DOE/SF/20282--T1

**Raytheon Engineers &
Constructors**

**Stone & Webster
Engineering Corporation**

Task No. 28

ITER

**Building Design (D230-B)
Final Report**

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December 1995

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A-1.S1003 & S1004	PF Coil Fabrication - 6.2.P PF Magnet Test - 6.2.Q
A-1.S1005	Tokamak Services - 6.2.D
A-1.S1006 & S1011	Magnet Power Supply Switching Network - 6.2.E NBI Power Conversion - 6.2.E
A-1.S1007	Magnet Power Conversion - 6.2.E
A-1.S1008	Site Services - 6.2.M
A-1.S1009	Assembly Laydown Storage - 6.2.N
A-1.S1010	RH Mock-up - 6.2.V
A-1.S1012	RF Auxiliary Heating Power Conversion - 6.2.E

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A-2.ES1002	Cryoplant Cold Box/Dewar - 6.2.J
A-2.ES1003	PF Coil Fabrication - 6.2.P
A-2.ES1004	PF Magnet Test - 6.2.Q
A-2.ES1005	Tokamak Services - 6.2.D
A-2.ES1006	Magnet Power Supply Switching Network - 6.2.E
A-2.ES1007	Magnet Power Conversion - 6.2.E
A-2.ES1008	Site Services - 6.2.M
A-2.ES1009	Assembly Laydown Storage - 6.2.N
A-2.ES1010	RH Mock-up - 6.2.V
A-2.ES1011	NBI Power Conversion - 6.2.E
A-2.ES1012	RF Auxiliary Heating Power Conversion - 6.2.E

Attachments (Continued)**A-3 Building Structural Drawings - Final Issue (CATIA V4 release 1.3 FR 4.1.3 -Electronic Copy - tape)**

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A-3.ES1002	Cryoplant Cold Box/Dewar - 6.2.J
A-3.ES1003	PF Coil Fabrication - 6.2.P
A-3.ES1004	PF Magnet Test - 6.2.Q
A-3.ES1005	Tokamak Services - 6.2.D
A-3.ES1006	Magnet Power Supply Switching Network - 6.2.E
A-3.ES1007	Magnet Power Conversion - 6.2.E
A-3.ES1008	Site Services - 6.2.M
A-3.ES1009	Assembly Laydown Storage - 6.2.N
A-3.ES1010	RH Mock-up - 6.2.V
A-3.ES1011	NBI Power Conversion - 6.2.E
A-3.ES1012	RF Auxiliary Heating Power Conversion - 6.2.E

EXECUTIVE SUMMARY

The International Thermonuclear Experimental Reactor (ITER) Project requires a set of buildings, each with its own distinct function, to support ITER's mission. The Joint Central Team (JCT) has identified all the buildings in the set and has placed them in an efficient arrangement on the site. The JCT has developed a conceptual layout of each individual building. The buildings have been categorized into two main groups: 1) "Level 1 Buildings" which are on the construction schedule critical path and 2) "Level 2 Buildings" which, while important, are not on the critical path. The buildings are further categorized according to construction material, that is, "reinforced concrete" or "steel-frame on concrete slab". This Report responds to the Project's request to perform the initial structural steel design for all the "steel-frame on concrete slab" buildings. Of the twelve (12) "steel-frame on concrete slab" buildings, four (4) are Level 1 and eight (8) are Level 2 Buildings. This Report is a deliverable for the ITER Task Assignment entitled "ITER Buildings Design (D230-B)", also designated as Task No. 28.

ITER U.S. Home Team Industrial Consortium members, Raytheon Engineers & Constructors (RE&C) and Stone & Webster Engineering Corporation (SWEC), teamed to perform Task 28. This task commenced in May 1995. It was performed in accordance with the design criteria specified by the ITER-JCT, San Diego Joint Work Site.

The following deliverables are provided for each building:

- Building structural layout drawings
- Structural member sizes based on JCT load requirements
- Calculations to document the selected member sizes
- Bills of material for the structural steel framing
- CATIA 3-D models for each building
- Overhead crane requirement based on JCT parameters

The building structural design effort was prepared using CATIA V4 release 1.3 CAD software. The structural analysis was performed using STAAD-III Version 20 software.

This Report contains the following sections and attachments:

1. Introduction
 2. Scope of Work
 3. Design Description
 4. Conclusions and Recommendations
 5. References
- Attachments
- A-1. Building Design Calculations
 - A-2. Building Structural Drawings - Final Issue ("E" size)
 - A-3. Building Structural Drawings - Final Issue (CATIA V4 Release 1.3) on tape.

Sections 1 and 2 of this Report provide an overview of this task assignment and the scope of work as defined by the JCT. Section 3 provides the design methodology, design criteria, crane selection, load combinations, analysis overview, bills of materials, and "B" size copies of the drawings for each of the twelve (12) buildings. Section 4 includes overall conclusions and recommendations. Attachment A-1 contains the detailed structural analysis (STAAD-III) results for each buildings. Attachment A-2 includes an "E" size copy of all the building drawings. Attachment A-3 provides an electronic file of each of the buildings in CATIA exported format.

The Design Description portion of this Report, Section 3, begins by presenting an overview of the task followed by detailed discussions for each of the twelve (12) "steel-frame on concrete slab" buildings. The overview discusses the design methodology, design criteria, cranes, loads and load combinations, and repetitive steel structural members design.

The design methodology utilized an iterative, three steps, process which included conceptual configuration, structural analysis, and 3D Modeling / drawings creation. All three steps were performed using the CATIA System. An initial 3D CATIA model was created, subject to JCT and RE&C/SWEC review. When this model became functional, structural analysis was completed. The structural analysis commenced with the geometric-kinematic definition of the members comprising the steel framing and the identification of the most probable load combinations expected to appear during the structure life. The JCT provided a number of typical load cases which were combined to meet the requirements of the Uniform Building Code. The structural analysis, member sizing, and code compliance checking of the stress and displacement of the members was conducted using the STAAD III computer code. The code check followed the AISC Manual of Steel Construction, Allowable Stress Design Method, and was performed and printed for every member of the main steel structural skeleton for all twelve(12) buildings. Following the structural analysis, a detailed 3D CATIA model and its related structural drawings were created.

The design criteria were provided to RE&C/SWEC by the JCT during the task kickoff meeting at San Diego on May 18, 1995. The design criteria were further discussed at a subsequent meeting and it was agreed to use the following:

- The 1994 Uniform Building Code (UBC)
- The Ninth Edition of the American Institute of Steel Construction (AISC)
- The metric system was recommended, but not mandatory
- The specifications of selected American crane manufactures (CMAA Spec #70, American Crane & Equipment Co. (ACECO), etc.)
- The STAAD III/ISDS Computer Program Version 20 for performing the structural analysis
- The SWEC CATIA/STRUDL Interface Extraction Program to produce the Bills of Material
- The CATIA system to produce all 3-D Models as well as drawings.

Overhead crane requirements are identified in this Report based on parameters provided by the JCT. Crane requirements such as loads, identification of rails and girders, overhead clearance which affect roof truss elevations and crane working areas have been established.

The evaluation of the individual load cases and their combinations was conducted in accordance with the requirements of the UBC. Additional requirements pertinent to the evaluation of the loads induced by the crane weights and movements followed recommendations of the AISC Code. The individual loads used in the structural analysis and sizing of all steel structural members were grouped into the following six (6) distinct categories: dead loads, live loads, crane induced loads, wind loads, snow loads and seismic. Although the magnitude of all individual load cases was given by the JCT, they were modified as necessary to meet the requirements of the UBC.

A relatively large number of repetitive structural members occur in the buildings. These members are predominantly found in the roof, floor and crane framing. The design process which was used to develop these members is presented.

This Report provides the necessary information for each of the ITER Project " steel-frame on concrete slab " buildings so that the JCT can proceed with further definition of the buildings and related services as well as refined cost estimates. By providing drawings and computer tapes of the CATIA 3D models for each building, the JCT can modify buildings, if necessary, in preparation for future design development. The bills of material that are included permit more accurate cost estimates for the structural items of the buildings than presently exist. Identification of crane types also permits better estimates of these costs. It remains, of course, to apply engineering judgment at this time to estimate costs for building services and common (or separate) utilities in conjunction with the process services. Future tasks will allow definition of these services so that they can be properly defined.

1. Introduction

This Report is a deliverable under ITER Task Assignment entitled "ITER Buildings Design (D230-B)", also called Task No. 28. This task provides the initial structural steel design of all twelve (12) ITER "steel-frame on concrete slab" buildings. The team of Raytheon Engineers and Constructors (RE&C) and Stone & Webster Engineering Corporation (SWEC) performed this task in accordance with the design criteria provided by the ITER Joint Central Team (JCT).

The ITER Plant General Layout is shown in Fig. 1. This Fig. shows eleven (11) "steel-frame on concrete slab" buildings (also known as industrial buildings) in conjunction with all the other ITER buildings. It should be noted that Building No. 6 (Tokamak Services Building) is an "operations building", however, the JCT added it to this task as a "steel-frame on concrete slab" building structure.

This Report provides all deliverables required by this task. It summarizes the work, discusses the design methodology and recommends how the building design should continue in order to ultimately achieve the ITER EDA requirements.

The task commenced on May 18, 1995 with a kick-off meeting held between members of RE&C, SWEC, US HT, and the JCT at the ITER-JWS in San Diego, California. The purpose of the meeting was to review the scope of work, establish lines of communication, format of data, and schedule of deliverables.

The JCT provided a document "Building Design Conditions for Task B of D230" (Rev. 0: 1995.05.18) to the RE&C/SWEC team. This document provided the generic loading conditions to be applied to the buildings as well as sketches showing overall dimensions and the framing concept for each building. It was provided in CANVAS format.

It was agreed between the parties that the work would be performed in three phases. Phase I required converting the building sketches provided in CANVAS format into CATIA drawing format and issuing (Issue 1) them to the JCT for comments. Phase II included incorporating JCT comments and re-issuing (Issue 2) the CATIA drawing to the JCT. Also, the various loading combinations for structural analysis were agreed upon between the parties. Phase III involved performing structural analysis, developing AISC member sizes, bills of material, 3-D model and drawings (Issue 3) for each building. The crane requirements were established in parallel and provided the necessary input data for the structural analysis.

Throughout execution of this task, the JCT task officer was continuously informed of the work progress and preliminary drawings were exchanged, permitting the incorporation of various comments. Examples of the structural analysis were also exchanged and commented upon.

- Industrial Structures
- Industrial Buildings
- Nuclear Buildings
- Operations Buildings
- Outdoor Storage
- Staff Buildings
- Fencing
- Utility Tunnels
- Compulsory Area Boundary (73.4 Hectare)

Key to Tokamak Buildings

1. Tokamak Hall
2. Assembly Hall
3. Laydown Hall
4. Hot Cell Building
5. Tritium Building
6. Tokamak Services Building
7. Electrical Termination Building
8. Radwaste Building
9. Personnel Building
10. Cryopant Compressor Building
11. Cryopant Cold Box / Dewar Building
12. Magnet Power Supply Switching Network Building
13. Magnet Power Conversion Buildings
14. RF Auxiliary Heating Power Conversion Building
15. NBI Power Conversion Building
16. Steady State Switchgear
17. Gas Storage Yard
18. Cooling Water Storage Basin
19. Plant Service Water Storage Basin
21. Emergency Power Generator Building
22. Laboratory Office Building
23. Control Building
24. Site Services Building
25. PF Coil Fabrication Building
26. PF Magnet Test Building

27. RH Mock-up Building
28. Assembly/Laydown Storage Building
29. Outdoor Water Treatment Tanks
30. Fuel Storage Tanks
31. Pulsed Power Switchyard
32. Steady State Switchyard
33. Outdoor Storage Areas

RE&C / SWEC

ITER Task D230-B

Plant General Layout

Fig. 1

NOTE: This Drawing was received from
ITER JCT San Diego JWS Aug.25,1995
and converted from CATIA

A mid-task coordination meeting took place in Princeton, NJ at Raytheon's office on July 17, 1995. The attendees discussed the work status, exchanged information and established the strategy for the next stage of work. During the meeting, the JCT informed the RE&C/SWEC team that the PF Coil Fabrication Building and the Magnet Test Building were placed on "hold" due to revised space and lifting device requirements by the JCT Super Conducting Coil & Structure Division. The "hold" was released on September 12, 1995.

A final coordination meeting took place at Raytheon's Princeton Office on November 2, 1995. Attendees discussed the overall design progress and agreed on the content, format, schedule, and distribution of the Final Report.

The task deliverables are located in the following Sections of this Report:

- Structural design/analysis methodology and related design conditions common to all buildings are presented in Sections 3.1, 3.2, 3.4, 3.5.
- Crane design concepts and conditions are described in Section 3.3.
- Bills of material and specific design conditions for each building are presented in Sections 3.6.1 through 3.6.12.
- Structural analysis specific to each building is presented in Attachment A1. As a minimum this Report transmits the entire input file for each building, the code check output, the support reactions as well as the points of maximum displacement.
- Drawings prepared from a 3-D CATIA model are presented in Attachment A2. It should be noted that 11" x 17" copies of these drawings are provided in Section 3.6 for those receiving the Report without attachments.
- Computer tapes of CATIA V4.1.3 files are placed in Attachment A3.

Below are listed the key contact individuals that participated in this task.

ITER JCT Task Officer:	Eiichi Tanaka	ITER-JWS-SD	(619) 622-5167
U.S. Home Team:			
Responsible Officer:	James Doggett	LLNL/USHT	(619) 534-6516
Contact Person:	Scott Thomson	Bechtel/USHT	(415) 768-9657
U.S. Home Team			
Industrial Consortium			
Lead Personnel:	Serban Stoenescu	RE&C	(609) 734-9181
	Gilbert Baptista	SWEC	(617) 589-1092

2. Scope of Work

The task scope of work was outlined in the ITER EDA JCT document S 62LS51095-04-02 F1 entitled "Task ID: D230 B - Design and Modeling of Steel Framed Buildings" (dated April 3, 1995). In addition, the document "Building Design Conditions for Task B of D230" was provided to the RE&C/SWEC team by the JCT during the task kickoff meeting held at the ITER-JWS in San Diego, CA on May 18, 1995. This document defined the input design requirements, structural loads and layout of each of the twelve (12) buildings within the task scope.

Table 2-1 lists the twelve (12) buildings included in this task. The table provides a cross reference of the following information:

- ITER Building Name
- ITER WBS designation
- ITER Level/Priority
- Drawing numbering system
- ITER Building number references as shown on the ITER Plant General Layout drawing
- Building design responsibility between the RE&C/SWEC team
- Comments

Two similar structures are required for both the Tokamak Services and the Magnet Power Conversion buildings. The design and analysis was only performed for one building.

Figures 2-1 and 2-2 show the ITER buildings pertaining to this task in both plan and isometric views respectively.

2.1 Task Description

The following highlights the task scope of work for each building as requested by the JCT.

- Structural design is performed in accordance with U.S. Codes (AISC, ACI and UBC) using the loads provided by the JCT. The analytical activities include the following:
 - Verification of structural design concepts and conditions
 - Calculation of the loads
 - Stress analysis using individual loads
 - Stress analysis using load combinations
 - Member sizes and weights in accordance with the AISC Code
- Crane requirements are developed based on the design conditions specified by the JCT. These requirements are shown on drawings which include crane geometries as well as the structural members required to support the crane.
- CAD drawings are created using CATIA and provided to the JCT in electronic format.

2.2 Task Deliverables (Task Period of Performance May 1995 - January 1996)

The following deliverables are provided for each building:

- B-1 Documentation of structural design and crane design concept and conditions.
(Included in the Final Report Section 3 - Design Description)
- B-2 Documentation of structural design calculations resulting in the form of a Member sizing Calculation. **(Included in the Final Report Attachment A-1 - Building Design Calculations)**
- B-3 Drawings including floor plan of each level, two sections (NS section and EW section), prepared from a 3D CATIA CAD model, a list of all structural members, bills of material, and description of crane and any other mechanical features.
(Included in the Final Report Section 3 - Design Description "B" size and in Attachment A-2 "E" size)

Table 2-1

ITER - Task D230B -Building List

Building Name	ITER WBS No.	Level / Priority	Drawing No. (*)	Plant Layout No. (**)	Responsibility	Comments
Cryoplant Compressor	6.2.J	1	ES-1001	10	SWEC	
Cryoplant Cold Box/Dewar	6.2.J	1	ES-1002	11	RE&C	
PF Coil Fabrication	6.2.P	1	ES-1003	25	SWEC	
Magnet Test	6.2.Q	1	ES-1004	26	SWEC	
Tokamak Services	6.2.D	2	ES-1005	6	RE&C	Two Buildings
Magnet Power Supply Switching Network	6.2.E	2	ES-1006	12	SWEC	
Magnet Power Conversion	6.2.E	2	ES-1007	13	SWEC	Two Buildings
Site Services	6.2.M	2	ES-1008	24	RE&C	
Assembly Laydown Storage	6.2.N	3	ES-1009	28	SWEC	
Remote Handling Mockup	6.2.V	3	ES-1010	27	SWEC	
NBI Power Conversion	6.2.E	3	ES-1011	15	SWEC	
RF Auxiliary Heating Power Conversion	6.2.E	3	ES-1012	14	RE&C	

(*) Temporary assigned identification number

(**) Number per ITER Plant General Layout (see Fig. 1)

PRIORITY

BUILDINGS

- 6. Tokamak Services
- 10. Cryopant Compressor
- 11. Cryopant Cold Box/Dewar
- 12. Magnet Power Supply Switching Network
- 13. Magnet Power Conversion
- 14. ICRF Auxiliary Heating Power Conversion
- 15. NBI Power Conversion
- 24. Site Services
- 25. PF Coils Fabrication
- 26. PF Magnet Test
- 27. RH Mock-up
- 28. Assembly/Laydown Storage

PRIORITY

- II
- I
- II
- II
- III
- III
- I
- III
- III

Number per Fig.1 ITER Plant General Layout

RE&C / SWEC
 ITER Task D230-B
 General Layout
 Fig. 2-1

ITER - Task D230B - The "INDUSTRIAL" (Steel-frame on slab) BUILDINGS
3-D View Looking N-E & down

RE&C / SWEC
ITER Task D230-B
Building Layout
Fig. 2-2

3.0 Design Description

Section 3 includes the following: 1) an overview of the design methodology used for all twelve (12) steel buildings; 2) a discussion of the design criteria which were provided by the JCT; 3) overhead crane requirements based on JCT parameters. Crane requirements were factored into the buildings design with regard to loading and space allocation; 4) individual load cases and combinations; 5) the design process used for all repetitive steel structural members; 6) a presentation of the design of each of the twelve (12) buildings in detail and includes the specific design methodology used for the building, bills of material, respective 11 x 17 drawings and a discussion which serves to highlight any specific concerns or possible items to be addressed at later stages of design.

3.1 Design Methodology Overview

The methodology used for the building design task complies with JCT requirements as described in Section 2, "Scope of Work". The methodology meets the requirement to provide deliverables in CATIA format.

The design criteria issued by the JCT provided the necessary information to conceptualize and generate the design models which are the basis for this effort. The building drawings are included in Section 3.6, and in Appendix A-2. The CATIA modeling and drawing creation was performed using Version 4 release 1.3.

The initial design effort entailed the layout and design of the steel framing for the twelve buildings listed in Table 2-1. The calculations for all primary steel framing elements were performed using either a 2D plane frame sectional method or a 3D space frame analysis.

The design work flow for the twelve buildings was divided into the following four phases, shown schematically in Fig. 3-1.

- 1 Building definition
2. Incorporation of JCT comments
3. Design of structural framing and final issue of 3-D models and drawings
4. Bills of Material

3.1.1 Building Definition

The first phase of work involved creation of a basic CATIA model from the initial information provided by the JCT. This first phase effort did not include member sizing but did incorporate planing of the structural framing. If necessary, framing changes were made to accommodate door openings, load paths for wind and other structural considerations. The general sketches provided by the JCT provided the column spacing. Adjustments were made to roof height, if required, for crane clearance or other structural considerations. The work did not include studies for egress, stairs and elevators, and other miscellaneous framing requirements. At this

point, all drawings were issued to the JCT as Issue 1, and denoted "Issued for Comments".

3.1.2 Incorporation of JCT Comments

Upon return of the Issue 1 drawings from the JCT, comments were incorporated where required. All the drawings were revised as Issue 2 and were made available for information and for analysis.

3.1.3 Design Process

The design process for buildings ES-1001, 3, 4, 6, 7, 9, 10 and 11 was as follows:

Once the 3D model for a given building was approved in Issue 2, the analysis process was initiated. The first step in this process utilized a SWEC proprietary interface program (See References, Item 6) that extracted CATIA modeling data to create a STRUDL compatible input file. (This automated process is limited to the models identified in Table 2-1 as SWEC responsibility.)

