | 565.47 | 771 | 1340 | 36.5 | .455 |
| 19 000 | 595.47 | 828 | 1477 | 35.9 | .495 |
| 19 960 | 624.27 | ........ | 1718 | ........ | .555 |
| 19 880 | 621.87 | ........ | 1800 | ........ | .570 |
| 17 300 | 544.47 | 962 | 2313 | 29.4 | .595 |

**BEAM 398**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 21 | 14 | 59.7 | 0.010 |
| 1000 | 56.09 | 48 | 39 | 55.4 | .020 |
| 2000 | 86.09 | 77 | 60 | 56.2 | .030 |
| 3000 | 116.09 | 103 | 74 | 58.1 | .040 |
| 4000 | 146.09 | 133 | 99 | 57.2 | .055 |
| 5000 | 176.09 | 169 | 137 | 55.3 | .070 |
| 6000 | 206.09 | 213 | 195 | 52.3 | .090 |
| 7000 | 236.09 | 267 | 296 | 47.4 | .120 |
| 8000 | 266.09 | 321 | 376 | 46.0 | .150 |
| 9000 | 296.09 | 369 | 468 | 44.1 | .185 |
| 10 000 | 326.09 | 415 | 564 | 42.4 | .215 |
| 11 000 | 356.09 | 461 | 667 | 40.9 | .250 |
| 12 000 | 386.09 | 507 | 747 | 40.4 | .280 |
| 13 000 | 416.09 | 554 | 839 | 39.8 | .310 |
| 14 000 | 446.09 | 605 | 932 | 39.4 | .345 |
| 15 000 | 476.09 | 647 | 1015 | 38.9 | .370 |
| 16 000 | 506.09 | 696 | 1118 | 38.4 | .400 |
| 17 000 | 536.09 | 747 | 1193 | 38.5 | .430 |
| 18 000 | 566.09 | 883 | 1294 | 38.3 | .470 |
| 18 930 | 593.99 | ........ | 1458 | ........ | .510 |
| 19 000 | 596.09 | 898 | 1538 | 36.9 | .525 |
| 19 100 | 599.09 | ........ | 1655 | ........ | .550 |
| 16 900 | 533.09 | 952 | 2089 | 31.3 | .565 |

**BEAM 408**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.09 | 23 | 17 | 57.5 | 0.005 |
| 1000 | 56.09 | 52 | 32 | 62.0 | .015 |
| 2000 | 86.09 | 76 | 53 | 59.1 | .025 |
| 3000 | 116.09 | 106 | 72 | 59.5 | .035 |
| 4000 | 146.09 | 131 | 94 | 58.3 | .045 |
| 5000 | 176.09 | 161 | 120 | 57.3 | .055 |
| 6000 | 206.09 | 204 | 174 | 54.0 | .070 |
| 7000 | 236.09 | 229 | 250 | 49.9 | .090 |
| 8000 | 266.09 | 302 | 338 | 47.2 | .120 |
| 9000 | 296.09 | 354 | 426 | 45.4 | .145 |
| 10 000 | 326.09 | 400 | 513 | 43.8 | .175 |
| 11 000 | 356.09 | 451 | 600 | 42.9 | .205 |
| 12 000 | 386.09 | 487 | 674 | 41.9 | .235 |
| 13 000 | 416.09 | 536 | 747 | 41.8 | .260 |
| 14 000 | 446.09 | 570 | 805 | 41.4 | .285 |
| 15 000 | 476.09 | 617 | 894 | 40.9 | .315 |
| 16 000 | 506.09 | 667 | 974 | 40.6 | .345 |
| 17 000 | 536.09 | 707 | 1050 | 40.2 | .375 |
| 18 000 | 566.09 | 753 | 1137 | 39.8 | .405 |
| 19 000 | 596.09 | 810 | 1215 | 40.0 | .435 |
| 20 000 | 626.09 | 857 | 1297 | 39.8 | .465 |
| 21 000 | 656.09 | 915 | 1385 | 39.8 | .500 |
| 21 840 | 681.29 | ........ | 1462 | ........ | .525 |
| 22 000 | 686.09 | ........ | 1504 | ........ | .540 |
| 20 000 | 626.09 | 978 | 2135 | 31.4 | .570 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 409**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.29 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 56.29 | 47 | 36 | 56.7 | .015 |
| 2000 | 86.29 | 71 | 55 | 56.5 | .025 |
| 3000 | 116.29 | 95 | 74 | 56.3 | .035 |
| 4000 | 146.29 | 124 | 96 | 56.4 | .045 |
| 5000 | 176.29 | 156 | 120 | 56.5 | .055 |
| 6000 | 206.29 | 196 | 168 | 53.9 | .075 |
| 7000 | 236.29 | 248 | 232 | 51.7 | .100 |
| 8000 | 266.29 | 295 | 311 | 48.7 | .125 |
| 9000 | 296.29 | 340 | 400 | 45.9 | .150 |
| 10 000 | 326.29 | 388 | 492 | 44.1 | .180 |
| 11 000 | 356.29 | 434 | 576 | 42.9 | .205 |
| 12 000 | 386.29 | 476 | 662 | 41.8 | .240 |
| 13 000 | 416.29 | 518 | 739 | 41.2 | .270 |
| 14 000 | 446.29 | 563 | 821 | 40.7 | .290 |
| 15 000 | 476.29 | 608 | 892 | 40.5 | .320 |
| 16 000 | 506.29 | 656 | 973 | 40.2 | .350 |
| 17 000 | 536.29 | 702 | 1051 | 40.0 | .380 |
| 18 000 | 566.29 | 749 | 1127 | 39.9 | .405 |
| 19 000 | 596.29 | 794 | 1200 | 39.8 | .440 |
| 20 000 | 626.29 | 858 | 1301 | 39.7 | .470 |
| 21 000 | 656.29 | 914 | 1397 | 39.5 | .500 |
| 21 300 | 665.29 | ........ | 1436 | ........ | .520 |
| 22 000 | 686.29 | 1004 | 1596 | 38.6 | .550 |
| 22 350 | 696.79 | ........ | 1826 | ........ | .595 |
| 20 000 | 626.29 | 1114 | 2388 | 31.8 | .625 |

**BEAM 410**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 23 | 15 | 60.4 | 0.010 |
| 1000 | 55.47 | 56 | 38 | 59.4 | .020 |
| 2000 | 85.47 | 82 | 53 | 60.7 | .030 |
| 3000 | 115.47 | 108 | 77 | 58.4 | .040 |
| 4000 | 145.47 | 133 | 99 | 57.2 | .050 |
| 5000 | 175.47 | 167 | 133 | 55.7 | .065 |
| 6000 | 205.47 | 210 | 183 | 53.4 | .080 |
| 7000 | 235.47 | 260 | 256 | 50.4 | .110 |
| 8000 | 265.47 | 315 | 350 | 47.4 | .140 |
| 9000 | 295.47 | 367 | 446 | 45.1 | .170 |
| 10 000 | 325.47 | 411 | 532 | 43.6 | .195 |
| 11 000 | 355.47 | 457 | 615 | 42.6 | .220 |
| 12 000 | 385.47 | 499 | 699 | 41.6 | .250 |
| 13 000 | 415.47 | 546 | 774 | 41.4 | .280 |
| 14 000 | 445.47 | 590 | 855 | 40.8 | .305 |
| 15 000 | 475.47 | 638 | 939 | 40.4 | .340 |
| 16 000 | 505.47 | 682 | 1017 | 40.1 | .365 |
| 17 000 | 535.47 | 725 | 1094 | 39.9 | .390 |
| 18 000 | 565.47 | 772 | 1173 | 39.7 | .420 |
| 19 000 | 595.47 | 838 | 1258 | 40.0 | .460 |
| 20 000 | 625.47 | 898 | 1349 | 40.0 | .490 |
| 21 000 | 655.47 | 961 | 1472 | 39.5 | .525 |
| 21 640 | 674.67 | ........ | 1568 | ........ | .560 |
| 21 690 | 676.17 | ........ | 1610 | ........ | .575 |
| 19 800 | 619.47 | 1080 | 2163 | 33.3 | .600 |

**BEAM 339**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 54.85 | 43 | 38 | 53.1 | .020 |
| 2000 | 84.85 | 68 | 60 | 53.3 | .030 |
| 2500 | 99.85 | 83 | 72 | 53.5 | .035 |
| 3000 | 114.85 | 98 | 91 | 52.0 | .040 |
| 3500 | 129.85 | 118 | 113 | 51.0 | .050 |
| 4000 | 144.85 | 148 | 173 | 46.1 | .060 |
| 4500 | 159.85 | 216 | 347 | 38.4 | .110 |
| 5000 | 174.85 | 261 | 526 | 33.2 | .155 |
| 5500 | 189.85 | 309 | 720 | 30.1 | .200 |
| 6000 | 204.85 | 349 | 892 | 28.1 | .245 |
| 6500 | 219.85 | 396 | 1127 | 26.0 | .280 |
| 5850 | 200.35 | ........ | 2037 | ........ | .390 |

**BEAM 340**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 21 | 14 | 59.7 | 0.010 |
| 1000 | 54.85 | 45 | 39 | 53.7 | .020 |
| 2000 | 84.85 | 72 | 62 | 53.6 | .030 |
| 2500 | 99.85 | 85 | 77 | 53.5 | .040 |
| 3000 | 114.85 | 102 | 92 | 52.5 | .045 |
| 3500 | 129.85 | 120 | 116 | 50.8 | .050 |
| 4000 | 144.85 | 145 | 161 | 47.4 | .650 |
| 4500 | 159.85 | 199 | 325 | 38.0 | .105 |
| 5000 | 174.85 | 257 | 585 | 30.5 | .165 |
| 5500 | 189.85 | 296 | 749 | 28.3 | .210 |
| 6000 | 204.85 | 329 | 884 | 27.1 | .250 |
| 6500 | 219.85 | 361 | 1029 | 25.9 | .290 |
| 5500 | 189.85 | 378 | 1600 | 19.1 | .335 |

**BEAM 341**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.85 | 17 | 15 | 52.5 | 0.005 |
| 1000 | 54.85 | 43 | 38 | 53.1 | .015 |
| 2000 | 84.85 | 67 | 65 | 50.6 | .025 |
| 2500 | 99.85 | 83 | 75 | 52.5 | .035 |
| 3000 | 114.85 | 99 | 92 | 51.7 | .040 |
| 3500 | 129.85 | 112 | 109 | 50.3 | .045 |
| 4000 | 144.85 | 135 | 142 | 48.2 | .055 |
| 4500 | 159.85 | 191 | 268 | 41.6 | .090 |
| 5000 | 174.85 | 265 | 585 | 31.1 | .155 |
| 5500 | 189.85 | 305 | 771 | 28.3 | .205 |
| 6000 | 204.85 | 344 | 949 | 26.6 | .250 |
| 6500 | 219.85 | 384 | 1144 | 25.2 | .300 |
| 6680 | 225.25 | ........ | (1212) | ........ | .320 |
| 5250 | 182.35 | 338 | 1080 | 23.8 | .330 |

**BEAM 351**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 55.06 | 47 | 31 | 60.2 | .020 |
| 2000 | 85.06 | 71 | 55 | 56.5 | .030 |
| 3000 | 115.06 | 100 | 77 | 56.5 | .040 |
| 3500 | 130.06 | 116 | 89 | 56.6 | .050 |
| 4000 | 145.06 | 132 | 104 | 55.9 | .055 |
| 4500 | 160.06 | 157 | 144 | 52.2 | .065 |
| 5000 | 175.06 | 197 | 215 | 47.8 | .085 |
| 5500 | 190.06 | 236 | 337 | 41.1 | .110 |
| 6000 | 205.06 | 282 | 479 | 37.1 | .150 |
| 7000 | 235.06 | 349 | 682 | 33.8 | .205 |
| 8000 | 265.06 | 404 | 872 | 31.6 | .260 |
| 9000 | 295.06 | 461 | 1046 | 30.6 | .315 |
| 10 000 | 325.06 | 519 | 1241 | 29.5 | .370 |
| 7850 | 260.56 | 517 | 1759 | 22.7 | .395 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 352** | | | | | |
| 0 | 25.47 | 19 | 24 | 44.4 | 0.010 |
| 1000 | 55.47 | 45 | 41 | 52.5 | .020 |
| 2000 | 85.47 | 70 | 65 | 51.8 | .030 |
| 3000 | 115.47 | 101 | 91 | 52.5 | .040 |
| 3500 | 130.47 | 115 | 106 | 52.0 | .045 |
| 4000 | 145.47 | 133 | 128 | 51.0 | .050 |
| 4500 | 160.47 | 158 | 171 | 48.1 | .065 |
| 5000 | 175.47 | 197 | 256 | 43.4 | .085 |
| 6000 | 205.47 | 268 | 458 | 36.9 | .140 |
| 7000 | 235.47 | 339 | 663 | 33.8 | .190 |
| 8000 | 265.47 | 388 | 843 | 31.5 | .245 |
| 9000 | 295.47 | 443 | 1003 | 30.6 | .300 |
| 10 000 | 325.47 | 497 | 1164 | 29.9 | .345 |
| 10 800 | 334.47 | | 1220 | | .380 |
| 8450 | 278.97 | 451 | 1080 | 29.4 | .430 |
| **BEAM 353** | | | | | |
| 0 | 25.06 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.06 | 47 | 36 | 56.7 | .015 |
| 2000 | 85.06 | 77 | 60 | 56.2 | .025 |
| 3000 | 115.06 | 103 | 80 | 56.3 | .035 |
| 3500 | 130.06 | 120 | 96 | 55.5 | .040 |
| 4000 | 145.06 | 133 | 111 | 54.5 | .050 |
| 4500 | 160.06 | 157 | 147 | 51.7 | .055 |
| 5000 | 175.06 | 188 | 207 | 47.6 | .075 |
| 6000 | 205.06 | 265 | 414 | 39.0 | .130 |
| 7000 | 235.06 | 327 | 607 | 35.0 | .185 |
| 8000 | 265.06 | 387 | 788 | 32.9 | .245 |
| 9000 | 295.06 | 438 | 950 | 31.6 | .305 |
| 9830 | 319.96 | | 1078 | | .360 |
| 8300 | 274.06 | 436 | 1002 | 30.3 | .370 |
| **BEAM 363** | | | | | |
| 0 | 25.47 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.47 | 42 | 39 | 51.9 | .015 |
| 2000 | 85.47 | 61 | 60 | 50.4 | .025 |
| 3000 | 115.47 | 90 | 77 | 54.0 | .035 |
| 4000 | 145.47 | 119 | 106 | 52.9 | .050 |
| 5000 | 175.47 | 153 | 147 | 51.0 | .065 |
| 6000 | 205.47 | 209 | 256 | 45.0 | .090 |
| 7000 | 235.47 | 269 | 426 | 38.7 | .135 |
| 8000 | 265.47 | 330 | 595 | 35.7 | .175 |
| 9000 | 295.47 | 387 | 747 | 34.1 | .225 |
| 10 000 | 325.47 | 432 | 884 | 32.8 | .265 |
| 11 000 | 355.47 | 484 | 1024 | 32.1 | .310 |
| 12 000 | 385.47 | 530 | 1149 | 31.6 | .350 |
| 13 000 | 415.47 | 583 | 1299 | 31.0 | .395 |
| 13 530 | 431.37 | | 1429 | | .445 |
| 11 130 | 359.37 | 613 | 1967 | 23.8 | .450 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 364** | | | | | |
| 0 | 25.06 | 17 | 14 | 54.1 | 0.010 |
| 1000 | 55.06 | 43 | 36 | 54.4 | .020 |
| 2000 | 85.06 | 68 | 55 | 55.3 | .030 |
| 3000 | 115.06 | 94 | 80 | 53.9 | .040 |
| 4000 | 145.06 | 127 | 113 | 52.9 | .050 |
| 5000 | 175.06 | 160 | 162 | 49.7 | .065 |
| 6000 | 205.06 | 210 | 267 | 44.0 | .090 |
| 7000 | 235.06 | 270 | 455 | 37.3 | .135 |
| 8000 | 265.06 | 321 | 629 | 33.8 | .175 |
| 9000 | 295.06 | 377 | 801 | 32.0 | .225 |
| 10 000 | 325.06 | 420 | 950 | 30.7 | .270 |
| 11 000 | 355.06 | 466 | 1094 | 29.9 | .315 |
| 12 000 | 385.06 | 513 | 1229 | 29.5 | .350 |
| 13 000 | 415.06 | 569 | 1448 | 28.2 | .410 |
| 13 100 | 418.06 | | 1543 | | .430 |
| 11 400 | 367.06 | 571 | 1925 | 22.9 | .445 |
| **BEAM 365** | | | | | |
| 0 | 25.26 | 19 | 12 | 60.7 | 0.010 |
| 1000 | 55.26 | 45 | 34 | 56.9 | .020 |
| 2000 | 85.26 | 66 | 55 | 54.6 | .030 |
| 3000 | 115.26 | 96 | 77 | 55.4 | .040 |
| 4000 | 145.26 | 119 | 101 | 54.1 | .050 |
| 5000 | 175.26 | 157 | 150 | 51.2 | .065 |
| 6000 | 205.26 | 215 | 267 | 44.6 | .100 |
| 7000 | 235.26 | 282 | 438 | 39.2 | .145 |
| 8000 | 265.26 | 337 | 576 | 36.9 | .180 |
| 9000 | 295.26 | 387 | 718 | 35.0 | .230 |
| 10 000 | 325.26 | 437 | 843 | 34.1 | .270 |
| 11 000 | 355.26 | 481 | 956 | 33.5 | .310 |
| 12 000 | 385.26 | 532 | 1080 | 33.0 | .350 |
| 13 000 | 415.26 | 588 | 1239 | 32.2 | .400 |
| 10 600 | 343.26 | 592 | 1812 | 24.6 | .425 |
| **BEAM 375** | | | | | |
| 0 | 25.06 | 19 | 12 | 60.7 | 0.005 |
| 1000 | 55.06 | 45 | 32 | 58.4 | .015 |
| 2000 | 85.06 | 69 | 53 | 56.6 | .025 |
| 3000 | 115.06 | 92 | 77 | 54.6 | .040 |
| 4000 | 145.06 | 122 | 106 | 53.6 | .050 |
| 5000 | 175.06 | 157 | 147 | 51.7 | .065 |
| 6000 | 205.06 | 204 | 220 | 48.1 | .090 |
| 7000 | 235.06 | 267 | 362 | 42.5 | .130 |
| 8000 | 265.06 | 324 | 511 | 38.8 | .165 |
| 9000 | 295.06 | 376 | 650 | 36.7 | .205 |
| 10 000 | 325.06 | 422 | 776 | 35.2 | .240 |
| 11 000 | 355.06 | 478 | 899 | 34.7 | .285 |
| 12 000 | 385.06 | 523 | 1024 | 33.8 | .320 |
| 13 000 | 415.06 | 573 | 1152 | 33.2 | .365 |
| 14 000 | 445.06 | 625 | 1270 | 33.0 | .405 |
| 15 000 | 475.06 | 683 | 1415 | 32.6 | .445 |
| 15 780 | 498.46 | | 1579 | | .500 |
| 12 900 | 412.06 | 644 | 1362 | 32.1 | .510 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 376**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 24.85 | 16 | 10 | 62.0 | 0.010 |
| 1000 | 54.85 | 43 | 36 | 54.4 | .020 |
| 2000 | 84.85 | 68 | 56 | 54.9 | .030 |
| 3000 | 114.85 | 94 | 79 | 54.2 | .040 |
| 4000 | 144.85 | 125 | 109 | 53.4 | .055 |
| 5000 | 174.85 | 165 | 164 | 50.2 | .070 |
| 6000 | 204.85 | 216 | 243 | 47.1 | .100 |
| 7000 | 234.85 | 273 | 368 | 42.6 | .135 |
| 8000 | 264.85 | 329 | 518 | 38.9 | .175 |
| 9000 | 294.85 | 372 | 643 | 36.6 | .215 |
| 10 000 | 324.85 | 425 | 762 | 35.8 | .255 |
| 11 000 | 354.85 | 470 | 884 | 34.7 | .295 |
| 12 000 | 384.85 | 511 | 983 | 34.2 | .330 |
| 13 000 | 414.85 | 560 | 1101 | 33.7 | .375 |
| 14 000 | 444.85 | 599 | 1205 | 33.2 | .410 |
| 14 990 | 474.55 | ........ | 1328 | ........ | .470 |
| 12 850 | 410.35 | 593 | 1193 | 33.2 | .475 |

**BEAM 377**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 24.85 | 17 | 22 | 43.5 | 0.010 |
| 1000 | 54.85 | 45 | 43 | 51.4 | .020 |
| 2000 | 84.85 | 69 | 68 | 50.3 | .025 |
| 3000 | 114.85 | 96 | 91 | 51.4 | .035 |
| 4000 | 144.85 | 123 | 116 | 51.5 | .050 |
| 5000 | 174.85 | 156 | 161 | 49.2 | .065 |
| 6000 | 204.85 | 205 | 239 | 46.2 | .090 |
| 7000 | 234.85 | 263 | 373 | 41.3 | .120 |
| 8000 | 264.85 | 322 | 520 | 38.3 | .165 |
| 9000 | 294.85 | 374 | 643 | 36.8 | .205 |
| 10 000 | 324.85 | 428 | 774 | 35.6 | .245 |
| 11 000 | 354.85 | 478 | 899 | 34.7 | .285 |
| 12 000 | 384.85 | 528 | 1027 | 33.9 | .325 |
| 13 000 | 414.85 | 571 | 1142 | 33.3 | .360 |
| 14 000 | 444.85 | 627 | 1267 | 33.1 | .405 |
| 15 000 | 474.85 | 693 | 1448 | 32.4 | .455 |
| 15 360 | 485.65 | ........ | 1543 | ........ | .490 |
| 12 650 | 404.35 | 637 | 1357 | 31.9 | .500 |

**BEAM 387**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 25.47 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.47 | 45 | 36 | 55.6 | .020 |
| 2000 | 85.47 | 73 | 56 | 56.7 | .030 |
| 3000 | 115.47 | 101 | 77 | 56.7 | .040 |
| 4000 | 145.47 | 132 | 99 | 57.1 | .050 |
| 5000 | 175.47 | 169 | 138 | 55.1 | .065 |
| 6000 | 205.47 | 219 | 195 | 52.9 | .085 |
| 7000 | 235.47 | 278 | 285 | 49.4 | .115 |
| 8000 | 265.47 | 338 | 390 | 46.5 | .145 |
| 9000 | 295.47 | 398 | 521 | 43.3 | .190 |
| 10 000 | 325.47 | 450 | 612 | 42.4 | .225 |
| 11 000 | 355.47 | 499 | 711 | 41.3 | .255 |
| 12 000 | 385.47 | 554 | 817 | 40.4 | .295 |
| 13 000 | 415.47 | 604 | 920 | 39.6 | .325 |
| 14 000 | 445.47 | 657 | 1026 | 39.0 | .365 |
| 15 000 | 475.47 | 701 | 1126 | 38.4 | .400 |
| 16 000 | 505.47 | 788 | 1249 | 38.7 | .440 |
| 16 880 | 531.87 | ........ | 1607 | ........ | .525 |
| 14 500 | 460.47 | 910 | 2140 | 29.8 | .545 |

**BEAM 388**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 25.26 | 17 | 15 | 52.5 | 0.010 |
| 1000 | 55.26 | 42 | 36 | 53.8 | .020 |
| 2000 | 85.26 | 66 | 55 | 54.6 | .030 |
| 3000 | 115.26 | 95 | 74 | 56.3 | .040 |
| 4000 | 145.26 | 120 | 99 | 54.8 | .050 |
| 5000 | 175.26 | 157 | 140 | 52.8 | .065 |
| 6000 | 205.26 | 200 | 217 | 47.9 | .090 |
| 7000 | 235.26 | 255 | 325 | 44.0 | .120 |
| 8000 | 265.26 | 311 | 453 | 40.6 | .160 |
| 9000 | 295.26 | 359 | 585 | 38.0 | .190 |
| 10 000 | 325.26 | 410 | 704 | 36.8 | .225 |
| 11 000 | 355.26 | 450 | 832 | 35.1 | .265 |
| 12 000 | 385.26 | 497 | 930 | 34.8 | .295 |
| 13 000 | 415.26 | 542 | 1031 | 34.4 | .330 |
| 14 000 | 445.26 | 590 | 1137 | 34.2 | .365 |
| 15 000 | 475.26 | 630 | 1232 | 33.8 | .395 |
| 16 000 | 505.26 | 680 | 1340 | 33.7 | .435 |
| 17 000 | 535.26 | ........ | 1516 | ........ | .485 |
| 15 000 | 475.26 | 758 | 1930 | 28.2 | .500 |

**BEAM 389**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 25.47 | 17 | 15 | 52.5 | 0.005 |
| 1000 | 55.47 | 47 | 39 | 54.8 | .015 |
| 2000 | 85.47 | 69 | 60 | 53.7 | .025 |
| 3000 | 115.47 | 101 | 82 | 55.2 | .035 |
| 4000 | 145.47 | 130 | 106 | 55.0 | .050 |
| 5000 | 175.47 | 164 | 138 | 54.3 | .065 |
| 6000 | 205.47 | 216 | 210 | 50.7 | .085 |
| 7000 | 235.47 | 273 | 299 | 47.7 | .115 |
| 8000 | 265.47 | 331 | 412 | 44.6 | .155 |
| 9000 | 295.47 | 383 | 528 | 42.0 | .185 |
| 10 000 | 325.47 | 432 | 650 | 39.9 | .225 |
| 11 000 | 355.47 | 484 | 762 | 38.9 | .260 |
| 12 000 | 385.47 | 532 | 863 | 38.1 | .295 |
| 13 000 | 415.47 | 580 | 966 | 37.5 | .325 |
| 14 000 | 445.47 | 629 | 1072 | 37.0 | .365 |
| 15 000 | 475.47 | 680 | 1171 | 36.8 | .395 |
| 16 000 | 505.47 | 731 | 1272 | 36.5 | .435 |
| 16 980 | 534.87 | ........ | 1463 | ........ | .485 |
| 14 350 | 455.97 | 806 | 2046 | 28.2 | .510 |

**BEAM 399**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 25.47 | 17 | 15 | 52.5 | 0.005 |
| 1000 | 55.47 | 47 | 34 | 58.0 | .015 |
| 2000 | 85.47 | 69 | 53 | 56.6 | .025 |
| 3000 | 115.47 | 98 | 74 | 56.9 | .035 |
| 4000 | 145.47 | 127 | 97 | 56.7 | .045 |
| 5000 | 175.47 | 159 | 126 | 55.8 | .060 |
| 6000 | 205.47 | 198 | 173 | 53.3 | .075 |
| 7000 | 235.47 | 246 | 244 | 50.3 | .100 |
| 8000 | 265.47 | 297 | 335 | 47.0 | .125 |
| 9000 | 295.47 | 349 | 446 | 43.9 | .160 |
| 10 000 | 325.47 | 399 | 544 | 42.3 | .190 |
| 11 000 | 355.47 | 444 | 634 | 41.2 | .220 |
| 12 000 | 385.47 | 492 | 723 | 40.5 | .245 |
| 13 000 | 415.47 | 540 | 814 | 39.9 | .275 |
| 14 000 | 445.47 | 587 | 896 | 39.6 | .310 |
| 15 000 | 475.47 | 630 | 979 | 39.2 | .335 |
| 16 000 | 505.47 | 678 | 1068 | 38.8 | .365 |
| 17 000 | 535.47 | 726 | 1154 | 38.6 | .395 |
| 18 000 | 565.47 | 778 | 1250 | 38.4 | .430 |
| 19 000 | 595.47 | 828 | 1338 | 38.2 | .460 |
| 19 650 | 614.97 | ........ | 1496 | ........ | .495 |
| 17 400 | 547.47 | 940 | 2048 | 31.4 | .525 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 400**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.68 | 17 | 14 | 54.1 | 0.005 |
| 1000 | 55.68 | 42 | 32 | 56.6 | .015 |
| 2000 | 85.68 | 62 | 51 | 54.7 | .025 |
| 3000 | 115.68 | 90 | 72 | 55.6 | .035 |
| 4000 | 145.68 | 114 | 92 | 55.4 | .045 |
| 5000 | 175.68 | 147 | 126 | 53.8 | .060 |
| 6000 | 205.68 | 187 | 174 | 51.8 | .075 |
| 7000 | 235.68 | 223 | 239 | 48.3 | .100 |
| 8000 | 265.68 | 277 | 337 | 45.1 | .125 |
| 9000 | 295.68 | 316 | 429 | 42.4 | .155 |
| 10 000 | 325.68 | 361 | 533 | 40.4 | .185 |
| 11 000 | 355.68 | 401 | 629 | 39.0 | .215 |
| 12 000 | 385.68 | 441 | 720 | 38.0 | .245 |
| 13 000 | 415.68 | 485 | 809 | 37.5 | .270 |
| 14 000 | 445.68 | 527 | 894 | 37.1 | .305 |
| 15 000 | 475.68 | 569 | 974 | 36.9 | .330 |
| 16 000 | 505.68 | 606 | 1056 | 36.5 | .360 |
| 17 000 | 535.68 | 648 | 1140 | 36.3 | .390 |
| 18 000 | 565.68 | 694 | 1229 | 36.1 | .420 |
| 19 000 | 595.68 | 741 | 1313 | 36.1 | .455 |
| 20 000 | 625.68 | ........ | 1415 | ........ | .495 |
| 17 500 | 550.68 | 828 | 2041 | 28.9 | .530 |

**BEAM 401**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 17 | 19 | 46.9 | 0.010 |
| 1000 | 55.47 | 43 | 38 | 53.1 | .015 |
| 2000 | 85.47 | 64 | 58 | 52.5 | .025 |
| 3000 | 115.47 | 94 | 79 | 54.2 | .035 |
| 4000 | 145.47 | 122 | 102 | 54.5 | .045 |
| 5000 | 175.47 | 157 | 140 | 52.8 | .060 |
| 6000 | 205.47 | 196 | 198 | 49.7 | .080 |
| 7000 | 235.47 | 243 | 273 | 47.1 | .105 |
| 8000 | 265.47 | 293 | 371 | 44.1 | .135 |
| 9000 | 295.47 | 347 | 475 | 42.2 | .165 |
| 10 000 | 325.47 | 391 | 585 | 40.0 | .195 |
| 11 000 | 355.47 | 437 | 687 | 38.9 | .225 |
| 12 000 | 385.47 | 474 | 769 | 38.1 | .250 |
| 13 000 | 415.47 | 520 | 860 | 37.7 | .285 |
| 14 000 | 445.47 | 560 | 945 | 37.2 | .310 |
| 15 000 | 475.47 | 602 | 1031 | 36.8 | .335 |
| 16 000 | 505.47 | 649 | 1113 | 36.8 | .370 |
| 17 000 | 535.47 | 689 | 1202 | 36.5 | .400 |
| 18 000 | 565.47 | 740 | 1290 | 36.4 | .430 |
| 19 000 | 595.47 | 802 | 1456 | 35.5 | .475 |
| 19 380 | 606.87 | ........ | 1578 | ........ | .505 |
| 17 450 | 548.97 | 842 | 2055 | 29.1 | .515 |

**BEAM 412**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 17 | 15 | 52.5 | 0.005 |
| 1000 | 55.47 | 42 | 36 | 53.8 | .010 |
| 2000 | 85.47 | 66 | 55 | 54.6 | .020 |
| 3000 | 115.47 | 85 | 77 | 52.5 | .030 |
| 4000 | 145.47 | 114 | 97 | 53.9 | .040 |
| 5000 | 175.47 | 141 | 125 | 53.1 | .055 |
| 6000 | 205.47 | 178 | 159 | 52.8 | .070 |
| 7000 | 235.47 | 218 | 207 | 51.3 | .090 |
| 8000 | 265.47 | 267 | 289 | 48.0 | .110 |
| 9000 | 295.47 | 318 | 369 | 46.3 | .140 |
| 10 000 | 325.47 | 368 | 468 | 44.0 | .170 |
| 11 000 | 355.47 | 409 | 557 | 42.4 | .195 |
| 12 000 | 385.47 | 442 | 634 | 41.1 | .220 |
| 13 000 | 415.47 | 481 | 723 | 40.0 | .250 |
| 14 000 | 445.47 | 519 | 802 | 39.3 | .280 |
| 15 000 | 475.47 | 569 | 896 | 38.8 | .310 |
| 16 000 | 505.47 | 604 | 979 | 38.2 | .340 |
| 17 000 | 535.47 | 646 | 1050 | 38.1 | .360 |
| 18 000 | 565.47 | 691 | 1128 | 38.0 | .390 |
| 19 000 | 595.47 | 733 | 1207 | 37.8 | .420 |
| 20 000 | 625.47 | 781 | 1292 | 37.7 | .455 |
| 21 000 | 655.47 | 828 | 1383 | 37.5 | .490 |
| 22 000 | 685.47 | 878 | 1492 | 37.0 | .530 |

**BEAM 413**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 16 | 17 | 47.9 | 0.010 |
| 1000 | 55.88 | 40 | 38 | 51.2 | .020 |
| 2000 | 85.88 | 59 | 58 | 50.4 | .030 |
| 3000 | 115.88 | 87 | 75 | 53.7 | .040 |
| 4000 | 145.88 | 109 | 96 | 53.2 | .050 |
| 5000 | 175.88 | 141 | 125 | 53.1 | .060 |
| 6000 | 205.88 | 176 | 162 | 52.1 | .075 |
| 7000 | 235.88 | 216 | 212 | 50.5 | .095 |
| 8000 | 265.88 | 266 | 291 | 47.7 | .120 |
| 9000 | 295.88 | 315 | 376 | 45.5 | .145 |
| 10 000 | 325.88 | 362 | 458 | 44.1 | .175 |
| 11 000 | 355.88 | 404 | 538 | 42.9 | .200 |
| 12 000 | 385.88 | 441 | 617 | 41.7 | .230 |
| 13 000 | 415.88 | 483 | 692 | 41.1 | .260 |
| 14 000 | 445.88 | 524 | 764 | 40.7 | .285 |
| 15 000 | 475.88 | 562 | 836 | 40.2 | .310 |
| 16 000 | 505.88 | 602 | 918 | 39.6 | .340 |
| 17 000 | 535.88 | 638 | 991 | 39.1 | .365 |
| 18 000 | 565.88 | 683 | 1068 | 39.0 | .395 |
| 19 000 | 595.88 | 725 | 1149 | 38.7 | .425 |
| 20 000 | 625.88 | 767 | 1236 | 38.3 | .455 |
| 21 000 | 655.88 | 810 | 1316 | 38.1 | .480 |
| 22 000 | 685.88 | 901 | 1550 | 36.8 | .555 |
| 20 000 | 625.88 | 854 | 1491 | 36.4 | .580 |

**BEAM 342**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.44 | 19 | 19 | 49.9 | 0.005 |
| 1000 | 54.44 | 43 | 38 | 53.1 | .015 |
| 1500 | 69.44 | 57 | 53 | 51.6 | .020 |
| 2000 | 84.44 | 69 | 63 | 52.1 | .025 |
| 3000 | 114.44 | 91 | 89 | 50.6 | .030 |
| 3500 | 129.44 | 110 | 103 | 51.6 | .040 |
| 4000 | 144.44 | 134 | 138 | 49.2 | .050 |
| 4500 | 159.44 | 166 | 219 | 43.2 | .070 |
| 5000 | 174.44 | 217 | 368 | 37.1 | .100 |
| 5500 | 189.44 | 260 | 561 | 31.7 | .160 |
| 6000 | 204.44 | 325 | 872 | 27.1 | .220 |
| 6280 | 212.84 | ........ | 1091 | ........ | .250 |
| 5300 | 183.44 | 389 | 1781 | 15.9 | .320 |

**BEAM 343**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.44 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 54.44 | 45 | 43 | 51.4 | .020 |
| 1500 | 69.44 | 59 | 60 | 49.6 | .025 |
| 2000 | 84.44 | 74 | 72 | 50.8 | .035 |
| 2500 | 99.44 | 88 | 84 | 51.0 | .040 |
| 3000 | 114.44 | 102 | 99 | 50.8 | .045 |
| 3500 | 129.44 | 118 | 115 | 50.6 | .050 |
| 4000 | 144.44 | 135 | 142 | 48.7 | .060 |
| 4500 | 159.44 | 168 | 200 | 45.7 | .085 |
| 5000 | 174.44 | 226 | 386 | 36.9 | .135 |
| 5500 | 189.44 | 282 | 603 | 31.9 | .185 |
| 5800 | 198.44 | ........ | 773 | ........ | .265 |
| 5100 | 177.44 | 307 | 740 | 29.3 | .345 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 344** | | | | | |
| 0 | 24.64 | 24 | 17 | 58.6 | 0.010 |
| 1000 | 54.64 | 55 | 39 | 58.4 | .020 |
| 2000 | 84.64 | 84 | 65 | 56.5 | .035 |
| 3000 | 114.64 | 120 | 101 | 54.3 | .045 |
| 3500 | 129.64 | 138 | 126 | 52.3 | .055 |
| 4000 | 144.64 | 170 | 183 | 48.1 | .075 |
| 4500 | 159.64 | 223 | 332 | 40.2 | .115 |
| 5000 | 174.64 | 293 | 610 | 32.5 | .175 |
| 5500 | 189.64 | 338 | 786 | 30.1 | .215 |
| 6000 | 204.64 | 382 | 947 | 28.8 | .275 |
| 6500 | 219.64 | 420 | 1111 | 27.5 | .325 |
| 6800 | 228.64 | ........ | 1169 | ........ | .365 |
| 5700 | 195.64 | 413 | 1113 | 27.1 | .415 |
| **BEAM 354** | | | | | |
| 0 | 24.64 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 54.64 | 45 | 39 | 53.7 | .020 |
| 2000 | 84.64 | 74 | 62 | 54.3 | .030 |
| 3000 | 114.64 | 100 | 85 | 54.1 | .040 |
| 4000 | 144.64 | 131 | 121 | 51.9 | .050 |
| 5000 | 174.64 | 178 | 193 | 47.9 | .075 |
| 6000 | 204.64 | 271 | 424 | 39.0 | .136 |
| 7000 | 234.64 | 345 | 674 | 33.9 | .200 |
| 8000 | 264.64 | 411 | 901 | 31.3 | .260 |
| 9000 | 294.64 | 488 | 1142 | 30.0 | .320 |
| 9600 | 312.64 | ........ | 1456 | ........ | .370 |
| 8400 | 276.64 | 596 | 2207 | 21.3 | .450 |
| **BEAM 355** | | | | | |
| 0 | 24.64 | 19 | 19 | 49.9 | 0.010 |
| 1000 | 54.64 | 43 | 39 | 52.5 | .020 |
| 2000 | 84.64 | 68 | 60 | 53.3 | .030 |
| 3000 | 114.64 | 94 | 80 | 53.9 | .040 |
| 3500 | 129.64 | 109 | 94 | 53.7 | .050− |
| 4000 | 144.64 | 127 | 115 | 52.5 | .050+ |
| 5000 | 174.64 | 166 | 168 | 49.7 | .070 |
| 6000 | 204.64 | 257 | 434 | 37.1 | .120 |
| 7000 | 234.64 | 332 | 709 | 31.9 | .190 |
| 8000 | 264.64 | 398 | 921 | 30.2 | .250 |
| 9000 | 294.64 | 457 | 1111 | 29.2 | .300 |
| 10 000 | 324.64 | 513 | 1306 | 28.2 | .360 |
| 10 450 | 338.14 | ........ | 1444 | ........ | (.420) |
| 8200 | 270.64 | 545 | 2046 | 21.0 | .430 |
| **BEAM 356** | | | | | |
| 0 | 24.44 | 23 | 19 | 54.9 | 0.005 |
| 1000 | 54.44 | 47 | 36 | 56.7 | .020 |
| 2000 | 84.44 | 75 | 58 | 56.3 | .030 |
| 3000 | 114.44 | 101 | 84 | 54.7 | .040 |
| 3500 | 129.44 | 117 | 97 | 54.6 | .045 |
| 4000 | 144.44 | 133 | 115 | 53.7 | .050 |
| 4500 | 159.44 | 155 | 140 | 52.5 | .060 |
| 5000 | 174.44 | 179 | 176 | 50.4 | .070 |
| 5500 | 189.44 | 219 | 268 | 45.0 | .090 |
| 6000 | 204.44 | 277 | 448 | 38.2 | .135 |
| 7000 | 234.44 | 354 | 711 | 33.3 | .200 |
| 8000 | 264.44 | 416 | 921 | 31.1 | .260 |
| 9000 | 294.44 | 477 | 1123 | 29.8 | .320 |
| 9950 | 322.94 | ........ | 1431 | ........ | .380 |
| 8300 | 273.44 | 571 | 2209 | 20.5 | .435 |
| **BEAM 366** | | | | | |
| 0 | 24.85 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 54.85 | 43 | 34 | 55.8 | .020 |
| 2000 | 84.85 | 71 | 56 | 56.0 | .030 |
| 3000 | 114.85 | 98 | 82 | 54.4 | .040 |
| 3500 | 129.85 | 112 | 101 | 52.5 | .050 |
| 4000 | 144.85 | 125 | 113 | 52.5 | .055 |
| 4600 | 162.85 | 142 | 130 | 52.1 | .060 |
| 5000 | 174.85 | 159 | 145 | 52.3 | .070 |
| 6000 | 204.85 | 203 | 205 | 49.8 | .080 |
| 7000 | 234.85 | 277 | 386 | 41.8 | .130 |
| 8000 | 264.85 | 338 | 600 | 36.0 | .180 |
| 9000 | 294.85 | 396 | 785 | 33.5 | .230 |
| 10 000 | 324.85 | 441 | 954 | 31.6 | .270 |
| 11 000 | 354.85 | 488 | 1096 | 30.8 | .310 |
| 12 000 | 384.85 | 547 | 1236 | 30.7 | .360 |
| 13 000 | 414.85 | 596 | 1374 | 30.2 | .400 |
| 13 950 | 443.35 | ........ | 1562 | ........ | .470 |
| 11 000 | 354.85 | 651 | 2248 | 22.5 | .490 |
| **BEAM 367** | | | | | |
| 0 | 25.26 | 16 | 19 | 45.3 | 0.010 |
| 1000 | 55.26 | 43 | 36 | 54.4 | .020 |
| 2000 | 85.26 | 69 | 56 | 55.3 | .025 |
| 3000 | 115.26 | 93 | 80 | 55.3 | .035 |
| 4000 | 145.26 | 125 | 111 | 52.9 | .045 |
| 5000 | 175.26 | 165 | 156 | 51.4 | .065 |
| 6000 | 205.26 | 214 | 244 | 46.7 | .090 |
| 7000 | 235.26 | 273 | 371 | 42.4 | .125 |
| 8000 | 265.26 | 334 | 561 | 37.3 | .175 |
| 9000 | 295.26 | 393 | 723 | 35.2 | .220 |
| 10 000 | 325.26 | 441 | 860 | 33.9 | .260 |
| 11 000 | 355.26 | 492 | 1009 | 32.8 | .305 |
| 12 000 | 385.26 | 539 | 1137 | 32.2 | .345 |
| 13 000 | 415.26 | 595 | 1279 | 31.7 | .390 |
| 13 870 | 441.36 | ........ | 1439 | ........ | ........ |
| 10 850 | 350.76 | 642 | 2265 | 22.1 | .465 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 368**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 19 | 14 | 57.1 | 0.010 |
| 1000 | 55.06 | 54 | 22 | 71.0 | .020 |
| 2000 | 85.06 | 86 | 34 | 71.7 | .030 |
| 3000 | 115.06 | 115 | 56 | 67.2 | .040 |
| 3500 | 130.06 | 131 | 72 | 64.6 | .050 |
| 4000 | 145.06 | 150 | 87 | 63.3 | .055 |
| 4500 | 160.06 | 166 | 106 | 61.0 | .060 |
| 5000 | 175.06 | 187 | 130 | 59.0 | .070 |
| 6000 | 205.06 | 237 | 200 | 54.2 | .090 |
| 7000 | 235.06 | 311 | 364 | 46.1 | .135 |
| 8000 | 265.06 | 374 | 547 | 40.6 | .185 |
| 9000 | 295.06 | 431 | 703 | 38.0 | .235 |
| 10 000 | 325.06 | 481 | 843 | 36.3 | .275 |
| 11 000 | 355.06 | 534 | 976 | 35.3 | .320 |
| 12 000 | 385.06 | 581 | 1103 | 34.5 | .365 |
| 13 000 | 415.06 | 635 | 1232 | 34.0 | .405 |
| 13 890 | 441.76 | ....... | 1390 | ....... | ....... |
| 10 800 | 349.06 | 692 | 2174 | 24.2 | .480 |

**BEAM 378**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.28 | 23 | 28 | 45.7 | 0.015 |
| 1000 | 56.28 | 42 | 47 | 46.9 | .025 |
| 2000 | 86.28 | 64 | 68 | 48.7 | .040 |
| 3000 | 116.28 | 88 | 94 | 48.4 | .050 |
| 4000 | 146.28 | 117 | 132 | 46.9 | .065 |
| 5000 | 176.28 | 161 | 190 | 46.0 | .080 |
| 6000 | 206.28 | 210 | 260 | 44.7 | .110 |
| 7000 | 236.28 | 277 | 377 | 42.3 | .150 |
| 8000 | 266.28 | 331 | 495 | 40.1 | .195 |
| 9000 | 296.28 | 389 | 619 | 38.6 | .235 |
| 10 000 | 326.28 | 443 | 743 | 37.4 | .275 |
| 11 000 | 356.28 | 493 | 859 | 36.5 | .315 |
| 12 000 | 386.28 | 542 | 973 | 35.8 | .355 |
| 13 000 | 416.28 | 593 | 1090 | 35.2 | .395 |
| 14 000 | 446.28 | 648 | 1210 | 34.9 | .440 |
| 14 230 | 453.18 | ....... | ....... | ....... | ....... |
| 11 700 | 377.28 | 724 | 1926 | 27.3 | .500 |

**BEAM 379**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.06 | 26 | 15 | 63.5 | 0.005 |
| 1000 | 55.06 | 51 | 41 | 55.2 | .015 |
| 2000 | 85.06 | 77 | 62 | 55.4 | .025 |
| 3000 | 115.06 | 107 | 87 | 55.1 | .040 |
| 4000 | 145.06 | 134 | 118 | 53.1 | .055 |
| 5000 | 175.06 | 171 | 168 | 50.4 | .070 |
| 6000 | 205.06 | 216 | 239 | 47.4 | .090 |
| 7000 | 235.06 | 282 | 361 | 43.9 | .130 |
| 8000 | 265.06 | 341 | 499 | 40.6 | .170 |
| 9000 | 295.06 | 393 | 632 | 38.4 | .210 |
| 10 000 | 325.06 | 446 | 749 | 37.3 | .255 |
| 11 000 | 355.06 | 501 | 870 | 36.5 | .295 |
| 12 000 | 385.06 | 551 | 993 | 35.7 | .335 |
| 13 000 | 415.06 | 604 | 1104 | 35.3 | .375 |
| 14 000 | 445.06 | 657 | 1234 | 34.7 | .420 |
| 14 850 | 470.56 | ....... | 1364 | ....... | .480 |
| 12 000 | 385.06 | 648 | 1274 | 33.7 | .505 |

**BEAM 380**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 24.64 | 16 | 17 | 47.9 | 0.005 |
| 1000 | 54.64 | 47 | 39 | 54.8 | .020 |
| 2000 | 84.64 | 74 | 62 | 54.3 | .030 |
| 3000 | 114.64 | 104 | 87 | 54.3 | .040 |
| 4000 | 144.64 | 136 | 120 | 53.1 | .055 |
| 5000 | 174.64 | 180 | 173 | 50.9 | .070 |
| 6000 | 204.64 | 229 | 248 | 48.0 | .095 |
| 7000 | 234.64 | 288 | 371 | 43.7 | .130 |
| 8000 | 264.64 | 347 | 532 | 39.5 | .175 |
| 9000 | 294.64 | 401 | 685 | 36.9 | .215 |
| 10 000 | 324.64 | 454 | 831 | 35.3 | .260 |
| 11 000 | 354.64 | 504 | 954 | 34.6 | .300 |
| 12 000 | 384.64 | 552 | 1082 | 33.8 | .335 |
| 13 000 | 414.64 | 608 | 1224 | 33.2 | .380 |
| 13 750 | 437.14 | ....... | 1366 | ....... | .420 |
| 14 000 | 444.64 | 691 | 1568 | 30.6 | .460 |
| 12 100 | 387.64 | 702 | 1974 | 26.2 | .470 |