The CATIA/STRUDL interface program manages revisions or changes to the input file by preserving node and element identifiers and geometry definitions. This protects outstanding work against the model file, for example loading input or member releases. This capability was used to help preserve continuity in the 2D sectional method by first using the program to generate a complete 3D joint, member file extraction. CATIA was then used to isolate and extract the section cuts for analysis allowing an automatic naming convention that is unique for a given element. Thus, whether an element appears in plan or section, the name is the same in each model for a given building.

The 3D STRUDL files contain data for the columns, girders, horizontal and vertical bracing, and any primary framing required for overall structural stability. Secondary framing elements such as roof and floor beams and girts were, by choice, omitted for the analytical model. These secondary elements are covered outside of 3D/2D frame analysis in Section 3.6. Analysis was performed using STAAD-III release 20, a PC based structural software package.

All of the buildings in this section were designed as Type 2, (Reference 2) commonly designated as simple framing, that is, the ends of beams and girders are connected for shear only and are free to rotate.

Buildings ES-1006, ES-1007, and ES-1011 were designed using the 2D sectional method. Based upon the experience gained in the 2D section method of analysis of Buildings ES-1006, ES-1007 and ES-1011 it was decided that a 3D analysis was more efficient, in addition to providing more reliable results, particularly for deflections. Consequently, Buildings ES-1001, ES-1003, ES-1004, ES-1009, and ES-1010 were designed using the 3D space frame method.

The loading input for the various buildings was prepared as defined in Section 3.4, and placed in the STAAD-III input file utilizing STAAD'S graphical user interface.

Column base plate boundary conditions were initially agreed to be pinned, however Building ES-1007 had a fixed base design. This building is 30 meters wide and 170 m long. The resulting transverse deflections were deemed to be excessive, consequently a fixed base column design as discussed in Section 3.6.7 was used.

Certain design parameters were assumed for this initial phase. For example:

- 1) The unbraced length of the roof beams were designed at $L/2$. A more economical design could be obtained if the roofing system was known;
- 2) If chosen, the design could utilize a horizontal diaphragm action (a roof with metal decking welded to the compression flange) which in turn would allow higher bending stress allowables. The same holds true for the floor slabs;
- 3) The crane beams are designed with the assumption that the unbraced length of the compression flange is $L/5$;
- 4) Major door openings are shown on the drawing to help with planning. The large doors in buildings ES-1003 and ES-1004 are 35m wide and were considered to be electric powered sliding hanger doors supported laterally on top and bottom, and therefore the wind load is transferred vertically to the building and floor. Special attention to this detail is required in the next phase of work, and a load path needs to be assessed at these critical door openings. Smaller overhead doors are assumed to be roll-up types, and therefore the wind load was transferred horizontally.

For all the buildings in this section, wind loads governed over the seismic load case.

The Cryoplant Box/Dewar (ES-1002), Tokamak Services (ES-1005), Site Services (ES-1008) and RF Heating Power Conversion (ES-1012) buildings were structurally conceived and designed with the same philosophy.

This philosophy is somewhat different than that used for the above described buildings and is based on designing each building as a three-dimensional symmetrical steel structure composed of two main structural categories: 1) principal structural components (transverse frames, longitudinal frames and the roof bracing systems) which support and transfer the loads, and 2) secondary repetitive type structural members (purlins, joists, crane supporting structure and lateral enclosure structure). A large number of steel members which make up the second category possess similar structural behavior and are subjected to identical load combinations. They are grouped, analyzed and sized as discussed in Sections 3.5 and 3.6. All the secondary repetitive elements support their tributary loads and carry them to the adjoining transverse frames.

It was initially agreed to use pinned column base plate boundary conditions, however, some of the buildings required a rigid portal frame necessitating a fixed base plate design. Fixed column base design was performed for buildings ES-1002, ES-1005, ES-1008, and ES-1012. This allows for a more economical column design.

The typical transverse frame is spaced along the longitudinal side of the building based on structural requirements. It is a two-dimensional structural component, capable of carrying all of its tributary collected vertical and horizontal transverse acting loads (wind parallel to the frame, transverse seismically induced loads and the transverse horizontal crane bracing loads) to the concrete mat. All transverse frames are designed to be rigidly connected to the foundation concrete slab. This approach was based on the following structural and economic considerations: 1) better distribution of the bending moments and resulting material along the members' length (the bending moments are distributed at both ends), 2) a reduced buckling length and 3) an increased lateral rigidity and stability of the overall structure. This approach also has an advantage, during construction, of eliminating the need for temporary supporting members. The columns of the transverse frame are designed with varying cross-sectional heights, or with a one-step configuration (for cranes having a lifting capacity over 20 tons). In general, they have a less stiffer upper section and a more developed lower section which is necessary to support the additional loads induced by the crane. The upper section is rigidly connected to the horizontal structural element (truss or beam); a moment connection is provided at the junction of the column to beam. This assures better moment distribution between the structural components. A truss is used to create the horizontal member frame in all cases where the span exceeds 10 meters (an exception is the Tokamak Services Building where a welded plate solution has been adopted for all the main structural components). The height of the truss was chosen as approximately 1/10 of the span dimension based on empirical data cited in the steel design textbooks. Considering the unusual dimensions of the buildings and the magnitude of the loads provided by the JCT, the above structural approach appears to be the most viable and economical among the "classical" types of solutions.

The longitudinal stability of the building is satisfied by using a number of typical longitudinal frames, each capable of carrying all the longitudinal horizontal loads such as: 1) wind blowing parallel to the longitudinal direction of the building; 2) the seismically induced longitudinal acting loads; and 3) the longitudinal crane braking loads. The columns of the typical transverse frames, described above, have a reduced bending capacity in the longitudinal direction and are conservatively considered as "hinged" in this direction. For this reason a rigid braced system is created along each longitudinal column line using portals, horizontal disposed beams and local vertical bracing systems. The vertical bracing system is a "K" type and is located at the roof level spanning the entire building length. The portals, which are the major structural elements, are located in the middle section of the building and allow the steel structure unrestricted thermal expansion. The portal bracing system is much stiffer at the locations under the crane girder elevation and less stiff above this elevation. The longitudinal frame is composed of a number of horizontally developed beams which insure the complete stability of the structure. These beams are considered hinged at their connection with the adjoining columns.

The third principal component of the three-dimensional frame is the roof structure. In addition to the vertical rigidity it provides as an integral part of the transverse frame component, the roof is also designed to act as a rigid horizontal diaphragm. Its role is crucial in realizing the transverse and longitudinal frame concept. To equally distribute the loads to each of the transverse and longitudinal frames, the roof is designed in horizontal plan as a number of bracing systems along the longitudinal and transverse directions. All transverse bracing systems are located at the end bays of the buildings and at interior bays at an average distance of 50 meters. They connect the adjoined horizontal structural elements of the transverse frames (beams and trusses). The longitudinal bracing systems are located at the centerline of the column lines. They add rigidity to the longitudinal framing and insure that the horizontal longitudinal loads are carried to the rigid portals. The transverse and longitudinal roof bracing systems were all designed as "X" type with members working in tension as well as in compression.

The structural analysis of the three-dimensional steel frame was conducted by considering three (3) typical two-dimensional sections which account for the behavior of the entire structure. These are: 1) transverse frame, 2) longitudinal frame, and 3) roof. All pertinent loads and load combinations related to each structural type are considered in the analysis. The structural analysis was carried out using the STAAD III computer code.

The analysis was performed using US standards. (The 1994 UBC code and the AISC code, ninth edition). General notes for the steel design can be found on drawing ES-1001A. A one-third (1/3) increase in allowable stress for wind and seismic load cases was used as permitted by the design codes.

3.1.4 Bills of Material

Once the building design was completed and the 3D CATIA model was updated with final member sizes, a bill of material was extracted. This extraction was executed by utilizing CATIA's reporter function and SWEC's reporter program modules. This data was transferred to a spreadsheet file which is presented in Section 3.6. Siding girt steel and miscellaneous connections were not modeled in CATIA, but the tonnage was estimated and added to the spread sheet, see Sections 3.6.1.b through 3.6.12.b.

3.2 JCT Design Criteria

The design criteria to be used for all buildings as well as the specific design requirements for each building were outlined by the JCT in the document "Building Design Conditions for Task B of 230". This was provided to both Raytheon and SWEC during the task kickoff meeting at San Diego on May 18, 1995.

It was agreed to use:

- a) The 1994 Uniform Building Code (UBC).
- b) The Ninth Edition of the American Institute of Steel Construction (AISC).
- c) The metric system was recommended but not mandatory.
- d) The specifications of selected American crane manufactures (CMAA Spec #70, American Crane & Equipment Co. (ACECO), etc.).
- e) The STAAD III / ISDS Computer Program in order to perform the structural analysis.
- f) The SWEC CATIA/STRUDL Interface Extraction Program to be used to produce the Bill of Material.
- g) The CATIA system to be used for all 3-D Models as well as drawings.

3.3 Cranes

3.3.1. Purpose

One of the objectives of this task is to identify overhead crane requirements based on parameters provided by the JCT (See References, Item 7). The crane parameters are used to size the respective building columns, crane girders, roof truss elevations, and working areas for the entire building. Also, establishing crane requirements, although conceptual, provides additional confidence in the crane cost estimates at this time.

Service classification requirements have been assumed in selecting the overhead crane for each building. It is expected that the Crane Manufacturers Associations of America (CMAA) Specification #70 (See References, Item 8), or similar document, will be used for the design as well as for the specification of the overhead cranes.

3.3.2 Service Condition

Overhead crane classification is based on identifying the most economical crane satisfying the load spectrum defined by the service conditions. Crane classification varies from "CLASS A"; i.e., standby or infrequent service condition to "CLASS F"; i.e., continuous severe service condition. These classifications are described in detail in CMAA Specification #70. At the time that this task was performed, crane service conditions were not specified to the point that cranes could be classified. With this in mind, it was felt prudent to identify all cranes in this task as "CLASS D"; i.e., heavy service condition.

3.3.3 Crane Selection

Table 3.3-1 shows the conditions for design of the cranes. This information is used to develop the necessary clearances for the crane girder and the trolley in all directions as shown in Figs. 3.3-1 and 3.3-2 which are generic guides used for each building. Table 3.3-2 and Table 3.3-3 are generated using Table 3.3-1 in conjunction with the recommendations of two overhead crane manufacturers from the United States [References, Items 9 and 10]. As discussed before, "CLASS D" cranes are used to select the crane parameters from the above mentioned crane manufacturers specifications. Other pertinent parameters such as types of trolley and crane bridge, lift speeds, etc., cannot be defined at this time due to the lack of service requirements. However, the project requirements in combination with the CMAA specification can be used to set these parameters later.

There are three options for mode of operation: 1) floor operated pendant push-button system; 2) cab (open or enclosed) operated system; and 3) radio or infrared remote controlled operated system. The floor operated pendant push-button hangs

from the overhead crane and is the least expensive operating system, whereas, the radio or infrared remote controlled operated system is the most expensive. Normally the cab and the radio controlled operations are optional. The mode of operation considered here is floor operated, but the final mode will be determined later.

3.3.4 Conclusion and Recommendation

For the information available to perform this task, the above Referenced Tables and Figures provide the data necessary to identify crane requirements for all the buildings that have cranes. However, service requirements must be defined at a later time to assign the correct crane classification per CMAA specification. This will reduce the actual cost of cranes where the classification is lower than the one used here. Furthermore, if crane usage permits a similar crane in the adjacent bay with the same crane elevations, it may be possible to use a single trolley system for both bays by adding a crane trolley transfer rail system connecting both crane spans. This will also reduce crane cost.

Table 3.3-1 Overhead Cranes - Conditions For Design

Building	Number of Cranes	Capacity Each (tons)	Span * (meter)	Hook Height (Lift) (meter)	Reference Drawing No.
Auxiliary -Magnet Power Conversion (High) (WBS 6.2.E)	1	5	10	* 12	ES-1007
Auxiliary -Magnet Power Conversion (Low) (WBS 6.2.E)	2	10	10	9	ES-1007
Auxiliary -ICRF/ECRF Power Supply (WBS 6.2.E)	2	20	20	10	ES-1012
Cryoplant - Compressor (WBS 6.2.J)	2	40	40	8	ES-1001
Cryoplant - Cold Box/Dewer (High Bay) (WBS 6.2.J)	2	120	25	26.5	ES-1002
Cryoplant - Cold Box/Dewer (Low Bay) (WBS 6.2.J)	1	10	33	12	ES-1002
Site Services (WBS 6.2.M)	2	20	20	7	ES-1008
Magnet Coil Test (WBS 6.2.Q)	4	125	N/A	22	ES-1004
Remote Handling Mockup (Low Bay) (WBS 6.2.V)	1	100	50	35	ES-1010
Remote Handling Mockup (High Bay) (WBS 6.2.V)	1	5	16	55	ES-1010

* The actual Crane Spans are changed from the values shown in this Column.

See Reference Drawings for the correct values.

The data in this Table is based on JCT input per References, Item 7

Table 3.3-2 Overhead Cranes Parameters

Building	Capacity (tons)	Span (meter)	Lift (meter)	A (meter)	B (meter)	C (meter)	D (meter)	E (meter)	Y (meter)	Z (meter)	ASCE CRANE RAIL #
Auxiliary Magnet Power Conversion (High) [WBS 6.2.E]	5	10.0	12.0	1.80	1.63	0.20	0.86	0.86	2.44	2.44	60
Auxiliary Magnet Power Conversion (Low) [WBS 6.2.E]	10	10.0	9.0	1.80	1.71	0.20	0.91	0.91	2.44	2.44	60
Auxiliary ICRF/ECRF Power Supply [WBS 6.2.E]	20	20.0	10.0	2.21	2.07	0.20	1.14	1.14	2.90	3.07	100
Cryoplant Compressor [WBS 6.2.J]	40	40.0	8.0	2.90	2.64	0.20	1.43	1.43	2.90	3.07	175
Cryoplant Cold Box/Dewer (High Bay) [WBS 6.2.J]	120	25.0	26.5	3.28	3.61	0.36	1.42	1.42	4.11	4.11	175
Cryoplant Cold Box/Dewer (Low Bay) [WBS 6.2.J]	10	33.0	12.0	1.85	2.15	0.20	1.00	1.00	3.23	3.23	100
Site Services [WBS 6.2.M]	20	20.0	7.0	2.21	2.07	0.20	1.14	1.14	2.59	2.59	100
Magnet Coil Test [WBS 6.2.Q]	125	N/A	22.0	3.20	1.83	-	-	-	-	-	-
Remote Handling Mockup (Low Bay) [WBS 6.2.V]	100	50.0	35.0	3.51	3.05	0.25	1.60	1.60	4.42	4.42	175
Remote Handling Mockup (High Bay) [WBS 6.2.V]	5	16.0	55.0	1.80	1.63	0.20	0.86	0.86	2.44	2.44	60

Minimum Side Clearance = 0.15 meter

Minimum Top Ceiling Clearance = 0.30 meter

Minimum End Of Building Clearance = 1.25 meter (Clear Distance From Any Obstacles)

Note: Work this Table with Figs. 3.3-1 and 3.3-2

Table 3.3-3 Overhead Cranes and Crane Wheel Parameters

Building	Capacit (tons)	Span (meter)	Lift (meter)	Crane Wt. (tons)	Trolley Wt. (tons)	ax. Whee Load (tons)	No. Of Wheels	Wheel Base (WB) (meter)	CC (meter)
Auxiliary Magnet Power Conversion (High) [WBS 6.2.E]	5	10	12	13.6	1.23	8.56	4	3.83	-
Auxiliary Magnet Power Conversion (Low) [WBS 6.2.E]	10	10	9	13.6	1.73	11.25	4	3.83	-
Auxiliary ICRF/ECRF Power Supply [WBS 6.2.E]	20	20	10	24.5	31.1	20.14	4	4.34	-
Cryoplant Compressor [WBS 6.2.J]	40	40	8	65.8	9.1	22	8	5.26	1.83
Cryoplant old Box/Dewe (High Bay) [WBS 6.2.J]	120	25	26.5	93	31.8	57.53	8	6.58	1.24
Cryoplant old Box/Dewe (Low Bay) [WBS 6.2.J]	10	33	12	41.3	1.75	16.33	4	4.57	-
Site Services [wbs 6.2.m]	20	20	7	24.5	3.2	20.14	4	4.34	-
Magnet Coil Test [WBS 6.2.Q]	125	N/A	22	-	42.6	-	-	-	-
Remote Handling Mockup (Low Bay) [WBS 6.2.V]	100	50	35	151	27.22	47.63	8	8	1.83
Remote Handling Mockup (High Bay) [WBS 6.2.V]	5	16	55	17	1.45	9.9	4	3.83	-

Note: Work this Table with Figs. 3.3-1 and 3.3-2.

Fig. 3.3-1 Front View Of The Crane

Note: Work this Fig. with Tables 3.3-2 and 3.3-3

Fig. 3.3-2 Side View Of The Crane

Note: Work this Fig. with Tables 3.3-2 and 3.3-3

3.4 Individual Load Cases and Load Combinations

The evaluation of the individual load cases and their combinations was conducted in accordance with the requirements of the Uniform Building Code (UBC), 1994 Edition , Volume II, "Structural Engineering Design Provisions". Additional requirements, from the American Institute of Steel Construction (AISC), Manual of Steel Construction , 9th Edition, were factored into the evaluation of the loads induced by the crane weights and movements.

3.4.1 Individual Load Cases Evaluation

The individual load cases were specified by the JCT (See References, Item 1).

The individual loads employed in the structural analysis and sizing of all steel structural members were grouped into six (6) distinct categories: dead loads, live loads, crane induced loads, wind loads, snow loads and inertial seismic induced loads. These categories were considered broad enough to cover all possible types of loading expected to appear during the postulated structural life. An exception is thermal impact, usually consider in the structural assessment, but discounted for the present study by JCT criteria (See References, Item 1).

An additional load case, consisting of a horizontal unit force acting at the roof level, was introduced. This load case is used to evaluate the global lateral stiffness of the steel framing and the structural integrity of the roof.

Although the magnitude of all individual load cases was given by the JCT, they were utilized, as necessary, to meet the requirements imposed by the UBC 1994 specifications (additional coefficients are imposed). A detailed description of all six individual load categories follows.

3.4.1.1 Dead Loads (DL)

The following six types of individual dead loads is considered.

- steel framing self weight (FSW) ;
- floor weight (FDL) ;
- roof weight (RDL);
- siding weight (SDL);
- floor equipment and piping (FEPDL);
- roof equipment and piping (REPDL).

The loads representing the self weight of the structural elements, steel framing (columns, beams, trusses, purlins, joists, etc.) and concrete slabs, were automatically generated by STAAD III computer code using the material description contained in Table 3.4-1. Both steel and concrete materials were considered as isotropic.

Because of the conceptual stage of development for this task, some information has not been specified. For example, roofing and enclosure loading required estimation based on common practice and previous experience. Its magnitude was estimated at 0.075 t/m^2 (15 psf) for a built up roofing system.

The magnitude of the equipment and piping loads which are located on roofs or floors for each specific building were obtained from ITER "Building Design Conditions for Task B of D230" (Table 3). Generally, a typical uniformly distributed vertical acting load of 0.100 t/m^2 was used in the structural evaluation of the roof and 1.00 t/m^2 for floors.

3.4.1.2 Live Loads (LL)

Two live loads were considered in the analysis. They were differentiated according to their location:

- floor live load (FLL);
- roof live load (RLL).

The JCT input criteria listed these loads by building and elevation. All the live loads acting on the roofs and floors have a value of 0.100 t/m^2 .

3.4.1.3 Crane Induced Loads (CRL)

The general description of the cranes located in some of the buildings is presented in Section 3.3 of this Report. The data furnished in that section was used to assess the final loads representing the crane impact on the supporting steel structure. In addition to the loading created by the crane component weight, the crane movements (transverse and longitudinal) result in vibrations and other dynamic effects which must ultimately be evaluated to insure acceptable structural response. Despite the dynamic nature of these loads, engineering practice normally replaces them with an equivalent set of static forces acting in three main directions: 1) vertical; 2) transverse (parallel with the

crane), and; 3) longitudinal (perpendicular to the crane). All data used in the crane loads evaluation is shown in Table 3.4-2.

Table 3.4-1 Structural Material Description

Material Type	Density	Young's Modules	Poisson's Ratio
	(t/m3)	(t/m2)	
Steel ASTM A36 Fy = 36 ksi	7.856	2.111E7	0.3
Concrete fc' = 4 ksi	2.400	2.537E6	0.17
Rebar Fy = 60 ksi	7.856	2.041E7	0.3

Table 3.4-2 Crane Information

Building	Capacity	Span	Lift Height	Weights			Maximum Wheel Load	Number of Wheels	Wheel Distances			Rail Type*
				Crane	Trolley	Lift			#1 - #2	#2 - #3	#3 - #4	
	(t)	(m)	(m)	(t)	(t)	(t)	(t)		(m)	(m)	(m)	(lb)
Cryoplant Compressor	40	40.00	8.00	65.80	9.10	40.00	22.00	8	1.83	1.60	1.83	105
Cryoplant Cold Box/Dewar	120	25.00	26.50	93.00	31.80	120.00	57.53	8	1.24	4.10	1.24	175
	10	33.00	12.00	41.30	1.75	10.00	16.33	4	4.57	0.00	0.00	104
PF Coil Fabrication	NONE											
Magnet Coil Test	125 (**)	N/A	22.00	N/A	42.60	125.00	N/A	N/A	N/A	N/A	N/A	N/A
Tokamak Services	NONE											
Magnet Power Supply Switching Network	NONE											
Magnet Power Conversion	10	10.00	9.00	13.56	1.73	10.00	11.25	4	3.83	0.00	0.00	60
	5	10.00	12.00	13.56	1.23	5.00	8.85	4	3.83	0.00	0.00	60
Site Services	20	20.00	7.00	24.50	3.20	20.00	20.14	4	4.34	0.00	0.00	104
Assembly Laydown Storage	NONE											
Remote Handling Mockup	100	50.00	35.00	151.30	27.22	100.00	47.63	8	1.83	4.34	1.83	175
	5	16.00	55.00	17.00	1.45	5.00	9.90	4	3.83	0.00	0.00	60
NBI Power Conversion	NONE											
RF Auxiliary Heating Power Conversion	20	20.00	10.00	24.50	3.10	20.00	20.14	4	4.34	0.00	0.00	104

(*) From AISC Manual of Steel construction (ASD) - 9th Edition (pages I-112)

(**) Hoist

The main load to be considered is the "Maximum Wheel Load" which is a combination of the crane self weight and the maximum lifting load. The final loads used in the structural analysis were computed according to the requirements of AISC. The vertical component acting at the wheel was computed by multiplying the maximum wheel load by a 1.25 impact coefficient AISC (A4.2). The horizontal transverse load per wheel was evaluated as 20% of the sum of trolley and lifted weights AISC (A.4.3). The longitudinal horizontal load at the wheel is calculated as 10% of the maximum wheel load, but unfactored for impact AISC (A.4.3). All crane induced loads, grouped per building and crane type, are summarized in Table 3.4-3. All loads are acting at the rail elevation and are a function of the crane configuration; they represent a mobile set. One or more individual crane loads were used in the structural analysis and sizing of the crane girder and steel framing main components.

3.4.1.4 Wind Loads (WI)

The wind loads considered in this task were evaluated as required by UBC 1994, Division II "Wind Design". The JCT input called for a 140 km/hour (90 mph) basic wind speed to be sustained by the steel framing. From UBC, Table 16-F, a corresponding 0.102 t/m² wind stagnation pressure (qs) was determined. The design wind pressure (pv) necessary for structural evaluation was calculated for different elevations accordingly to UBC formula (18-1). Two types of wind loads were considered:

- wind uplift of the roof (WU);
- wind (windward and leeward) horizontal action (WH).

Table 3.4-4 contains all the variables used to calculate the wind pressure variation from ground level up to 61 m height.

3.4.1.5 Snow Loads (SN)

The load created by the existence of the snow on the building's roofs was determined in accordance with UBC 1994, Volume II provisions, contained in Appendix Chapter 16, Division I "Snow Load Design". The ground snow load (pg) given by the JCT, has a magnitude of 0.300 t/m². The final roof snow load (pf) was calculated as required by UBC formula (37-1A). The results of the roof snow load calculation for all twelve buildings are shown in Table 3.4-5. For buildings with multi-level roofs, additional snow loads resulted from snow drifting.

Table 3.4-3 Crane Loads

Building	Capacity	Maximum Wheel Load	Crane and Trolley Weight	Number of Wheels	Loads per Wheel			Rail Weight	Wheel Distances		
					Vertical	Horizontal Transverse	Horizontal Longitudinal		#1 - #2	#2 - #3	#3 - #4
	(t)	(t)	(t)		(t)	(t)	(t)	(t/m)	(m)	(m)	(m)
Cryoplant Compressor	40	22.00	74.90	8	27.50	1.00	2.20	0.157	1.83	1.60	1.83
Cryoplant Cold Box/Dewar	120	57.53	124.80	8	71.91	3.00	5.75	0.261	1.24	4.10	1.24
	10	16.33	43.05	4	20.41	0.50	1.63	0.157	4.57	0.00	0.00
PF Coil Fabrication	NONE										
Magnetic Coil Test	125(*)	N/A	N/A	N/A	210.00	12.50	12.50	N/A	N/A	N/A	N/A
Tokamak Services	NONE										
Magnet Power Supply	NONE										
Magnet Power Conversion	10	11.25	15.29	4	14.06	0.50	1.13	0.090	3.83	0.00	0.00
	5	8.85	14.79	4	11.06	0.25	0.89	0.090	3.83	0.00	0.00
Site Services	20	20.14	27.70	4	25.18	1.00	2.01	0.157	4.34	0.00	0.00
Assembly Storage & Laydown	NONE										
Remote Handling Mockup	100	47.63	178.52	8	59.54	2.50	4.76	0.261	1.83	4.34	1.83
	5	9.90	18.45	4	12.38	0.25	0.99	0.090	3.83	0.00	0.00
NBI Power Supply	NONE										
RF Power Conversion	20	20.14	27.60	4	25.18	1.00	2.01	0.157	4.34	0.00	0.00

(*) Hoist

Table 3.4-4 Wind Loads

Height			Basic Wind Speed		qs		Iw	Cq			Ce Exposure "C"	pv			
(ft)	(m)	(mph)	(km/h)	(psf)	(kg/m2)			Windward Wall	Leeward Wall	Flat Roof		(psf)	(kg/m2)	(psf)	(kg/m2)
0.00	0.00	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.06	17.64	86.20	11.02	53.87
20.00	6.10	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.13	18.80	91.89	11.75	57.43
25.00	7.62	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.19	19.80	96.77	12.38	60.48
30.00	9.14	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.23	20.47	100.02	12.79	62.51
40.00	12.19	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.31	21.80	106.53	13.62	66.58
60.00	18.29	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.43	23.80	116.29	14.87	72.68
80.00	24.38	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.53	25.46	124.42	15.91	77.76
100.00	30.48	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.61	26.79	130.93	16.74	81.83
120.00	36.58	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.67	27.79	135.80	17.37	84.88
160.00	48.77	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.79	29.79	145.56	18.62	90.98
200.00	60.96	90.00	140.00	20.80	101.65	1.00		0.80	0.50	0.70	1.87	31.12	152.07	19.45	95.04

Note: All Calculations in Accordance to WBC 1994 (Volume 2) Division II - Wind Design

Table 3.4-5 Snow Loads

Building	Elevation	Structural Type	Ce	I	pg	pf (*)
	(m)				(t/m2)	(t/m2)
Cryoplant Compressor	16.00	Roof	0.700	1.000	0.300	0.210
Cryoplant Cold Box	35.00	High Roof	0.700	1.000	0.300	0.210
	20.00	Low Roof	0.700	1.000	0.300	0.210
PF Coil Fabrication	20.00	Roof	0.700	1.000	0.300	0.210
	8.00	Roof	0.700	1.000	0.300	0.210
Magnetic Coil Test	29.00	High Roof	0.700	1.000	0.300	0.210
	20.00	Roof	0.700	1.000	0.300	0.210
	8.00	Low Roof	0.700	1.000	0.300	0.210
Tokamak Services	33.00	Roof	0.700	1.000	0.300	0.210
Magnet Power Supply	23.00	High Roof	0.700	1.000	0.300	0.210
Magnet Power Conversion	17.00	High Roof	0.700	1.000	0.300	0.210
	13.00	Low Roof	0.700	1.000	0.300	0.210
Site Services	22.00	High Roof	0.700	1.000	0.300	0.210
	12.00	Low Roof	0.700	1.000	0.300	0.210
Assembly Storage & Laydown	12.00	Roof	0.700	1.000	0.300	0.210
Remote Handling Mockup	60.00	High Roof	0.700	1.000	0.300	0.210
	45.00	Roof	0.700	1.000	0.300	0.210
	10.00	Low Roof	0.700	1.000	0.300	0.210
NBI Power Supply	12.00	Roof	0.700	1.000	0.300	0.210
RF Power Conversion	21.00	Roof	0.700	1.000	0.300	0.210

(*) All calculations in accordance with WBC 1994 (Vol. 2) - Appendix Chapter 16, Division I - Snow Load Design

3.4.1.6 Seismic Loads (SE)

Seismic motion creates a random and spatial motion of the ground and results in creating a three dimensional set of inertial forces. The evaluation of these inertial forces can be divided into two categories:

- seismic horizontal acting inertial force (SH);
- seismic vertical acting inertial force (SV).

For both cases the inertial loads were evaluated by multiplying the maximum ground acceleration, measured in g units, with the sum of all existing dead loads and 75% of the snow load (UBC 1994, Volume II, Section 1603.6). The 0.05 g ground acceleration was used for horizontal and vertical inertial loads evaluation as required by JCT input.

3.4.2 Load Combinations

The provisions contained in UBC 1994, Volume 2, Section 1603.6 entitled "Load Factors and Load Combinations" were used to develop the load combinations. Eight (8) generic load combinations were developed and used in the structural analysis. Table 3.4-6 shows the matrix definition of these load combinations and the coefficients used for each individual load case.

3.4.3 STAAD-III Individual Load Cases and Load Combinations

Based upon the individual load cases and their generic load combinations described in the previous sections, a more detailed specific set of loads was developed for the STAAD-III structural analysis. The following individual load cases were considered for all building designs. While some of the load cases may not be applicable, or have a null value, they still remain in the generic load combinations given on the following pages. Each of the load cases is identified by either a two or three digit identifier followed by a brief word description.

Table 3.4-7 presents the STAAD - III individual load cases in tabular format.

Table 3.4-6 Load Combinations Definition Matrix

[illegible]

TABLE 3.4-7 STAAD III - Individual Load Cases

LOAD NUMBER	DESCRIPTION		CATEGORY	
10	FRAMING SELF WT	(FSW)	DEAD LOADS	(DL)
20	FLOOR DEAD LOAD	(FDL)	DEAD LOADS	(DL)
30	ROOF DEAD LOAD	(RDL)	DEAD LOADS	(DL)
40	SIDING DEAD LOAD	(SDL)	DEAD LOADS	(DL)
50	EQUIP AND PIPING FLOOR LOAD	(FEPDL)	DEAD LOADS	(DL)
60	EQUIP AND PIPING ROOF LOAD	(REPDL)	DEAD LOADS	(DL)
71	CRANE SOUTH	(CRL)	CRANE LOADS	(CL)
72	MIDDLE CRANE	(CRL)	CRANE LOADS	(CL)
73	CRANE NORTH	(CRL)	CRANE LOADS	(CL)
100	FLOOR LIVE LOAD	(FLL)	LIVE LOADS	(LL)
110	LIVE LOAD ROOF	(RLL)	LIVE LOADS	(LL)
200	UPLIFT	(WU)	WIND LOADS	(WL)
300	WIND SOUTH TO NORTH	(WH)	WIND LOADS	(WL)
310	WIND NORTH TO SOUTH	(WH)	WIND LOADS	(WL)
400	WIND WEST TO EAST	(WH)	WIND LOADS	(WL)
410	WIND EAST TO WEST	(WH)	WIND LOADS	(WL)
520	ROOF SNOW LOAD	(SN)	SNOW LOADS	(SN)
530	ROOF SNOW DRIFT	(SD)	SNOW LOADS	(SN)
800	HORIZONTAL SEISMIC LOADS	(SH)	SEISMIC LOADS	(SE)
810	VERTICAL SEISMIC LOADS	(SV)	SEISMIC LOADS	(SE)

Based on the load cases listed above and the required load combinations for working stress design from UBC Section 1603.6, the following load combinations were investigated.

The load combinations in Group 1 include both Equations 1 and 5 of UBC Section 1603.6 as well as the footnote relative to crane loads being combined with three quarters of the snow load. Groups 2, 3, and 4 satisfy Equations 2, 3 and 4 of UBC Section 1603.6. While Group 6 is not uniquely identified in UBC Section 1603.6, the intent is to cover construction during the latter stage. Group 7 covers the footnote of UBC Section 1603.6 relative to crane loads combined with one half of the wind load.

The four digit numbers used to identify the load combinations are the maximum allowed by the STAAD-III program. The first number refers to the Group number and, in general, the last three digits refer to the wind direction as identified in the wind load cases.

TABLE 3.4-8 STAAD III - Load Combinations

GROUP 1

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI					SN		SE	
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
700								1	1	1											
1000	(I)	1	1	1	1	1	1														
1100	(II)	1	1	1	1	1	1				1	1									
1500	(III)	1	1	1	1	1	1				1							1	1		
1570	(IV)	1	1	1	1	1	1	1	1	1	1							.75	.75		

GROUP 2

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI					SN		SE	
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
2300	(V)	1	1	1	1	1	1				1	1		1							
2310	(V)	1	1	1	1	1	1				1	1			1						
2400	(V)	1	1	1	1	1	1				1	1				1					
2410	(V)	1	1	1	1	1	1				1	1					1				

TABLE 3.4-8 STAAD III - Load Combinations (Continued)

GROUP 3

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI					SN		SE	
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
3300	(VI)	1	1	1	1	1	1				1			1				0.5	0.5		
3310	(VI)	1	1	1	1	1	1				1				1			0.5	0.5		
3400	(VI)	1	1	1	1	1	1				1					1		0.5	0.5		
3410	(VI)	1	1	1	1	1	1				1						1	0.5	0.5		

GROUP 4

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI					SN		SE	
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
4400	(VII)	1	1	1	1	1	1				1					0.5		1	1		
4410	(VII)	1	1	1	1	1	1				1						0.5	1	1		
4300	(VII)	1	1	1	1	1	1				1			0.5				1	1		
4310	(VII)	1	1	1	1	1	1				1				0.5			1	1		

TABLE 3.4-8 STAAD III - Load Combinations (Continued)

GROUP 6

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI						SN		SE
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
6000	(VIII)	0.9	0.9	0.9	0.9								1								
6300	(VIII)	0.9	0.9	0.9	0.9								1	1							
6310	(VIII)	0.9	0.9	0.9	0.9								1		1						
6400	(VIII)	0.9	0.9	0.9	0.9								1			1					
6410	(VIII)	0.9	0.9	0.9	0.9								1				1				

GROUP 7

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI					SN		SE	
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
7300	(IX)	1	1	1	1	1	1	1	1	1	1			0.5							
7310	(IX)	1	1	1	1	1	1	1	1	1	1				0.5						
7400	(IX)	1	1	1	1	1	1	1	1	1	1					0.5					
7410	(IX)	1	1	1	1	1	1	1	1	1	1						0.5				

GROUP 8

LOAD COMB		LOAD CASES																			
		DL						CRL			LL		WI						SN		SE
Number	Type	10	20	30	40	50	60	71	72	73	100	110	200	300	310	400	410	520	530	800	810
8000	(X)	1	1	1	1	1	1											1		1	1

3.5 Roof, Floor and Crane Girder Members Design

The three-dimensional steel skeleton of a building contains a relatively large number of repetitive structural elements. These structural elements, usually part of the roof (purlins and horizontal bracing), floors (joists) and crane supports (crane girders, secondary bracing beams, and their three-dimensional bracing systems and rails), carry their tributary loads to the main structural components of the framing. Because these elements possess similar structural roles and loading conditions they can be standardized and used in a repetitive and economical manner. This section describes the design process for all three repetitive categories, that is, roof beams, floor beams and crane girders.

3.5.1 Roof and Floor Beams Design

Using the loading provisions detailed in Section 3.4 of this Report, a specific set of individual loads and load combinations is computed for this type of repetitive structural element.

Table 3.5-1 contains all pertinent values related to the individual loads and their combinations. The last column of the table provides the maximum value calculated for all specified load combinations for each beam location. This is the design load used in the structural analysis and sizing calculations; it has been increased by 10% in order to account for the self weight of the member. This assumption of self weight has been verified.

The structural evaluation of the beams was conducted in accordance with the AISC Code, and is presented in tabular form in Table 3.5-2. All the steel beams were considered simply supported with the span equal to the maximum span existing in any particular building. These beams collect the load from their tributary loading area. They were evaluated based on three criteria: bending capacity, shear capacity and maximum allowable displacement. The governing criterion was found to be the bending capacity of the steel member. It should be mentioned that the beams supporting the concrete floors were not designed as composite beams. This assumption is conservative, but will give more flexibility to the future, detailed design of the floors.

The weights of the calculated, repetitive structural elements can be used to determine enveloped dead load for the entire roof or floor. These values can be used later in the analysis of the main structural elements. A typical value of 0.125 t/m^2 (25 lb/ft^2) was obtained for roofing (roofing plus beams) and 0.435 t/m^2 (90 lb/ft^2) for floors (considers 0.15 m of concrete slab plus beams).

Table 3.5-1 Roof and Floor Loads For Typical Beam Design

Building	Elevation	Structural Type	Dead Loads				Live Load	Snow	Seismic	Load Combination No.*					Maximum Load
			Roofing	Concrete Deck	Equipment & Pipes	Total DL				I	II	III	IV	V	
	(m)		(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)	(t/m ²)
Cryoplant Compressor	16.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.385	0.292	0.485	0.449	0.485
Cryoplant Cold Box	35.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	20.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
PF Coil Fabrication	20.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	8.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
Magnetic Coil Test	29.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	20.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	8.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
Tokamak Services	33.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	22.00	Floor	0.000	0.360	1.000	1.360	0.100	0.000	0.068	1.460	1.460	1.528	1.460	1.528	1.528
	11.00	Floor	0.000	0.360	1.000	1.360	0.100	0.000	0.068	1.460	1.460	1.528	1.460	1.528	1.528
	0.00	Floor	0.000	0.360	1.000	1.360	0.100	0.000	0.068	1.460	1.460	1.528	1.460	1.528	1.528
Magnet Power Supply	23.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	12.00	Floor	0.000	0.360	1.000	1.360	0.100	0.000	0.068	1.460	1.460	1.528	1.460	1.528	1.528
Magnet Power Conversion	17.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	13.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
Site Services	22.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	12.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
Assembly Storage & Laydown	12.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
Remote Handling Mockup	60.00	High Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	45.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	10.00	Low Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
NBI Power Supply	21.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
RF Power Conversion	21.00	Roof	0.075	0.000	0.100	0.175	0.100	0.210	0.017	0.275	0.485	0.292	0.485	0.449	0.485
	6.00	Floor	0.000	0.360	1.000	1.360	0.100	0.000	0.068	1.460	1.460	1.528	1.460	1.528	1.528

Note: (*) The following load combinations were used:

I- DL + LL

II- DL + Snow

III- DL + LL + Seismic

IV- DL + LL + Snow

V- DL + Snow + Seismic

For Seismic Loads See (3.4.1.6)

Table 3.5-2 Roof and Floor Typical Beams Design

Building	Elevation	Structural Type	Maximum Distributed Load (*)	Maximum Interax Distance	Maximum Span	Design Requirements				Design Results (****)			
						Load (**)	Bending Moment	Shear Force	Deflection (***)	Beam Size	Lb	Fb	fb
						(t/m2)	(t-m)	(t)	(m)		(ksi)	(ksi)	(t-m)
Cryoplant Compressor	16.00	Roof	0.485	1.67	10.00	0.891	11.137	4.455	0.056	W14X43	5.000	18.490	15.340
			0.485	1.67	6.70	0.891	4.999	2.985	0.037	W14X26	3.350	14.990	12.270
Cryoplant Cold Box/Dewer	35.00	High Roof	0.485	2.10	10.00	1.120	14.004	5.602	0.056	W14X48	5.000	21.100	17.300
	20.00	Low Roof	0.485	1.65	10.00	0.880	11.003	4.401	0.056	W14X43	5.000	18.490	15.340
PF Coil Fabrication	20.00	Roof	0.485	2.25	7.50	1.090				W14x30	3.750		
			0.485	2.25	8.75	1.090				W14x43	4.380		
	8.00	Roof	0.485	1.88	8.00	1.000				W14x30	4.000		
			0.485	1.88	9.00	1.000				W14x38	4.500		
Magnetic Coil Test	29.00	Roof	0.485	2.25	7.50	1.090				W14x30	3.750		
			0.485	2.25	8.75	1.090				W14x43	4.380		
	20.00	Roof	0.485	2.25	7.50	1.090				W14x30	3.750		
			0.485	2.25	8.75	1.090				W14x43	4.380		
			0.485	1.88	9.00	1.000				W14x30	4.000		
			0.485	1.88	9.00	1.000				W14x38	4.500		
Tokamak Services	33.00	Roof	0.485	2.00	6.80	1.067	6.167	3.628	0.038	W14X30	3.400	18.750	12.740
	22.00	Floor	1.528	2.00	6.80	3.362	19.430	11.429	0.038	W18X50	0.100	22.000	18.960
	11.00	Floor	1.528	2.00	6.80	3.362	19.430	11.429	0.038	W18X50	0.100	22.000	18.960
	0.00	Floor	1.528	2.00	6.80	3.362	19.430	11.429	0.038	W18X50	0.100	22.000	18.960
Magnet Power Supply	23.00	Roof	0.485	1.83	10.00	0.976	12.204	4.882	0.056	W14X43	5.000	18.490	16.930
	12.00	Roof	1.528							W24x68			
Magnet Power Conversion	17.00	High Roof	0.485	1.67	10.00	0.891	11.137	4.455	0.056	W14X43	5.000	18.490	15.340
	13.00	Low Roof	0.485	1.67	10.00	0.891	11.137	4.455	0.056	W14X43	5.000	18.490	15.340
Site Services	22.00	High Roof	0.485	2.00	7.50	1.067	7.502	4.001	0.042	W14X30	3.750	17.660	15.500
	12.00	Low Roof	0.485	2.00	7.50	1.067	7.502	4.001	0.042	W14X30	3.750	17.660	15.500
Assembly Storage & Laydown	12.00	Roof	0.485	1.88	7.50	1.003	7.052	3.761	0.042	W14X30	3.750	17.900	14.510
Remote Handling Mockup	60.00	High Roof	0.485	1.60	5.00	0.854	2.668	2.134	0.028	W12X16	2.500	15.100	13.520
	45.00	Roof	0.485	1.71	8.00	0.912	7.298	3.649	0.044	W14X30	4.000	17.070	15.050
	10.00	Low Roof	0.485	1.71	8.00	0.912	7.298	3.649	0.044	W14X30	4.000	17.070	15.050
NBI Power Supply	21.00	Roof	0.485	1.79	10.00	0.955	11.937	4.775	0.056	W14X43	5.000	18.940	16.410
RF Power Conversion	21.00	Roof	0.485	2.00	10.00	1.067	13.338	5.335	0.056	W14X48	5.000	21.100	16.500
	6.00	Floor	1.528	2.00	10.00	3.362	42.020	16.808	0.056	W24X84	0.100	22.000	18.600

Note:

-(*) Values from Table 3.5-1

-(****) AISC Manual of Steel Construction, 9th Edition

-(**) 10% increase to account for the beam weight

-(***) DEFLECTION = SPAN/180 (UBC APP. 16 SECT.1643)

3.5.2 Crane Supporting Member Design

A detailed presentation of the crane characteristics and the evaluation of the maximum loads per wheel that was used in connection with the structural analysis can be found in Sections 3.3 and 3.4. As discussed in Section 3.4.1.3, the weight of the crane components and their movements can be modeled as a three-dimensional load set. Due to the three-dimensional nature of the loading, a corresponding three-dimensional steel structure is created to carry these loads to the supporting columns. The crane support structure is typically composed of four structural elements: crane girder; secondary crane beam; rail; and, three-dimensional bracing system. Each of these elements has a well defined structural role.