**BEAM 390**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.69 | 28 | 22 | 55.5 | 0.010 |
| 1000 | 56.69 | 49 | 33 | 59.9 | .020 |
| 2000 | 86.69 | 55 | 70 | 44.1 | .030 |
| 3000 | 116.69 | 82 | 71 | 53.5 | .040 |
| 4000 | 146.69 | 114 | 86 | 57.0 | .050 |
| 5000 | 176.69 | 146 | 105 | 58.3 | .065 |
| 6000 | 206.69 | 195 | 163 | 54.5 | .080 |
| 7000 | 236.69 | 246 | 225 | 52.3 | .105 |
| 8000 | 266.69 | 313 | 322 | 49.3 | .145 |
| 9000 | 296.69 | 369 | 427 | 46.3 | .180 |
| 10 000 | 326.69 | 423 | 539 | 44.0 | .220 |
| 11 000 | 356.69 | 480 | 635 | 43.0 | .260 |
| 12 000 | 386.69 | 530 | 727 | 42.2 | .290 |
| 13 000 | 416.69 | 583 | 825 | 41.4 | .330 |
| 14 000 | 446.69 | 636 | 915 | 41.0 | .365 |
| 15 000 | 476.69 | 686 | 1013 | 40.4 | .405 |
| 16 000 | 506.69 | 733 | 1105 | 39.9 | .435 |
| 16 980 | 536.09 | ....... | ....... | ....... | ....... |
| 14 400 | 458.69 | 813 | 1896 | 30.0 | .510 |

**BEAM 391**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 26 | 12 | 68.3 | 0.005 |
| 1000 | 55.47 | 52 | 29 | 64.2 | .015 |
| 2000 | 85.47 | 78 | 51 | 60.6 | .025 |
| 3000 | 115.47 | 103 | 75 | 57.8 | .035 |
| 4000 | 145.47 | 127 | 92 | 58.0 | .045 |
| 5000 | 175.47 | 158 | 125 | 55.9 | .060 |
| 6000 | 205.47 | 201 | 193 | 51.0 | .080 |
| 7000 | 235.47 | 245 | 280 | 46.7 | .105 |
| 8000 | 265.47 | 321 | 390 | 45.1 | .140 |
| 9000 | 295.47 | 370 | 513 | 41.9 | .170 |
| 10 000 | 325.47 | 436 | 622 | 41.2 | .210 |
| 11 000 | 355.47 | 480 | 737 | 39.4 | .245 |
| 12 000 | 385.47 | 525 | 853 | 38.1 | .275 |
| 13 000 | 415.47 | 573 | 973 | 37.1 | .310 |
| 14 000 | 445.47 | 620 | 1080 | 36.5 | .345 |
| 15 000 | 475.47 | 663 | 1186 | 35.9 | .380 |
| 16 000 | 505.47 | 714 | 1291 | 35.6 | .415 |
| 17 000 | 535.47 | 760 | 1391 | 35.4 | .455 |
| 17 440 | 548.67 | ....... | 1487 | ....... | .490 |
| 14 500 | 460.47 | 808 | 2087 | 27.9 | .515 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 392**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 21 | 14 | 59.7 | 0.005 |
| 1000 | 55.26 | 43 | 44 | 49.6 | .015 |
| 2000 | 85.26 | 65 | 78 | 48.7 | .025 |
| 3000 | 115.26 | 89 | 91 | 49.4 | .035 |
| 4000 | 145.26 | 115 | 120 | 48.9 | .050 |
| 5000 | 175.26 | 145 | 154 | 48.5 | .060 |
| 6000 | 205.26 | 184 | 221 | 45.5 | .085 |
| 7000 | 235.26 | 236 | 309 | 43.3 | .105 |
| 8000 | 265.26 | 292 | 422 | 40.9 | .140 |
| 9000 | 295.26 | 357 | 564 | 38.8 | .185 |
| 10 000 | 325.26 | 408 | 667 | 37.9 | .220 |
| 11 000 | 355.26 | 464 | 768 | 37.6 | .260 |
| 12 000 | 385.26 | 520 | 884 | 37.0 | .295 |
| 13 000 | 415.26 | 570 | 986 | 36.6 | .325 |
| 14 000 | 445.26 | 623 | 1094 | 36.3 | .365 |
| 15 000 | 475.26 | 673 | 1202 | 35.9 | .400 |
| 16 000 | 505.26 | 728 | 1309 | 35.7 | .440 |
| 17 000 | 535.26 | 809 | 1533 | 34.5 | .495 |
| 17 250 | 542.76 | ........ | 1668 | ........ | .525 |
| 14 400 | 457.26 | 894 | 2528 | 26.1 | .575 |

**BEAM 404**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.47 | 19 | 17 | 52.5 | 0.010 |
| 1000 | 55.47 | 43 | 39 | 52.5 | .020 |
| 2000 | 85.47 | 68 | 60 | 53.3 | .030 |
| 3000 | 115.47 | 96 | 79 | 54.8 | .040 |
| 4000 | 145.47 | 120 | 101 | 54.3 | .050 |
| 5000 | 175.47 | 147 | 126 | 53.8 | .060 |
| 6000 | 205.47 | 186 | 171 | 52.1 | .075 |
| 7000 | 235.47 | 236 | 239 | 49.7 | .100 |
| 8000 | 265.47 | 289 | 333 | 46.5 | .125 |
| 9000 | 295.47 | 335 | 431 | 43.8 | .155 |
| 10 000 | 325.47 | 388 | 537 | 42.0 | .190 |
| 11 000 | 355.47 | 442 | 646 | 40.6 | .220 |
| 12 000 | 385.47 | 485 | 737 | 39.7 | .255 |
| 13 000 | 415.47 | 535 | 826 | 39.3 | .285 |
| 14 000 | 445.47 | 592 | 920 | 39.1 | .320 |
| 15 000 | 475.47 | 631 | 998 | 38.8 | .345 |
| 16 000 | 505.47 | 678 | 1084 | 38.5 | .375 |
| 17 000 | 535.47 | 722 | 1174 | 38.1 | .405 |
| 18 000 | 565.47 | 780 | 1274 | 38.0 | .445 |
| 19 000 | 595.47 | 826 | 1374 | 37.5 | .475 |
| 20 000 | 625.47 | 896 | 1568 | 36.4 | .525 |
| 20 200 | 631.47 | ........ | 1771 | ........ | ........ |
| 18 300 | 574.47 | 962 | 2166 | 30.7 | .575 |

**BEAM 402**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.90 | 37 | 19 | 66.0 | 0.010 |
| 1000 | 56.90 | 54 | 30 | 64.3 | .015 |
| 2000 | 86.90 | 81 | 46 | 63.9 | .030 |
| 3000 | 116.90 | 109 | 61 | 64.0 | .040 |
| 4000 | 146.90 | 137 | 83 | 62.3 | .050 |
| 5000 | 176.90 | 169 | 108 | 61.2 | .060 |
| 6000 | 206.90 | 206 | 145 | 58.8 | .075 |
| 7000 | 236.90 | 247 | 195 | 55.9 | .095 |
| 8000 | 266.90 | 299 | 277 | 51.9 | .120 |
| 9000 | 296.90 | 352 | 372 | 48.6 | .155 |
| 10 000 | 326.90 | 405 | 445 | 47.6 | .185 |
| 11 000 | 356.90 | 449 | 570 | 44.1 | .215 |
| 12 000 | 386.90 | 497 | 661 | 42.9 | .250 |
| 13 100 | 419.90 | 551 | 764 | 41.9 | .285 |
| 14 000 | 446.90 | 592 | 844 | 41.2 | .315 |
| 15 000 | 476.90 | 633 | 928 | 40.5 | .345 |
| 16 000 | 506.90 | 680 | 1014 | 40.1 | .375 |
| 17 000 | 536.90 | 727 | 1102 | 39.7 | .410 |
| 18 000 | 566.90 | 777 | 1186 | 39.6 | .440 |
| 19 000 | 596.90 | 823 | 1295 | 38.9 | .475 |
| 19 920 | 624.50 | ........ | ........ | ........ | ........ |
| 17 050 | 538.40 | 899 | 1938 | 31.7 | .550 |

**BEAM 414**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 23 | 19 | 54.9 | 0.010 |
| 1000 | 55.26 | 47 | 36 | 56.7 | .020 |
| 2000 | 85.26 | 77 | 58 | 57.0 | .030 |
| 3000 | 115.26 | 101 | 75 | 57.3 | .040 |
| 4000 | 145.26 | 129 | 96 | 57.4 | .050 |
| 5000 | 175.26 | 161 | 121 | 57.1 | .060 |
| 6000 | 205.26 | 196 | 157 | 55.5 | .075 |
| 7000 | 235.26 | 245 | 221 | 52.6 | .095 |
| 8000 | 265.26 | 289 | 287 | 50.2 | .120 |
| 9000 | 295.26 | 342 | 374 | 47.8 | .145 |
| 10 000 | 325.26 | 395 | 470 | 45.7 | .175 |
| 11 000 | 355.26 | 441 | 554 | 44.3 | .205 |
| 12 000 | 385.26 | 489 | 643 | 43.2 | .235 |
| 13 000 | 415.26 | 538 | 733 | 42.3 | .265 |
| 14 000 | 445.26 | 581 | 817 | 41.6 | .295 |
| 15 000 | 475.26 | 626 | 892 | 41.2 | .325 |
| 16 000 | 505.26 | 674 | 976 | 40.8 | .355 |
| 17 000 | 535.26 | 719 | 1048 | 40.7 | .385 |
| 18 000 | 565.26 | 761 | 1130 | 40.3 | .415 |
| 19 000 | 595.26 | 810 | 1222 | 39.8 | .445 |
| 20 000 | 625.26 | 861 | 1315 | 39.6 | .480 |
| 21 000 | 655.26 | 948 | 1569 | 37.7 | .525 |
| 21 410 | 667.56 | ........ | 1916 | ........ | .585 |
| 18 700 | 586.26 | 1068 | 2441 | 30.4 | .615 |

**BEAM 403**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.88 | 23 | 14 | 62.0 | 0.010 |
| 1000 | 55.88 | 54 | 29 | 65.1 | .020 |
| 2000 | 85.88 | 84 | 48 | 63.5 | .040 |
| 3000 | 115.88 | 110 | 70 | 61.1 | .055 |
| 4000 | 145.88 | 135 | 96 | 58.4 | .070 |
| 5000 | 175.88 | 163 | 121 | 57.4 | .085 |
| 6000 | 205.88 | 211 | 181 | 53.8 | .110 |
| 7000 | 235.88 | 252 | 244 | 50.8 | .130 |
| 8000 | 265.88 | 308 | 344 | 47.2 | .160 |
| 9000 | 295.88 | 357 | 456 | 43.9 | .200 |
| 10 000 | 325.88 | 406 | 568 | 41.7 | .230 |
| 11 100 | 358.88 | 457 | 679 | 40.2 | .265 |
| 12 000 | 385.88 | 502 | 766 | 39.6 | .300 |
| 13 000 | 415.88 | 550 | 862 | 38.9 | .325 |
| 14 000 | 445.88 | 594 | 961 | 38.2 | .360 |
| 15 000 | 475.88 | 642 | 1058 | 37.8 | .390 |
| 16 000 | 505.88 | 692 | 1152 | 37.5 | .425 |
| 17 000 | 535.88 | 740 | 1244 | 37.3 | .455 |
| 18 000 | 565.88 | 791 | 1345 | 37.0 | .490 |
| 19 000 | 595.88 | 849 | 1475 | 36.5 | .525 |
| 19 860 | 621.68 | ........ | 1675 | ........ | ........ |
| 17 100 | 538.88 | 763 | 1827 | 29.5 | .595 |

**BEAM 415**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 26.69 | 15 | 15 | 49.1 | 0.005 |
| 1000 | 56.69 | 37 | 38 | 49.2 | .015 |
| 2000 | 86.68 | 56 | 53 | 51.1 | .025 |
| 3000 | 116.69 | 79 | 71 | 52.5 | .035 |
| 4000 | 146.69 | 107 | 92 | 53.8 | .045 |
| 5000 | 176.69 | 132 | 115 | 53.5 | .055 |
| 6000 | 206.69 | 171 | 152 | 52.8 | .070 |
| 7000 | 236.69 | 212 | 200 | 51.5 | .090 |
| 8000 | 266.69 | 258 | 258 | 50.0 | .115 |
| 9000 | 296.69 | 304 | 334 | 47.6 | .140 |
| 10 000 | 326.69 | 355 | 423 | 45.6 | .170 |
| 11 000 | 356.69 | 401 | 503 | 44.4 | .200 |
| 12 050 | 388.19 | 452 | 597 | 43.1 | .230 |
| 13 000 | 416.69 | 493 | 673 | 42.3 | .260 |
| 14 000 | 446.69 | 540 | 748 | 41.9 | .285 |
| 15 000 | 476.69 | 581 | 822 | 41.4 | .315 |
| 16 000 | 506.69 | 625 | 896 | 41.1 | .340 |
| 17 000 | 536.69 | 668 | 970 | 40.8 | .370 |
| 18 000 | 566.69 | 716 | 1050 | 40.6 | .400 |
| 19 000 | 596.69 | 757 | 1121 | 40.3 | .430 |
| 20 000 | 626.69 | 810 | 1222 | 39.9 | .460 |
| 21 000 | 656.69 | 845 | 1397 | 37.7 | .500 |
| 21 440 | 669.89 | ........ | ........ | ........ | ........ |
| 19 250 | 604.19 | 973 | 2295 | 29.8 | .585 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 416**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 25.26 | 21 | 17 | 55.1 | 0.010 |
| 1000 | 55.26 | 50 | 38 | 57.0 | .020 |
| 2000 | 85.26 | 75 | 56 | 57.1 | .030 |
| 3000 | 115.26 | 103 | 79 | 56.6 | .040 |
| 4000 | 145.26 | 133 | 103 | 56.3 | .055 |
| 5000 | 175.26 | 167 | 132 | 55.8 | .065 |
| 6000 | 205.26 | 207 | 173 | 54.5 | .085 |
| 7000 | 235.26 | 257 | 238 | 51.9 | .105 |
| 8000 | 265.26 | 308 | 315 | 49.5 | .125 |
| 9000 | 295.26 | 366 | 402 | 47.7 | .160 |
| 10 000 | 325.26 | 418 | 487 | 46.2 | .190 |
| 11 000 | 355.26 | 467 | 579 | 44.7 | .215 |
| 12 000 | 385.26 | 522 | 682 | 43.4 | .250 |
| 13 000 | 415.26 | 565 | 759 | 42.7 | .275 |
| 14 000 | 445.26 | 609 | 839 | 42.1 | .305 |
| 15 000 | 475.26 | 662 | 928 | 41.7 | .340 |
| 16 000 | 505.26 | 704 | 1000 | 41.3 | .365 |
| 17 000 | 535.26 | 752 | 1082 | 41.0 | .395 |
| 18 000 | 565.26 | 797 | 1168 | 40.6 | .425 |
| 19 000 | 595.26 | 855 | 1267 | 40.3 | .460 |
| 20 000 | 625.26 | 904 | 1366 | 39.8 | .495 |
| 21 000 | 655.26 | 1008 | 1651 | 37.9 | .560 |
| 19 000 | 595.26 | 1124 | 2485 | 31.2 | .635 |

**BEAM 417**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.73 | 42 | 34 | 55.1 | 0.015 |
| 500 | 35.73 | 75 | 65 | 53.6 | .030 |
| 1000 | 50.73 | 107 | 97 | 52.5 | .045 |
| 1500 | 65.73 | 143 | 123 | 53.8 | .055 |
| 2000 | 80.73 | 179 | 161 | 52.7 | .070 |
| 2500 | 95.73 | 229 | 209 | 52.3 | .090 |
| 3000 | 110.73 | 285 | 296 | 49.1 | .115 |
| 3500 | 125.73 | 365 | 439 | 45.4 | .155 |
| 4000 | 140.73 | 454 | 595 | 43.3 | .205 |
| 4500 | 155.73 | 531 | 728 | 42.2 | .260 |
| 5000 | 170.73 | 600 | 853 | 41.3 | .305 |
| 5500 | 185.73 | 688 | 1009 | 40.5 | .370 |
| 5900 | 197.73 | ........ | 1169 | ........ | .440 |
| 4600 | 158.73 | 683 | 1015 | 40.2 | .445 |

**BEAM 418**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 45 | 29 | 60.6 | 0.010 |
| 500 | 35.93 | 82 | 55 | 59.8 | .025 |
| 1000 | 50.93 | 113 | 80 | 58.5 | .040 |
| 1500 | 65.93 | 145 | 108 | 57.3 | .050 |
| 2000 | 80.93 | 182 | 147 | 55.4 | .060 |
| 2500 | 95.93 | 228 | 188 | 54.8 | .085 |
| 3000 | 110.93 | 276 | 248 | 52.7 | .105 |
| 3500 | 125.93 | 346 | 349 | 49.8 | .135 |
| 4000 | 140.93 | 449 | 533 | 45.7 | .190 |
| 4500 | 155.93 | 522 | 677 | 43.5 | .240 |
| 5000 | 170.93 | 591 | 829 | 41.6 | .285 |
| 5500 | 185.93 | 674 | 976 | 40.8 | .335 |
| 5900 | 191.93 | ........ | 1132 | ........ | .385 |
| 5000 | 170.93 | 762 | 1564 | 32.8 | .420 |

**BEAM 419**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.31 | 45 | 32 | 58.4 | 0.015 |
| 500 | 35.31 | 97 | 60 | 61.7 | .035 |
| 1000 | 50.31 | 134 | 87 | 60.6 | .045 |
| 1500 | 65.31 | 177 | 123 | 59.0 | .060 |
| 2000 | 80.31 | 226 | 162 | 58.3 | .080 |
| 2500 | 95.31 | 272 | 217 | 55.7 | .095 |
| 3000 | 110.31 | 337 | 318 | 51.4 | .125 |
| 3500 | 125.31 | 426 | 480 | 47.0 | .165 |
| 4000 | 140.31 | 505 | 629 | 44.5 | .210 |
| 4500 | 155.31 | 588 | 744 | 44.1 | .255 |
| 5000 | 170.31 | 666 | 897 | 42.6 | .305 |
| 5500 | 185.31 | 765 | 1062 | 41.9 | .360 |
| 6000 | 200.31 | 840 | 1205 | 41.1 | .410 |
| 6390 | 212.01 | ........ | 1294 | ........ | .445 |
| 5100 | 173.31 | 799 | 1171 | 40.6 | .455 |

**BEAM 429**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 37 | 24 | 60.7 | 0.010 |
| 1000 | 51.14 | 106 | 70 | 60.2 | .035 |
| 2000 | 81 14 | 179 | 126 | 58.7 | .060 |
| 2500 | 96.14 | 227 | 166 | 57.7 | .075 |
| 3000 | 111.14 | 274 | 210 | 56.6 | .090 |
| 3500 | 126.14 | 321 | 260 | 55.3 | .110 |
| 4000 | 141.14 | 377 | 326 | 53.6 | .135 |
| 4500 | 156.14 | 444 | 403 | 52.4 | .160 |
| 5000 | 171.14 | 516 | 499 | 50.8 | .190 |
| 5500 | 186.14 | 585 | 595 | 49.6 | .225 |
| 6000 | 201.14 | 658 | 699 | 48.5 | .275 |
| 7000 | 231.14 | 802 | 913 | 46.8 | .350 |
| 8000 | 261.14 | 954 | 1125 | 45.9 | .420 |
| 8500 | 276.14 | 1073 | 1311 | 45.0 | .485 |
| 8700 | 282.14 | ........ | 1405 | ........ | .520 |
| 7400 | 243.14 | 1155 | 1848 | 38.5 | .540 |

**BEAM 430**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 41 | 26 | 61.4 | 0.010 |
| 1000 | 51.14 | 123 | 82 | 60.1 | .040 |
| 2000 | 81.14 | 196 | 138 | 58.6 | .060 |
| 2500 | 96.14 | 243 | 179 | 57.6 | .087 |
| 3000 | 111.14 | 281 | 226 | 55.5 | .100 |
| 3500 | 126.14 | 330 | 284 | 53.7 | .125 |
| 4000 | 141.14 | 378 | 345 | 52.3 | .145 |
| 4500 | 156.14 | 453 | 426 | 51.3 | .175 |
| 5000 | 171.14 | 524 | 509 | 50.7 | .210 |
| 5500 | 186.14 | 603 | 609 | 49.7 | .240 |
| 6000 | 201.14 | 652 | 691 | 48.6 | .275 |
| 7000 | 231.14 | 805 | 885 | 47.6 | .350 |
| 8000 | 261.14 | 953 | 1089 | 46.7 | .420 |
| 8500 | 276.14 | 1072 | 1236 | 46.5 | .475 |
| 8760 | 283.94 | ........ | 1362 | ........ | .520 |
| 7700 | 252.14 | 1219 | 1769 | 40.8 | .540 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 431**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 52 | 24 | 68.3 | 0.010 |
| 500 | 35.93 | 94 | 41 | 69.6 | .035 |
| 1000 | 50.93 | 130 | 68 | 65.6 | .045 |
| 1500 | 65.93 | 169 | 97 | 63.6 | .060 |
| 2000 | 80.93 | 202 | 126 | 61.6 | .080 |
| 2500 | 95.93 | 244 | 159 | 60.6 | .090 |
| 3000 | 110.93 | 282 | 198 | 58.8 | .110 |
| 3500 | 125.93 | 331 | 260 | 56.0 | .130 |
| 4000 | 140.93 | 391 | 313 | 55.6 | .155 |
| 4500 | 155.93 | 454 | 383 | 54.2 | .175 |
| 5000 | 170.93 | 518 | 474 | 52.2 | .210 |
| 5500 | 185.93 | 589 | 556 | 51.5 | .245 |
| 6000 | 200.93 | 657 | 655 | 50.1 | .280 |
| 6500 | 215.93 | 726 | 733 | 49.8 | .305 |
| 7000 | 230.93 | 788 | 821 | 49.0 | .345 |
| 7500 | 245.93 | 878 | 920 | 48.8 | .395 |
| 8000 | 260.93 | 948 | 1010 | 48.4 | .430 |
| 8500 | 275.93 | 1032 | 1113 | 48.1 | .465 |
| 8940 | 289.13 | ........ | 1234 | ........ | .505 |
| 7500 | 245.93 | 1013 | 1087 | 48.2 | .525 |

**BEAM 441**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.52 | 50 | 27 | 64.9 | 0.015 |
| 1000 | 50.52 | 135 | 72 | 65.3 | .035 |
| 2000 | 80.52 | 230 | 130 | 63.9 | .070 |
| 2500 | 95.52 | 277 | 168 | 62.3 | .090 |
| 3000 | 110.52 | 333 | 207 | 61.7 | .110 |
| 3500 | 125.52 | 388 | 253 | 60.5 | .130 |
| 4000 | 140.52 | 455 | 313 | 59.3 | .150 |
| 4500 | 155.52 | 522 | 376 | 58.1 | .170 |
| 5000 | 170.52 | 594 | 443 | 57.3 | .200 |
| 5500 | 185.52 | 673 | 508 | 57.0 | .230 |
| 6000 | 200.52 | 740 | 574 | 56.3 | .255 |
| 7000 | 230.52 | 921 | 713 | 56.4 | .315 |
| 8000 | 260.52 | 1104 | 884 | 55.5 | .385 |
| 9000 | 290.52 | 1277 | 1029 | 55.4 | .445 |
| 10 000 | 320.52 | 1487 | 1215 | 55.0 | .525 |
| 10 500 | 335.52 | 1690 | 1414 | 54.5 | .585 |
| 9700 | 311.52 | 1807 | 1810 | 50.0 | .620 |

**BEAM 442**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.73 | 47 | 27 | 63.4 | 0.015 |
| 1000 | 50.73 | 120 | 67 | 64.2 | .040 |
| 2000 | 80.73 | 201 | 121 | 62.4 | .065 |
| 2500 | 95.73 | 249 | 159 | 61.1 | .085 |
| 3000 | 110.73 | 299 | 198 | 60.2 | .100 |
| 3500 | 125.73 | 347 | 236 | 59.5 | .120 |
| 4000 | 140.73 | 398 | 280 | 58.7 | .135 |
| 4500 | 155.73 | 462 | 335 | 58.0 | .160 |
| 5000 | 170.73 | 525 | 397 | 56.9 | .190 |
| 6000 | 200.73 | 661 | 523 | 55.8 | .240 |
| 7000 | 230.73 | 801 | 655 | 55.0 | .295 |
| 8000 | 260.73 | 963 | 800 | 54.6 | .360 |
| 9000 | 290.73 | 1143 | 933 | 55.1 | .425 |
| 10 000 | 320.73 | 1309 | 1070 | 55.0 | .490 |
| 10 500 | 335.73 | 1471 | 1186 | 55.4 | .540 |
| 10 750 | 343.23 | 1506 | 1231 | 55.0 | .560 |
| 10 900 | 347.73 | ........ | 1335 | ........ | .595 |
| 9800 | 314.73 | 1616 | 1713 | 48.6 | .600 |