The crane girder is the main structural element of the system and has been designed as a simply supported beam, spanning between the center lines of the adjoining columns. This element carries the vertical crane load and the longitudinal, horizontal braking force to the supporting columns. It is developed in vertical plan with the main rigidity axis horizontal. Its rigidity along the vertical axis is less developed. An additional structural element, the secondary crane beam, is instrumental in carrying the transverse braking force. The secondary beam, located at the same level with the upper flange of the crane girder between adjoining columns, and the upper flange of the crane girder are braced together and create a special truss supporting the transverse bracing load as a horizontal deployed truss system. Additional vertical braking is used to complete the special system. Only the crane girder has been considered and analyzed. The other components are identified based on engineering experience. For the present calculations the weight of the crane girder and rail was assumed to be 0.260 t/m (175 lb/ft) for all four crane wheels and 0.520 t/m (350 lb/ft) for all eight crane wheels. The uplift wind loads were discounted.

Table 3.5-3 contains the loads and responses related to the crane girder sizing. The maximum bending moments, the position of the mobile set to produce them and the maximum reactions are calculated using the AISC Manual of Steel Construction, 9th Edition, Beams Diagrams and Deflections, page 2-310.

Table 3.5-3 Crane Girders

Building	Capacity	Equivalent Loads per Wheel			Maximum Bending Moments and Reaction Forces							Girder	Secondary Beam	Bracing
		Vertical	Horizontal Transversal	Horizontal Longitudinal	Maximum Span	Equivalent Wheel Distance	Vertical Reaction	Mz	xmax	Horizontal Reaction	My			
	(t)	(t)	(t)	(t)	(m)	(m)	(k)	(k-in)	(m)	(k)	(k-in)			
Cryopant Compressor	40.00	55.00	2.46	4.40	10.00	3.43	206.64	20375	4.14	8.98	732.42	W36x260	W12X40	L3x3x0.25
Cryopant Cold Box/Dewer	120.00	143.82	7.60	11.50	10.00	5.34	470.47	37517	3.67	24.56	1771.17	W40X436	W12X43	L3x3x0.25
	10.00	20.41	0.59	1.63	10.00	4.57	72.30	7269	3.86	2.01	152.32	W27X129	W12X40	L3x3x0.25
PF Coil Fabrication	NONE													
Magnetic Coil Test	125(*)	210.00	12.50	12.50										
Tokamak Services	NONE													
Magnet Power Supply	NONE													
Magnet Power Conversion	10.00	14.06	0.59	1.13	10.00	3.83	53.00	5986	4.04	2.10	167.28	W27X114	W12X40	L3x3x0.25
	5.00	11.06	0.31	0.89	10.00	3.83	42.30	5136	4.04	1.10	87.89	W27X102	W12X40	L3x3x0.25
Site Services	20.00	25.18	1.16	2.01	7.50	4.34	81.77	6137	2.67	3.63	190.59	W27X114	W12X40	L3x3x0.25
Assembly Storage & Laydown	NONE													
Remote Handling Mockup	100.00	119.08	6.36	9.52	8.00	6.17	328.26	24660	4.00	17.22	1103.46	W36X300	W12X43	L3x3x0.25
	5.00	12.38	0.32	0.99	8.00	3.83	44.40	4485	3.04	1.07	64.24	W27X84	W12X40	L3x3x0.25
NBI Power Supply	NONE													
RF Power Conversion	20.00	25.18	1.16	2.01	10.00	4.34	89.80	8696	3.92	4.00	308.48	W27X146	W12X40	L3x3x0.25

Note:

- Crane Girder + Rail = 175 lb/ft for 4 Wheels Crane
- Crane Girder + Rail = 350 lb/ft for 8 Wheels Crane
- Lb = 0.2 L for all cases (Fb=22.00 ksi)

3.6 Building Design

3.6.1 Cryoplant Compressor Building - 6.2.J / S1001

3.6.1.a Building Design Methodology

The Cryoplant Compressor Building (S1001) is a one floor steel frame structure. The building dimensions are approximately 90 meters in the north-south direction and 95 meters in the east-west direction. The building consists of three bays in the north-south direction. The northern bay (between col. lines A & B) and the southern bay (between col. lines C & D) are each 40 meters long and are separated by the 10 meter middle pipe rack bay. The northern bay and the southern bay are symmetrical about the pipe rack bay. An expansion joint is used to separate the southern and northern bays. The southern portion of the building (between columns D and C) was analyzed using a 3D analytical model.

Eleven interior roof trusses along column lines 2 through 12 span 40 meters in the north-south direction. These trusses are non-symmetric Pratt trusses, consequently the diagonals are essentially tension members, while the vertical members are predominately in compression. These trusses support all the roof loads.

In-plane stiffness of the roof is furnished by the addition of diagonal members, thereby providing diaphragm action to carry the transverse wind and seismic loads to the end walls. At the truss locations on the roof, vertical bracing of the exterior walls provides both stability and a load path to carry the wind and seismic loads to the ground.

The 40 ton crane was positioned at multiple locations to envelop the different truss spacing and to maximize impact on the 3D structure. The selected truss and column member sizes were used to envelop member sizes for the remaining trusses.

The load combinations and the allowable stress criteria are in accordance with the UBC. A design limit is set at 95 percent of the full allowable stresses for member selection.

The building was modeled in 3D using CATIA V4R1.3. A proprietary CATIA/STRUDL interface program, developed by SWEC, was used to extract the analytical model from the 3D model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidence, member properties and the beta angle

constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the 3D structural analysis model.

The stress analysis of the Cryoplant Compressor Building is given in Attachment A-1.S1001. This attachment provides the design criteria, applied loads and load combinations, STAAD-III input file, selected output, and the stress level of members. The Cryoplant Compressor Building was analyzed as a three dimensional structure. Floor joists are spaced at approximately 2 meters and are provided on the top level of the roof in the north-south direction to carry the roof loading to the east-west girders. While the floor joists were not included in the model (design of these members are addressed in Attachment A-1.S1000), appropriate parameters were included in the STAAD-III structural model to reflect the lateral support provided to the east-west girders. On the lower level of the roof, a single member in the north-south direction affords lateral bracing and self weight support for the diagonals. The building design is basically simple framing, i.e., the beams and girders are connected for shear only and are free to rotate under load. The base of the columns is considered to be pin connected.

The STAAD III computer code was used for the structural analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program. The results of the code check are given in Attachment A-1.S1001, along with selected joint deflections and base shears for the columns.

ITER Task No. 28 Building Design D230B			
CRYOPLANT COMPRESSOR BUILDING (S1001)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (Ft.)	TONS (US)
RAIL 175#	48	1246.7	36.2
L3X3X1/4	380	1309.1	3.2
W10X22	44	461.3	5.0
W10X30	132	1384.4	20.6
W10X33	4	98.1	1.6
W10X45	192	2921.8	64.9
W12X40	158	2255.1	44.0
W12X45	88	806.7	17.7
W12X53	188	2057.0	53.4
W12X65	88	806.7	25.8
W14X26	552	12073.5	155.2
W14X43	74	2427.8	50.9
W14X48	4	85.3	2.0
W14X53	18	437.4	11.4
W14X61	4	87.5	2.6
W14X68	8	159.3	5.3
W14X74	2	65.6	2.4
W16X100	72	1870.1	93.3
W16X50	48	1246.7	31.0
W18X119	48	1246.7	74.1
W18X97	18	944.9	45.7
W21X166	24	2974.7	246.0
W24X104	8	419.9	21.7
W24X146	44	433.1	31.5
W24X162	22	2887.1	233.4
W24X229	44	1876.6	217.6
W36X150	52	112.7	8.4
W36X260	48	1246.7	160.6
W8X15	796	4970.8	36.9
W8X31	72	1870.1	28.6
W8X35	132	3229.3	55.8
W8X40	8	216.5	4.3
WT10.5X41.	20	585.4	12.0
WT6X13	84	1246.4	8.0
WT7X21.5	34	818.5	8.6
WT8X25	8	231.6	2.9
WT9X35.5	28	831.5	14.7
WT9X38	16	476.1	9.0
WT9X48.5	12	368.2	8.9
Sub Total			1854.9

ITER Task No. 28 Building Design D230B			
CRYOPLANT COMPRESSOR BUILDING (S1001)			
Total tons of girts			87.4
% of est girts to steel			4.7%
Sub Total			1942.2
Est for connections			48.6
% of est connections to steel			2.5%
Total tonnage of steel			1990.8

3.6.1.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1001

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span< =10 m			C12X20.7 For span> 10 meters			
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons	
East Face	80	16	17.35	10	16	2.88				
West Face	80	16	17.35	10	16	2.88				
North Face	55	16	11.92	40	16	11.54				
South Face	55	16	11.92	40	16	11.54				
Total Tons C8's			58.54	Total Tons C10's			28.85	Total Tons C12's		
									Total tons of girts	87.39

* Girt Spacing is at 5 feet o.c.

3.6.1.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Cryoplant Compressor Building (S1001):

04749.05-ES-1001A-3 Structural Floor Plan
04749.05-ES-1001B-3 Structural Plan
04749.05-ES-1001C-3 Structural Roof Plan
04749.05-ES-1001D-3 Structural Elevations
04749.05-ES-1001E-3 Structural Elevations
04749.05-ES-1001F-3 Isometric View
04749.05-ES-1001G-3 Structural Analysis Model

3.6.1.d Discussion

The member sizes shown on the drawings have been determined by the stress calculations in Attachment A-1.S1001 to be within the AISC code allowable limits.

A selective code check was applied to trusses and columns along column lines 6, 7, 11 (critical crane loading location), south vertical brace line, east and west vertical brace lines, horizontal trusses and some critical floor beams. These governing sizes were then enveloped throughout the remaining typical members.

The southern portion of the building will be isolated from the northern portion by providing horizontal slotted connections in the north-south direction at column line B, thus allowing each portion to move independently as designed. The maximum base shear occurs in the north-south direction and is approximately 72 kips, thereby allowing for a simple column base connection.

The maximum in-plane deflection for the roof is approximately 5.5 centimeters and occurs in the north-south direction. This deflection is equivalent to $L/320$ which is satisfactory.

GENERAL NOTES:

1. FABRICATION AND ERECTION OF STEEL SHALL BE IN ACCORDANCE WITH THE 1989 AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS - ALLOWABLE STRESS DESIGN AND PLASTIC DESIGN.
2. STRUCTURAL SHAPES AND PLATES SHALL CONFORM TO ASTM A36 UNLESS OTHERWISE NOTED.
3. PIPES SHALL CONFORM TO ASTM A500, GRADE B.
4. BOLTS SHALL BE GALVANIZED 3/4" DIAMETER ASTM A325 - 3 WITH 13/16" DIAMETER HOLES, U.O.S. BOLTS SHALL BE PRETENSIONED USING DIRECT TENSION INDICATORS, U.O.S.
5. BOLTS SHALL BE INSTALLED IN ACCORDANCE WITH THE LATEST SPECIFICATION FOR STRUCTURAL JOINTS USING A-325 OR A-490 BOLTS.
6. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF AWS D1.1 USING E70XX ELECTRODES, UNLESS OTHERWISE NOTED.
7. WHERE WELD SIZES ARE NOT SPECIFIED, A MINIMUM WELD SIZE IN ACCORDANCE WITH THE REQUIREMENTS OF AWS D1.1 SHALL BE USED.
8. WELDS SHALL BE VISUALLY INSPECTED UNLESS OTHERWISE NOTED.
9. FULL PENETRATION GROOVE WELDS SHALL BE INSPECTED USING MAGNETIC PARTICLE TESTING AFTER PERFORMING A VISUAL INSPECTION.
10. SHOP AND FIELD WELDS SHALL BE INSPECTED BY AN AWS CERTIFIED WELDING INSPECTOR.
11. ANCHOR BOLTS SHALL CONFORM TO ASTM A307 GRADE B GALVANIZED, UNLESS OTHERWISE NOTED.
12. STEEL JOISTS SHALL CONFORM TO AND BE INSTALLED IN ACCORDANCE WITH THE STEEL JOIST INSTITUTE STANDARD SPECIFICATIONS FOR STEEL JOIST CONSTRUCTION.
13. STEEL JOISTS SHALL BE DESIGNED FOR A CONCENTRATED LOAD OF 200 LBS AT ANY PANEL POINT IN ADDITION TO ALL OTHER LOADS. THESE CONCENTRATED LOADS SHALL NOT BE INCLUDED WHEN DESIGNING FOR UPLIFT.
14. WHERE THE BOTTOM CHORD OF A JOIST IS ATTACHED TO A ROOF GIRDER THE ATTACHMENT SHALL BE MADE AFTER THE ROOF SYSTEM HAS BEEN INSTALLED.
15. GRATING SHALL BE TYPE W-19-4 GALVANIZED WITH 3/16" THICK BEARING BARS IN DEPTH INDICATED U.O.S.
16. PIPE HANDRAILS SHALL COMPLY WITH OSHA REQUIREMENTS.
17. LADDERS AND CAGES SHALL COMPLY WITH OSHA REQUIREMENTS.
18. O INDICATES HORIZONTAL BRACING CONNECTION AT THE BOTTOM OF JOIST CHORD OR THE BOTTOM BEAM FLANGE.
19. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.

DESCRIPTION		APPROVED	TITLE		DWG FRAME SIZE 1070 x 810		ITER-EDA		
DESIGN INFORMATION ONLY FOR CONSTRUCTION		DATE	DATE		DWG CHK'D		NOT FOR PUBLICATION		
TASK TITLE: ITER BUILDING DESIGN (0230-8)		12-19-95	6-22-92		FJC		The information on this drawing is confidential and the terms of the ITER EDA agreement. This information shall not be transmitted in any form to any other person or organization.		
05-ES-1001A-3			BASELINE VERSION		SAN DIEGO J.W.S.				
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000		2D0000P----

FLOOR PLAN EL 0 M &
CRANE RAIL SUPPORT BEAM TOS EL 8.3 M
SCALE: 1/150

ISSUE	3
PRECONCEPTUAL & ISSUED FOR INFO NOT TO BE USED	
TASK NO.: ITER-SW-4000E (DOC 1/)	
DRAWING NUMBER 04749.	

PROJECT: 10018-5 SHEET: 10018-5 DATE: 12-17-64 DRAWN: J.W.S. CHECKED: J.W.S. TITLE: STRUCTURAL PLAN		WORK: REPAIRS TO STRUCTURE 6-2-4 PROJECT: 10018-5 SHEET: 10018-5 DATE: 12-17-64 DRAWN: J.W.S. CHECKED: J.W.S. TITLE: STRUCTURAL PLAN		PROJECT: 10018-5 SHEET: 10018-5 DATE: 12-17-64 DRAWN: J.W.S. CHECKED: J.W.S. TITLE: STRUCTURAL PLAN	
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NOTE3:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. FOR TRUSS DETAILS, SEE DRAWING 1001D

[illegible]

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
 2. FOR GENERAL NOTES, SEE DRAWING 1041A
 3. ALL CRACK DIMENSIONS CURRENTLY SHOWN ON DRAWING ARE PRELIMINARY.

ITEM ONLY INSTRUCTION DATE 1-2-74 1-2-74 ASK: TITLE: TCR BUILDING DESIGN (0236-8) 1-1001-3		TITLE STRUCTURAL ELEVATIONS DATE 8-25-69 SCHEMATIC POSITION WORK DRAWING STRUCTURE 6.2.J CRYOPLANT COMPRESSOR BLOC THIRD ANGLE PROJECTION		NEW PHONE 51221070 x 310 NEW CHG'D S.E.S. T.O. FIVE SIX SAN DIEGO J.W.S. 0000000000002000000P		ITER-EDA NOT FOR APPLICATION All Information on this drawing is confidential and its release to the public is prohibited Only Information need not be maintained as top secret and is authorized for release
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[illegible]

ISOMETRIC
LOOKING NORTH
SCALE: 1/8" = 1'-0"

ISSN 131 0001
PRECONCEPTUAL DESIGN
ISSUED FOR INFORMATION
NOT TO BE USED FOR CONSTRUCTION
TASK NO. 1
1128-20-4000 (DOC TASK NO. 20)
DRAWING NUMBER 04749.05-E3

1. AFTER TASK D2300

64749,9500,1001,503,05,C8 CYTOPLANT COMPRESSOR BLOC STRU

AISC SECTION	QUANTITY	LENGTH (FT)	TONS (US)
CRANE-RAIL	48	1246.719	36.163
L3T3X1/4	380	1309.033	3.262
W10X22	44	481.290	5.029
W10X30	132	1386.350	20.356
W10X33	6	98.052	1.584
W10X45	192	2921.839	64.833
W12X40	158	2255.038	43.983
W12X45	83	806.670	17.714
W12X53	183	2056.985	33.399
W12X65	83	806.670	25.768
W14X26	332	12073.491	155.169
W14X43	74	2427.822	50.880
W14X48	6	85.362	2.009
W14X53	16	437.402	11.367
W14X61	4	87.533	2.624
W14X68	8	156.278	5.333
W14X74	2	85.617	2.398
W16X100	72	1870.678	93.264
W16X50	48	1246.719	30.986
W16X119	48	1246.719	74.068
W18X97	18	944.892	43.667
W21X166	24	2674.672	245.973
W24X104	8	419.948	21.724
W24X146	44	433.071	31.526
W24X162	22	2887.138	233.461
W24X229	44	1876.640	217.602
W36X150	52	112.718	8.399
W36X260	48	1246.718	180.578
WBX15	796	4970.801	36.891
WBX31	72	1870.678	28.596
WBX35	132	3229.260	55.767
WBX40	8	216.335	4.273
WT10.5X41.	20	583.367	12.016
WT6X13	84	1246.407	8.025
WT7X21.5	36	818.548	8.577
WT8X25	8	231.619	2.878
WT9X35.5	28	831.547	14.630
WT9X58	16	476.065	8.978
WT9X48.5	12	568.213	8.890

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIZING GIRT ESTIMATE IS INCLUDED IN THE S.O.M.
PRESENTED IN THE 157R EQA TASK NO. 28 FINAL REPORT.

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 31 32		TITLE ISOMETRIC VIEW		DRG NUMBER 5121070 x 810 DES. ONE'S D.S.N. T.S. FILE 478 DATE OF COMPLETION SAN DIEGO J.W.S.		ITER-EDA POST DED PUBLICATION The information on this drawing is copyrighted by International Telephone and Telegraph Corporation and is loaned to you for your use only. It is not to be reproduced or transmitted in any manner without the written consent of the Corporation.
FROM GATE 12-19-57		DATE 6-22-60 DRAWING DESIGN 12-19-57		NAME BRILLIANT STRUCTURE 6-2-J TYPE CRYOPLANT COMPRESSOR BLDG		FILE 01F-3		FILE 01F-3	
DO NOT WRITE RECOMMENDATIONS OR ONLY REVISIONS HERE		NORTH ANGLE PROJECTION		00 00000 00000 20 00000 P		00 00000 00000 20 00000 P		00 00000 00000 20 00000 P	

3.6.2 Cryoplant Cold Box/Dewar Building - 6.2.J / S1002**3.6.2.a Building Design Methodology**

The Cryoplant Cold Box/Dewar Building (S1002) is a one floor steel structure with an approximate floor plan of 70 x 100 meters. The long dimension of the building is orientated parallel to the north-south direction of the site. The structural elements of this building are shown on the attached drawings in Section 3.6.2.c.

The building has ten (10) transverse frames running in the east-west direction and spaced at distances varying from a minimum of five (5) meters to a maximum of ten (10) meters (the eight (8) meter long bay is the most common). A typical transverse frame has three (3) large spans: 1) two (2) spans at twenty-five (25) meters each (between column lines A - B and C - D); 2) one (1) span at thirty-three (33) meters (between column lines E - F), and two small spans of 7 meters and 10 meters. The roof of the building is located at two different elevations. The lower portion of the roof, located at 20 meters above the floor, covers the space between column lines E and F along the 100 meter length of the building. The upper roof, located at 35 meters above the floor, covers the remaining area of the building and spans between column lines A to E.

The Cryoplant Cold Box/Dewar Building has three industrial cranes. One has a 10 ton lifting capacity and spans the 33 meter side of the building; the other two are each 120 tons and span 25 meters. The cranes geometrical requirements and the loads induced by them are detailed in Section 3.3 and 3.4.

From a structural point of view, the Cryoplant Cold Box/Dewar Building is designed and analyzed using the methodology discussed in Section 3.1. The typical transverse frame is composed of two independent symmetrical frames. The frame covering the lower side of the building is a classical portal type. The cross-section of the columns is constant and uses W40x183 with W27x129 corbels attached at elevation 10.86 meters to support the rail and crane girder. The horizontal component of the frame is a planar symmetrical truss, generically denoted Truss "A", and is composed of two parallel W24x84 cords, nine TS 6x6x3/16 vertical members and ten TS 12x6x5/16 diagonal members. The transverse frame covering the higher side of the Cryoplant Box/Dewar Building is composed of four one-step type columns. The lower segment it is a welded plate member, WPG 68x22-243 lb for columns located on lines B to D and WPG 68x22-342 lb for line A (AISC Manual of Steel Construction, 9th

Edition, page 2-231). It continues above the crane supporting elevation with a W 33x141 laminated steel profile. The four columns are tied laterally by two planar trusses (Truss "B") and in the center by a number of rigid connected W24x117 members. Truss "B" is constructed of two W 24x62 horizontal cords, nine TS 6x6x3/16 vertical members and ten TS 6x6x3/16 diagonal members. The central set of columns and beams is the core of the higher structure. An additional, less stiffer, member ties the two frames over the two different elevations. The members of this addition are designed for a functional rather than a structural role; they are hinge connected at the connection points. The intent of this approach is to create two independent frames which will only interact locally.

Two typical frames were created in the longitudinal direction; one frame for the lower side and one for the taller side of the building. A longitudinal vertical bracing system is located at the column center lines. The "K" type braces are all W 8x31. Two rigid portals are placed along each column line. The bracing located above the elevation of the crane girder is typically W 8x31. The bracing located under the crane girder elevation increases to W 12x65. The horizontal beams are W14x43. They are part of the longitudinal frame and are all hinge connected to the adjoining columns.

The bracing system for the roof is designed using WT 5x11 members. All are considered truss elements in the structural analysis, carrying only their own weight in bending. Two repetitive type structural elements, the roof purlins and the crane supporting structure, are employed in the Cryoplant Cold Box/Dewar Building. The roof has a number of typical W14x43 purlins with a maximum 1.67 meter tributary width. The crane girders are designed as indicated in Section 3.5.2. These girders are W 27x129 for the 10 ton crane and W40x436 for the 120 ton crane.

As presented in Fig. 3-1, the overall design process used the CATIA V4R1.3 modeling software. Due to the fact that the structural analysis was conducted on two-dimensional sections and the existing CATIA version does not have an automatic model-to-analysis conversion capability, the structural models were manually input into STAAD III code.

The structural analysis was accomplished using the STAAD III computer code and is detailed in Attachment A-1.S1002. The attachment provides all the pertinent information regarding the applied load magnitudes, load combinations used and design parameters

required for code checking calculations. All the calculations were performed in accordance with the AISC Code.

The analysis shows that the maximum horizontal displacements are 2.397 inches for the transverse frame and 0.57 inches for the longitudinal frame. This is acceptable.

Using the geometric requirements provided by the JCT and the member sizes resulting from analysis, a final three-dimensional model was created. The two-dimensional drawings were created from the three-dimensional model. A material list was automatically extracted from the model and is presented in Section 3.6.2. b.

ITER Task No. 28 Building Design D230B			
CRYOPLANT COLD BOX/DEWAR BUILDING (S1002)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (Ft.)	TONS (US)
C15X50	38	2061.3	51.3
RAIL104	18	459.3	19.5
RAIL175	36	918.6	56.3
TS12X6X0.3	300	2962.4	54.7
TS6X6X0.18	270	1913.9	14.2
W12X40	54	1378.0	26.9
W12X65	80	2194.3	70.1
W14X30	28	2821.5	41.8
W14X43	914	22965.9	481.3
W24X117	69	1859.5	117.5
W24X62	40	3283.8	100.6
W24X84	20	2100.4	88.5
W27X129	39	511.3	32.7
W33X141	40	1318.9	92.3
W40X183	20	2296.6	117.4
W40X436	36	918.6	198.4
W8X31	171	3296.0	50.0
WPG68X22-2	30	3444.9	298.7
WPG68X22-3	10	1148.3	153.2
WT5X11	409	6335.0	34.5
Sub Total			2100.0
Total tons of girts			210.0
% of est girts to steel			10.0%
Sub Total			2310.1
Est for connections			57.8
% of est conn. to steel			2.5%
Total tonnage of steel			2367.8

3.6.2.c Building Structural Drawings - Final Issue (11"x17")

The following drawings are for the Cryoplant cold Box/Dewar Building:

04749.05-ES-1002A-3	Structural Plans
04749.05-ES-1002B-3	Structural Elevations
04749.05-ES-1002C-3	Isometric View

The structural analysis model drawings are part of the analysis, see Attachment A-1.

3.6.2.d Discussion

The Cryoplant Cold Box/Dewar Building was designed in accordance with the structural philosophy discussed in Section 3.1.

The main structural problem encountered in the design of this building was its obvious asymmetry exhibited along the longitudinal axis. The existence of this asymmetry is responsible for the eccentric location of the rigidity center of the building and consequently the component frames are not equally loaded horizontally. To implement the principle of the unique transverse frame, the structure has been designed as two symmetrical structures (one located on the lower side, the other on the higher side of the building) which are only functionally interrelated. This solution assures a more favorable structural behavior during wind or seismic events.

CRANE PLAN ELEVATION 12.00 & 27.00 M

SCALE 1/400

FLOOR PLAN ELEVATION 0.00 M

SCALE 1/400

SECTION 2-2

SCALE 1/200

IN 1-1

1/125

ELEVATION 35.00 M

ELEVATION 32.38 M

ELEVATION 26.17 M

ELEVATION 24.95 M

ELEVATION 20.00 M

ELEVATION 10.86 M

ELEVATION 5.00 M

ELEVATION 0.00 M

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 001A.
3. WPG = WELDED PLATE ELEMENT H X B - Weight (AISC - Manual Of Steel Construction 9th Edition)

T.O.S. ELEVATION 20.00 M

T.O.S. ELEVATION 16.40 M

RAIL ELEVATION 11.70 M

T.O.S. ELEVATION 10.86 M

T.O.S. ELEVATION 5.00 M

FLOOR ELEVATION 0.00 M

SECTION 3-3

SCALE 1/200

ISSUE 3 PRELIMINARY DESIGN (USED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION)		APPROVED ISS DATE 12/01/95		TITLE STRUCTURAL PLANS AND ELEVATIONS		DTD FRAME SIZE 1070 x 810 DRN DK'D D.G.M. T.O.		ITER-EDA NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the ITER EDA agreement. This information must not be transmitted to anyone who is not authorized to receive it.			
TASK NO.: ITER-SM-0006 (CODE TASK NO. 26)		TASK TITLE: ITER BUILDING DESIGN (0230-B)		DATE: DECEMBER 01, 1995		WORK BREAKDOWN STRUCTURE 6.2.E		NAME OF ORGANIZATION SAN DIEGO J.H.S.		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN	
DRAWING NUMBER 04749.05-ES-1002B-3		U.S.S. TITLE CRYOPLANT COLD BOX BLDG		THIRD ANGLE PROJECTION		00 0000 0000 20 00 00 P---

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A.

ISSUE 3 PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		DESCRIPTION APPROVED ISS DATE 12/01/95		TITLE ISOMETRIC VIEW		DRG FRAME SIZE 1070 x 810 DRN CHK'D D.D.M. T.O.		ITER-EDA <small>NOT FOR PUBLICATION</small> <small>The information on this drawing is confidential</small> <small>under the terms of the ITER EDA agreement.</small> <small>This information shall not be transmitted to anyone</small> <small>who is not authorized to receive it.</small>	
TASK NO.: ITER-SH-4006E (DOE TASK NO. 28)		TASK TITLE: ITER BUILDING DESIGN (0230-01)		DATE: DECEMBER 01, 1995		WORK BREAKDOWN STRUCTURE 6.2.E			
DRAWING NUMBER 04749.05-ES-1002C-3		BASELINE VERSION		U.S.S. TITLE CRYOPLANT COLD BOX BLDG		U.S.S. ORG. ORIGINATOR SAN DIEGO J.W.S.			
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		000000000000200000P---					

3.6.3 Poloidal Field Coil Fabrication - 6.2.P / S1003**3.6.3.a Building Design Methodology**

The Poloidal Field Coil Fabrication Building (S1003), as shown on the drawings in Section 3.6.3.c, is a one story steel frame structure with a roof elevation of 20 meters. In the north-south direction, there are five equal bays of 8 meters and four equal bays of 9 meters. Also, in the north-south direction, there is an attached office/machine room structure along the entire length of the building with a roof elevation of 8 meters. There is a door on both the north and south ends of the building that are 34 meters wide and 10 meters in height.

Roof trusses span 50 meters in the east-west direction, along column lines A through K. These trusses are symmetric Pratt trusses, consequently the diagonals are essentially tension members, while the shorter verticals are predominately compression members.

In-plane stiffness of the roof is furnished by the addition of in-plane diagonal members, thereby providing diaphragm action to carry the transverse wind and seismic loads to the exterior walls. Vertical bracing of the exterior walls provides both stability and a load path to carry the wind and seismic loads to the ground.

The load combinations follow the UBC (Section 5.1) and the allowable stress criteria is in accordance with the UBC (Section 5.2). A design limit of 95 percent of the full allowable stress is used for member selection.

Except for the two items noted below, the Poloidal Field Coil Fabrication Building (S1003) and the Magnet Coil Test Building (S1004) are identical.

- The roof elevation for the Magnet Coil Test Building (S1004) is at 29 meters between column lines E and K as opposed to 20 meters for the entire Poloidal Field Coil Fabrication Building (S1003). This increase in height is for the stationary crane. Note the Poloidal Field Coil Fabrication Building (S1003) does not have a crane.
- The Magnet Coil Test Building (S1004) has two bays of diagonal bracing in the east-west direction, that is, at each roof elevation, while the Poloidal Field Coil Fabrication Building (S1003) has only one bay of diagonal bracing. Both buildings have diagonal bracing running in the north-south direction between column lines 1.3 and 1.5.

Consequently, the member sizes determined from the structural analysis of the Magnet Coil Test Building (S1004) at the 20 meter elevation are used to establish the member sizes for the Poloidal Field Coil Fabrication Building (S1003). The stress analysis of the Magnet Coil Test Building (S1004) is given in Attachment A-1.S1004.

ITER Task No. 28 Building Design D230B			
PF COIL FABRICATION BUILDING (S1003)			
AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
W10X19	1	39.5	0.4
W10X22	1	29.5	0.3
W10X45	18	498.7	11.1
W12X40	31	846.5	16.5
W14X132	20	1049.9	68.7
W14X145	14	1640.4	118.2
W14X193	14	1640.4	157.6
W14X30	67	1673.2	24.8
W14X38	11	324.8	6.1
W14X43	133	3579.6	75.0
W14X48	12	293.6	6.9
W14X53	13	328.9	8.6
W14X61	9	243.7	7.3
W14X68	128	2032.6	68.1
W14X74	16	280.7	10.3
W14X82	24	425.2	17.2
W14X90	28	373.5	16.6
W14X99	24	608.7	29.9
W18X76	43	1154.9	43.6
W18X86	4	118.1	5.1
W18X97	16	472.4	22.8
W21X62	12	171.9	5.3
W24X146	10	295.3	21.5
W36X300	8	262.5	39.1
W36X359	2	229.7	40.9
W8X15	160	1962.8	14.6
W8X28	6	164.0	2.3
W8X31	27	748.0	11.4
WT10.5X46.5	1	20.6	0.5
WT10.5X61	36	1384.8	42.0
WT10.5X66	4	157.4	5.2
WT12X88	6	240.2	10.6
WT6X15	24	479.5	3.6
WT6X32.5	1	19.2	0.3
WT6X36	1	19.2	0.3
WT7X54.5	2	44.1	1.2
WT8X25	4	88.3	1.1
WT8X44.5	6	126.0	2.8
WT8X50	6	118.3	3.0
Sub Total			920.3

ITER Task No. 28 Building Design D230B			
PF COIL FABRICATION BUILDING (S1003)			
Total tons of girts			51.7
% of est girts to steel			5.6%
Sub Total			972.1
Est for connections			24.3
% of est conn. to steel			2.5%
Total tonnage of steel			996.4

3.6.3.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1003

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span< =10 m			C12X20.7 For span> 10 meters		
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons
East Face	76	20	20.24						
West Face	76	8	8.96						
North Face	24	8	2.83						
	15	7	1.58						
	35	5	2.83						
	50	5	4.04						
South Face	24	8	2.83						
	15	7	1.58						
	35	5	2.83						
	50	5	4.04						
Total Tons C8's			51.74	Total Tons C10's			Total Tons C12's		
								Total tons of girts	51.74

* Girt Spacing is at 5 feet o.c.

3.6.3.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Poloidal Field Coil Fabrication Building (S1003):

04749.05-ES-1003A-3 Plan Views
04749.05-ES-1003B-3 Roof Plan and Elevation
04749.05-ES-1003C-3 Elevations
04749.05-ES-1003D-3 Elevations
04749.05-ES-1003E-3 Elevations
04749.05-ES-1003F-3 Isometric View

3.6.3.d Discussion

The member sizes shown on the drawings in section 3.6.3.c. have been determined by the stress calculations in Attachment A-1.S1004 to be within the AISC code allowable limits. Refer to this calculation for additional discussion.

1. DESIGN INFORMATION FOR CONSTRUCTION ONLY DATE: 1-2-76 DRAWN BY: [Signature] CHECKED BY: [Signature] APPROVED BY: [Signature]		2. TITLE PLAN VIEWS		3. PROJECT INFORMATION PROJECT NAME: 118 BUILDING DESIGN (0223-8) PROJECT NO: 118-05-ES-1003A-3 PROJECT LOCATION: [Blank]	
4. CLIENT INFORMATION CLIENT NAME: [Blank] CLIENT ADDRESS: [Blank] CLIENT PHONE: [Blank]		5. DESIGNER INFORMATION DESIGNER NAME: [Blank] DESIGNER ADDRESS: [Blank] DESIGNER PHONE: [Blank]		6. MATERIALS MATERIALS LIST: [Blank]	
7. NOTES 1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED. 2. FOR GENERAL NOTES, SEE DRAWING 1001A.		8. SCALE SCALE: 1/150		9. OTHER INFORMATION OTHER INFORMATION: [Blank]

NOT TO SCALE

ROOF PLAN EL 20 M
 ROOF TRUSS, TOP CHORD, 105 EL 20 M (U.O.S.)
 SCALE: 1/150

1 3		DESCRIPTION		APPROVED		TITLE		SHEET FRAME SIZE 1070 x 810		ITER-EDA
1		ICEPTUAL DESIGN		DATE		ROOF PLAN AND ELEVATION		DIN EN 27 D.O.W. T.O.		NOT FOR PUBLICATION		
2		FOR INFORMATION ONLY		DATE		DATE JULY 14, 1985		FJE CFB		The information on this drawing is sufficient to cover the terms of the ITER Agreement.		
3		TO BE USED FOR CONSTRUCTION		DATE		WORK BREAKDOWN STRUCTURE 6.2.P		DATE OF REVISIONS		First information about the drawing is given on the drawing and is given on the drawing.		
4		BASE TITLE:		BASELINE VERSION		W.B.S. TITLE		SAN DIEGO J.W.S.				
5		ITER BUILDING DESIGN (3230-B)		P.F. COIL FABRICATION BLDG								
6		DO NOT TAKE MEASUREMENTS		THIRD ANGLE PROJECTION								
7		USE ONLY DIMENSIONS GIVEN										
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NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		DATE		WEEK BREAKDOWN STRUCTURE 6.2.P		ITER-EDA		
QUAL DESIGN INFORMATION ONLY USED FOR CONSTRUCTION		DATE	ELEVATIONS		JULY 14, 1995		FJE GFB		NOT FOR PUBLICATION		
TASK TITLE: ITER BUILDING DESIGN (2230-B)		1-2-95	V.B.S. TITLE		PF COIL FABRICATION BLDG		SAN DIEGO J.W.S.		The information on this drawing is submitted as is and is not to be used for any other purpose without the written consent of ITER-EDA.		
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN			THIRD ANGLE PROJECTION		0000000000200000P---

3-3
FRAMING TYPICAL FOR COLUMN LINES 1 & 2 (U.O.S.)
SCALE: 1/100

4-4
FRAMING TYPICAL FOR COLUMN LINES 1.2 & 1.8 (U.O.S.)
SCALE: 1/100

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5-5
FRAMING TYPICAL FOR COLUMN LINES 1.3, 1.5 & 1.7
SCALE: 1/100

6-6
COLUMN LINE 3
SCALE: 1/100

ISOMETRIC VIEW LOOKING NORTH-EAST
SCALE: NONE

JANUARY 2, 1996

10.23.59

ITER TASK D2308

04749.0500.1003.S01.00.C3 PF COIL FABRICATION BUILDING STRU

AISC SECTION	QUANTITY	LENGTH (FT)	TONS (US)
V10X19	1	39.507	.372
V10X22	1	29.528	.322
V10X45	18	498.688	11.069
V12X40	31	846.457	16.509
V14X132	20	1049.669	68.699
V14X145	14	1640.420	118.221
V14X193	14	1640.420	157.576
V14X30	67	1673.228	24.799
V14X38	11	324.803	6.092
V14X43	133	3579.648	75.019
V14X48	12	293.603	6.913
V14X53	13	328.888	8.562
V14X61	9	243.678	7.304
V14X68	128	2032.556	68.055
V14X74	16	280.730	10.259
V14X82	24	425.224	17.181
V14X90	28	373.527	16.627
V14X99	24	608.680	29.859
V18X76	43	1154.856	43.559
V18X86	4	118.110	5.057
V18X97	16	472.441	22.834
V21X62	12	171.878	5.275
V24X146	10	295.276	21.495
V36X300	8	262.467	39.076
V36X359	2	229.659	40.886
V4X15	160	1962.762	14.567
V8X28	6	164.042	2.263
V8X31	27	748.031	11.439
WT10.5X46.5	1	20.591	.475
WT10.5X61	36	1284.787	41.991
WT10.5X66	4	157.413	5.168
WT12X68	6	240.239	10.572
WT6X15	24	479.467	3.556
WT6X32.5	1	19.218	.307
WT6X36	1	19.218	.340
WT7X54.5	2	44.139	1.192
WT8X25	4	88.278	1.097
WT8X44.5	6	126.046	2.789
WT8X50	6	118.315	2.950

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		ITER-EDA		
CONCEPTUAL DESIGN		DATE	ITER TASK D2308		NOT FOR PUBLICATION		
FOR INFORMATION ONLY		1-2-96	ITER BUILDING DESIGN (D230-B)		The information on this drawing is confidential		
TO BE USED FOR CONSTRUCTION					The information on this drawing is confidential		
TASK TITLE:		ITER BUILDING DESIGN (D230-B)		DATE OF SUBMITTAL		ITER-EDA	
ITER BUILDING DESIGN (D230-B)		ITER BUILDING DESIGN (D230-B)		SAN DIEGO J.W.S.		ITER-EDA	
DO NOT TAKE MEASUREMENTS		THIRD ANGLE PROJECTION		000000000000200000P		ITER-EDA	
USE ONLY DIMENSIONS GIVEN						ITER-EDA	

3.6.4 Magnet Coil Test - 6.2.Q / S1004

3.6.4.a Building Design Methodology

The Magnet Coil Test Building (S1004), as shown on the drawings in section 3.6.4.c, is a one story steel frame structure with three different roof elevations. The main structure has roof elevations of 29 and 20 meters, while the attached office/machine room structure has a roof elevation of 8 meters.