**BEAM 443**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.73 | 43 | 32 | 57.2 | 0.020 |
| 1000 | 50.73 | 113 | 82 | 57.9 | .050 |
| 2000 | 80.73 | 196 | 140 | 58.3 | .070 |
| 2500 | 95.73 | 234 | 168 | 58.2 | .085 |
| 3000 | 110.73 | 286 | 200 | 58.9 | .105 |
| 3500 | 125.73 | 335 | 243 | 58.0 | .120 |
| 4000 | 140.73 | 385 | 284 | 57.6 | .135 |
| 4500 | 155.73 | 446 | 330 | 57.5 | .160 |
| 5000 | 170.73 | 508 | 386 | 56.8 | .180 |
| 6000 | 200.73 | 644 | 526 | 55.0 | .240 |
| 7000 | 230.73 | 776 | 679 | 53.3 | .295 |
| 8000 | 260.73 | 928 | 807 | 53.5 | .355 |
| 9000 | 290.73 | 1069 | 928 | 53.5 | .415 |
| 10 000 | 320.73 | 1258 | 1060 | 54.3 | .495 |
| 10 500 | 335.73 | 1385 | 1188 | 53.8 | .530 |
| 11 000 | 350.73 | 1488 | 1292 | 53.5 | .575 |
| 11 470 | 364.83 | ........ | 1458 | ........ | .625 |
| 10 000 | 320.73 | 1595 | 1826 | 46.6 | .630 |

**BEAM 453**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.52 | 50 | 29 | 63.3 | 0.015 |
| 1000 | 50.52 | 136 | 77 | 63.8 | .040 |
| 2000 | 80.52 | 223 | 137 | 61.9 | .065 |
| 3000 | 110.52 | 318 | 207 | 60.6 | .110 |
| 4000 | 140.52 | 437 | 308 | 58.7 | .140 |
| 5000 | 170.52 | 570 | 427 | 57.2 | .195 |
| 6000 | 200.52 | 711 | 557 | 56.1 | .250 |
| 7000 | 230.52 | 886 | 685 | 56.4 | .320 |
| 8000 | 260.52 | 1046 | 826 | 55.9 | .380 |
| 9000 | 290.52 | 1242 | 959 | 56.4 | .440 |
| 10 000 | 320.52 | 1440 | 1096 | 56.8 | .510 |
| 11 000 | 350.52 | 1654 | 1246 | 57.0 | .590 |
| 11 300 | 359.52 | 1818 | 1332 | 57.7 | .640 |
| 11 470 | 364.62 | 1962 | 1465 | 57.3 | .680 |
| 11 700 | 371.52 | 2082 | 1684 | 55.3 | .740 |
| 10 400 | 332.52 | 2161 | 1976 | 52.2 | .760 |

**BEAM 454**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 50 | 36 | 58.3 | 0.020 |
| 1000 | 50.93 | 137 | 87 | 61.2 | .035 |
| 2000 | 80.93 | 216 | 140 | 60.7 | .065 |
| 3000 | 110.93 | 313 | 214 | 59.4 | .095 |
| 4000 | 140.93 | 427 | 306 | 58.2 | .135 |
| 5000 | 170.93 | 561 | 431 | 56.5 | .185 |
| 6000 | 200.93 | 707 | 547 | 56.4 | .235 |
| 7000 | 230.93 | 850 | 679 | 55.6 | .295 |
| 8000 | 260.93 | 1030 | 827 | 55.5 | .365 |
| 9000 | 290.93 | 1212 | 968 | 55.6 | .425 |
| 10 000 | 320.93 | 1431 | 1126 | 56.0 | .515 |
| 11 000 | 350.93 | 1728 | 1357 | 56.0 | .635 |
| 11 130 | 354.83 | 2027 | 1655 | 55.1 | .765 |
| 10 400 | 332.93 | 2073 | 1646 | 55.7 | .800 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 455**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 43 | 31 | 57.9 | 0.010 |
| 1000 | 50.93 | 111 | 84 | 56.9 | .040 |
| 2000 | 80.93 | 185 | 138 | 57.3 | .065 |
| 3000 | 110.93 | 269 | 200 | 57.4 | .095 |
| 4000 | 140.93 | 375 | 280 | 57.2 | .130 |
| 5000 | 170.93 | 495 | 386 | 56.2 | .175 |
| 6000 | 200.93 | 622 | 491 | 55.9 | .225 |
| 7000 | 230.93 | 784 | 639 | 55.1 | .290 |
| 8000 | 260.93 | 929 | 786 | 54.2 | .350 |
| 9000 | 290.93 | 1082 | 942 | 53.5 | .420 |
| 10 000 | 320.93 | 1268 | 1097 | 53.6 | .500 |
| 11 000 | 350.93 | 1542 | 1335 | 53.6 | .595 |
| 11 450 | 364.43 | 1713 | 1508 | 53.2 | .665 |
| 10 750 | 343.43 | 1882 | 1986 | 48.7 | .720 |

**BEAM 465**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.73 | 57 | 32 | 64.2 | 0.015 |
| 1000 | 50.73 | 146 | 79 | 64.9 | .040 |
| 2000 | 80.73 | 232 | 128 | 64.4 | .070 |
| 3000 | 110.73 | 316 | 188 | 62.7 | .100 |
| 4000 | 140.73 | 415 | 260 | 61.5 | .130 |
| 5000 | 170.73 | 528 | 357 | 59.7 | .175 |
| 6000 | 200.73 | 659 | 463 | 58.7 | .225 |
| 7000 | 230.73 | 806 | 578 | 58.2 | .275 |
| 8000 | 260.73 | 975 | 713 | 57.8 | .330 |
| 9000 | 290.73 | 1142 | 832 | 57.8 | .385 |
| 10 000 | 320.73 | 1321 | 957 | 58.0 | .460 |
| 11 000 | 350.73 | 1508 | 1077 | 58.3 | .515 |
| 12 000 | 380.73 | 1790 | 1231 | 59.3 | .605 |
| 12 500 | 395.73 | 2039 | 1444 | 58.5 | .700 |
| 13 000 | 410.73 | 2240 | 1632 | 57.8 | .750 |
| 13 100 | 413.73 | ........ | ........ | ........ | ........ |
| 12 000 | 380.73 | 2643 | 2256 | 54.0 | .875 |

**BEAM 466**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 54 | 31 | 63.6 | 0.015 |
| 1000 | 50.93 | 128 | 79 | 61.9 | .040 |
| 2000 | 80.93 | 194 | 125 | 60.8 | .060 |
| 3000 | 110.93 | 286 | 193 | 59.7 | .090 |
| 4000 | 140.93 | 376 | 262 | 58.9 | .120 |
| 5000 | 170.93 | 491 | 369 | 57.1 | .165 |
| 6000 | 200.93 | 616 | 477 | 56.3 | .210 |
| 7000 | 230.93 | 750 | 562 | 57.2 | .270 |
| 8000 | 260.93 | 894 | 680 | 56.8 | .330 |
| 9000 | 290.93 | 1041 | 802 | 56.5 | .390 |
| 10 000 | 320.93 | 1187 | 911 | 56.6 | .450 |
| 11 000 | 350.93 | 1374 | 1046 | 56.8 | .510 |
| 12 000 | 380.93 | 1566 | 1176 | 57.1 | .590 |
| 12 500 | 395.93 | 1727 | 1291 | 57.2 | .630 |
| 12 820 | 405.53 | ........ | 1379 | ........ | .670 |
| 13 000 | 410.93 | 1933 | 1506 | 56.2 | .700 |
| 13 080 | 413.33 | ........ | 1544 | ........ | .720 |
| 13 460 | 424.73 | ........ | 1906 | ........ | .810 |
| 12 400 | 392.93 | 2373 | 2198 | 51.9 | .830 |

**BEAM 467**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 43 | 29 | 59.5 | 0.015 |
| 1000 | 50.93 | 108 | 79 | 57.8 | .035 |
| 2000 | 80.93 | 181 | 123 | 59.6 | .065 |
| 3000 | 110.93 | 261 | 181 | 59.1 | .090 |
| 4000 | 140.93 | 350 | 251 | 58.2 | .120 |
| 5000 | 170.93 | 452 | 340 | 57.0 | .160 |
| 6000 | 200.93 | 559 | 436 | 56.2 | .200 |
| 7000 | 230.93 | 700 | 537 | 56.6 | .250 |
| 8000 | 260.93 | 806 | 655 | 55.2 | .320 |
| 9000 | 290.93 | 941 | 786 | 54.5 | .375 |
| 10 000 | 320.93 | 1084 | 903 | 54.6 | .430 |
| 11 000 | 350.93 | 1228 | 1012 | 54.8 | .495 |
| 12 000 | 380.93 | 1412 | 1132 | 55.5 | .555 |
| 12 500 | 395.93 | 1509 | 1193 | 55.9 | .600 |
| 13 000 | 410.93 | 1600 | 1246 | 56.2 | .635 |
| 13 500 | 425.93 | 1726 | 1318 | 56.7 | .690 |
| 13 950 | 439.93 | 1946 | 1562 | 55.5 | .780 |
| 14 100 | 443.93 | ........ | 1762 | ........ | .845 |
| 12 900 | 407.93 | 2158 | 1997 | 51.9 | .850 |

**BEAM 477**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 57 | 26 | 68.7 | 0.015 |
| 1000 | 51.14 | 126 | 68 | 64.9 | .040 |
| 2000 | 81.14 | 202 | 115 | 63.7 | .065 |
| 3000 | 111.14 | 278 | 174 | 61.5 | .090 |
| 4000 | 141.14 | 375 | 239 | 61.1 | .120 |
| 5000 | 171.14 | 461 | 316 | 59.3 | .155 |
| 6000 | 201.14 | 572 | 409 | 58.3 | .195 |
| 7000 | 231.14 | 694 | 504 | 57.9 | .235 |
| 8000 | 261.14 | 828 | 612 | 57.5 | .280 |
| 9000 | 291.14 | 975 | 709 | 57.9 | .335 |
| 10 000 | 321.14 | 1141 | 821 | 58.2 | .380 |
| 11 000 | 351.14 | 1307 | 938 | 58.2 | .460 |
| 12 000 | 381.14 | 1475 | 1050 | 58.4 | .520 |
| 13 000 | 411.14 | 1668 | 1179 | 58.6 | .575 |
| 14 000 | 441.14 | 2077 | 1409 | 59.6 | .705 |
| 14 500 | 456.14 | 2298 | 1545 | 59.8 | .765 |
| 14 870 | 467.24 | 2684 | 1925 | 58.2 | .885 |
| 13 700 | 432.14 | 3024 | 2455 | 55.2 | .955 |

**BEAM 478**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 47 | 24 | 66.0 | 0.015 |
| 1000 | 50.93 | 118 | 67 | 63.8 | .035 |
| 2000 | 80.93 | 197 | 115 | 63.1 | .055 |
| 3000 | 110.93 | 278 | 158 | 62.4 | .085 |
| 4000 | 140.93 | 370 | 227 | 62.0 | .120 |
| 5000 | 170.93 | 468 | 303 | 60.7 | .150 |
| 6000 | 200.93 | 574 | 383 | 60.0 | .185 |
| 7000 | 230.93 | 693 | 477 | 59.2 | .230 |
| 8000 | 260.93 | 822 | 573 | 58.9 | .280 |
| 9000 | 290.93 | 963 | 696 | 58.0 | .330 |
| 10 000 | 320.93 | 1113 | 812 | 57.8 | .380 |
| 11 000 | 350.93 | 1297 | 930 | 58.2 | .435 |
| 12 000 | 380.93 | 1467 | 1043 | 58.5 | .515 |
| 13 000 | 410.93 | 1661 | 1198 | 58.2 | .580 |
| 14 000 | 440.93 | 1958 | 1403 | 58.3 | .690 |
| 14 500 | 455.93 | 2285 | 1641 | 58.2 | .815 |
| 14 590 | 458.63 | 2387 | 1701 | 58.4 | .870 |
| 13 500 | 425.93 | 2390 | 1648 | 59.2 | .885 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 479** | | | | | |
| 0 | 20.93 | 48 | 26 | 64.7 | 0.015 |
| 1000 | 50.93 | 117 | 65 | 64.3 | .045 |
| 2000 | 80.93 | 195 | 115 | 62.8 | .070 |
| 3000 | 110.93 | 275 | 162 | 62.9 | .090 |
| 4000 | 140.93 | 368 | 231 | 61.4 | .125 |
| 5000 | 170.93 | 457 | 296 | 60.7 | .155 |
| 6000 | 200.93 | 566 | 386 | 59.4 | .195 |
| 7000 | 230.93 | 689 | 475 | 59.2 | .235 |
| 8000 | 260.93 | 809 | 573 | 58.5 | .275 |
| 9000 | 290.93 | 959 | 677 | 58.6 | .355 |
| 10 000 | 320.93 | 1088 | 768 | 58.6 | .400 |
| 11 000 | 350.93 | 1254 | 880 | 58.8 | .455 |
| 12 000 | 380.93 | 1418 | 997 | 58.7 | .510 |
| 13 000 | 410.93 | 1598 | 1097 | 59.3 | .590 |
| 14 000 | 440.93 | 1818 | 1243 | 59.4 | .650 |
| 14 500 | 455.93 | 2008 | 1340 | 60.0 | .700 |
| 14 830 | 465.83 | 2153 | 1455 | 59.7 | .775 |
| 14 800 | 464.93 | 2279 | 1624 | 58.4 | .805 |
| 15 000 | 470.93 | 2464 | 1795 | 57.9 | .845 |
| 15 170 | 476.03 | ........ | 1969 | ........ | .875 |
| 13 600 | 428.93 | 2679 | 2215 | 54.7 | .885 |
| **BEAM 489** | | | | | |
| 0 | 21.14 | 61 | 31 | 66.2 | 0.005 |
| 1000 | 51.14 | 133 | 68 | 66.2 | .030 |
| 2000 | 81.14 | 217 | 115 | 65.3 | .060 |
| 3000 | 111.14 | 305 | 164 | 65.1 | .085 |
| 4000 | 141.14 | 400 | 229 | 63.6 | .110 |
| 5000 | 171.14 | 508 | 297 | 63.1 | .150 |
| 6000 | 201.14 | 628 | 381 | 62.3 | .185 |
| 7000 | 231.14 | 792 | 482 | 62.2 | .235 |
| 8000 | 261.14 | 910 | 573 | 61.4 | .270 |
| 9000 | 291.14 | 1083 | 672 | 61.7 | .330 |
| 10 000 | 321.14 | 1250 | 769 | 61.9 | .380 |
| 11 000 | 351.14 | 1428 | 868 | 62.2 | .435 |
| 12 000 | 381.14 | 1650 | 983 | 62.7 | .510 |
| 13 000 | 411.14 | 1844 | 1094 | 62.8 | .575 |
| 14 000 | 441.14 | 2112 | 1219 | 63.4 | .650 |
| 15 000 | 471.14 | 2510 | 1381 | 64.5 | .755 |
| 15 100 | 474.14 | ........ | ........ | ........ | .800 |
| 15 320 | 480.74 | ........ | ........ | ........ | .855 |
| 15 500 | 486.14 | 3172 | 1805 | 63.7 | .905 |
| 15 750 | 493.64 | ........ | 2046 | ........ | .980 |
| 14 200 | 447.14 | 3718 | 2168 | 63.2 | .990 |
| **BEAM 490** | | | | | |
| 0 | 21.34 | 45 | 32 | 58.4 | 0.015 |
| 1000 | 51.34 | 116 | 75 | 60.6 | .025 |
| 2000 | 81.34 | 199 | 121 | 62.2 | .055 |
| 3000 | 111.34 | 278 | 174 | 61.5 | .080 |
| 4000 | 141.34 | 363 | 239 | 60.3 | .110 |
| 5000 | 171.34 | 462 | 304 | 60.3 | .140 |
| 6000 | 201.34 | 580 | 383 | 60.2 | .175 |
| 7000 | 231.34 | 700 | 479 | 59.4 | .225 |
| 8000 | 261.34 | 829 | 574 | 59.1 | .265 |
| 9000 | 291.34 | 967 | 662 | 59.3 | .315 |
| 10 000 | 321.34 | 1126 | 769 | 59.4 | .375 |
| 11 000 | 351.34 | 1291 | 860 | 60.0 | .440 |
| 12 000 | 381.34 | 1459 | 954 | 60.5 | .495 |
| 13 000 | 411.34 | 1641 | 1055 | 60.9 | .545 |
| 14 000 | 441.34 | 1891 | 1176 | 61.7 | .640 |
| 15 000 | 471.34 | 2215 | 1318 | 62.7 | .720 |
| 15 500 | 486.34 | 2414 | 1417 | 63.0 | .765 |
| 15 700 | 492.34 | ........ | ........ | ........ | .850 |
| 15 820 | 495.94 | ........ | ........ | ........ | ........ |
| 16 000 | 501.34 | 3242 | 1974 | 62.2 | 1.005 |
| 14 600 | 459.34 | 3629 | 2152 | 62.8 | 1.090 |
| **BEAM 491** | | | | | |
| 0 | 21.34 | 45 | 31 | 59.1 | 0.015 |
| 1000 | 51.34 | 112 | 77 | 59.4 | .045 |
| 2000 | 81.34 | 179 | 118 | 60.2 | .065 |
| 3000 | 111.34 | 252 | 166 | 60.3 | .090 |
| 4000 | 141.34 | 328 | 219 | 60.0 | .110 |
| 5000 | 171.34 | 411 | 282 | 59.3 | .145 |
| 6000 | 201.34 | 511 | 344 | 59.8 | .180 |
| 7000 | 231.34 | 615 | 438 | 58.4 | .210 |
| 8000 | 261.34 | 755 | 530 | 58.8 | .260 |
| 9000 | 291.34 | 884 | 622 | 58.7 | .310 |
| 10 000 | 321.34 | 1020 | 711 | 58.9 | .350 |
| 11 000 | 351.34 | 1175 | 827 | 58.7 | .415 |
| 12 000 | 381.34 | 1329 | 918 | 59.2 | .465 |
| 13 000 | 411.34 | 1506 | 1029 | 59.4 | .515 |
| 14 000 | 441.34 | 1765 | 1145 | 60.6 | .610 |
| 15 000 | 471.34 | 2109 | 1313 | 61.6 | .700 |
| 15 500 | 486.34 | 2335 | 1417 | 62.2 | .770 |
| 15 950 | 499.84 | ........ | ........ | ........ | .830 |
| 16 000 | 501.34 | 2748 | 1646 | 62.5 | .860 |
| 16 350 | 511.84 | ........ | ........ | ........ | .930 |
| 16 410 | 513.64 | ........ | 1993 | ........ | 1.000 |
| 14 800 | 465.34 | 3923 | 2477 | 61.3 | 1.115 |
| **BEAM 420** | | | | | |
| 0 | 20.52 | 45 | 27 | 62.3 | 0.015 |
| 1000 | 50.52 | 113 | 75 | 60.2 | .045 |
| 2000 | 80.52 | 184 | 137 | 57.3 | .070 |
| 2500 | 95.52 | 228 | 185 | 55.2 | .085 |
| 3000 | 110.52 | 268 | 234 | 53.4 | .105 |
| 3500 | 125.52 | 315 | 313 | 50.2 | .125 |
| 4000 | 140.52 | 381 | 398 | 48.9 | .155 |
| 4500 | 155.52 | 461 | 564 | 45.0 | .195 |
| 5000 | 170.52 | 541 | 745 | 42.1 | .245 |
| 5500 | 185.52 | 614 | 933 | 39.7 | .295 |
| 6000 | 200.52 | 674 | 1085 | 38.3 | .345 |
| 6120 | 204.12 | ........ | 1265 | ........ | .395 |
| 5500 | 185.52 | 760 | 1557 | 32.8 | .415 |
| **BEAM 421** | | | | | |
| 0 | 21.34 | 42 | 27 | 61.1 | 0.010 |
| 1000 | 51.34 | 106 | 79 | 57.4 | .040 |
| 2000 | 81.34 | 165 | 133 | 55.4 | .065 |
| 2500 | 96.34 | 205 | 171 | 54.5 | .080 |
| 3000 | 111.34 | 244 | 210 | 53.7 | .095 |
| 3500 | 126.34 | 280 | 258 | 52.0 | .115 |
| 4000 | 141.34 | 330 | 337 | 49.5 | .140 |
| 4500 | 156.34 | 404 | 492 | 45.1 | .185 |
| 5000 | 171.34 | 482 | 711 | 40.4 | .240 |
| 5500 | 186.34 | 543 | 875 | 38.3 | .280 |
| 5880 | 197.74 | ........ | 1044 | ........ | .340 |
| 5100 | 174.34 | 623 | 1475 | 29.7 | .380 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 422**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 47 | 31 | 60.2 | 0.015 |
| 1000 | 50.93 | 114 | 79 | 59.0 | .040 |
| 2000 | 80.93 | 182 | 142 | 56.2 | .070 |
| 2500 | 95.93 | 224 | 188 | 54.3 | .085 |
| 3000 | 110.93 | 264 | 238 | 52.6 | .105 |
| 3500 | 125.93 | 316 | 297 | 51.5 | .130 |
| 4000 | 140.93 | 367 | 378 | 49.3 | .150 |
| 4500 | 155.93 | 445 | 554 | 44.5 | .200 |
| 5000 | 170.93 | 520 | 757 | 40.7 | .250 |
| 5500 | 185.93 | 596 | 959 | 38.3 | .305 |
| 5840 | 196.13 | ........ | 1070 | ........ | .340 |
| 5860 | 196.73 | ........ | 1197 | ........ | .360 |
| 5300 | 179.93 | 678 | 1450 | 31.8 | .380 |

**BEAM 432**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.55 | 42 | 29 | 58.9 | 0.015 |
| 1000 | 51.55 | 95 | 74 | 56.3 | .035 |
| 2000 | 81.55 | 158 | 126 | 55.7 | .060 |
| 3000 | 111.55 | 227 | 178 | 56.1 | .090 |
| 4000 | 141.55 | 294 | 253 | 53.8 | .115 |
| 4500 | 156.55 | 344 | 311 | 52.5 | .140 |
| 5000 | 171.55 | 398 | 376 | 51.4 | .160 |
| 5500 | 186.55 | 451 | 463 | 49.3 | .180 |
| 6000 | 201.55 | 495 | 540 | 47.8 | .205 |
| 7000 | 231.55 | 614 | 762 | 44.6 | .260 |
| 8000 | 261.55 | 736 | 974 | 43.1 | .330 |
| 8730 | 283.45 | 815 | 1162 | 41.2 | .400 |
| 8810 | 285.85 | ........ | 1219 | ........ | .420 |
| 7800 | 255.55 | 783 | 1138 | 40.8 | .430 |

**BEAM 433**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.76 | 39 | 27 | 59.3 | 0.010 |
| 1000 | 51.76 | 92 | 72 | 56.2 | .035 |
| 2000 | 81.76 | 145 | 118 | 55.2 | .060 |
| 3000 | 111.76 | 202 | 173 | 53.8 | .080 |
| 4000 | 141.76 | 267 | 248 | 51.8 | .110 |
| 4500 | 156.76 | 314 | 294 | 51.7 | .130 |
| 5000 | 171.76 | 351 | 340 | 50.8 | .150 |
| 5500 | 186.76 | 396 | 410 | 49.2 | .170 |
| 6000 | 201.76 | 450 | 497 | 47.5 | .200 |
| 6500 | 216.76 | 500 | 583 | 46.2 | .230 |
| 7000 | 231.76 | 554 | 687 | 44.6 | .260 |
| 8000 | 261.76 | 652 | 872 | 42.8 | .320 |
| 9000 | 291.76 | 778 | 1101 | 41.4 | .400 |
| 9400 | 303.76 | ........ | 1214 | ........ | .440 |
| 9400 | 303.76 | ........ | 1231 | ........ | .450 |

**BEAM 434**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 42 | 29 | 58.9 | 0.015 |
| 1000 | 51.14 | 100 | 65 | 60.7 | .035 |
| 2000 | 81.14 | 164 | 115 | 58.8 | .060 |
| 3000 | 111.14 | 230 | 171 | 57.4 | .080 |
| 3500 | 126.14 | 266 | 203 | 56.8 | .100 |
| 4000 | 141.14 | 304 | 232 | 56.7 | .110 |
| 4500 | 156.14 | 342 | 272 | 55.7 | .130 |
| 5000 | 171.14 | 390 | 321 | 54.8 | .150 |
| 5500 | 186.14 | 434 | 386 | 52.9 | .170 |
| 6000 | 201.14 | 511 | 463 | 52.4 | .200 |
| 6500 | 216.14 | 561 | 545 | 50.7 | .230 |
| 7000 | 231.14 | 612 | 619 | 49.7 | .260 |
| 8000 | 261.14 | 728 | 826 | 46.8 | .325 |
| 9000 | 291.14 | 842 | 1065 | 44.2 | .400 |
| 9270 | 299.24 | ........ | 1200 | ........ | .435 |
| 8200 | 267.14 | 910 | 1526 | 37.3 | .445 |

**BEAM 444**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.34 | 42 | 31 | 57.3 | 0.015 |
| 1000 | 51.34 | 100 | 67 | 60.0 | .035 |
| 2000 | 81.34 | 164 | 111 | 59.6 | .060 |
| 3000 | 111.34 | 232 | 168 | 58.0 | .090 |
| 4000 | 141.34 | 306 | 229 | 57.2 | .115 |
| 5000 | 171.34 | 385 | 316 | 54.9 | .150 |
| 6000 | 201.34 | 471 | 427 | 52.4 | .190 |
| 7000 | 231.34 | 575 | 562 | 50.6 | .240 |
| 8000 | 261.34 | 665 | 697 | 48.8 | .290 |
| 9000 | 291.34 | 772 | 855 | 47.5 | .345 |
| 10 000 | 321.34 | 879 | 997 | 46.8 | .400 |
| 11 000 | 351.34 | 991 | 1138 | 46.5 | .460 |
| 12 000 | 381.34 | 1111 | 1285 | 46.4 | .515 |
| 9900 | 318.34 | 1163 | 1956 | 37.3 | ........ |

**BEAM 445**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.34 | 37 | 27 | 58.0 | 0.015 |
| 1000 | 51.34 | 93 | 72 | 56.4 | .040 |
| 2000 | 81.34 | 154 | 123 | 55.6 | .060 |
| 3000 | 111.34 | 205 | 168 | 54.9 | .080 |
| 4000 | 141.34 | 279 | 238 | 54.0 | .115 |
| 5000 | 171·34 | 356 | 333 | 51.8 | .150 |
| 6000 | 201.34 | 449 | 434 | 50.9 | .190 |
| 7000 | 231.34 | 529 | 564 | 48.4 | .235 |
| 8000 | 261.34 | 628 | 718 | 46.7 | .285 |
| 9000 | 291.34 | 723 | 862 | 45.6 | .335 |
| 10 000 | 321.34 | 819 | 995 | 45.1 | .385 |
| 11 000 | 351.34 | 931 | 1164 | 44.4 | .455 |
| 11 750 | 373.84 | ........ | 1381 | ........ | .525 |
| 9900 | 318.34 | 1068 | 1991 | 34.9 | .535 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 446** | | | | | |
| 0 | 21.34 | 42 | 26 | 62.0 | 0.015 |
| 1000 | 51.34 | 105 | 74 | 58.6 | .040 |
| 2000 | 81.34 | 166 | 118 | 58.5 | .060 |
| 3000 | 111.34 | 238 | 174 | 57.7 | .085 |
| 4000 | 141.34 | 313 | 253 | 55.3 | .115 |
| 5000 | 171.34 | 388 | 338 | 53.5 | .150 |
| 6000 | 201.34 | 478 | 455 | 51.2 | .190 |
| 7000 | 231.34 | 576 | 586 | 49.6 | .235 |
| 8000 | 261.34 | 674 | 737 | 47.7 | .285 |
| 9000 | 291.34 | 783 | 899 | 46.6 | .340 |
| 10 000 | 321.34 | 888 | 1044 | 45.9 | .395 |
| 11 000 | 351.34 | 1014 | 1209 | 45.6 | .450 |
| 12 000 | 381.34 | 1159 | 1482 | 43.9 | .535 |
| 10 300 | 330.34 | 1182 | 1831 | 39.2 | .560 |
| **BEAM 456** | | | | | |
| 0 | 21.14 | 42 | 27 | 61.1 | 0.015 |
| 1000 | 51.14 | 110 | 72 | 60.5 | .040 |
| 2000 | 81.14 | 173 | 115 | 60.1 | .065 |
| 3000 | 111.14 | 242 | 166 | 59.4 | .090 |
| 4000 | 141.14 | 318 | 222 | 58.9 | .120 |
| 5000 | 171.14 | 405 | 313 | 56.4 | .150 |
| 6000 | 201.14 | 495 | 409 | 54.8 | .190 |
| 7000 | 231.14 | 593 | 532 | 52.7 | .235 |
| 8000 | 261.14 | 697 | 668 | 51.1 | .280 |
| 9000 | 291.14 | 806 | 802 | 50.1 | .330 |
| 10 000 | 321.14 | 916 | 932 | 49.6 | .385 |
| 11 000 | 351.14 | 1020 | 1062 | 49.0 | .435 |
| 12 000 | 381.14 | 1184 | 1244 | 48.8 | .500 |
| 12 500 | 396.14 | ........ | 1482 | ........ | .550 |
| 11 200 | 357.14 | 1325 | 1809 | 42.3 | .565 |
| **BEAM 457** | | | | | |
| 0 | 21.76 | 32 | 24 | 57.0 | 0.010 |
| 1000 | 51.76 | 93 | 67 | 58.1 | .035 |
| 2000 | 81.76 | 145 | 111 | 56.6 | .055 |
| 3000 | 111.76 | 216 | 156 | 58.0 | .080 |
| 4000 | 141.76 | 283 | 215 | 56.8 | .115 |
| 5000 | 171.76 | 362 | 285 | 56.0 | .140 |
| 6000 | 201.76 | 454 | 388 | 53.9 | .180 |
| 7000 | 231.76 | 549 | 504 | 52.1 | .225 |
| 8000 | 261.76 | 643 | 641 | 50.1 | .270 |
| 9000 | 291.76 | 739 | 776 | 48.8 | .320 |
| 10 000 | 321.76 | 834 | 901 | 48.1 | .365 |
| 11 000 | 351.76 | 942 | 1029 | 47.5 | .415 |
| 12 000 | 381.76 | 1055 | 1173 | 47.4 | .470 |
| 13 000 | 411.76 | 1181 | 1320 | 47.2 | .535 |
| 14 000 | 441.76 | 1348 | 1571 | 46.2 | .615 |
| 11 550 | 368.26 | 1239 | 1366 | 47.6 | .645 |
| **BEAM 458** | | | | | |
| 0 | 21.55 | 38 | 34 | 52.5 | 0.015 |
| 1000 | 51.55 | 108 | 74 | 59.4 | .035 |
| 2000 | 81.55 | 172 | 120 | 58.8 | .060 |
| 3000 | 111.55 | 243 | 179 | 57.6 | .090 |
| 4000 | 141.55 | 319 | 239 | 57.2 | .115 |
| 5000 | 171.55 | 402 | 318 | 55.8 | .150 |
| 6000 | 201.55 | 496 | 412 | 54.6 | .190 |
| 7000 | 231.55 | 611 | 532 | 53.5 | .240 |
| 8000 | 261.55 | 708 | 663 | 51.6 | .290 |
| 9000 | 291.55 | 812 | 797 | 50.5 | .340 |
| 10 000 | 321.55 | 919 | 938 | 49.5 | .390 |
| 11 000 | 351.55 | 1043 | 1079 | 49.2 | .445 |
| 12 000 | 381.55 | 1183 | 1221 | 49.2 | .510 |
| 12 920 | 409.15 | ........ | 1405 | ........ | .570 |
| 13 000 | 411.55 | 1384 | 1515 | 47.7 | .590 |
| 13 200 | 417.55 | ........ | 1610 | ........ | .620 |
| 12 200 | 387.55 | 1471 | 1976 | 42.7 | .625 |
| **BEAM 468** | | | | | |
| 0 | 21.34 | 37 | 29 | 56.3 | 0.010 |
| 1000 | 51.34 | 93 | 63 | 59.6 | .025 |
| 2000 | 81.34 | 155 | 97 | 61.4 | .045 |
| 3000 | 111.34 | 220 | 140 | 61.1 | .070 |
| 4000 | 141.34 | 289 | 191 | 60.2 | .105 |
| 5000 | 171.34 | 366 | 255 | 58.9 | .125 |
| 6000 | 201.34 | 448 | 333 | 57.4 | .160 |
| 7000 | 231.34 | 550 | 427 | 56.3 | .200 |
| 8000 | 261.34 | 646 | 520 | 55.4 | .235 |
| 9000 | 291.34 | 753 | 624 | 54.7 | .305 |
| 10 000 | 321.34 | 847 | 721 | 54.0 | .345 |
| 11 000 | 351.34 | 964 | 822 | 54.0 | .395 |
| 12 000 | 381.34 | 1063 | 918 | 53.7 | .440 |
| 13 000 | 411.34 | 1185 | 1024 | 53.6 | .490 |
| 14 000 | 441.34 | 1317 | 1128 | 53.9 | .550 |
| 14 560 | 458.14 | ........ | 1188 | ........ | .585 |
| 13 600 | 429.34 | 1434 | 1130 | 55.9 | .630 |
| **BEAM 469** | | | | | |
| 0 | 21.34 | 35 | 27 | 56.5 | 0.015 |
| 1000 | 51.34 | 95 | 65 | 59.4 | .035 |
| 2000 | 81.34 | 158 | 108 | 59.4 | .055 |
| 3000 | 111.34 | 222 | 154 | 59.0 | .080 |
| 4000 | 141.34 | 292 | 212 | 58.0 | .110 |
| 5000 | 171.34 | 378 | 275 | 57.9 | .135 |
| 6000 | 201.34 | 463 | 361 | 56.2 | .175 |
| 7000 | 231.34 | 557 | 460 | 54.8 | .215 |
| 8000 | 261.34 | 656 | 564 | 53.8 | .255 |
| 9000 | 291.34 | 758 | 668 | 53.2 | .295 |
| 10 000 | 321.34 | 865 | 769 | 52.9 | .345 |
| 11 000 | 351.34 | 974 | 875 | 52.7 | .395 |
| 12 000 | 381.34 | 1081 | 979 | 52.5 | .440 |
| 13 000 | 411.34 | 1222 | 1096 | 52.7 | .500 |
| 14 000 | 441.34 | 1360 | 1209 | 52.9 | .555 |
| 14 550 | 457.84 | ........ | 1296 | ........ | .595 |
| 12 900 | 408.34 | 1608 | 2002 | 44.5 | .665 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 470**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 35 | 31 | 53.3 | 0.015 |
| 1000 | 51.14 | 98 | 74 | 56.9 | .035 |
| 2000 | 81.14 | 166 | 116 | 58.9 | .050 |
| 3000 | 111.14 | 227 | 166 | 57.7 | .070 |
| 4000 | 141.14 | 303 | 221 | 57.8 | .100 |
| 5000 | 171.14 | 380 | 285 | 57.2 | .130 |
| 6000 | 201.14 | 466 | 369 | 55.8 | .160 |
| 7000 | 231.14 | 568 | 474 | 54.5 | .200 |
| 8000 | 261.14 | 662 | 574 | 53.5 | .240 |
| 9000 | 291.14 | 765 | 687 | 52.7 | .280 |
| 10 000 | 321.14 | 870 | 807 | 51.9 | .320 |
| 11 000 | 351.14 | 980 | 926 | 51.4 | .365 |
| 12 000 | 381.14 | 1090 | 1044 | 51.1 | .450 |
| 13 000 | 411.14 | 1246 | 1178 | 51.4 | .510 |
| 14 000 | 441.14 | 1399 | 1344 | 51.0 | .570 |
| 14 250 | 448.64 | ........ | 1402 | ........ | .600 |
| 14 500 | 456.14 | ........ | 1509 | ........ | .620 |
| 15 000 | 471.14 | 1662 | 1747 | 48.7 | .670 |
| 13 500 | 426.14 | 1724 | 2156 | 44.4 | .700 |

**BEAM 480**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.55 | 35 | 26 | 57.4 | 0.020 |
| 1000 | 51.55 | 100 | 65 | 60.7 | .040 |
| 2000 | 81.55 | 163 | 108 | 60.1 | .060 |
| 3000 | 111.55 | 224 | 156 | 58.9 | .080 |
| 4000 | 141.55 | 295 | 202 | 59.3 | .105 |
| 5000 | 171.55 | 369 | 260 | 58.7 | .135 |
| 6000 | 201.55 | 443 | 323 | 57.8 | .165 |
| 7000 | 231.55 | 521 | 393 | 57.0 | .195 |
| 8000 | 261.55 | 614 | 479 | 56.2 | .235 |
| 9000 | 291.55 | 702 | 562 | 55.5 | .270 |
| 10 000 | 321.55 | 792 | 651 | 54.9 | .310 |
| 11 000 | 351.55 | 883 | 742 | 54.3 | .345 |
| 12 000 | 381.55 | 985 | 838 | 54.0 | .390 |
| 13 000 | 411.55 | 1078 | 928 | 53.7 | .430 |
| 14 000 | 441.55 | 1184 | 1019 | 53.7 | .470 |
| 15 000 | 471.55 | 1297 | 1125 | 53.6 | .515 |
| 16 000 | 501.55 | 1478 | 1280 | 53.6 | .580 |
| 16 650 | 521.05 | ........ | 1547 | ........ | .645 |
| 15 000 | 471.55 | 1750 | 2068 | 45.8 | .685 |

**BEAM 482**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 20.93 | 35 | 24 | 59.3 | 0.015 |
| 1000 | 50.93 | 99 | 58 | 63.0 | .030 |
| 2000 | 80.93 | 160 | 94 | 62.9 | .050 |
| 3000 | 110.93 | 225 | 138 | 62.0 | .075 |
| 4000 | 140.93 | 294 | 190 | 60.8 | .095 |
| 5000 | 170.93 | 362 | 244 | 59.8 | .115 |
| 6000 | 200.93 | 437 | 308 | 58.7 | .140 |
| 7000 | 230.93 | 517 | 379 | 57.7 | .215 |
| 8000 | 260.93 | 615 | 463 | 57.0 | .250 |
| 9000 | 290.93 | 711 | 549 | 56.4 | .285 |
| 10 000 | 320.93 | 804 | 632 | 56.0 | .325 |
| 11 000 | 350.93 | 903 | 713 | 55.9 | .350 |
| 12 000 | 380.93 | 1011 | 793 | 56.0 | .400 |
| 13 000 | 410.93 | 1122 | 885 | 55.9 | .440 |
| 14 000 | 440.93 | 1226 | 974 | 55.7 | .480 |
| 15 000 | 470.93 | 1355 | 1063 | 56.0 | .525 |
| 16 000 | 500.93 | 1511 | 1183 | 56.1 | .580 |
| 16 650 | 520.43 | ........ | 1366 | ........ | .635 |
| 17 000 | 530.93 | 1782 | 1520 | 54.0 | .665 |
| 17 300 | 539.93 | ........ | 1677 | ........ | .700 |
| 17 500 | 545.93 | ........ | 1785 | ........ | .775 |
| 16 100 | 503.93 | 2069 | 2190 | 48.6 | .810 |

**BEAM 492**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.55 | 32 | 27 | 54.2 | 0.015 |
| 1000 | 51.55 | 95 | 67 | 58.7 | .035 |
| 2000 | 81.55 | 153 | 106 | 59.1 | .060 |
| 3000 | 111.55 | 218 | 149 | 59.4 | .080 |
| 4000 | 141.55 | 289 | 200 | 59.1 | .105 |
| 5000 | 171.55 | 364 | 250 | 59.3 | .130 |
| 6000 | 201.55 | 440 | 308 | 58.8 | .160 |
| 7000 | 231.55 | 520 | 374 | 58.1 | .190 |
| 8000 | 261.55 | 610 | 453 | 57.4 | .225 |
| 9000 | 291.55 | 703 | 538 | 56.6 | .255 |
| 10 000 | 321.55 | 801 | 626 | 56.1 | .295 |
| 11 000 | 351.55 | 899 | 708 | 55.9 | .335 |
| 12 000 | 381.55 | 999 | 797 | 55.6 | .375 |
| 13 000 | 411.55 | 1112 | 887 | 55.6 | .415 |
| 14 000 | 441.55 | 1236 | 978 | 55.8 | .455 |
| 15 000 | 471.55 | 1355 | 1067 | 55.9 | .500 |
| 16 000 | 501.55 | 1487 | 1164 | 56.1 | .550 |
| 17 000 | 531.55 | 1694 | 1347 | 55.7 | .615 |
| 18 000 | 561.55 | 1906 | 1545 | 55.2 | .680 |
| 14 000 | 441.55 | 1754 | 1385 | 55.9 | .605 |
| 15 000 | 471.55 | 1814 | 1439 | 55.8 | .625 |
| 16 000 | 501.55 | 1877 | 1497 | 55.6 | .650 |
| 17 000 | 531.55 | 1944 | 1559 | 55.5 | .675 |
| 18 000 | 561.55 | 2056 | 1667 | 55.2 | .740 |
| 18 060 | 563.35 | ........ | 1726 | ........ | .760 |
| 18 060 | 563.35 | ........ | 1950 | ........ | .795 |
| 17 000 | 531.55 | 2301 | 2316 | 49.8 | .820 |

**BEAM 493**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.96 | 42 | 29 | 58.9 | 0.015 |
| 1000 | 51.96 | 103 | 68 | 60.1 | .055 |
| 2000 | 81.96 | 157 | 104 | 60.2 | .075 |
| 3000 | 111.96 | 223 | 144 | 60.8 | .095 |
| 4000 | 141.96 | 279 | 186 | 60.0 | .120 |
| 5000 | 171.96 | 345 | 236 | 59.4 | .145 |
| 6000 | 201.96 | 418 | 291 | 59.0 | .175 |
| 7000 | 231.96 | 503 | 354 | 58.7 | .200 |
| 8000 | 261.96 | 591 | 429 | 57.9 | .240 |
| 9000 | 291.96 | 681 | 504 | 57.5 | .275 |
| 10 000 | 321.96 | 783 | 585 | 57.2 | .315 |
| 11 000 | 351.96 | 879 | 662 | 57.0 | .355 |
| 12 000 | 381.96 | 978 | 745 | 56.8 | .390 |
| 13 000 | 411.96 | 1103 | 851 | 56.4 | .440 |
| 14 000 | 441.96 | 1193 | 935 | 56.1 | .475 |
| 15 000 | 471.96 | 1324 | 1024 | 56.4 | .525 |
| 16 000 | 501.96 | 1436 | 1116 | 56.3 | .565 |
| 17 000 | 531.96 | 1596 | 1224 | 56.6 | .625 |
| 17 410 | 544.26 | ........ | 1311 | ........ | .670 |
| 17 850 | 557.46 | 1866 | 1431 | 56.6 | .730 |
| 17 880 | 558.36 | ........ | 1600 | ........ | .785 |
| 16 800 | 525.96 | 2034 | 1680 | 54.8 | .805 |