In the north-south direction, the high roof at 29 meters has five equal bays of 8 meters, while the low roof of 20 meters has 4 equal bays of 9 meters. Roof trusses span 50 meters in the east-west direction, along column lines A through K. There are two trusses along column line E where the roof elevation changes from 29 meters to 20 meters. These trusses are symmetric Pratt trusses, consequently the diagonals are essentially tension members, while the shorter verticals are predominately compression members. On the north end of the building there is a door 34 meters wide by 15 meters high, while on the south end the door is 34 meters wide by 10 meters in height.

In-plane stiffness of the roof is furnished by the addition of in-plane diagonal members, thereby providing diaphragm action to carry the transverse wind and seismic loads to the exterior walls. Vertical bracing of the exterior walls provides both stability and a load path to carry the wind and seismic loads to the ground.

The load combinations are from the UBC (Section 5.1) and the allowable stress criteria is in accordance with the UBC (Section 5.2). A design limit of 95 percent of the full allowable stress is used for member selection.

The building was modeled in CATIA V4R1.3. A proprietary CATIA / STRUDL interface program developed by Stone & Webster Engineering Corporation was used to extract the analytical model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidences, member properties and the beta angle constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the structural analysis model.

The stress analysis of the Magnet Coil Test Building is given in Attachment A-1.S1004. This attachment provides the design criteria, applied loads, load combinations, input file, selected output, and the stress level of all members.

The Magnet Coil Test Building was analyzed as a three dimensional structure. Floor joists running in the east-west direction are spaced at 1.8 meters on the high roof and at 2.25 meters on the low roof to carry the roof loading to the north-south girders. Only those floor joists that have diagonal bracing attached were included in the structural model, however, appropriate parameters were included in the STAAD-III structural model to reflect the lateral support provided to the north-south girders by the floor joists. The top roof diagonals are affixed to the middle floor joist to provide lateral bracing of the floor joist and self weight support of the diagonals. Additionally, these members provide the in-plane stiffness of the roof. The roof trusses in the east-west direction provides lateral bracing for the north-south girders.

The building design is basically simple framing, i.e., the beams and girders are connected for shear only and are free to rotate under load. The base of the columns are considered to be pinned connected.

The STAAD III computer code was used for the structural analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program. The results of the code check are given in Attachment A-1.S1004, along with selected joint deflections and base shears for the columns.

**IFER Task No. 28
Building Design D230B**

MAGNET COIL TEST BUILDING (S1004)

AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
W10X19	1	39.5	0.4
W10X22	1	29.5	0.3
W10X45	22	603.7	13.4
W10X49	2	50.8	1.2
W12X40	31	846.5	16.5
W14X120	5	89.9	5.4
W14X132	19	572.0	37.4
W14X145	7	708.7	51.1
W14X193	7	820.2	78.8
W14X211	1	164.0	17.2
W14X257	1	164.0	21.0
W14X30	65	1624.0	24.1
W14X311	7	676.7	104.9
W14X342	28	1777.4	303.1
W14X38	11	324.8	6.1
W14X398	4	164.0	32.6
W14X43	126	3416.6	71.6
W14X48	10	256.7	6.0
W14X53	23	525.9	13.7
W14X61	37	844.9	25.3
W14X68	121	1879.6	62.9
W14X74	15	279.0	10.2
W14X82	21	479.9	19.4
W14X90	15	296.8	13.2
W14X99	46	1068.8	52.4
W16X100	2	59.1	2.9
W18X76	42	1128.6	42.6
W18X86	5	144.4	6.2
W18X97	16	472.4	22.8
W21X101	3	83.7	4.2
W21X62	9	135.2	4.1
W24X146	8	236.2	17.2
W36X300	4	321.5	47.9
W36X359	10	278.9	49.6
W8X15	160	1962.8	14.6
W8X28	6	164.0	2.3
W8X31	37	970.2	14.8
WT10.5X31	2	37.4	0.6
WT10.5X46	1	20.6	0.5
WT10.5X61	27	1013.2	30.7
WT10.5X66	4	135.0	4.4

3.6.4.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Magnet Coil Test Building (S1004):

04749.05-ES-1004A-3 Plan Views
04749.05-ES-1004B-3 Roof Plan and Elevation
04749.05-ES-1004C-3 Elevations
04749.05-ES-1004D-3 Elevations
04749.05-ES-1004E-3 Elevations
04749.05-ES-1004F-3 Elevations
04749.05-ES-1004G-3 Isometric View
04749.05-ES-1004H-3 Structural Analysis Model
04749.05-ES-1004J-3 Structural Analysis Model
04749.05-ES-1004K-3 Structural Analysis Model

3.6.4.d Discussion

The member sizes shown on the drawings in Section 3.6.4.c. have been determined by the stress calculations in Attachment A-1.S1004 to be within the AISC code allowable limits.

The maximum deflection in the north-south direction occurs over the doors. For the 15 meter high door the deflection is approximately 7.3 centimeters. For the 10 meter high door it is approximately 3.8 centimeters. The maximum deflection in the east-west direction occurs on column line E and is approximately 5.1 centimeters on the high roof. The maximum vertical deflection occurs on column line E and is 4.1 centimeters.

These doors are expected to be custom designed electric power sliding doors, designed for the required loading and deflection. Consequently, the above deflection of 7.3 centimeters is not expected to be a problem. However, if this deflection is deemed to be excessive, an exterior horizontal truss spanning over the door may be used to reduce the deflection.

ITER Task No. 28 Building Design D230B			
MAGNET COIL TEST BUILDING (S1004)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (Ft.)	TONS (US)
WT10.5X73.	10	345.7	12.6
WT12X88	2	82.4	3.6
WT16.5X131	1	38.9	2.5
WT6X15	28	555.8	4.1
WT6X29	1	18.0	0.3
WT6X32.5	1	19.2	0.3
WT6X36	1	19.2	0.3
WT7X54.5	2	44.1	1.2
WT8X25	4	88.3	1.1
WT8X44.5	6	126.0	2.8
WT8X50	6	118.3	3.0
WT9X48.5	1	41.8	1.0
Sub Total			1286.6
Total tons of girts			59.9
% of est girts to steel			4.7%
Sub Total			1346.5
Est for connections			33.7
% of est conn. to steel			2.5%
Total tonnage of steel			1380.1

3.6.4.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1004

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span< =10 m			C12X20.7 For span> 10 meters			
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons	
East Face	36	20	9.59							
	40	29	15.11							
West Face	76	8	8.96							
North Face	24	8	2.83							
	15	7	1.58							
	35	5	2.83							
	50	5	4.04							
South Face	24	8	2.83							
	15	7	1.58							
	50	9	6.51							
	50	5	4.04							
	Total Tons C8's		59.88	Total Tons C10's			Total Tons C12's			
									Total tons of girts	59.88

* Girt Spacing is at 5 feet o.c.

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. ALL HOIST DIMENSIONS CURRENTLY SHOWN ON DRAWING ARE PRELIMINARY.

[illegible]

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		SHEET FRAME SIZE 1070 x 810		ITER-EDA		
PTUAL DESIGN OR INFORMATION ONLY E USED FOR CONSTRUCTION		DATE	ELEVATIONS		SHEET		NOT FOR PUBLICATION		
TASK TITLE: ITER BUILDING DESIGN (0230-8)		12-14-5	DATE JULY 14, 1988		FJE CFB		The information on this drawing is not to be used for any other purpose without the written consent of the ITER EDA.		
4749.05-ES-1004C-3			WORK BREAKDOWN STRUCTURE 6.2.0		PART OF REGISTRATION		This information must not be transmitted to anyone else without the written consent of the ITER EDA.		
W.D.S. TITLE		PF MAGNET COIL TEST BLDG		SAN DIEGO J.W.S.					
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION

6-6
FRAMING TYPICAL FOR COLUMN LINES 1 & 2 (U.O.S.)
SCALE: 1/100

7-7
FRAMING TYPICAL FOR COLUMN LINES 1.2 & 1.8 (U.O.S.)
SCALE: 1/100

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- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		SHEET 01211070 X 810		ITER-EDA	
TUAL DESIGN R INFORMATION ONLY USED FOR CONSTRUCTION		DATE 2-19-95	ELEVATIONS		DATE JULY 14, 1995			
TASK TITLE: ITER BUILDING DESIGN (0230-8)			WORK BREAKDOWN STRUCTURE 6.2.0		DATE OF REGISTRATION SAN DIEGO J.W.S.		NOT FOR PUBLICATION No Acknowledgment or other opinion is authorized under the terms of the ITER EDA agreement. This Acknowledgment must not be transmitted to anyone who is not authorized to receive it.	
E (DOC TASK NO.28)			V.D.S. TITLE PF MAGNET COIL TEST BLDG		THIRD ANGLE PROJECTION		00 0000 0000 2D 0000 P	
749.05-ES-1004E-3			DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. ALL HOIST DIMENSIONS CURRENTLY SHOWN ON DRAWING ARE PRELIMINARY.

DESCRIPTION SECTION INFORMATION ONLY FOR CONSTRUCTION DATE: 12-19-45 DRAWING NO.: 05-ES-1004F-3		TITLE ELEVATIONS DATE: JULY 14, 1946 SCALE: 1/8" = 1'-0" U.S.S. TITLE: PF MAGNET COIL TEST BLDG THIRD ANGLE PROJECTION		DRAWING NO.: 1070 x 810 DESIGNED BY: J.W.S. CHECKED BY: CFB DATE OF SUBMITTAL: SAN DIEGO J.W.S.		ITER-EDA NOT FOR PUBLICATION No alterations or additions shall be made without the written approval of the design engineer. This document shall not be considered as a contract.			
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1:1
L001

ISOMETRIC VIEW
SOUTH-EAST

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIDING GIRT ESTIMATE IS INCLUDED IN THE B.O.M. PRESENTED IN THE ITER EDA TASK NO. 28 FINAL REPORT.

DECEMBER 19, 1995 14.20.35

ITER TASK D230B

04749.0500.1004.502.00.CS PF MAGNET COIL TEST BUILDING STRU

AISC SECTION	QUANTITY	LENGTH (FT)	TONS (US)
W10X19	1	39.307	.372
W10X22	1	29.528	.322
W10X45	22	603.475	13.398
W10X49	2	50.830	1.229
W12X40	31	846.457	16.509
W14X120	5	89.926	5.357
W14X132	19	571.993	37.429
W14X145	7	708.661	51.071
W14X193	7	820.210	78.788
W14X211	1	164.042	17.205
W14X257	1	164.042	21.007
W14X30	65	1624.016	24.069
W14X311	7	876.673	104.911
W14X342	28	1777.395	303.076
W14X38	11	324.803	6.092
W14X398	4	164.042	32.571
W14X43	126	3416.631	71.603
W14X48	10	256.710	6.045
W14X53	23	525.937	13.692
W14X61	37	844.901	25.327
W14X65	121	1879.603	62.933
W14X74	15	279.008	10.197
W14X82	21	479.892	19.390
W14X90	15	296.794	13.211
W14X99	46	1068.810	52.431
W18X100	2	59.055	2.845
W18X76	42	1128.609	42.569
W18X86	5	144.357	6.181
W18X97	16	472.441	22.834
W21X101	3	83.661	4.205
W21X62	9	135.152	4.148
W24X146	8	236.220	17.196
W36X300	4	321.322	47.668
W36X359	10	278.871	49.647
WBX15	160	1962.762	14.567
WBX26	6	164.042	2.263
WBX31	37	970.183	14.836
WT10.5X31	2	37.437	.575
WT10.5X46	1	20.591	.475
WT10.5X61	27	1013.222	30.724
WT10.5X66	4	135.045	4.434
WT10.5X73	10	345.696	12.646
WT12X88	2	82.365	3.625
WT16.5X131	1	38.897	2.546
WFX15	28	555.802	4.122
WFX29	1	17.989	.256
WFX32.5	1	19.218	.307
WFX36	1	19.218	.340
WFX54.5	2	44.139	1.192
WFX25	4	88.278	1.097
WFX44.5	6	126.046	2.789
WFX50	6	118.315	2.950
WFX48.5	1	41.758	1.009

ISSUE	3	DESCRIPTION	APPROVED
PRECONCEPTUAL DESIGN		DATE	
ISSUED FOR INFORMATION ONLY		12-19-95	
NOT TO BE USED FOR CONSTRUCTION			
ASK NO.: ITER-SW-4808E (DOE TASK NO.28)	TASK TITLE: ITER BUILDING DESIGN (D230-B)		
DRAWING NUMBER 04749.05-ES-1004G-3			

TITLE ISOMETRIC VIEW		SHEET FRAME 3121070 x 810	
DATE JULY 14, 1998	WORK BREAKDOWN STRUCTURE 6.2.Q	DES	CHK'D B.O.W. T.O.
BASISLINE VERSION	W.B.S. TITLE PF MAGNET COIL TEST BLDG	FJC	GFB
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		SITE OF INSTALLATION SAN DIEGO J.W.S.	
THIRD ANGLE PROJECTION			

ITER-EDA		DO NOT FOR PUBLICATION	
The information on this drawing is confidential under the terms of the ITER EDA agreement. This document must not be distributed to anyone who is not authorized to receive it.			
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C VIEW LOOKING SOUTH-EAST
EXTERIOR WALLS
SCALE: NONE

DESCRIPTION		APPROVED	TITLE	BSC FRAME SIZE 1070 X 810		ITER-EDA
DESIGN INFORMATION ONLY FOR CONSTRUCTION		DATE	STRUCTURAL ANALYSIS MODEL	SIZE	CMB'S	S.O.M.	T.O.	
		12-15-73	DATE JULY 14, 1982	F/F	G/R	NOT FOR PUBLICATION		
		BASELINE VERSION	WORK BREAKDOWN STRUCTURE 6.2.Q	The information on this drawing is confidential and its release or disclosure to unauthorized persons may result in damage to the health, safety or interest of the United States Government.				
			PF MAGNET COIL TEST BLDG	This information must not be transmitted to anyone other than authorized personnel.				
			THIRD ANGLE PROJECTION	SAN DIEGO J.W.S.				
TASK NO. 283	TASK TITLE:	ITER BUILDING DESIGN (D230-H)	DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN	0000000000		2000000P----		
.05-ES-1004H-3

ISOMETRIC VIEW LOOKING SOUTH-EAST
FRAMING AT TOP CHORD OF ROOF TRUSS
SCALE: NONE

ERIC VIEW LOOKING SOUTH-EAST
AT BOTTOM CHORD OF ROOF TRUSS
SCALE: NONE

[illegible]

3.6.5 Tokamak Services Building - 6.2.D / S1005**3.6.5.a Building Design Methodology**

The Tokamak Services Building (S1005) is a three-floor steel structure with an approximate floor plan of 20x70 meters. The long dimension of the building is orientated in the north-south direction of the site. The structural elements of this building are shown on the attached drawings in Section 3.6.2.c. The building floors are located at elevations 0.00, 11.00 and 22.00 meters. The steel roof is located at elevation 33.00 meters. The below grade portion of the building is a concrete box type structure. The building does not have an industrial crane.

The building has ten (10) typical transverse frames orientated parallel to the east-west direction and spaced at 6.8 meters. A typical transverse frame has one 18 meter large span and rises 33.00 meters above the ground. It has three floors of 11.00 meters each. The typical frame is considered fixed and is entirely fabricated from welded plate members. For the first two floors the column has a cross-section of a welded plate WPG 61x20-208lb (AISC, Manual of Steel Construction, 9th Edition, page 2-231). The cross-section changes to WPG 49x16-129lb at the third floor. The girders supporting the concrete floors at elevation 11.00 and 22.00 meters are denoted "Welded Plate Girder A". They are moment connected into the column and have a variable cross-section. At the moment connection, the cross-section is a welded plate WPG 61x20-293lb. The cross-section changes to WPG 49x16-129lb for the interior zone. The welded plate girder supporting the roof has a constant cross-section WPG 49x16-129lb and is denoted "Welded Plate Girder B". The welded plate girder located at elevation 0.00 meters, although identical to the "Welded Plate Girder A", is not part of the transverse frame. It carries its reactions directly into the wall of the underground concrete box.

Typical longitudinal frames were created on each side of the building with the vertical bracing system placed at the column center lines between E and G. The columns are considered hinged into the concrete floor for this direction. Two rigid portals designed as "X" type are made from W8x31 typical bracing members and are placed in the middle section of the building. The lateral joints of the floors and the purlins of the roof are used as horizontal members for the frame. To reduce the buckling length of the columns in the longitudinal bending plan, additional beams W14x43 were placed at the half elevation of each floor. All horizontal members which are part of the longitudinal frame are considered hinge connected to the adjoining columns.

The bracing system of the roof is designed with WT 5x11 steel members. All are considered as truss elements carrying only their own weight in bending.

Two repetitive type structural elements, roof purlins and floor joists, are employed in the Tokamak Services Building. The roof has a number of typical W14x30 purlins with a maximum 2.0 meters tributary width. The lateral purlins are W 14x84 and play an important role in the longitudinal stability of the structure. The floor joists are all W 18x50 members. These elements were sized without consideration for the composite concrete-steel interaction.

The concrete floors are 0.15 meters thick. They are designed as one-way reinforced concrete slabs supported on metal deck and are considered acting as a rigid horizontal diaphragm

As presented in Fig. 3-1, the overall design process used the CATIA V4R1.3 modeling software. Because the structural analysis was conducted on two-dimensional sections and the existing CATIA version does not have an automatic model-to-analysis conversion capability, the structural models were manually input into STAAD III code.

The structural analysis was accomplished using the STAAD III computer code and is detailed in Attachment A-1.S1005. The attachment provides all the pertinent information regarding the applied load magnitudes, load combinations used and design parameters required for code checking calculations. All the calculations were performed in accordance with AISC Code.

Using the geometric requirements provided by the JCT and the member sizes resulting from the structural analysis, a final three-dimensional model was created. The two-dimensional drawings were created from the three-dimensional model. A material list was automatically extracted from the model and is presented in Section 3.6.2.b.

ITER Task No. 28 Building Design D230B			
TOKAMAK SERVICES BUILDING (S1005)			
AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
W14X30	160	3571.1	52.9
W18X50	269	5967.0	147.5
W8X31	48	904.1	13.8
WPG49X16-1	65	2794.4	180.7
WPG61X20-2	22	1660.1	173.0
WPG61X20-2	62	234.6	34.4
WT5X11	111	1486.4	8.1
SubTotal			610.4
Total tons of girts			61.0
% of est girts to steel			10.0%
Sub Total			671.5
Est for connections			16.8
% of est conn. to steel			2.5%
Total tonnage of steel			688.2

3.6.5.c Building Structural Drawings - Final Issue (11"x17")

The following drawings describe one of the two Tokamak Service Buildings. Structurally, the two buildings have been considered identical.

04749.05-ES-1005A-3	Structural Plans
04749.05-ES-1005B-3	Structural Sections
04749.05-ES-1005C-3	Isometric View

The structural analysis model drawings are part of the analysis, see Attachment A-1.

3.6.5.d Discussion

The Tokamak Services Building is a symmetric building. It has been designed using the methodology discussed in Section 3.1.

FLOOR PLAN ELEVATION 0.00 M
(T.O.S. ELEVATION -0.15 M)

SCALE 1/150

FLOOR PLAN
(T.O.S. ELEVATION -0.15 M)

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A.