**BEAM 494**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.76 | 42 | 26 | 62.0 | 0.010 |
| 1000 | 51.76 | 104 | 65 | 61.6 | .035 |
| 2000 | 81.76 | 170 | 108 | 61.1 | .060 |
| 3000 | 111.76 | 234 | 149 | 61.1 | .080 |
| 4000 | 141.76 | 302 | 197 | 60.5 | .100 |
| 5000 | 171.76 | 377 | 255 | 59.6 | .130 |
| 6000 | 201.76 | 452 | 308 | 59.5 | .165 |
| 7000 | 231.76 | 534 | 374 | 58.8 | .195 |
| 8000 | 261.76 | 628 | 453 | 58.1 | .225 |
| 9000 | 291.76 | 721 | 533 | 57.5 | .260 |
| 10 000 | 321.76 | 809 | 614 | 56.9 | .295 |
| 11 000 | 351.76 | 909 | 697 | 56.6 | .340 |
| 12 000 | 381.76 | 1011 | 781 | 56.4 | .375 |
| 13 000 | 411.76 | 1126 | 868 | 56.5 | 415 |
| 14 000 | 441.76 | 1240 | 956 | 56.5 | .455 |
| 15 000 | 471.76 | 1367 | 1046 | 56.6 | .505 |
| 16 000 | 501.76 | 1501 | 1149 | 56.6 | .555 |
| 17 000 | 531.76 | 1746 | 1374 | 56.0 | .635 |
| 17 500 | 546.76 | ........ | 1515 | ........ | .685 |
| 17 800 | 555.76 | 2005. | 1651 | 54.8 | .725 |
| 17 950 | 560.26 | ........ | 1706 | ........ | .765 |
| 18 000 | 561.76 | 2135 | 1769 | 54.7 | .780 |
| 18 140 | 565.96 | ........ | 1807 | ........ | .805 |
| 16 300 | 510.76 | 2239 | 2200 | 50.4 | .830 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 423** | | | | | |
| 0 | 21.34 | 37 | 29 | 56.3 | 0.010 |
| 1000 | 51.34 | 90 | 67 | 57.3 | .030 |
| 2000 | 81.34 | 148 | 108 | 57.8 | .050 |
| 2500 | 96.34 | 177 | 132 | 57.3 | .065 |
| 3000 | 111.34 | 214 | 169 | 55.9 | .080 |
| 3500 | 126.34 | 246 | 202 | 55.0 | .090 |
| 4000 | 141.34 | 282 | 243 | 53.7 | .105 |
| 4500 | 156.34 | 328 | 308 | 51.6 | .125 |
| 5000 | 171.34 | 381 | 398 | 48.9 | .150 |
| 5500 | 186.34 | 458 | 603 | 43.2 | .210 |
| 6000 | 201.34 | 536 | 788 | 30.5 | .260 |
| 6500 | 216.34 | 591 | 933 | 38.8 | .310 |
| 6610 | 219.64 | ........ | 1101 | ........ | .360 |
| 5100 | 174.34 | 602 | 1897 | 24.1 | .400 |
| **BEAM 424** | | | | | |
| 0 | 21.14 | 32 | 21 | 60.1 | 0.015 |
| 1000 | 51.14 | 84 | 56 | 60.0 | .035 |
| 2000 | 81.14 | 133 | 99 | 57.2 | .055 |
| 2500 | 96.14 | 171 | 126 | 57.6 | .065 |
| 3000 | 111.14 | 206 | 162 | 56.0 | .080 |
| 3500 | 126.14 | 239 | 195 | 55.0 | .095 |
| 4000 | 141.14 | 274 | 238 | 53.5 | .110 |
| 4500 | 156.14 | 325 | 328 | 49.7 | .135 |
| 5000 | 171.14 | 392 | 467 | 45.6 | .175 |
| 5500 | 186.14 | 464 | 680 | 40.6 | .225 |
| 6000 | 201.14 | 525 | 848 | 38.2 | .280 |
| 6460 | 214.94 | ........ | 945 | ........ | .335 |
| 5200 | 177.14 | 489 | 855 | 36.4 | .340 |
| **BEAM 425** | | | | | |
| 0 | 21.14 | 45 | 34 | 56.9 | 0.010 |
| 1000 | 51.14 | 98 | 77 | 55.9 | .035 |
| 2000 | 81.14 | 154 | 128 | 54.6 | .060 |
| 2500 | 96.14 | 183 | 157 | 53.8 | .070 |
| 3000 | 111.14 | 211 | 191 | 52.5 | .080 |
| 3500 | 126.14 | 248 | 232 | 51.7 | .100 |
| 4000 | 141.14 | 289 | 294 | 49.6 | .120 |
| 4500 | 156.14 | 335 | 381 | 46.8 | .140 |
| 5000 | 171.14 | 409 | 585 | 41.1 | .190 |
| 5500 | 186.14 | 476 | 756 | 38.6 | .240 |
| 6000 | 201.14 | 534 | 904 | 37.1 | .290 |
| 6320 | 210.74 | ........ | 1029 | ........ | .330 |
| 5100 | 174.14 | 499 | 899 | 35.7 | .350 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 435** | | | | | |
| 0 | 20.93 | 37 | 29 | 56.3 | 0.010 |
| 1000 | 50.93 | 100 | 72 | 58.0 | .035 |
| 2000 | 80.93 | 153 | 115 | 57.2 | .050 |
| 2500 | 95.93 | 191 | 140 | 57.6 | .065 |
| 3000 | 110.93 | 229 | 169 | 57.5 | .080 |
| 3500 | 125.93 | 259 | 195 | 57.0 | .090 |
| 4000 | 140.93 | 296 | 231 | 56.2 | .105 |
| 4500 | 155.93 | 329 | 270 | 54.9 | .120 |
| 5000 | 170.93 | 379 | 328 | 53.6 | .140 |
| 5500 | 185.93 | 432 | 405 | 51.6 | .165 |
| 6000 | 200.93 | 479 | 480 | 49.9 | .190 |
| 7000 | 230.93 | 577 | 646 | 47.2 | .240 |
| 8000 | 260.93 | 673 | 831 | 44.8 | .300 |
| 9000 | 290.93 | 786 | 1019 | 43.6 | .370 |
| 9500 | 305.93 | ........ | 1210 | ........ | .420 |
| 7650 | 250.43 | 863 | 1798 | 32.4 | .440 |
| **BEAM 436** | | | | | |
| 0 | 21.34 | 32 | 29 | 52.5 | 0.015 |
| 1000 | 51.34 | 88 | 65 | 57.4 | .035 |
| 2000 | 81.34 | 138 | 113 | 54.9 | .055 |
| 2500 | 96.34 | 172 | 137 | 55.7 | .070 |
| 3000 | 111.34 | 199 | 159 | 55.6 | .080 |
| 3500 | 126.34 | 230 | 188 | 55.0 | .090 |
| 4000 | 141.34 | 266 | 224 | 54.2 | .110 |
| 4500 | 156.34 | 298 | 267 | 52.8 | .125 |
| 5000 | 171.34 | 337 | 326 | 50.8 | .140 |
| 5500 | 186.34 | 383 | 390 | 49.5 | .160 |
| 6000 | 201.34 | 430 | 470 | 47.8 | .190 |
| 7000 | 231.34 | 533 | 655 | 44.9 | .240 |
| 8000 | 261.34 | 631 | 863 | 42.2 | .305 |
| 9000 | 291.34 | 724 | 1072 | 40.3 | .375 |
| 9300 | 300.34 | ........ | 1202 | ........ | .410 |
| 8000 | 261.34 | 699 | 1096 | 38.9 | .420 |
| **BEAM 437** | | | | | |
| 0 | 20.93 | 30 | 27 | 52.5 | 0.015 |
| 1000 | 50.93 | 90 | 67 | 57.3 | .035 |
| 2000 | 80.93 | 143 | 113 | 55.8 | .055 |
| 2500 | 95.93 | 173 | 138 | 55.6 | .065 |
| 3000 | 110.93 | 207 | 171 | 54.8 | .080 |
| 3500 | 125.93 | 239 | 203 | 54.1 | .095 |
| 4000 | 140.93 | 277 | 244 | 53.2 | .110 |
| 4500 | 155.93 | 318 | 296 | 51.8 | .130 |
| 5000 | 170.93 | 361 | 350 | 50.7 | .150 |
| 6000 | 200.93 | 451 | 501 | 47.3 | .200 |
| 7000 | 230.93 | 545 | 675 | 44.7 | .255 |
| 8000 | 260.93 | 634 | 867 | 42.2 | .315 |
| 9000 | 290.93 | 738 | 1056 | 41.1 | .380 |
| 9550 | 307.43 | ........ | 1253 | ........ | .435 |
| 8200 | 266.93 | 828 | 1668 | 33.2 | .455 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches | Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | | | | Upper Fiber | Steel Fiber | | |
| **BEAM 447** | | | | | | **BEAM 459** | | | | | |
| 0 | 20.73 | 35 | 24 | 59.3 | 0.010 | 0 | 21.14 | 34 | 22 | 60.6 | 0.015 |
| 1000 | 50.73 | 90 | 65 | 58.0 | .030 | 1000 | 51.14 | 86 | 56 | 60.6 | .030 |
| 2000 | 80.73 | 151 | 106 | 58.7 | .050 | 2000 | 81.14 | 140 | 103 | 57.6 | .050 |
| 3000 | 110.73 | 211 | 144 | 59.4 | .070 | 3000 | 111.14 | 202 | 144 | 58.4 | .075 |
| 4000 | 140.73 | 277 | 195 | 58.7 | .100 | 4000 | 141.14 | 258 | 188 | 57.9 | .095 |
| 5000 | 170.73 | 345 | 258 | 57.2 | .125 | 5000 | 171.14 | 326 | 248 | 56.8 | .120 |
| 6000 | 200.73 | 429 | 342 | 55.6 | .160 | 6000 | 201.14 | 397 | 325 | 55.0 | .150 |
| 7000 | 230.73 | 514 | 431 | 54.4 | .190 | 7000 | 231.14 | 485 | 432 | 52.9 | .190 |
| 8000 | 260.73 | 603 | 549 | 52.3 | .230 | 8000 | 261.14 | 574 | 545 | 51.3 | .230 |
| 9000 | 290.73 | 690 | 680 | 50.4 | .280 | 9000 | 291.14 | 665 | 672 | 49.7 | .275 |
| 10 000 | 320.73 | 784 | 815 | 49.0 | .335 | 10 000 | 321.14 | 770 | 800 | 49.0 | .325 |
| 11 000 | 350.73 | 882 | 938 | 48.5 | .385 | 11 000 | 351.14 | 868 | 926 | 48.4 | .370 |
| 12 000 | 380.73 | 986 | 1096 | 47.4 | .440 | 12 000 | 381.14 | 959 | 1051 | 47.7 | .415 |
| 12 600 | 398.73 | ........ | 1354 | ........ | .500 | 13 000 | 411.14 | 1075 | 1195 | 47.4 | .470 |
| 10 700 | 341.73 | 1086 | 1826 | 37.3 | .510 | 13 730 | 433.04 | ........ | 1315 | ........ | .525 |
| | | | | | | 12 000 | 381.04 | 1245 | 1436 | 46.4 | .620 |
| **BEAM 448** | | | | | | **BEAM 460** | | | | | |
| 0 | 21.14 | 34 | 19 | 63.9 | 0.010 | 0 | 21.14 | 34 | 24 | 58.5 | 0.010 |
| 1000 | 51.14 | 92 | 60 | 60.4 | .030 | 1000 | 51.14 | 90 | 63 | 58.7 | .030 |
| 2000 | 81.14 | 137 | 97 | 58.5 | .050 | 2000 | 81.14 | 140 | 99 | 58.6 | 050 |
| 3000 | 111.14 | 185 | 137 | 57.5 | .075 | 3000 | 111.14 | 196 | 140 | 58.3 | .070 |
| 4000 | 141.14 | 253 | 188 | 57.4 | .100 | 4000 | 141.14 | 253 | 191 | 57.0 | .095 |
| 5000 | 171.14 | 317 | 248 | 56.1 | .130 | 5000 | 171.14 | 318 | 256 | 55.4 | .120 |
| 6000 | 201.14 | 379 | 330 | 53.5 | .155 | 6000 | 201.14 | 398 | 345 | 53.6 | .150 |
| 7000 | 231.14 | 478 | 448 | 51.6 | .195 | 7000 | 231.14 | 480 | 446 | 51.9 | .190 |
| 8000 | 261.14 | 561 | 578 | 49.3 | .240 | 8000 | 261.14 | 566 | 569 | 49.9 | .230 |
| 9000 | 291.14 | 639 | 715 | 47.2 | .290 | 9000 | 291.14 | 658 | 711 | 48.1 | .280 |
| 10 000 | 321.14 | 727 | 851 | 46.1 | .340 | 10 000 | 321.14 | 744 | 839 | 47.0 | .330 |
| 11 000 | 351.14 | 826 | 995 | 45.4 | .395 | 11 000 | 351.14 | 830 | 961 | 46.3 | .370 |
| 12 000 | 381.14 | 916 | 1120 | 45.0 | .445 | 12 000 | 381.14 | 914 | 1096 | 45.5 | .420 |
| 12 830 | 406.04 | ........ | 1311 | ........ | .515 | 13 000 | 411.14 | 1006 | 1234 | 44.9 | .470 |
| 10 700 | 342.14 | 895 | 1197 | 42.8 | .520 | 13 980 | 440.54 | ........ | 1385 | ........ | .530 |
| | | | | | | 12 250 | 388.64 | 1144 | 1937 | 37.1 | .550 |
| **BEAM 449** | | | | | | **BEAM 461** | | | | | |
| 0 | 21.14 | 32 | 26 | 55.1 | 0.010 | 0 | 20.93 | 32 | 26 | 55.1 | 0.015 |
| 1000 | 51.14 | 92 | 63 | 59.3 | .030 | 1000 | 50.93 | 86 | 58 | 59.8 | .035 |
| 2000 | 81.14 | 146 | 106 | 57.9 | .050 | 2000 | 80.93 | 138 | 104 | 57.0 | .060 |
| 3000 | 111.14 | 204 | 149 | 57.7 | .070 | 3000 | 110.93 | 206 | 147 | 58.3 | .080 |
| 4000 | 141.14 | 264 | 195 | 57.5 | .090 | 4000 | 140.93 | 266 | 202 | 56.9 | .105 |
| 5000 | 171.14 | 334 | 262 | 56.0 | .120 | 5000 | 170.93 | 336 | 267 | 55.7 | .135 |
| 6000 | 201.14 | 401 | 338 | 54.3 | .150 | 6000 | 200.93 | 425 | 352 | 54.7 | .170 |
| 7000 | 231.14 | 490 | 455 | 51.9 | .190 | 7000 | 230.93 | 519 | 462 | 52.9 | .220 |
| 8000 | 261.14 | 581 | 573 | 50.3 | .230 | 8000 | 260.93 | 609 | 576 | 51.4 | .260 |
| 9000 | 291.14 | 669 | 701 | 48.8 | .280 | 9000 | 290.93 | 714 | 708 | 50.2 | .310 |
| 10 000 | 321.14 | 764 | 839 | 47.7 | .330 | 10 000 | 320.93 | 815 | 832 | 49.5 | .360 |
| 11 000 | 351.14 | 845 | 976 | 46.4 | .380 | 11 000 | 350.93 | 913 | 959 | 48.8 | .410 |
| 12 000 | 381.14 | 944 | 1109 | 46.0 | .430 | 12 000 | 380.93 | 1014 | 1084 | 48.3 | .460 |
| 13 000 | 411.14 | ........ | 1376 | ........ | .510 | 13 000 | 410.93 | 1117 | 1221 | 47.8 | .525 |
| 11 000 | 351.14 | 1167 | 2484 | 32.0 | .580 | 13 100 | 413.93 | ........ | 1272 | ........ | .570 |
| | | | | | | 11 500 | 365.93 | 1118 | 1205 | 48.1 | .580 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 471** | | | | | |
| 0 | 21.14 | 41 | 26 | 61.4 | 0.010 |
| 1000 | 51.14 | 92 | 60 | 50.4 | .030 |
| 2000 | 81.14 | 149 | 97 | 60.6 | .050 |
| 3000 | 111.14 | 205 | 138 | 59.8 | .070 |
| 4000 | 141.14 | 273 | 186 | 59.5 | .095 |
| 5000 | 171.14 | 337 | 244 | 58.0 | .120 |
| 6000 | 201.14 | 409 | 306 | 57.2 | .145 |
| 7000 | 231.14 | 495 | 376 | 56.8 | .180 |
| 8000 | 261.14 | 587 | 451 | 56.5 | .215 |
| 9000 | 291.14 | 681 | 550 | 55.3 | .255 |
| 10 000 | 321.14 | 781 | 662 | 54.1 | .300 |
| 11 000 | 351.14 | 880 | 768 | 53.4 | .340 |
| 12 000 | 381.14 | 969 | 870 | 52.7 | .380 |
| 13 000 | 411.14 | 1074 | 988 | 52.1 | .425 |
| 14 000 | 441.14 | 1182 | 1109 | 51.6 | .475 |
| 15 000 | 471.14 | 1308 | 1270 | 50.7 | .535 |
| 15 400 | 483.14 | ........ | 1545 | ........ | .585 |
| 13 400 | 423.14 | 1585 | 2831 | 35.9 | .690 |
| **BEAM 472** | | | | | |
| 0 | 21.14 | 35 | 21 | 62.4 | 0.015 |
| 1000 | 51.14 | 90 | 65 | 58.0 | .035 |
| 2000 | 81.14 | 142 | 104 | 57.8 | .055 |
| 3000 | 111.14 | 198 | 142 | 58.2 | .075 |
| 4000 | 141.14 | 261 | 188 | 58.2 | .100 |
| 5000 | 171.14 | 320 | 239 | 57.2 | .125 |
| 6000 | 201.14 | 394 | 299 | 56.8 | .150 |
| 7000 | 231.14 | 466 | 373 | 55.5 | .180 |
| 8000 | 261.14 | 548 | 467 | 54.0 | .220 |
| 9000 | 291.14 | 631 | 566 | 52.7 | .260 |
| 10 000 | 321.14 | 721 | 670 | 51.8 | .300 |
| 11 000 | 351.14 | 810 | 781 | 50.9 | .340 |
| 12 000 | 381.14 | 902 | 891 | 50.3 | .385 |
| 13 000 | 411.14 | 1009 | 1012 | 49.9 | .435 |
| 14 000 | 441.14 | 1119 | 1156 | 49.2 | .485 |
| 15 000 | 471.14 | 1273 | 1381 | 48.0 | .565 |
| 15 570 | 488.24 | ........ | 1561 | ........ | .640 |
| 13 500 | 426.14 | 1423 | 2070 | 40.7 | .660 |
| **BEAM 473** | | | | | |
| 0 | 21.14 | 32 | 24 | 57.0 | 0.010 |
| 1000 | 51.14 | 90 | 62 | 59.1 | .030 |
| 2000 | 81.14 | 145 | 101 | 59.0 | .055 |
| 3000 | 111.14 | 198 | 140 | 58.6 | .075 |
| 4000 | 141.14 | 266 | 195 | 57.7 | .105 |
| 5000 | 171.14 | 330 | 250 | 56.9 | .130 |
| 6000 | 201.14 | 405 | 323 | 55.7 | .160 |
| 7000 | 231.14 | 491 | 417 | 54.1 | .195 |
| 8000 | 261.14 | 578 | 516 | 52.8 | .230 |
| 9000 | 291.14 | 667 | 626 | 51.6 | .275 |
| 10 000 | 321.14 | 757 | 735 | 50.7 | .315 |
| 11 000 | 351.14 | 854 | 846 | 50.2 | .360 |
| 12 000 | 381.14 | 965 | 978 | 49.7 | .415 |
| 13 000 | 411.14 | 1051 | 1082 | 49.3 | .460 |
| 14 000 | 441.14 | 1146 | 1195 | 49.0 | .500 |
| 14 920 | 468.74 | ........ | 1368 | ........ | .570 |
| 15 000 | 471.14 | 1340 | 1566 | 46.1 | .590 |
| 13 400 | 423.14 | 1481 | 2316 | 39.0 | .660 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| **BEAM 483** | | | | | |
| 0 | 21.34 | 35 | 24 | 59.3 | 0.010 |
| 1000 | 51.34 | 93 | 63 | 59.6 | .030 |
| 2000 | 81.34 | 147 | 94 | 61.0 | .050 |
| 3000 | 111.34 | 203 | 138 | 59.5 | .070 |
| 4000 | 141.34 | 263 | 181 | 59.3 | .095 |
| 5000 | 171.34 | 327 | 229 | 58.8 | .120 |
| 6000 | 201.34 | 401 | 292 | 57.8 | .145 |
| 7000 | 231.34 | 474 | 362 | 56.7 | .175 |
| 8000 | 261.34 | 552 | 432 | 56.1 | .210 |
| 9000 | 291.34 | 643 | 520 | 55.3 | .240 |
| 10 000 | 321.34 | 737 | 609 | 54.8 | .280 |
| 11 000 | 351.34 | 831 | 703 | 54.2 | .325 |
| 12 000 | 381.34 | 930 | 802 | 53.7 | .365 |
| 13 000 | 411.34 | 1021 | 892 | 53.4 | .405 |
| 14 000 | 441.34 | 1134 | 1003 | 53.1 | .455 |
| 15 000 | 471.34 | 1219 | 1091 | 52.8 | .490 |
| 16 000 | 501.34 | 1371 | 1232 | 52.7 | .550 |
| 17 000 | 531.34 | ........ | 1638 | ........ | .655 |
| 15 900 | 498.34 | 1658 | 2065 | 44.5 | .665 |
| **BEAM 484** | | | | | |
| 0 | 21.76 | 37 | 21 | 63.7 | 0.010 |
| 1000 | 51.76 | 86 | 58 | 59.8 | .030 |
| 2000 | 81.76 | 142 | 92 | 60.6 | .050 |
| 3000 | 111.76 | 200 | 133 | 60.0 | .070 |
| 4000 | 141.76 | 261 | 178 | 59.5 | .095 |
| 5000 | 171.76 | 321 | 227 | 58.6 | .115 |
| 6000 | 201.76 | 388 | 289 | 57.3 | .145 |
| 7000 | 231.76 | 463 | 359 | 56.3 | .175 |
| 8000 | 261.76 | 541 | 444 | 54.9 | .205 |
| 9000 | 291.76 | 624 | 530 | 54.1 | .240 |
| 10 000 | 321.76 | 710 | 624 | 53.2 | .275 |
| 11 000 | 351.76 | 797 | 716 | 52.7 | .315 |
| 12 000 | 381.76 | 895 | 812 | 52.4 | .355 |
| 13 000 | 411.76 | 992 | 908 | 52.2 | .395 |
| 14 000 | 441.76 | 1093 | 1003 | 52.1 | .440 |
| 15 000 | 471.76 | 1199 | 1101 | 52.1 | .480 |
| 16 000 | 501.76 | 1314 | 1200 | 52.3 | .530 |
| 17 000 | 531.76 | 1433 | 1308 | 52.3 | .585 |
| 17 550 | 548.26 | ........ | 1540 | ........ | ........ |
| 15 750 | 494.26 | 1526 | 1432 | 51.6 | .685 |
| **BEAM 485** | | | | | |
| 0 | 21.55 | 37 | 22 | 62.7 | 0.010 |
| 1000 | 51.55 | 87 | 55 | 61.3 | .030 |
| 2000 | 81.55 | 145 | 94 | 60.7 | .050 |
| 3000 | 111.55 | 203 | 133 | 60.4 | .075 |
| 4000 | 141.55 | 265 | 176 | 60.1 | .095 |
| 5000 | 171.55 | 329 | 224 | 59.5 | .120 |
| 6000 | 201.55 | 400 | 280 | 58.8 | .145 |
| 7000 | 231.55 | 477 | 345 | 58.0 | .175 |
| 8000 | 261.55 | 560 | 421 | 57.1 | .210 |
| 9000 | 291.55 | 645 | 497 | 56.5 | .245 |
| 10 000 | 321.55 | 738 | 586 | 55.7 | .280 |
| 11 000 | 351.55 | 846 | 687 | 55.2 | .325 |
| 12 000 | 381.55 | 937 | 779 | 54.6 | .365 |
| 13 000 | 411.55 | 1034 | 875 | 54.2 | .405 |
| 14 000 | 441.55 | 1137 | 971 | 53.9 | .445 |
| 15 000 | 471.55 | 1249 | 1067 | 53.9 | .490 |
| 16 100 | 504.55 | 1396 | 1219 | 53.4 | .545 |
| 17 000 | 531.55 | 1574 | 1482 | 51.5 | .615 |
| 15 700 | 492.55 | 1923 | 2641 | 42.1 | .745 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 495** | | | | | |
| 0 | 21.34 | 41 | 21 | 66.2 | 0.015 |
| 1000 | 51.34 | 94 | 55 | 63.2 | .035 |
| 2000 | 81.34 | 150 | 85 | 63.8 | .055 |
| 3000 | 111.34 | 207 | 121 | 63.2 | .075 |
| 4000 | 141.34 | 272 | 164 | 62.4 | .095 |
| 5000 | 171.34 | 335 | 209 | 61.6 | .120 |
| 6000 | 201.34 | 406 | 258 | 61.2 | .140 |
| 7000 | 231.34 | 478 | 313 | 60.4 | .165 |
| 8000 | 261.34 | 556 | 376 | 59.6 | .195 |
| 9000 | 291.34 | 652 | 448 | 59.3 | .230 |
| 10 000 | 321.34 | 740 | 523 | 58.6 | .260 |
| 11 000 | 351.34 | 838 | 603 | 58.2 | .300 |
| 12 000 | 381.34 | 914 | 679 | 57.4 | .330 |
| 13 000 | 411.34 | 1024 | 762 | 57.3 | .370 |
| 14 000 | 441.34 | 1104 | 834 | 57.0 | ........ |
| 15 000 | 471.34 | 1198 | 915 | 56.7 | .445 |
| 16 000 | 501.34 | 1318 | 1002 | 56.8 | .485 |
| 17 000 | 531.34 | 1409 | 1079 | 56.6 | .520 |
| 18 100 | 564.34 | 1521 | 1174 | 56.4 | .565 |
| 19 000 | 591.34 | 1675 | 1313 | 56.0 | .620 |
| 19 730 | 613.24 | ........ | 1602 | ........ | .680 |
| 18 100 | 564.34 | 1821 | 1950 | 48.3 | .690 |
| **BEAM 496** | | | | | |
| 0 | 21.96 | 35 | 24 | 59.3 | 0.015 |
| 1000 | 51.96 | 91 | 58 | 61.2 | .030 |
| 2000 | 81.96 | 145 | 91 | 61.4 | .050 |
| 3000 | 111.96 | 205 | 130 | 61.2 | .070 |
| 4000 | 141.96 | 265 | 169 | 61.0 | .090 |
| 5000 | 171.96 | 321 | 210 | 60.4 | .110 |
| 6000 | 201.95 | 382 | 260 | 59.5 | .135 |
| 7000 | 231.96 | 448 | 316 | 58.7 | .165 |
| 8000 | 261.96 | 520 | 383 | 57.6 | .195 |
| 9000 | 291.96 | 589 | 453 | 56.5 | .225 |
| 10 000 | 321.96 | 665 | 526 | 55.8 | .255 |
| 11 000 | 351.96 | 741 | 603 | 55.1 | .290 |
| 12 000 | 381.96 | 828 | 691 | 54.5 | .325 |
| 13 000 | 411.96 | 908 | 773 | 54.0 | .360 |
| 14 000 | 441.96 | 1004 | 862 | 53.8 | .400 |
| 16 000 | 501.96 | 1190 | 1031 | 53.6 | .475 |
| 17 000 | 531.96 | 1294 | 1120 | 53.6 | .515 |
| 18 000 | 561.96 | 1392 | 1217 | 53.4 | .560 |
| 19 000 | 591.96 | 1493 | 1320 | 53.1 | .605 |
| 19 520 | 607.56 | ........ | 1443 | ........ | .650 |
| 19 700 | 612.96 | ........ | 1579 | ........ | .690 |
| 17 500 | 546.96 | (1833) | 2340 | 43.9 | .745 |
| **BEAM 497** | | | | | |
| 0 | 21.55 | 34 | 15 | 69.7 | 0.015 |
| 1000 | 51.55 | 91 | 53 | 63.2 | .035 |
| 2000 | 81.55 | 141 | 85 | 62.4 | .055 |
| 3000 | 111.55 | 199 | 121 | 62.2 | .075 |
| 4000 | 141.55 | 251 | 152 | 62.3 | .095 |
| 5000 | 171.55 | 309 | 198 | 61.0 | .115 |
| 6000 | 201.55 | 373 | 246 | 60.3 | .140 |
| 7000 | 231.55 | 442 | 304 | 59.3 | .170 |
| 8000 | 261.55 | 512 | 362 | 58.6 | .195 |
| 9000 | 291.55 | 586 | 427 | 57.8 | .225 |
| 10 000 | 321.55 | 667 | 497 | 57.3 | .260 |
| 11 000 | 351.55 | 750 | 568 | 56.9 | .290 |
| 12 000 | 381.55 | 835 | 641 | 56.6 | .320 |
| 13 000 | 411.55 | 921 | 715 | 56.3 | .360 |
| 14 000 | 441.55 | 1010 | 786 | 56.2 | .395 |
| 15 000 | 471.55 | 1098 | 865 | 55.9 | .430 |
| 16 000 | 501.55 | 1196 | 942 | 55.9 | .470 |
| 17 000 | 531.55 | 1286 | 1015 | 55.9 | .510 |
| 18 000 | 561.55 | 1400 | 1109 | 55.8 | .555 |
| 19 000 | 591.55 | 1499 | 1191 | 55.7 | .595 |
| 20 000 | 621.55 | 1655 | 1385 | 54.4 | .690 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 426** | | | | | |
| 0 | 20.73 | 35 | 24 | 59.3 | 0.015 |
| 1000 | 50.73 | 98 | 75 | 56.6 | .040 |
| 2000 | 80.73 | 153 | 121 | 56.0 | .065 |
| 2500 | 95.73 | 186 | 152 | 55.0 | .075 |
| 3000 | 110.73 | 226 | 191 | 54.2 | .090 |
| 3500 | 125.73 | 263 | 231 | 53.2 | .105 |
| 4000 | 140.73 | 304 | 285 | 51.7 | .125 |
| 4500 | 155.73 | 362 | 378 | 48.9 | .155 |
| 5000 | 170.73 | 433 | 525 | 45.2 | .195 |
| 5500 | 185.73 | 513 | 723 | 41.5 | .245 |
| 6000 | 200.73 | 579 | 889 | 39.5 | .295 |
| 6460 | 214.53 | ........ | 1161 | ........ | ........ |
| 5000 | 170.73 | 655 | 1696 | 27.9 | .375 |
| **BEAM 427** | | | | | |
| 0 | 20.52 | 39 | 27 | 59.3 | 0.015 |
| 1000 | 50.52 | 97 | 72 | 57.5 | .040 |
| 1500 | 65.52 | 127 | 97 | 56.7 | .050 |
| 2000 | 80.52 | 158 | 123 | 56.2 | .065 |
| 2500 | 95.52 | 191 | 154 | 55.4 | .075 |
| 3000 | 110.52 | 226 | 190 | 54.3 | .095 |
| 3500 | 125.52 | 262 | 227 | 53.6 | .110 |
| 4000 | 140.52 | 314 | 291 | 51.9 | .135 |
| 4500 | 155.52 | 378 | 388 | 49.4 | .160 |
| 5000 | 170.52 | 465 | 556 | 45.5 | .210 |
| 5500 | 185.52 | 539 | 670 | 44.6 | .260 |
| 6000 | 200.52 | 609 | 802 | 43.1 | .305 |
| 6500 | 215.52 | 680 | 926 | 42.4 | .385 |
| 4700 | 161.52 | 703 | 1800 | 28.1 | .410 |
| **BEAM 428** | | | | | |
| 0 | 20.93 | 37 | 26 | 58.8 | 0.015 |
| 1000 | 50.93 | 95 | 68 | 58.3 | .035 |
| 1500 | 65.93 | 129 | 94 | 57.9 | .050 |
| 2000 | 80.93 | 156 | 118 | 56.9 | .060 |
| 2500 | 95.93 | 190 | 145 | 56.7 | .070 |
| 3000 | 110.93 | 222 | 178 | 55.5 | .085 |
| 3500 | 125.93 | 262 | 217 | 54.7 | .100 |
| 4000 | 140.93 | 314 | 284 | 52.5 | .125 |
| 4500 | 155.93 | 375 | 368 | 50.5 | .165 |
| 5000 | 170.93 | 442 | 494 | 47.2 | .190 |
| 5500 | 185.93 | 514 | 639 | 44.6 | .235 |
| 6000 | 200.93 | 586 | 809 | 42.0 | .285 |
| 6400 | 212.93 | ........ | 949 | ........ | ........ |
| 4800 | 164.93 | 1053 | 921 | 53.3 | .430 |

## Appendix II—Log Sheets of Concrete Beams—Continued

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 438** | | | | | |
| 0 | 19.90 | 41 | 27 | 60.5 | 0.015 |
| 1000 | 49.90 | 103 | 70 | 59.4 | .040 |
| 2000 | 79.90 | 166 | 115 | 59.1 | .060 |
| 2500 | 94.90 | 202 | 144 | 58.4 | .080 |
| 3100 | 112.90 | 247 | 178 | 58.1 | .090 |
| 3500 | 124.90 | 277 | 207 | 57.3 | .105 |
| 4000 | 139.90 | 322 | 243 | 57.0 | .120 |
| 4500 | 154.90 | 366 | 289 | 55.9 | .140 |
| 5000 | 169.90 | 419 | 349 | 54.6 | .160 |
| 5500 | 184.90 | 476 | 417 | 53.3 | .185 |
| 6000 | 199.90 | 530 | 489 | 52.0 | .210 |
| 7000 | 229.90 | 652 | 692 | 48.5 | .275 |
| 8000 | 259.90 | 775 | 904 | 46.2 | .350 |
| 9000 | 289.90 | 901 | 1125 | 44.5 | .425 |
| 9500 | 304.90 | ........ | 1325 | ........ | ........ |
| 8000 | 259.90 | 1019 | 1860 | 35.4 | .510 |
| **BEAM 439** | | | | | |
| 0 | 20.52 | 39 | 27 | 59.3 | 0.015 |
| 1000 | 50.52 | 97 | 72 | 57.5 | .035 |
| 2000 | 80.52 | 158 | 115 | 57.8 | .055 |
| 2500 | 95.52 | 187 | 138 | 57.6 | .070 |
| 3000 | 110.52 | 222 | 164 | 57.5 | .085 |
| 4000 | 140.52 | 289 | 222 | 56.5 | .110 |
| 4500 | 155.52 | 333 | 267 | 55.5 | .130 |
| 5000 | 170.52 | 379 | 326 | 53.8 | .150 |
| 6000 | 200.52 | 483 | 463 | 51.1 | .195 |
| 7000 | 230.52 | 600 | 648 | 48.1 | .260 |
| 8000 | 260.52 | 709 | 836 | 45.9 | .325 |
| 9000 | 290.52 | 816 | 1009 | 44.7 | .390 |
| 9930 | 318.42 | ........ | 1174 | ........ | ........ |
| 7400 | 242.52 | 744 | 933 | 44.4 | .475 |
| **BEAM 440** | | | | | |
| 0 | 20.52 | 37 | 26 | 58.8 | 0.015 |
| 1000 | 50.52 | 99 | 70 | 58.7 | .040 |
| 2000 | 80.52 | 156 | 115 | 57.5 | .060 |
| 3000 | 110.52 | 217 | 164 | 57.0 | .085 |
| 3500 | 125.52 | 253 | 195 | 56.5 | .100 |
| 4000 | 140.52 | 289 | 224 | 56.3 | .115 |
| 4500 | 155.52 | 331 | 265 | 55.5 | .135 |
| 5000 | 170.52 | 377 | 323 | 53.9 | .155 |
| 6000 | 200.52 | 482 | 474 | 50.4 | .210 |
| 7000 | 230.52 | 600 | 667 | 47.4 | .270 |
| 8000 | 260.62 | 710 | 863 | 45.1 | .340 |
| 9000 | 290.52 | 813 | 1034 | 44.0 | .410 |
| 9850 | 316.02 | ........ | 1183 | ........ | ........ |
| 7900 | 257.52 | 936 | 1879 | 33.2 | .500 |

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| **BEAM 450** | | | | | |
| 0 | 20.52 | 39 | 24 | 62.0 | 0.015 |
| 1000 | 50.52 | 99 | 62 | 61.5 | .035 |
| 2000 | 80.52 | 163 | 103 | 61.3 | .060 |
| 3000 | 110.52 | 229 | 144 | 61.2 | .080 |
| 4000 | 140.52 | 295 | 197 | 59.9 | .105 |
| 5000 | 170.52 | 370 | 270 | 57.8 | .135 |
| 6000 | 200.52 | 463 | 373 | 55.4 | .175 |
| 7000 | 230.52 | 570 | 504 | 53.1 | .220 |
| 8000 | 260.52 | 678 | 648 | 51.1 | .270 |
| 9000 | 290.52 | 785 | 793 | 49.7 | .320 |
| 10 000 | 320.52 | 903 | 957 | 48.5 | .380 |
| 11 000 | 350.52 | 1010 | 1104 | 47.8 | .440 |
| 12 000 | 380.52 | 1122 | 1272 | 46.9 | .500 |
| 10 500 | 335.52 | 1283 | 2079 | 38.2 | .570 |
| **BEAM 451** | | | | | |
| 0 | 20.52 | 42 | 21 | 66.7 | 0.015 |
| 1000 | 50.52 | 102 | 60 | 63.0 | .035 |
| 2000 | 80.52 | 167 | 99 | 62.8 | .055 |
| 3000 | 110.52 | 231 | 147 | 61.1 | .080 |
| 4000 | 140.52 | 300 | 200 | 60.0 | .105 |
| 5000 | 170.52 | 376 | 272 | 58.1 | .135 |
| 6000 | 200.52 | 466 | 369 | 55.8 | .170 |
| 7000 | 230.52 | 566 | 497 | 53.3 | .215 |
| 8000 | 260.52 | 669 | 646 | 50.9 | .265 |
| 9000 | 290.52 | 775 | 798 | 49.3 | .320 |
| 10 000 | 320.52 | 878 | 961 | 47.7 | .375 |
| 11 000 | 350.52 | 987 | 1120 | 46.9 | .430 |
| 12 000 | 380.52 | ........ | 1297 | ........ | ........ |
| 10 300 | 329.52 | 1134 | 1834 | 38.2 | .510 |
| **BEAM 452** | | | | | |
| 0 | 20.31 | 37 | 24 | 60.7 | 0.010 |
| 1000 | 50.31 | 100 | 60 | 62.5 | .030 |
| 2000 | 80.31 | 164 | 108 | 60.2 | .050 |
| 3000 | 110.31 | 228 | 152 | 60.0 | .080 |
| 4000 | 140.31 | 299 | 207 | 59.1 | .100 |
| 5000 | 170.31 | 369 | 277 | 57.1 | .130 |
| 6000 | 200.31 | 451 | 368 | 55.1 | .170 |
| 7000 | 230.31 | 547 | 479 | 53.3 | .210 |
| 8000 | 260.31 | 648 | 615 | 51.3 | .265 |
| 9000 | 290.31 | 747 | 750 | 49.9 | .315 |
| 10 000 | 320.31 | 848 | 894 | 48.7 | .370 |
| 11 000 | 350.31 | 955 | 1039 | 47.9 | .425 |
| 12 000 | 380.31 | 1079 | 1227 | 46.8 | .505 |
| 10 900 | 347.31 | 1216 | 1991 | 37.9 | .570 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 462**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 21.95 | 42 | 15 | 73.3 | 0.015 |
| 1000 | 51.95 | 84 | 43 | 66.3 | .035 |
| 2000 | 81.95 | 163 | 81 | 66.8 | .060 |
| 3000 | 111.95 | 219 | 122 | 64.2 | .080 |
| 4000 | 141.95 | 275 | 182 | 60.2 | .110 |
| 5000 | 171.95 | 340 | 251 | 57.6 | .140 |
| 6000 | 201.95 | 405 | 326 | 55.4 | .170 |
| 7000 | 231.95 | 489 | 423 | 53.7 | .210 |
| 8000 | 261.95 | 603 | 538 | 52.9 | .255 |
| 9000 | 291.95 | 684 | 653 | 51.2 | .300 |
| 10 000 | 321.95 | 775 | 793 | 49.4 | .355 |
| 11 000 | 351.95 | 877 | 928 | 48.6 | .405 |
| 12 000 | 381.95 | 971 | 1053 | 48.0 | .455 |
| 13 000 | 411.95 | 1065 | 1186 | 47.3 | .510 |
| 13 900 | 438.95 | | | | |
| 11 500 | 366.95 | 1059 | 1261 | 45.6 | .600 |

**BEAM 463**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 20.73 | 37 | 29 | 56.3 | 0.010 |
| 1000 | 50.73 | 95 | 75 | 56.0 | .030 |
| 2000 | 80.73 | 152 | 123 | 55.2 | .055 |
| 3000 | 110.73 | 212 | 171 | 55.4 | .075 |
| 4000 | 140.73 | 281 | 219 | 56.2 | .105 |
| 5000 | 170.73 | 344 | 272 | 55.8 | .130 |
| 6000 | 200.73 | 424 | 347 | 55.0 | .165 |
| 7000 | 230.73 | 503 | 439 | 53.4 | .200 |
| 8000 | 260.73 | 596 | 561 | 51.5 | .245 |
| 9000 | 290.73 | 691 | 696 | 49.8 | .295 |
| 10 000 | 320.73 | 787 | 829 | 48.7 | .345 |
| 11 000 | 350.73 | 886 | 959 | 48.0 | .395 |
| 12 000 | 380.73 | 989 | 1089 | 47.6 | .450 |
| 13 000 | 410.73 | 1095 | 1226 | 47.2 | .510 |
| 13 350 | 421.23 | | 1303 | | |
| 11 500 | 365.73 | 1116 | 1169 | 48.8 | .575 |

**BEAM 464**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 20.52 | 39 | 27 | 59.3 | 0.010 |
| 1000 | 50.52 | 100 | 65 | 60.7 | .030 |
| 2000 | 80.52 | 162 | 106 | 60.5 | .055 |
| 3000 | 110.52 | 226 | 152 | 59.8 | .075 |
| 4000 | 140.52 | 295 | 207 | 58.8 | .110 |
| 5000 | 170.52 | 374 | 272 | 57.9 | .135 |
| 6000 | 200.52 | 452 | 350 | 56.4 | .180 |
| 7000 | 230.52 | 560 | 460 | 54.9 | .220 |
| 8000 | 260.52 | 667 | 579 | 53.5 | .265 |
| 9000 | 290.52 | 758 | 699 | 52.0 | .315 |
| 10 000 | 320.52 | 857 | 824 | 51.0 | .360 |
| 11 000 | 350.52 | 964 | 962 | 50.1 | .415 |
| 12 000 | 380.52 | 1065 | 1087 | 49.5 | .470 |
| 13 000 | 410.52 | 1187 | 1238 | 49.0 | .535 |
| 13 250 | 418.02 | | 1379 | | |
| 11 500 | 365.52 | 1215 | 1262 | 49.0 | .630 |

**BEAM 474**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 22.16 | 43 | 20 | 67.2 | 0.015 |
| 1000 | 52.16 | 100 | 56 | 64.1 | .045 |
| 2000 | 82.16 | 164 | 93 | 63.7 | .065 |
| 3000 | 112.16 | 226 | 131 | 63.4 | .085 |
| 4000 | 142.16 | 296 | 181 | 62.0 | .115 |
| 5000 | 172.16 | 373 | 241 | 60.7 | .145 |
| 6000 | 202.16 | 457 | 319 | 58.9 | .180 |
| 7000 | 232.16 | 552 | 418 | 56.9 | .220 |
| 8000 | 262.16 | 650 | 527 | 55.2 | .260 |
| 9000 | 292.16 | 749 | 633 | 54.2 | .305 |
| 10 000 | 322.16 | 851 | 760 | 52.9 | .350 |
| 11 000 | 352.16 | 956 | 868 | 52.4 | .395 |
| 12 000 | 382.16 | 1064 | 997 | 51.6 | .450 |
| 13 000 | 412.16 | 1179 | 1150 | 50.6 | .505 |
| 14 000 | 442.16 | 1353 | 1370 | 49.7 | .580 |
| 14 480 | 456.56 | | | | |
| 13 100 | 415.16 | 1424 | 1883 | 43.1 | .650 |

**BEAM 475**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 21.14 | 39 | 24 | 62.0 | 0.015 |
| 1000 | 51.14 | 89 | 58 | 60.6 | .035 |
| 2000 | 81.14 | 142 | 97 | 59.4 | .055 |
| 3000 | 111.14 | 203 | 142 | 58.9 | .075 |
| 4000 | 141.14 | 260 | 185 | 58.5 | .095 |
| 5000 | 171.14 | 320 | 241 | 57.0 | .125 |
| 6000 | 201.14 | 384 | 301 | 56.1 | .150 |
| 7200 | 237.14 | 480 | 397 | 54.7 | .190 |
| 8000 | 261.14 | 548 | 472 | 53.7 | .225 |
| 9000 | 291.14 | 631 | 571 | 52.5 | .265 |
| 10 000 | 321.14 | 733 | 684 | 51.7 | .315 |
| 11 000 | 351.14 | 818 | 785 | 51.0 | .355 |
| 12 000 | 381.14 | 915 | 896 | 50.5 | .405 |
| 13 000 | 411.14 | 1010 | 1007 | 50.1 | .450 |
| 14 000 | 441.14 | 1110 | 1121 | 49.7 | .505 |
| 15 000 | 471.14 | 1217 | 1246 | 49.4 | .565 |
| 15 250 | 478.64 | | 1285 | | |
| 13 900 | 438.14 | 1208 | 1200 | 50.1 | .620 |

**BEAM 476**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch | | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| | | Upper Fiber | Steel Fiber | | |
| 0 | 20.73 | 42 | 26 | 62.0 | 0.015 |
| 1000 | 50.73 | 104 | 65 | 61.6 | .040 |
| 2000 | 80.73 | 168 | 106 | 61.3 | .060 |
| 3000 | 110.73 | 231 | 150 | 60.6 | .085 |
| 4000 | 140.73 | 302 | 200 | 60.2 | .115 |
| 5000 | 170.73 | 374 | 258 | 59.2 | .140 |
| 6000 | 200.73 | 457 | 337 | 57.5 | .175 |
| 7000 | 230.73 | 550 | 431 | 56.1 | .215 |
| 8000 | 260.73 | 657 | 538 | 55.0 | .280 |
| 9000 | 290.73 | 755 | 658 | 53.4 | .305 |
| 10 000 | 320.73 | 872 | 802 | 52.1 | .355 |
| 11 000 | 350.73 | 973 | 916 | 51.5 | .405 |
| 12 000 | 380.73 | 1085 | 1044 | 50.9 | .455 |
| 13 000 | 410.73 | 1223 | 1215 | 50.2 | .515 |
| 14 000 | 440.73 | 1374 | 1462 | 48.4 | .585 |
| 14 240 | 447.93 | | 1668 | | |
| 13 050 | 412.23 | 1587 | 2296 | 40.9 | .695 |

## Appendix II—Log Sheets of Concrete Beams—Continued

**BEAM 486**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.95 | 34 | 34 | 60.4 | 0.010 |
| 1000 | 51.95 | 93 | 85 | 62.6 | .030 |
| 2000 | 81.95 | 149 | 144 | 61.1 | .055 |
| 3000 | 111.95 | 216 | 202 | 62.0 | .080 |
| 4000 | 141.95 | 281 | 270 | 61.2 | .100 |
| 5000 | 171.95 | 352 | 335 | 61.5 | .125 |
| 6000 | 201.95 | 431 | 421 | 60.7 | .155 |
| 7000 | 231.95 | 514 | 518 | 59.8 | .185 |
| 8000 | 261.95 | 603 | 626 | 58.9 | .220 |
| 9000 | 291.95 | 699 | 740 | 58.3 | .260 |
| 10 000 | 321.95 | 796 | 853 | 57.9 | .300 |
| 11 000 | 351.95 | 903 | 978 | 57.6 | .345 |
| 12 000 | 381.95 | 1010 | 1108 | 57.2 | .385 |
| 13 000 | 411.95 | 1122 | 1241 | 57.0 | .430 |
| 14 000 | 441.95 | 1229 | 1368 | 56.8 | .480 |
| 15 000 | 471.95 | 1347 | 1501 | 56.8 | .525 |
| 16 000 | 501.95 | 1524 | 1730 | 56.2 | .595 |
| 17 000 | 531.95 | 1677 | 2222 | 51.6 | .675 |
| 15 500 | 486.95 | 1883 | 2949 | 46.8 | .720 |

**BEAM 487**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 37 | 22 | 62.7 | 0.015 |
| 1000 | 51.14 | 91 | 58 | 61.2 | .030 |
| 2100 | 84.14 | 150 | 94 | 61.5 | .055 |
| 3000 | 111.14 | 202 | 132 | 60.4 | .075 |
| 4000 | 141.14 | 260 | 171 | 60.3 | .095 |
| 5000 | 171.14 | 319 | 214 | 59.8 | .115 |
| 6000 | 201.14 | 387 | 265 | 59.3 | .145 |
| 7000 | 231.14 | 461 | 330 | 58.3 | .170 |
| 8000 | 261.14 | 538 | 409 | 56.8 | .205 |
| 9000 | 291.14 | 619 | 484 | 56.1 | .240 |
| 10 000 | 321.14 | 714 | 576 | 55.4 | .275 |
| 11 000 | 351.14 | 792 | 656 | 54.7 | .310 |
| 12 000 | 381.14 | 889 | 752 | 54.2 | .350 |
| 13 000 | 411.14 | 970 | 836 | 53.7 | .390 |
| 14 000 | 441.14 | 1079 | 932 | 53.6 | .435 |
| 15 000 | 471.14 | 1151 | 1015 | 53.1 | 470 |
| 16 000 | 501.14 | 1242 | 1103 | 53.0 | .520 |
| 17 000 | 531.14 | 1360 | 1207 | 53.0 | .570 |
| 18 000 | 561.14 | 1456 | 1350 | 51.9 | .620 |
| 15 600 | 489.14 | 1400 | 1299 | 51.9 | .680 |

**BEAM 488**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.14 | 35 | 21 | 62.4 | 0.015 |
| 1000 | 51.14 | 92 | 55 | 62.7 | .035 |
| 2000 | 81.14 | 155 | 96 | 61.7 | .055 |
| 3000 | 111.14 | 210 | 132 | 61.4 | .075 |
| 4000 | 141.14 | 274 | 176 | 60.8 | .100 |
| 5000 | 171.14 | 332 | 221 | 60.0 | .120 |
| 6000 | 201.14 | 402 | 280 | 59.0 | .145 |
| 7000 | 231.14 | 478 | 349 | 57.8 | .175 |
| 8000 | 261.14 | 550 | 424 | 56.5 | .210 |
| 9000 | 291.14 | 639 | 515 | 55.4 | .245 |
| 10 000 | 321.14 | 721 | 607 | 54.3 | .285 |
| 11 000 | 351.14 | 808 | 696 | 53.7 | .325 |
| 12 000 | 381.14 | 898 | 785 | 53.4 | .365 |
| 13 000 | 411.14 | 998 | 877 | 53.2 | .405 |
| 14 000 | 441.14 | 1096 | 971 | 53.0 | .450 |
| 15 000 | 471.14 | 1200 | 1070 | 52.9 | .490 |
| 16 000 | 501.14 | 1300 | 1174 | 52.5 | .535 |
| 17 000 | 531.14 | 1422 | 1320 | 51.9 | .595 |
| 17 850 | 556.64 | | 1603 | | |
| 15 500 | 486.14 | 1632 | 2179 | 42.8 | .685 |

**BEAM 498**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.34 | 39 | 22 | 64.0 | 0.015 |
| 1000 | 51.34 | 97 | 55 | 63.7 | .035 |
| 2000 | 81.34 | 152 | 92 | 62.3 | .055 |
| 3000 | 111.34 | 210 | 128 | 62.1 | .075 |
| 4100 | 144.34 | 277 | 169 | 62.1 | .095 |
| 5000 | 171.34 | 336 | 207 | 61.9 | .120 |
| 6000 | 201.34 | 404 | 255 | 61.3 | .145 |
| 7000 | 231.34 | 481 | 311 | 60.7 | .170 |
| 8000 | 261.34 | 578 | 379 | 60.4 | .205 |
| 9000 | 291.34 | 666 | 462 | 59.1 | .245 |
| 10 000 | 321.34 | 756 | 545 | 58.1 | .275 |
| 11 000 | 351.34 | 842 | 622 | 57.5 | .310 |
| 12 000 | 381.34 | 924 | 704 | 56.8 | .355 |
| 13 000 | 411.34 | 1026 | 790 | 56.5 | .385 |
| 14 000 | 441.34 | 1119 | 879 | 56.0 | .425 |
| 15 000 | 471.34 | 1231 | 976 | 55.8 | .470 |
| 16 000 | 501.34 | 1324 | 1058 | 55.6 | .505 |
| 17 000 | 531.34 | 1445 | 1147 | 55.7 | .555 |
| 18 000 | 561.34 | 1590 | 1256 | 55.9 | .610 |
| 19 000 | 591.34 | 1747 | 1479 | 54.1 | .675 |
| 19 250 | 598.84 | | 1665 | | |
| 17 400 | 543.34 | 1782 | 1576 | 53.1 | .795 |

**BEAM 499**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 23.19 | 44 | 15 | 74.4 | 0.010 |
| 1000 | 53.19 | 94 | 47 | 66.7 | .030 |
| 2000 | 83.19 | 149 | 78 | 65.7 | .050 |
| 3100 | 116.19 | 204 | 113 | 64.4 | .070 |
| 4000 | 143.19 | 266 | 146 | 64.5 | .090 |
| 5100 | 176.19 | 335 | 192 | 63.6 | .115 |
| 6000 | 203.19 | 393 | 231 | 63.0 | .140 |
| 7000 | 233.19 | 465 | 292 | 61.4 | .165 |
| 8000 | 263.19 | 533 | 359 | 59.8 | .195 |
| 9000 | 293.19 | 608 | 433 | 58.4 | .225 |
| 10 000 | 323.19 | 682 | 503 | 57.6 | .255 |
| 11 000 | 353.19 | 768 | 571 | 57.4 | .290 |
| 12 000 | 383.19 | 848 | 669 | 55.9 | .325 |
| 13 000 | 413.19 | 928 | 760 | 55.0 | .365 |
| 14 000 | 443.19 | 1000 | 848 | 54.1 | .400 |
| 15 000 | 473.19 | 1110 | 922 | 54.6 | .435 |
| 16 000 | 503.19 | 1209 | 1002 | 54.7 | .480 |
| 17 000 | 533.19 | 1311 | 1096 | 54.5 | .520 |
| 18 000 | 563.19 | 1426 | 1210 | 54.1 | .570 |
| 19 000 | 593.19 | 1584 | 1445 | 52.3 | .630 |
| 19 800 | 617.19 | | | | |
| 17 500 | 548.19 | 1797 | 2289 | 44.0 | .725 |