ELEVATION 11.00 M & 22.00 M
ELEVATION 10.85 M & 21.85 M

ROOF PLAN ELEVATION 33.00 M
(T.O.S. ELEVATION 33.00 M)

SCALE 1/150

SCALE 1/150

ISSUE 3		DESCRIPTION		APPROVED		TITLE		DPO FRAME SIZE 070 x 810		ITER-EDA		
PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		DATE		155		STRUCTURAL PLANS AND ELEVATIONS		DIN OK'D D.G.K. T.O.		NOT FOR PUBLICATION		
TASK NO.: ITER-SM-4008E (DOE TASK NO. 28)		DATE		12/01/95		DATE: DECEMBER 01, 1995		155 155		The information on this drawing is confidential under the terms of the ITER EDA agreement. This information shall not be transmitted to anyone not authorized to receive it.		
TASK TITLE: ITER BUILDING DESIGN (0230-B)		DATE		12/01/95		WORK BREAKDOWN STRUCTURE 6.2.E		155 155		SAN DIEGO J.W.S.		
DRAWING NUMBER 04749.05-ES-1005A-3		TASK TITLE: ITER BUILDING DESIGN (0230-B)		DATE		V.B.S. TITLE		SAN DIEGO J.W.S.		THIRD ANGLE PROJECTION		
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		DATE		12/01/95		TOKAMAK SERVICES BUILDING		SAN DIEGO J.W.S.		00 0000 0000 2000 00 P----

SECTION 1-1

SCALE 1/150

SECTION 2-2

SCALE 1/150

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A.
3. WPG = WELDED PLATE ELEMENT HXB - Weight
(AISC - Manual of Steel Construction
9th Edition page 2-230)

ISSUE 3 PRELIMINARY DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		DESCRIPTION APPROVED ISS DATE 12/01/95		TITLE STRUCTURAL PLANS AND ELEVATIONS DATE: DECEMBER 01, 1995 WORK BREAKDOWN STRUCTURE 6, 2, E BASELINE VERSION V.B.S. TITLE TOKAMAK SERVICES BUILDING DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		ORG. FRAME SIZE 1070 x 810 CHN CH'D D.O.M. T.O. ISS ISS NAME OF ORGANISATION SAN DIEGO J. H. S. THIRD ANGLE PROJECTION		ITER-EDA NOT FOR PUBLICATION This information is only to be used for information under the terms of the ITER 88 agreement. This information shall not be transmitted to anyone who is not authorized to receive it.			
TASK NO.: ITER-SM-4000E (CODE TASK NO. 28)		TASK TITLE: ITER BUILDING DESIGN (0230-01)		DRAWING NUMBER 04749.05-ES-1005B-3		0000000000002D0000P---

3.6.6 Auxiliary Building - Magnet Power Supply Switching Network - 6.2.E / S1006**3.6.6.a Building Design Methodology**

The Auxiliary Building - Magnet Power Supply Switching Network (S1006) is a two floor steel structure. In the north-south direction there are six equal spans of 11 meters for a total width of 66 meters, while in the east-west direction there are 8 spans of 10 meters, for a total building length of 80 meters. The floor elevation is at 12 meters and the top of steel for the roof is at 23 meters. Interior columns are provided at the intersection of the above spans and extend from the ground level to the roof.

In-plane stiffness of the floor and roof is furnished by in-plane diagonal members, thereby providing diaphragm action to carry the transverse wind and seismic loads to the end walls. These diagonals are provided in the center bay in the east-west direction and a bay adjacent to the middle of the structure in the north-south direction. Where the diagonal bracing of the floor and roof intersects with the exterior walls, vertical bracing of the exterior walls is furnished, thereby providing stability and a load path to carry the wind and seismic loads to the ground.

The load combinations and the allowable stress criteria is in accordance with the UBC. A design limit is set at 95 percent of the full allowable stress for member selection.

The building was modeled in 3D using CATIA V4R1.3. A proprietary CATIA/STRUDL interface program developed by SWEC was used to extract the analytical model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidence, member properties and the beta angle constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the 3D structural analysis model.

The stress analysis of the Auxiliary Building - Magnet Power Supply Switching Network is provided in Attachment A-1.S1006. This attachment provides the design criteria, applied loads and load combinations. Additionally, the STAAD-III input file along with selected output, including the stress level of all members, is provided. The Auxiliary Building - Magnet Power Supply Switching Network was analyzed as a two dimensional plane structure. That is, the floor, the roof, an exterior north-south and an exterior east-west model were analyzed separately.

The floor and the roof models were analyzed first, since a portion of the output of these files is required as input to the exterior wall models. For the floor and roof models, the column locations were considered as simple supports. The floor and roof joists are spaced at approximately 2 meters in the east-west direction and carry the floor and roof dead and live loadings to girders spanning in the north-south direction. The floor and roof joists were not included in the structural model, however, appropriate parameters were included in the STAAD-III model to reflect the lateral support provided to the north-south girders by the floor and roof joists. The floor and roof diagonals are affixed at mid span to the middle floor joist which provides self weight support.

The exterior column support reactions from the floor and roof structural models are applied as joint loads, along with the wind load, siding loads, etc., to the two exterior structural models.

The building design is basically simple framing, i.e., the beams and girders are connected for shear only and are free to rotate under load. The base of the columns is considered to be pin connected.

The CATIA/STRUDL interface was used to create a unique 3D model joint/member identification list to provide for model continuity. CATIA managed the break-out of the previously discussed analytical models for the roof, floor and the two exterior elevations.

The STAAD-III computer code was used for the analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program in accordance with the AISC. The results of the code check are given in Attachment A-1.S1006, along with selected joint deflection, and base shears for the columns.

ITER Task No. 28 Building Design D230B			
MAGNET POWER SUPPLY SWITCHING NETWORK BUILDING (S1006)			
AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
W10X17	40	1395.5	11.7
W12X40	18	600.3	11.7
W12X45	2	71.7	1.6
W12X50	4	137.7	3.4
W12X53	60	2031.9	52.7
W14X145	26	1108.9	79.9
W14X233	28	1194.2	138.5
W14X43	214	7021.0	147.1
W14X90	28	918.6	40.9
W14X99	26	853.0	41.8
W16X31	5	60.1	0.9
W16X50	14	459.3	11.4
W16X57	3	49.2	1.4
W24X55	4	131.2	3.6
W24X68	212	6955.4	234.9
W24X76	14	459.3	17.3
W24X84	10	360.9	15.0
W30X108	6	196.9	10.5
W30X357	35	1263.1	225.9
W30X90	28	918.6	41.3
W33X118	35	1263.1	73.6
W33X169	10	360.9	32.2
W8X24	40	1443.6	17.1
WT10.5X50.	3	146.3	3.7
WT10.5X55.	4	195.1	5.4
WT10.5X61	2	97.5	3.0
WT10.5X66	2	97.5	3.2
WT12X58.5	2	97.5	2.8
WT13.5X47	2	97.5	2.3
WT6X15	12	292.6	2.2
WT6X17.5	12	292.6	2.6
WT9X25	2	97.5	1.2
WT9X38	2	97.5	1.8
WT9X43	5	243.9	5.2
Sub Total			1247.8

ITER Task No. 28 Building Design D230B			
MAGNET POWER SUPPLY SWITCHING NETWORK BUILDING (S1006)			
Total tons of girts			124.7
% of est girts to steel			10.0%
Sub Total			1372.4
Est for connections			34.3
% of est connections to steel			2.5%
Total tonage of steel			1406.7

3.6.6.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1006

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span<=10 m			C12X20.7 For span> 10 meters		
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons
East Face							55	23	30.04
West Face							55	23	30.04
North Face				80	23	32.29			
South Face				80	23	32.29			
Total Tons C8's									
Total Tons C10's									
64.59									
Total Tons C12's									
60.08									
Total tons of girts									
124.67									

* Girt Spacing is at 5 feet o.c.

3.6.6.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Auxiliary Building - Magnet Power Supply Switching Network (S1006):

04749.05-ES-1006A-3 Structural Plans and Elevations
04749.05-ES-1006B-3 Structural Plans and Elevations
04749.05-ES-1006C-3 Structural Plans and Elevations
04749.05-ES-1006D-3 Isometric View
04749.05-ES-1006E-3 Structural Analysis Model
04749.05-ES-1006F-3 Structural Analysis Model

3.6.6.d Discussion

The initial vertical bracing design which used only two bays resulted in relatively large base shears on some of the columns due in part to the heavy equipment and piping live load on the floor. Consequently, additional vertical bracing was required to reduce the column base shears to allow for simple column connections at the base of the structure. This resulted in a maximum base shear of approximately 100 kips in the north-south direction and 90 kips in the east-west direction.

The maximum deflection at the roof elevation in the north-south direction is approximately 1.8 centimeters and in the east-west direction it is approximately 2.0 centimeters. This is satisfactory.

3 DESCRIPTION CONCEPTUAL DESIGN FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED DATE 16-10-1995	TITLE STRUCTURAL PLANS AND ELEVATIONS		DWG FRAME SIZE 1070 x 810 DER CRE'D S.O.M. T.O. FJE OFB	ITER-EDA NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the ITER EDA agreement. This information shall not be transmitted to anyone who is not authorized to receive it	
TASK TITLE: ITER BUILDING DESIGN (D230-B)		DATE JULY 14, 1995	MORE BREAKDOWN STRUCTURE 6.2.E		DATE BY REVISITATION SAN DIEGO J.W.S.		
TASK TITLE: ITER BUILDING DESIGN (D230-B)		W.B.S. TITLE MAGNET POWER SUPPLY SWITCHING NETWORK BLOC		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		00 0000 0000 20 0000 P---	
04749.05-ES-1006A-3		THIRD ANGLE PROJECTION

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		DRG FRAME SIZE 1070 X 810		ITER-EDA		
DESIGN OR INFORMATION ONLY		DATE	STRUCTURAL PLANS AND ELEVATIONS		DRN	CHK'D	D.O.W.	T.O.	
FOR CONSTRUCTION		16-33-75	WORK BREAKDOWN STRUCTURE 6.2.E		F.J.E.	G.F.B.			
TASK TITLE: ITER BUILDING DESIGN (0230-B)			W.B.S. TITLE		WALL BY REINFORCEMENT				
ITER BUILDING DESIGN (0230-B)			MAGNET POWER SUPPLY SWITCHING BLDG		SAN DIEGO J.W.S.				
DO NOT TAKE MEASUREMENTS		THIRD ANGLE PROJECTION		0000000000002D00000P

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TOS (-)50
CENTERED
(TYP U.O.S.)

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

3 CONCEPTUAL DESIGN FOR INFORMATION ONLY BE USED FOR CONSTRUCTION		APPROVED DATE (0-23-21)	TITLE STRUCTURAL PLANS AND ELEVATIONS		DWG FRAME SIZE 1070 x 810	ITER-EDA NOT FOR PUBLICATION <small>The submission of this drawing is held subject to the terms of the ITER EDA agreement. No part of this drawing may be reproduced or transmitted in any form or by any means electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, without the prior written permission of ITER-EDA.</small>	
TASK TITLE: ITER BUILDING DESIGN (D230-B)		DATE JULY 16, 1995	WORK BREAKDOWN STRUCTURE 6.2.E	BYN CMK'D B.S.W. T.O. FJE GFB			
TASK NO. 04749.05-ES-1006C-3		BASELINE VERSION	W.B.S. TITLE MAGNET POWER SUPPLY SWITCHING BLDG	NAME OF ORGANIZATION SAN DIEGO J.W.S.			
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION

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OCTOBER 27, 1995 15.11.23

ITER TASK D2308

04749.0500.1008.S02.CO.CS MAGNET POWER SUPPLY SWITCHING BUILDING STRU

AISC SECTION	QUANTITY	LENGTH	TONS
W10X17	40	1395.451	11.668
W12X40	18	600.334	11.709
W12X45	2	71.719	1.575
W12X50	4	137.731	3.370
W12X53	60	2031.879	52.748
W14X145	26	1108.824	78.817
W14X233	28	1184.226	138.457
W14X43	214	7020.987	147.140
W14X80	28	918.635	40.891
W14X99	28	853.018	41.845
W16X31	5	60.149	.920
W16X50	14	459.318	11.416
W16X57	3	49.213	1.393
W24X55	4	151.234	3.589
W24X68	212	6955.331	234.918
W24X76	14	459.318	17.312
W24X84	10	360.892	15.040
W30X108	6	198.850	10.500
W30X137	35	1263.123	225.879
W30X180	28	918.635	41.339
W33X118	35	1263.123	73.604
W33X169	10	360.892	32.180
W8X24	40	1443.570	17.052
WT10.5X50	3	146.320	3.677
WT10.5X55	4	195.093	5.388
WT10.5X61	2	97.546	2.958
WT10.5X66	2	97.546	3.203
WT12X58.5	2	97.546	2.835
WT13.5X47	2	97.546	2.269
WT6X15	12	292.639	2.170
WT6X17.5	12	292.639	2.554
WT9X25	2	97.546	1.205
WT9X38	2	97.546	1.840
WT9X43	5	243.866	5.221

V LOOKING NORTH-EAST
SCALE: NONE

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIDING GIRT ESTIMATE IS INCLUDED IN THE S.G.W. PRESENTED IN THE ITER EDA TASK NO. 28 FINAL REPORT.

DESCRIPTION	DATE	TITLE	DATE	ITER-EDA	
AL DESIGN INFORMATION ONLY USED FOR CONSTRUCTION	1995	ISOMETRIC VIEW	1995	ITER-EDA	
TASK NO. 28	TASK TITLE:	WORK DESCRIPTION	DATE OF SUBMISSION	ITER-EDA	
49.05-ES-1008D-3	ITER BUILDING DESIGN (D230-8)	MAGNET POWER SUPPLY SWITCHING BLDG	SAN DIEGO J.W.S.	ITER-EDA	
DO NOT SCALE DIMENSIONS USE ONLY DIMENSIONS GIVEN			THIRD ANGLE PROJECTION	0000000000200000P

ISOMETRIC VIEW LOOKING NORTH-EAST
SCALE: NONE

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
2. FOR GENERAL NOTES, SEE DRAWING 10BIA

[illegible]

3.6.7 Magnet Power Conversion Building - 6.2.E / S1007

3.6.7.a Building Design Methodology

The Magnet Power Conversion Building (S1007) is a one floor steel structure with a low roof in the north and south bays and a high roof in the middle bay. In the east-west direction the building is divided into seventeen (17) 10 meter bays for a total of 170 meters. A rigid frame is spaced every 10 meters along column lines 2 through 17 spanning 30 meters in the north-south direction. This frame supports gravity loads and lateral loads (tributary north-south wind loads). In addition to this frame, the building roof contains a horizontal truss which aids in the distribution of north-south wind loads to the braced end walls along column lines 1 and 18. In the north-south direction there are three equal bays of 10 meters for a total width of 30 meters. The east-west lateral loads are resisted by vertical bracing along column lines A, B, C and D. The low and high roof are a complete truss system that acts as a diaphragm.

The load combinations and the allowable stress criteria is in accordance with the UBC. A design limit is set at 95 percent of the full allowable stresses for member selection.

The building was modeled in 3D using CATIA V4R13. A proprietary CATIA/STRUDL interface program, developed by SWEC, was used to extract the analytical model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidence, member properties and the beta angle constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the 3D structural analysis model.

The stress analysis of the Magnet Power Conversion Building is provided in Attachment A-1.S1007. This attachment provides the applied loads, load combinations and the stress level of all members. The snow load for this building included the UBC snow drift requirements due to the low roof of the middle bay. Several cross-sections of The Magnet Power Conversion Building were analyzed. The sections analyzed are a typical rigid frame, braced end wall (east wall), low roof, high roof and vertical bents along column lines C and D. Those sections modeled and enveloped the structural behavior of the building. A horizontal spring support (in the north-south direction) was used for the roof truss to model the resistance provided by the rigid frames. Floor joists, spaced at 2 meters, are provided in the roof (spanning in the east-west direction). The floor joists were not

included in the model (design of these members are addressed in Attachment A-1.S1000) but appropriate parameters were input into STAAD-III to model their effect. These floor joists are provided to carry the roof loading to the north-south girders and support the self weight of the diagonals. The column bases are considered to be fixed.

The CATIA/STRUDL interface was used to create a unique 3D model joint/member identification list to provide for model continuity. CATIA was used to manage the break-out of the previously discussed analytical models, for the roof, floor and the two exterior elevations.

The STAAD III computer code was used for the structural analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program in accordance with the AISC. The results of the code check are given in Attachment A-1.S1007, along with selected joint deflections and base shears for the columns.

ITER Task No. 28 Building Design D230B			
MAGNET POWER CONVERSION BUILDING (S1007)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (FL.)	TONS (US)
RAIL 60#	102	3352.1	33.8
L3X3X1/4	1020	3673.4	9.0
W10X15	255	1666.5	12.3
W10X49	24	772.0	18.7
W12X40	68	2224.4	43.4
W12X53	4	143.4	3.7
W14X43	204	6686.1	140.1
W14X61	68	2224.4	66.7
W18X106	126	865.4	45.6
W18X130	66	2103.1	134.6
W21X101	32	1469.8	73.9
W21X111	36	1535.4	84.8
W21X147	4	223.1	16.3
W21X83	32	315.0	12.9
W24X104	2	65.5	3.4
W27X102	34	1115.4	56.4
W27X114	68	2234.7	126.3
W8X35	72	2294.0	39.6
WT10.5X22	43	1995.1	21.7
WT10.5X46.	59	1554.3	35.9
Sub Total			979.1
Total tons of girts			127.9
% of est girts to steel			13.1%
Sub Total			1107.0
Est for connections			27.7
% of est connections to steel			2.5%
Total tonnage of steel			1134.6

3.6.7.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1007

LOCATION	C8X11.5			C10X15.3			C12X20.7		
	For spans 8 meter or less			For 8 m < span ≤ 10 m			For span > 10 meters		
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons
East Face				20	13	4.78			
				10	17	3.05			
West Face				20	13	4.78			
				10	17	3.05			
North Face				170	13	40.64			
				170	4	15.46			
South Face				170	13	40.64			
				170	4	15.46			
Total Tons C8's				Total Tons C10's			Total Tons C12's		
							Total tons of girts		
							127.86		

* Girt Spacing is at 5 feet o.c.

3.6.7.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Magnet Power Conversion Building (S1007):

04749.05-ES-1007A-3 Structural Floor and Roof Plans
04749.05-ES-1007B-3 Structural Elevations
04749.05-ES-1007C-3 Isometric View
04749.05-ES-1007D-3 Structural Analysis Model
04749.05-ES-1007E-3 Structural Analysis Model

3.6.7.d Discussion

The member sizes shown on the drawings in Section 3.6.7.c. have been determined by the stress calculations in Attachment A-1.S1007 to be within the AISC code allowable limits.

Although the Magnet Power Conversion Building is a long building (170 meter long). The vertical bracing was located at midspan along column lines A, B, C and D thus leaving 85 meters to be considered for thermal growth. According to AISC Report No. 13, "Guide for the Design and Construction of Mill Buildings", buildings 150 meters or less in length that are not subjected to a wide range of temperature changes do not require an expansion joint.

The maximum base shear occurred in the north-south direction and is approximately 40 kips. The maximum moment at the base plate is approximately 530 ft-kips.

The maximum in-plane deflection for the roof in the north-south direction is approximately 6 centimeters and in the east-west direction, approximately 0.25 centimeters. The deflection in the north-south direction is equivalent to approximately $L/280$ which is satisfactory.

3 - 3
FRAMING TYPICAL FOR COLUMN
SCALE: 1/200

4 - 4
FRAMING TYPICAL FOR COLUMN
SCALE: 1/200

1 - 1
FRAMING TYPICAL FOR COLUMN LINES 1 AND 18
SCALE: 1/100

- NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED
 2. FOR GENERAL NOTES, SEE DRAWING 1001A
 3. ALL CRANE DIMENSIONS CURRENTLY SHOWN ON DRAWING ARE PRELIMINARY.

2 - 2
FRAMING TYPICAL FOR COLUMN LINES 2 THROUGH 17
SCALE: 1/100

PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		DATE 12-1-75		TITLE STRUCTURAL ELEVATIONS		DATE JULY 16, 1980		PROJECT MAGNET POWER CONVERSION BUILDING		SCALE 1/100		PROJECT NO. 04749.05-ES-1007B-3	
DESIGNED BY J.W.S.		CHECKED BY J.W.S.		DATE JULY 16, 1980		PROJECT MAGNET POWER CONVERSION BUILDING		SCALE 1/100		PROJECT NO. 04749.05-ES-1007B-3		PROJECT NO. 04749.05-ES-1007B-3

ISOMETRIC VIEW LOOKING NC
SCALE: NONE

100% 131
PRECONCEPTUAL DESIGN
ISSUED FOR IMPROVEMENT
NOT TO BE USED FOR
SHEET NO. 1
ITER-20-000000 (DOC 1)
DRAWING NUMBER 04749.

NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIDING GIRT ESTIMATE IS INCLUDED IN THE B.O.M
PRESENTED IN THE ITER EDA TASK NO. 28 FINAL REPORT.

DECEMBER 6, 1995 . 15.59.28

3.6.8 Site Services Building -6.2.M /S1008

3.6.8.a Building Design Methodology

The Site Services Building (S1008) is a complex, one floor steel structure with an approximately 70 x 150 meter "L" shaped plan. The longest dimension of the housed area is 150 meters and is orientated parallel to the east-west direction of the site. The arrangement of the structural elements making up the steel skeleton of this building are depicted on the attached drawings in Section 3.6.8.c.

The three-dimensional steel structure comprises twenty-two (22) typical transverse frames orientated parallel to the north-south direction and spaced for structural reasons at 7.5 meters. A typical transverse frame has three large spans, 20 meters each (between column lines A - D and E - F) and a shorter one of 10 meters (between column lines D - E). The roof of the building is located at two different elevations. The lower portion of the roof is located at elevation 12.00 meters and covers almost the entire building surface between column lines C and F along the 150 meter length of the building. The upper roof is located at elevation 22.00 meters and covers a reduced portion of the building by spanning between column lines A - B in the north-south direction and 17 - 21 in the east-west direction.