**BEAM 500**

| Applied Load, lbs. | $\frac{M}{bd^2}$ lbs. per sq. in. | Deformation, millionths of inch per inch: Upper Fiber | Deformation, millionths of inch per inch: Steel Fiber | K, per cent | Deflection, inches |
|---|---|---|---|---|---|
| 0 | 21.34 | 39 | 19 | 67.2 | 0.015 |
| 1000 | 51.34 | 102 | 53 | 65.7 | .030 |
| 2000 | 81.34 | 154 | 85 | 64.4 | .055 |
| 3100 | 114.34 | 215 | 126 | 63.1 | .075 |
| 4000 | 141.34 | 265 | 166 | 61.4 | .095 |
| 5000 | 171.34 | 333 | 210 | 61.3 | .120 |
| 6000 | 201.34 | 402 | 255 | 61.2 | .140 |
| 7000 | 231.34 | 462 | 306 | 60.2 | .170 |
| 8000 | 261.34 | 537 | 371 | 59.2 | .200 |
| 9000 | 291.34 | 606 | 438 | 58.1 | .230 |
| 10 000 | 321.34 | 682 | 509 | 57.2 | .260 |
| 11 000 | 351.34 | 771 | 595 | 56.5 | .300 |
| 12 000 | 381.34 | 860 | 672 | 56.1 | .335 |
| 13 000 | 411.34 | 950 | 754 | 55.8 | .370 |
| 14 000 | 441.34 | 1037 | 832 | 55.5 | .405 |
| 15 000 | 471.34 | 1120 | 908 | 55.2 | .445 |
| 16 000 | 501.34 | 1222 | 993 | 55.2 | .485 |
| 17 000 | 531.34 | 1320 | 1089 | 54.8 | .525 |
| 18 000 | 561.34 | 1428 | 1198 | 54.4 | .570 |
| 19 000 | 591.34 | 1577 | 1385 | 53.2 | .635 |
| 19 760 | 614.14 | | 1658 | | |
| 17 900 | 558.34 | 2001 | 2600 | 43.5 | .805 |

# Appendix III—Additional Beam Data

## 1:2:4 GRANITE CONCRETE BEAMS

| No. of Beam | Cross Section | First Crack | Crack of Failure | No. of Beam | Cross Section | First Crack | Crack of Failure |
|---|---|---|---|---|---|---|---|
| | Inches | Ft in | Ft in | | Inches | Ft in | Ft in |
| 162 | 8.00x11.00 | 0 8 | 1 2 | ... | .......... | ..... | ..... |
| 163 | 8.06x11.19 | 1 6 | 0 6 | 169 | 8.00x11.13 | ..... | 2 6 |
| 164 | 8.06x11.00 | 0 4 | 0 4 | 170 | 8.06x11.13 | ..... | 1 6 |
| 174 | 8.00x10.88 | 0 3 | 0 6 | 180 | 8.00x11.13 | ..... | 0 4 |
| 175 | 8.00x10.88 | 0 6 | 1 6 | 181 | 8.06x11.06 | ..... | 1 10 |
| 176 | 7.94x10.94 | 0 8 | 0 6 | 182 | 8.06x11.06 | ..... | 1 6 |
| 186 | 7.94x11.25 | 1 0 | 2 0 | 192 | 8.00x11.00 | ..... | 1 2 |
| 187 | 8 00x11.00 | 0 4 | 0 10 | 193 | 8.00x10.94 | ..... | 0 6 |
| 188 | 8.06x11.19 | 0 9 | 1 0 | 194 | 8.06x11.19 | ..... | 1 2 |
| 198 | 8.00x11.06 | 0 6 | 1 0 | 204 | 8.00x11.19 | ..... | 0 10 |
| 199 | 8.00x11.00 | 0 0 | 1 3 | 205 | 8.06x11.06 | ..... | 0 10 |
| 200 | 8.00x11.19 | ..... | 0 10 | 206 | 8.06x11.06 | ..... | 0 11 |
| 210 | 8.00x11.06 | 0 10 | 0 6 | 216 | 8.06x11.00 | ..... | 0 5 |
| 211 | 8.00x11.25 | 0 5 | 1 10 | 217 | 8.06x11.13 | ..... | 0 11 |
| 212 | 8.00x10.94 | 0 6 | 0 0 | 218 | 8.00x11.06 | ..... | 0 10 |
| 222 | 8.00x11.00 | 0 2 | 0 0 | 231 | 8.00x11.13 | ..... | 0 7 |
| 223 | 8.00x11.06 | 1 1 | 0 1 | 232 | 8.00x11.19 | ..... | 0 5 |
| 224 | 8.00x11.06 | ..... | 0 2 | 233 | 8.00x11.00 | ..... | 0 0 |
| 237 | 8.00x11.00 | ..... | 1 6 | 240 | 8.00x11.13 | ..... | 1 5 |
| 238 | 8.06x10.88 | 0 10 | 1 1 | ... | .......... | ..... | ..... |
| 239 | 8.13x11.00 | 0 8 | 1 3 | 242 | 8.06x11.00 | ..... | 1 0 |
| 165 | 8.00x11.00 | 0 6 | 0 6 | 171 | 8.00x11.25 | 0 1 | 0 1 |
| 166 | 8.00x11.00 | 0 6 | 0 1 | 172 | 8.06x11.00 | 0 0 | 0 0 |
| 167 | 8.00x11.00 | 0 5 | 1 8 | 173 | 8.06x11.13 | ..... | 1 5 |
| 177 | 8.00x11.00 | 0 2 | 1 4 | 183 | 8.06x11.13 | ..... | 1 0 |
| 178 | 8.13x10.94 | 0 0 | 1 3 | 184 | 8.06x11.13 | ..... | 1 1 |
| 179 | 8.00x11.13 | 0 0 | 1 3 | 185 | 8.06x11.25 | ..... | 1 4 |
| 189 | 8.00x11.00 | 0 2 | 0 2 | 195 | 8.06x11.13 | ..... | 1 9 |
| 190 | 8.00x11.00 | 0 3 | 1 6 | 196 | 8.06x11.13 | ..... | 1 0 |
| 191 | 7.94x11.06 | 2 0 | 0 2 | 197 | 8.00x11.13 | ..... | 1 3 |
| 201 | 8.00x11.13 | ..... | 0 3 | 207 | 8.00x11.13 | ..... | 0 2 |
| 202 | 8.00x11.06 | 0 4 | 0 0 | 208 | 8.06x11.00 | ..... | 0 5 |
| 203 | 8.00x11.00 | 0 5 | 0 5 | 209 | 8.06x11.13 | ..... | 2 1 |
| 213 | 8.00x11.06 | ..... | 2 1 | 219 | 8.06x11.19 | ..... | 2 3 |
| 214 | 8.00x11.00 | ..... | 0 11 | 220 | 8.06x11.19 | ..... | 0 1 |
| 215 | 7.94x11.00 | 0 0 | 0 0 | 221 | 8.06x11.19 | ..... | 1 2 |
| 225 | 8.00x11.00 | ..... | 0 5 | 228 | 8.06x11.00 | ..... | 0 3 |
| 226 | 8.00x11.13 | ..... | 0 11 | 229 | 8.00x11.19 | ..... | 1 2 |
| 227 | 8.00x11.00 | 0 6 | 1 3 | 230 | 8.06x11.16 | ..... | 1 8 |
| 243 | 8.00x11.13 | ..... | 0 0 | 234 | 8.00x11.00 | ..... | 0 7 |
| 244 | 8.06x11.06 | 0 8 | 1 9 | 235 | 8.06x11.00 | ..... | 1 7 |
| 245 | 8.00x11.13 | ..... | 0 11 | 236 | 8.06x11.00 | ..... | 1 1 |

## Appendix III—Additional Beam Data—Continued.

### 1 : 2 : 4 LIMESTONE CONCRETE BEAMS

| No. of Beam | Cross Section | First Crack | Crack of Failure | No. of Beam | Cross Section | First Crack | Crack of Failure |
|---|---|---|---|---|---|---|---|
| | Inches | Ft in | Ft in | | Inches | Ft in | Ft in |
| ... | ......... | ..... | ..... | 252 | 8.00x11.06 | ..... | 0 4 |
| 256 | 8.00x11.00 | ..... | 0 8 | 253 | 8.06x11.13 | ..... | 0 7 |
| 257 | 8.00x11.06 | 0 7 | 0 7 | 254 | 8.13x11.31 | ..... | 0 6 |
| 261 | 8.00x11.38 | 0 2 | 2 0 | 267 | 8.06x11.13 | ..... | 0 6 |
| 262 | 8.00x11.25 | 0 6 | 1 10 | 268 | 8.06x11.19 | ..... | 1 11 |
| 263 | 8.00x11.50 | ..... | 1 0 | 269 | 8.06x11.13 | ..... | 1 6 |
| 273 | 8.06x11.25 | 1 9 | 1 2 | 279 | 8.00x11.06 | ..... | 1 7 |
| 274 | 8.00x11.50 | 1 6 | 1 0 | 280 | 8.06x11.13 | ..... | 0 7 |
| 275 | 8.00x11.31 | 0 2 | 0 4 | 281 | 8.06x11.06 | ..... | 0 2 |
| 285 | 7.94x11.25 | 0 8 | 1 7 | 291 | 8.06x11.13 | ..... | 0 3 |
| 286 | 8.06x11.13 | ..... | 1 3 | 292 | 8.06x11.13 | ..... | 0 9 |
| 287 | 8.13x11.38 | ..... | 0 2 | 293 | 8.06x11.13 | ..... | 0 3 |
| 297 | 8.00x11.31 | 0 8 | 0 3 | 303 | 8.13x11.00 | ..... | 1 2 |
| 298 | 8.00x11.00 | ..... | 1 4 | 304 | 8.00x11.19 | ..... | 0 0 |
| 299 | 7.94x11.38 | 0 6 | 0 0 | 305 | 8.00x11.31 | ..... | 0 0 |
| 318 | 8.00x11.25 | ..... | 0 11 | 315 | 8.06x11.13 | ..... | 0 8 |
| 319 | 8.00x11.06 | ..... | 0 0 | 316 | 8.06x11.31 | ..... | 1 1 |
| 320 | 8.06x11.06 | ..... | 0 6 | 317 | 8.06x11.19 | ..... | 0 2 |
| 321 | 8.00x11.13 | ..... | 0 7 | 327 | 8.06x11.13 | 0 1 | 0 5 |
| 322 | 8.06x10.94 | ..... | 1 6 | 328 | 8.06x11.13 | ..... | 1 11 |
| 323 | 7.94x11.25 | ..... | 0 2 | ... | ......... | ..... | ..... |
| 249 | 8.06x11.13 | ..... | 2 0 | 246 | 8.06x11.13 | ..... | 1 1 |
| 250 | 8.06x11.13 | 0 2 | 0 2 | 247 | 8.13x11.19 | ..... | 0 1 |
| 251 | 8.00x11.13 | 0 7 | 0 4 | 248 | 8.06x11.06 | ..... | 2 1 |
| 264 | 8.00x11.13 | ..... | 1 5 | 270 | 8.06x11.25 | ..... | 0 7 |
| 265 | 8.00x11.13 | ..... | 0 2 | 271 | 8.00x11.38 | ..... | 1 3 |
| 266 | 8.00x11.06 | ..... | 0 3 | 272 | 8.06x11.31 | ..... | 0 0 |
| 276 | 8.00x11.00 | ..... | 2 0 | 282 | 8.00x11.31 | ..... | 0 7 |
| 277 | 8.00x11.25 | 0 5 | 0 2 | 283 | 8.06x11.31 | ..... | 0 7 |
| 278 | 8.00x11.13 | ..... | 1 10 | 284 | 7.94x11.25 | ..... | 1 1 |
| 288 | 8.06x11.06 | ..... | 1 3 | 294 | 7.94x11.38 | ..... | 0 2 |
| 289 | 8.00x11.06 | 0 5 | 1 3 | 295 | 8.06x11.31 | ..... | 0 10 |
| 290 | 8.00x11.19 | ..... | 1 8 | 296 | 8.06x11.25 | ..... | 0 5 |
| 300 | 8.00x11.13 | ..... | 1 2 | 306 | 8.00x11.00 | ..... | 0 0 |
| 301 | 8.00x11.19 | 0 9 | 0 2 | 307 | 8.13x11.31 | 1 7 | 0 9 |
| 302 | 8.00x11.00 | ..... | 0 5 | 308 | 7.94x11.25 | ..... | 0 2 |
| 312 | 8.13x10.94 | ..... | 0 11 | 309 | 8.00x11.19 | ..... | 1 6 |
| 313 | 8.00x11.13 | ..... | 1 4 | 310 | 8.06x11.00 | 1 7 | 1 5 |
| 314 | 8.06x11.06 | ..... | 1 5 | 311 | 8.13x11.06 | ..... | 0 4 |
| 324 | 8.00x11.06 | ..... | 1 2 | 330 | 8.06x11.19 | 2 0 | 1 7 |
| 325 | 8.06x11.25 | ..... | 0 7 | 331 | 8.06x11.00 | ..... | 1 1 |
| 326 | 8.00x11.06 | ..... | 0 8 | 332 | 7.94x11.06 | ..... | 0 10 |

## Appendix III—Additional Beam Data—Continued.

### 1:2:4 GRAVEL CONCRETE BEAMS

| No. of Beam | Cross Section | First Crack | Crack of Failure | No. of Beam | Cross Section | First Crack | Crack of Failure |
|---|---|---|---|---|---|---|---|
| | Inches | Ft in | Ft in | | Inches | Ft in | Ft in |
| 333 | 8.00x10.94 | 0 5 | 1 2 | 339 | 8.06x11.06 | 0 6 | 0 6 |
| 334 | 8.13x10.94 | 0 4 | 0 1 | 340 | 8.06x11.19 | ..... | 0 10 |
| 335 | 8.06x11.19 | 1 6 | 1 6 | 341 | 8.06x11.00 | ..... | 1 8 |
| 345 | 8.00x11.00 | ..... | 1 2 | 351 | 8.06x11.13 | ..... | 0 5 |
| 346 | 8.00x11.00 | ..... | 0 8 | 352 | 8.06x11.25 | ..... | 1 4 |
| 347 | 8.00x11.00 | ..... | 0 0 | 353 | 8.06x11.06 | ..... | 1 3 |
| 357 | 8.00x11.00 | ..... | 1 0 | 363 | 8.06x11.13 | 0 9 | 0 9 |
| 358 | 8.00x10.94 | 0 0 | 0 5 | 364 | 8.06x11.25 | ..... | 1 1 |
| 359 | 8.00x11.13 | ..... | 1 6 | 365 | 8.06x11.06 | ..... | 0 6 |
| 369 | 8.06x11.00 | 0 8 | 1 2 | 375 | 8.00x11.19 | 1 7 | 1 5 |
| 370 | 8.00x11.00 | 0 4 | 0 0 | 376 | 8.06x11.19 | ..... | 1 4 |
| 371 | 7.94x10.81 | ..... | 1 10 | 377 | 8.06x11.06 | ..... | 1 5 |
| 381 | 7.88x11.00 | ..... | 0 7 | 387 | 8.06x11.00 | ..... | 0 3 |
| 382 | 8.06x11.00 | 0 8 | 1 1 | 388 | 8.00x11.25 | ..... | 0 6 |
| 383 | 8.00x11.06 | ..... | 0 10 | 389 | 8.06x11.00 | ..... | 1 2 |
| 393 | 8.00x10.94 | ..... | 1 6 | 399 | 8.06x11.00 | ..... | 0 0 |
| 394 | 8.00x10.88 | 0 5 | 1 6 | 400 | 8.00x11.31 | ..... | 0 8 |
| 395 | 8.00x11.13 | ..... | 0 5 | 401 | 8.00x11.06 | 0 0 | 1 3 |
| 405 | 7.94x10.94 | 0 4 | 0 8 | ... | .......... | ..... | ..... |
| 406 | 8.00x10.94 | 1 9 | 0 2 | 412 | 8.06x11.13 | 0 7 | 1 3 |
| 407 | 8.00x10.88 | ..... | 0 3 | 413 | 8.06x11.06 | ..... | 2 0 |
| 336 | 8.00x11.13 | 1 8 | 1 2 | 342 | 7.94x11.13 | 0 6 | 0 6 |
| 337 | 8.06x11.19 | 0 7 | 1 6 | 343 | 8.06x10.94 | ..... | 1 5 |
| 338 | 8.06x11.06 | 1 8 | 0 2 | 344 | 8.06x10.88 | ..... | 1 3 |
| 348 | 8.00x11.00 | ..... | 0 11 | 354 | 8.00x11.00 | ..... | 0 0 |
| 349 | 8.00x11.19 | ..... | 0 5 | 355 | 8.06x11.00 | ..... | 0 5 |
| 350 | 8.00x11.00 | ..... | 0 11 | 356 | 8.00x11.06 | ..... | 1 2 |
| 360 | 8.00x11.06 | ..... | 0 6 | 366 | 7.94x11.13 | ..... | 0 1 |
| 361 | 8.06x11.25 | 1 10 | 1 1 | 367 | 8.06x11.06 | ..... | 1 1 |
| 362 | 8.00x11.00 | 1 11 | 1 2 | 368 | 8.06x10.94 | ..... | 0 10 |
| 372 | 8.00x11.06 | ..... | 0 5 | 378 | 8.00x10.88 | ..... | 0 3 |
| 373 | 8.00x11.13 | ..... | 1 0 | 379 | 8.00x11.00 | ..... | 1 3 |
| 374 | 8.00x11.06 | ..... | 0 3 | 380 | 7.94x11.06 | ..... | 0 4 |
| 384 | 8.06x11.06 | ..... | 0 2 | 390 | 8.06x11.00 | ..... | 0 9 |
| 385 | 8.00x11.06 | ..... | 0 7 | 391 | 8.06x11.13 | ..... | 0 8 |
| 386 | 8.00x11.00 | 0 3 | 0 8 | 392 | 8.06x10.94 | ..... | 0 8 |
| 396 | 8.00x11.06 | 1 0 | 0 0 | 402 | 8.06x11.00 | ..... | 0 6 |
| 397 | 8.00x11.13 | ..... | 0 3 | 403 | 8.06x11.00 | ..... | 1 5 |
| 398 | 8.06x10.94 | ..... | 0 5 | 404 | 8.00x11.06 | 0 0 | 0 7 |
| 408 | 8.00x11.06 | ..... | 1 2 | 414 | 8.00x10.94 | ..... | 0 6 |
| 409 | 8.00x11.13 | 1 9 | 0 8 | 415 | 8.00x11.00 | ..... | 0 11 |
| 410 | 8.00x11.13 | ..... | 0 7 | 416 | 8.06x10.88 | 0 6 | 0 5 |

## Appendix III—Additional Beam Data—Continued

### 1:2:4 CINDER CONCRETE BEAMS

| No. of Beam | Cross Section | First Crack | Crack of Failure | No. of Beam | Cross Section | First Crack | Crack of Failure |
|---|---|---|---|---|---|---|---|
| | Inches | Ft in | Ft in | | Inches | Ft in | Ft in |
| 417 | 8.00x10.94 | 0 7 | 1 4 | 423 | 8.06x11.06 | 0 0 | 0 10 |
| 418 | 8.00x11.00 | ..... | 0 10 | 424 | 8.00x11.13 | ..... | 1 8 |
| 419 | 8.00x11.00 | ..... | 1 7 | 425 | 8.06x11.06 | ..... | 1 10 |
| 429 | 8.00x11.00 | 0 10 | 0 0 | 435 | 8.00x11.00 | 0 6 | 0 7 |
| 430 | 8.00x10.94 | 0 9 | 0 5 | 436 | 8.06x11.19 | ..... | 1 9 |
| 431 | 8.00x10.88 | 1 6 | 1 6 | 437 | 8.00x11.13 | ..... | 0 5 |
| 441 | 8.00x10.81 | 1 7 | 1 2 | 447 | 8.06x11.13 | ..... | 0 9 |
| 442 | 8.00x10.94 | ..... | 1 0 | 448 | 8.00x11.31 | ..... | 1 5 |
| 443 | 8.00x11.00 | ..... | 1 2 | 449 | 8.06x11.13 | ..... | 0 7 |
| 453 | 7.88x10.94 | ..... | 0 3 | 459 | 8.00x11.19 | ..... | 0 3 |
| 454 | 8.00x11.00 | ..... | 1 4 | 460 | 8.06x11.19 | ..... | 0 7 |
| 455 | 8.00x10.94 | ..... | 0 5 | 461 | 8.00x11.00 | ..... | 1 10 |
| 465 | 8.00x10.88 | ..... | 0 3 | 471 | 8.00x11.13 | ..... | 0 10 |
| 466 | 8.00x11.06 | ..... | 0 6 | 472 | 8.00x11.19 | ..... | 0 3 |
| 467 | 7.94x10.94 | ..... | 0 2 | 473 | 8.00x11.06 | ..... | 0 5 |
| 477 | 7.94x11.00 | ..... | 1 0 | 483 | 8.06x11.13 | ..... | 0 2 |
| 478 | 8.00x11.06 | ..... | 1 10 | 484 | 8.00x11.25 | ..... | 2 0 |
| 479 | 8.00x11.00 | ..... | 1 0 | 485 | 8.06x11.06 | ..... | 0 11 |
| 489 | 8.00x10.88 | 0 7 | 0 9 | 495 | 8.06x11.06 | 1 10 | 1 2 |
| 490 | 8.00x11.13 | ..... | 0 6 | 496 | 8.00x11.19 | ..... | 0 5 |
| 491 | 7.94x11.44 | ..... | 0 3 | 497 | 8.06x11.06 | ..... | 1 3 |
| 420 | 7.94x11.06 | 0 3 | 0 3 | 426 | 7.94x11.00 | ..... | 0 10 |
| 421 | 8.00x11.13 | ..... | 0 2 | 427 | 7.94x10.94 | ..... | 0 4 |
| 422 | 8.00x11.06 | ..... | 0 2 | 428 | 8.00x10.88 | 0 6 | 1 3 |
| 432 | 8.00x11.06 | ..... | 1 10 | 438 | 8.00x10.88 | ..... | 0 1 |
| 433 | 8.00x11.19 | 0 2 | 1 11 | 439 | 8.00x10.88 | ..... | 1 6 |
| 434 | 8.06x11.13 | ..... | 0 11 | 440 | 8.06x10.88 | ..... | 0 7 |
| 444 | 8.06x11.06 | ..... | 0 8 | 450 | 8.06x10.81 | 0 0 | 0 7 |
| 445 | 8.13x11.19 | 0 6 | 0 8 | 451 | 8.00x11.19 | ..... | 0 9 |
| 446 | 8.00x11.13 | ..... | 0 2 | 452 | 7.94x11.00 | ..... | 0 6 |
| 456 | 8.00x11.06 | ..... | 0 10 | 462 | 7.94x11.13 | ..... | 1 8 |
| 457 | 7.94x11.19 | ..... | 1 6 | 463 | 8.00x11.00 | ..... | 1 3 |
| 458 | 8.06x11.00 | ..... | 0 10 | 464 | 8.06x10.81 | ..... | 1 5 |
| 468 | 8.00x11.00 | ..... | 1 3 | 474 | 8.06x10.81 | ..... | 0 5 |
| 469 | 8.00x11.00 | ..... | ..... | 475 | 8.00x11.13 | ..... | 1 5 |
| 470 | 8.00x11.19 | 0 5 | 0 2 | 476 | 7.94x10.88 | ..... | 0 3 |
| 480 | 8.00x11.06 | 1 6 | 0 5 | 486 | 8.00x10.81 | ..... | 0 8 |
| ... | .......... | ..... | ..... | 487 | 8.00x11.19 | ..... | 1 8 |
| 482 | 8.00x11.13 | 2 0 | 0 2 | 488 | 8.00x11.06 | ..... | 0 8 |
| 492 | 8.00x11.06 | ..... | 0 10 | 498 | 8.00x10.94 | ..... | 2 0 |
| 493 | 8.13x11.19 | 1 4 | 1 4 | 499 | 8.06x11.00 | ..... | 1 2 |
| 494 | 8.00x11.00 | ..... | 0 0 | 500 | 7.94x11.06 | ..... | 0 5 |