The Site Services Building has two simultaneously operating industrial cranes. Both cranes are located on the lower side of the building and span over 20 meters; they each have a 20 ton lifting capacity. The cranes geometric requirements and the loads induced by them upon the structure are detailed in Sections 3.3 and 3.4.

The Site Services Building is analyzed along the general principles presented in Section 3.1. The typical transverse frame is composed of two independent symmetrical frames, both fixed at the concrete floor. The frame covering the higher side of the building is a classical portal type. The cross-section of the columns is constant and uses a W 30x173 steel profile. The horizontal component of the frame is a planar symmetrical truss, generically called "Truss B", and is made of two parallel W14x34 cords, nine W6x9 vertical members and ten pairs of MC 6x12 diagonal members. The transverse frame located on the lower side of the building is composed of four typical columns. The lower segment is a W 30x149 standard steel profile and continues above the crane supporting elevation with a W 30x90 laminated steel profile. The corbels are located at elevation 6.39 meters above the concrete floor slab and are W 24x68. The columns are tied laterally by

planar "Truss A", and in the center by a number of two rigidly connected W 30x90. "Truss A" is constructed from two W 14x30 horizontally positioned cords, nine W 6x9 vertical members and ten pairs of C 9x15 diagonal members. The central arrangement of columns and beams represents the structural core of the lower structure. The lower and the higher sections of the building are separated for seismic purposes by a seismic joint.

Two typical longitudinal frames were created in the longitudinal direction, one for the lower side and one for the taller side of the building. A longitudinal vertical bracing system is placed at the column center lines. The "K" type braces are made from W 8x18 and are placed near the roof level along the entire length of the building. Two rigid "K" type portals are placed along each column line. These two portals are not located as might be expected in the middle section of the building because of the excessive length of the building. The temperature effects were initially discounted by the JCT input; it is expected that future design will call for a temperature joint to be located at the 75 meter location, in the center of the present configuration. For the main structure of the building which is located on the lower side, the bracing is located above the elevation of the crane girder and is typically W 8x18. The size of the profile is increased to W 8x31 for the bracing located under the crane girder elevation. The horizontal beams are 2C 6x8.2 at all levels except the roof elevation where 2 C 12x20.7 is used. These beams are part of the longitudinal frame arrangement and are hinge connected to the columns. An identical arrangement was used for the much shorter frames located on the higher portion of the building.

The bracing system for the roof is designed using WT 5x11 steel members. All are considered as truss elements in the structural analysis. Two repetitive type structural elements are employed in the Site Services Building: roof purlins and the crane supporting structure. The roof has a number of typical W14x43 purlins which have a maximum 2.0 meters tributary width. At the edges of the 20 meters spans, the typical purlin has been replaced with 2 C 12x20.7 which play a crucial role in the longitudinal frame configuration. The crane girders are designed as indicated in Section 3.5.1 and are created from a W 27x114 steel profile.

The analysis shows that the maximum horizontal displacements are 0.362 inches for the transverse frame and 0.395 inches for the longitudinal frame. This is acceptable.

ITER Task No. 28 Building Design D230B			
SITE SERVICES BUILDING (S1008)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (Ft.)	TONS (US)
C12X20.7	176	4192.0	43.1
C15X50	10	630.8	15.7
C6X8.2	368	8736.2	35.4
C9X15	940	6814.5	50.8
W14X30	590	18123.4	268.6
W24X68	162	898.0	30.3
W27X114	80	1963.3	111.0
W30X148	84	1758.3	129.0
W30X173	10	721.8	62.0
W30X90	105	2186.1	96.7
W6X9	423	2287.7	10.2
W8X18	218	2905.5	25.6
W8X31	44	1367.0	20.9
WT5X11	526	7135.4	38.9
SubTotal			938.3
Total tons of girts			93.8
% of est girts to steel			10.0%
Sub Total			1032.1
Est for connections			25.8
% of est conn. to steel			2.5%
Total tonnage of steel			1057.9

3.6.8.c Building Structural Drawings - Final Issue (11"x17")

The drawings for the Site Services Building are:

04749.05-ES-1008A-3	Structural Plans
04749.05-ES-1008B-3	Structural Sections
04749.05-ES-1008C-3	Isometric View

The structural analysis model drawings are included in the analysis, see Attachment A-1.

3.6.8.d Discussion

The Site Services Building has been designed by implementing the structural principles discussed in Section 3.1.

The main problem encountered in the structural development of this building was its obvious asymmetry exhibited along the longitudinal axis. The existence of this asymmetry is responsible for the eccentric location of the rigidity center of the building and consequently the component frames are not equally loaded horizontally. To implement the principle of the unique transverse frame, the structure has been designed as two symmetrical structures (one located on the lower side, the other on the higher side of the building) which are only functionally interrelated. This solution assures a more favorable structural behavior during wind or seismic events.

FLOOR PLAN ELEVATION 0.00 M

SCALE 1/450

ROOF PLAN ELEVATION 12.00 M & 22.00 M

SCALE 1/300

- NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A.
 3. THE LONGITUDINAL PURLINS C 12X20.7 PLACED IN PAIRS AT COLUMN FACES SHOULD BE BRACED TOGETHER EVERY 1.5 M

10 M

ISSUE 3		DESCRIPTION		APPROVED		TITLE		CFO FRAME SIZE 1070 x 810		ITER-EDA		
PRECONCEPTUAL DESIGN		ISSUED FOR INFORMATION ONLY		ISS		STRUCTURAL PLANS AND ELEVATIONS		CFO		NOT FOR PUBLICATION		
NOT TO BE USED FOR CONSTRUCTION		DATE		12/01/95		DATE DECEMBER 01, 1995		WORK BREAKDOWN STRUCTURE 6.2.E		The information on this drawing is confidential under the terms of the ITER JEA agreement. This information shall not be disclosed to anyone else without the prior written consent of ITER-EDA.		
TASK NO. 1: ITER-SM-4000E (CODE TASK NO. 28)		TASK TITLE: ITER BUILDING DESIGN (0230-01)		DATE		V.B.S. TITLE SITE SERVICES BUILDING		NAME OF ORGANISATION SAN DIEGO J.N.S.		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		
DRAWING NUMBER 04749.05-ES-1008A-3						THIRD ANGLE PROJECTION		00000000000020000000		P---

SECTION 3-3
 SCALE 1/200

SECTION 1-1
SCALE 1/100

SECTION 2-2
SCALE 1/200

T.O.S. ELEVATION 12.00 M
T.O.S. ELEVATION 9.65 M
RAIL ELEVATION 7.21 M
T.O.S. ELEVATION 6.39 M
FLOOR ELEVATION 0.00 M

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A.

ISSUE 31		DESCRIPTION		APPROVED		TITLE		Dwg. FILE SIZE 1070 x 810		ITER-EDA		
PRELIMINARY DESIGN		ISS		DATE		STRUCTURAL PLANS AND ELEVATIONS		DWN		D.O.M.		
ISSUED FOR INFORMATION ONLY		12/01/95		DATE		WORK BREAKDOWN STRUCTURE 6.2.E		ISS		T.O.		
NOT TO BE USED FOR CONSTRUCTION				DATE		V.B.S. TITLE						
TASK NO. 1		TASK TITLE:		BASELINE VERSION		SITE SERVICES BUILDING		NAME OF ORGANISATION		SAN DIEGO J.H.S.		<p>NOT FOR PUBLICATION</p> <p>Any information on this drawing is confidential under the terms of the ITER 800 agreement. This information shall not be transmitted to anyone else for use without the express permission of ITER-EDA.</p>
ITER-54-4000E (CODE TASK NO. 28)		ITER BUILDING DESIGN (0230-81)										
DRAWING NUMBER		04749.05-ES-1008B-3		DO NOT USE MEASUREMENTS		USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000002000000P----

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A.

ISSUE 3		DESCRIPTION		APPROVED		TITLE		Dwg Frame Size 1070 x 810		ITER-EDA		<p>NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the ITER 800 agreement. This information shall not be transmitted to anyone you do not authorize to receive it.</p>
PRECONCEPTUAL DESIGN (ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION)		ISS		DATE		DATE DECEMBER 01, 1995		WORK BREAKDOWN STRUCTURE 6.2.E		155		
		DATE		12/01/95		V.B.S. TITLE		NAME OF ORGANISATION		155		
TASK NO.: ITER-SM-4008E (CODE TASK NO.28)		TASK TITLE: ITER BUILDING DESIGN (0229-B1)				SITE SERVICES BUILDING		SAN DIEGO J.V.S.		155		
DRAWING NUMBER 04749.05-ES-1008C-3						DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		00 0000 0000 2000 00 P---		

3.6.9 Assembly Laydown Storage - 6.2.N / S1009

3.6.9.a Building Design Methodology

The Assembly Laydown Storage Building (S1009) is a one floor steel structure. In the north-south direction there are four equal spans of 22 meters for a total width of 88 meters. In the east-west direction there are 8 spans of 15 meters for a total building length of 120 meters. Seven interior roof trusses along column lines 2 through 7 span each of these 88 meter bays. These trusses are non-symmetric Pratt trusses, consequently the longer diagonals are essentially tension members, while the shorter vertical members are predominately in compression. Columns at the ends of the building are spaced at 7.3 meters thereby allowing for conventional wide flange shapes to be used along column lines 1 and 9 to support the roof loads.

In-plane stiffness of the roof is provided by the addition of diagonal members thereby providing diaphragm action to carry the transverse wind and seismic loads to the end walls. At the truss locations on the roof, vertical bracing of the exterior walls provides both stability and a load path to carry the wind and seismic loads to the ground.

The load combinations and the allowable stress criteria is in accordance with the UBC. A design limit is set at 95 percent of the full allowable stress for member selection.

The building was modeled in 3D using CATIA V4R1.3. A proprietary CATIA/STRUDL interface program, developed by SWEC, was used to extract the analytical model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidence, member properties and the beta angle constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the 3D structural analysis model.

The stress analysis of the Assembly Laydown Storage Building is given in Attachment A-1.S1009. This attachment provides the design criteria, applied loads, load combinations, STAAD-III input file, selected output, and the stress level of all members. The Assembly Laydown Storage Building was analyzed as a three dimensional structure. Floor joists spaced at approximately 2 meters are provided on the top level of the roof in the north-south direction to carry the roof loading to the east-west girders. While the floor joists were not included in the model, with the exception of the floor joists that are used to brace the diagonal members, appropriate parameters were

included in the STAAD-III structural model to reflect the lateral support provided to the east-west girders. The top roof diagonals are affixed to the middle floor joist to provide lateral bracing and self weight support of the diagonals. On the lower level of the roof a single member in the north-south direction affords lateral bracing and self weight support of the diagonals. The building design is basically simple framing, i.e., the beams and girders are connected for shear only and are free to rotate under load. The column bases are considered to be pin connected.

The STAAD III computer code was used for the structural analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program in accordance with the AISC. The results of the code check are given in Attachment A-1.S1009, along with selected joint deflections and base shears for the columns.

ITER Task No. 28
Building Design D230B

ASSEMBLY LAYDOWN STORAGE BUILDING (S1009)

AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
W10X33	84	2021.0	32.6
W10X39	12	288.7	5.5
W10X49	2	56.7	1.4
W14X120	28	2021.0	120.4
W14X145	28	2021.0	145.6
W14X159	21	826.8	65.3
W14X30	555	13289.0	197.0
W14X43	25	984.3	20.6
W14X48	2	78.7	1.9
W14X61	19	674.2	20.2
W18X35	56	1364.8	23.6
W36X135	82	4035.4	269.6
W36X150	3	147.6	11.0
W40X149	3	147.6	10.7
W6X15	156	3753.3	27.9
W6X20	23	738.2	7.3
W6X25	1	49.2	0.6
W6X9	92	1097.0	4.9
W8X15	192	4724.4	35.1
W8X24	92	4279.3	50.5
W8X31	75	698.5	10.7
W8X35	107	481.3	8.3
W8X48	12	310.9	7.4
WT10.5X22	4	137.7	1.5
WT5X16.5	4	102.4	0.8
WT6X15	86	615.2	4.6
WT6X48	63	410.5	9.7
WT6X60	105	684.1	20.4
WT7X15	2	68.8	0.5
WT7X17	1	34.4	0.3
WT7X21.5	12	300.4	3.1
WT7X26.5	2	68.8	0.9
WT8X15.5	1	34.4	0.3
WT8X18	3	103.2	0.9
WT8X20	4	137.7	1.4
WT8X25	4	137.7	1.7
WT9X20	5	172.1	1.7
WT9X25	5	172.1	2.1
WT9X27.5	4	137.7	1.9
WT9X30	30	1032.4	15.4
WT9X38	5	172.0	3.2

ITER Task No. 28 Building Design D230B			
ASSEMBLY LAYDOWN STORAGE BUILDING (S1009)			
Sub Total			1148.5
-			
Total tons of girts			69.6
% of est girts to steel			6.1%
Sub Total			1218.1
Est for connections			30.5
% of est connections to steel			2.5%
Total tonnage of steel			1248.6

3.6.9.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1009

	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m<span<=10 m			C12X20.7 For span> 10 meters			
LOCATION	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons	
East Face	88	12	14.72							
West Face	88	12	14.72							
North Face	120	12	20.08							
South Face	120	12	20.08							
Total Tons C8's			69.61	Total Tons C10's			Total Tons C12's			
								Total tons of girts		69.61

* Girt Spacing is at 5 feet o.c.

3.6.9.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Assembly Laydown Storage Building (S1009):

- 04749.05-ES-1009A-3 Structural Plan
- 04749.05-ES-1009B-3 Structural Plan
- 04749.05-ES-1009C-3 Structural Plan
- 04749.05-ES-1009D-3 Structural Elevations
- 04749.05-ES-1009E-3 Structural Elevations
- 04749.05-ES-1009F-3 Isometric View
- 04749.05-ES-1009G-3 Structural Analysis Model
- 04749.05-ES-1009H-3 Structural Analysis Model
- 04749.05-ES-1009J-3 Structural Analysis Model

3.6.9.d Discussion

The member sizes shown on the drawings in Section 3.6.9.c. have been determined by the stress calculations in Attachment A-1.S1009 to be in accordance with the AISC Code.

The dividing line between short and long spans may be defined as the point at which the capacity of the longest rolled shape is exceeded. Since this depends upon the loading, there is no unique definable length. A span of 22 meters falls into this range. For this design, no parametric studies were performed; only a once through analysis was done. A truss was chosen for this 22 meter span since it was clear that a satisfactory design could be accomplished. However, it is possible that a more cost efficient design may be achieved with a heavy rolled section. If a truss were to be utilized, increasing the depth of the truss would likely result in a weight reduction.

The maximum base shear occurred in the north-south direction and is approximately 80 kips, thereby allowing for a simple column base connection.

The maximum in-plane deflection for the roof in the north-south direction is approximately 5 centimeters and in the east-west direction it is approximately 2.5 centimeters. The maximum vertical deflection is 6.6 centimeters, which represents a span to deflection ratio of approximately 330; this is satisfactory.

FLOOR PLAN EL 0 M
SCALE: 1/150

NOTES:
 1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION CONCEPTUAL DESIGN FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED GEA DATE 12-19-45	TITLE STRUCTURAL PLAN		ONE FORM SIZE 1070 x 810 ONE CHL'D S.O.M. T.S.	ITER-EDA NOT FOR PUBLICATION No information on this drawing is to be furnished under any circumstances to any third party unless authorized in writing by the originator. Only the information on this drawing is to be used for the construction of the structure.	
DATE JULY 14, 1946 ANALYST WORTHON		WORK BREAKDOWN STRUCTURE 6.2.N P.L.S. TITLE ASSEMBLY LAYOUT STORAGE BUILDING		NAME OF ORGANIZATION SAN DIEGO J.W.S.	00000000002D0000P		
04749.05-ES-1009A-3		THIRD ANGLE PROJECTION

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 001A

DESCRIPTION ALL DESIGN INFORMATION ONLY USED FOR CONSTRUCTION (SEE TASK NO. 25)		TITLE STRUCTURAL PLAN DATE: JULY 14, 1960 DRAWING NO.: 001A		DATE JULY 14, 1960 DRAWING NO.: 001A		PROJECT WAREHOUSE STRUCTURE 6, 2, N W.O.S., TITLE ASSEMBLY LAYDOWN STORAGE BUILDING SAN DIEGO J.W.S.		ITER-EDA NOT FOR PUBLICATION Any information on this drawing is confidential under the terms of the W.O.S. agreement. Any information given out by unauthorized persons will be held responsible as such.			
TASK TITLE: ITER BUILDING DESIGN (0230-8)		THIRD ANGLE PROJECTION		000000000000200000P		000000000000200000P		000000000000200000P		000000000000200000P

CONCEPTUAL DESIGN PREPARED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		DATE 12-10-75		PROJECT 04749.05-ES-1009C-3	
DESCRIPTION STRUCTURAL PLAN ASSEMBLY LAYOUT STORAGE BUILDING		DATE JULY 16, 1976		PROJECT 04749.05-ES-1009C-3	
DESIGNER J.W.S.		CHECKED J.W.S.		DATE 12-10-75	
SCALE 1/8" = 1'-0"		UNIT METRIC		PROJECT 04749.05-ES-1009C-3	
PROJECT 04749.05-ES-1009C-3		DATE JULY 16, 1976		PROJECT 04749.05-ES-1009C-3	
PROJECT 04749.05-ES-1009C-3		DATE JULY 16, 1976		PROJECT 04749.05-ES-1009C-3

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION OPTUAL DESIGN FOR INFORMATION ONLY BE USED FOR CONSTRUCTION		ACCOUNT GEN DATE 12-19-77		TITLE STRUCTURAL ELEVATIONS		000 FROM SIZE 1070 X 810 000 CHG'S 0.0.0.0 T.O. FIVE OFF		ITER-EDA NOT FOR PUBLICATION Any further work on this drawing by contract under the terms of any other agreement. This drawing shall not be reproduced or copied without the prior written consent of the owner.		
NOC (NOC TASK NO. 76)		TASK TITLE: ITER BUILDING DESIGN (0220-0)		DATE: JULY 16, 1978		WORK DESIGNER: STRUCTURE G-2-N		PROJECT OF ORGANIZATION: SAN DIEGO J.W.S.		
34749.05-ES-1009D-3		NO COPY TASK MEASUREMENTS ARE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000200000P

3 - 3
COLUMN LINE E
SCALE: 1/150

4 - 4
FRAMING TYPICAL FOR COLUMN LINES B THRU
SCALE: 1/150

5 - 5
COLUMN LINE A
SCALE: 1/150

NOTES:
 1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

USBX 13 PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED DATE 12-19-41		TITLE STRUCTURAL ELEVATIONS		SHEET NUMBER 001070 x 810		INTER-EDA PREP FOR PUBLICATION		
TASK NO. 1 172-30-0000 (DOC TASK NO. 20)		TASK TITLE 172 BUILDING DESIGN (0230-0)		DATE JULY 14, 1960		VENDOR BUILDING STRUCTURE 6.2.N		FILE 001070		
DRAWING NUMBER 04749.05-ES-1009E-3		DO NOT SCALE DIMENSIONS USE ONLY DIMENSIONS GIVEN		W.S.S. TITLE ASSEMBLY LAYDOWN STORAGE BUILDING		SAN DIEGO J.W.S.		001000000000200000P		
				THIRD ANGLE PROJECTION

ISOMETRIC VIEW LOOKING NORTH-EAST
SCALE: NONE

ITER TASK 02300

64749.0500.1009.384.00.CS ASSEMBLY LAYDOWN STORAGE BLOC STRU

AISC SECTION	QUANTITY	LENGTH (FT)	TONS (US)
W10X33	84	2020.897	32.647
W10X39	12	208.714	5.329
W10X49	2	56.711	1.371
W14X120	28	2020.897	120.394
W14X145	28	2020.997	145.648
W14X159	21	826.772	65.316
W14X230	333	13289.042	186.934
W14X43	23	984.252	20.627
W14X48	2	78.760	1.834
W14X61	19	674.213	20.210
W18X33	56	1384.829	23.381
W36X135	82	4035.433	260.373
W36X150	3	147.638	10.980
W40X149	3	147.638	10.706
W6X15	156	3783.281	27.924
W6X20	23	738.189	7.306
W6X25	1	48.215	.610
W8X9	92	1067.049	4.896
W8X15	192	4724.409	35.082
W8X24	92	4278.285	50.549
W8X31	75	688.521	10.681
W8X35	107	481.276	8.311
W8X48	12	310.923	7.396
WT10.5x22	6	137.672	1.495
WT5X16.5	4	102.369	.827
WT6X15	86	615.186	4.562
WT6X48	63	410.450	9.738
WT6X60	105	684.083	20.353
WT7X15	2	68.613	.510
WT7X17	1	34.429	.289
WT7X21.3	12	300.386	3.148
WT7X26.5	2	68.613	.896
WT8X15.3	1	34.429	.263
WT8X18	3	103.242	.916
WT8X20	4	137.672	1.363
WT8X25	4	157.672	1.711
WT8X20	3	172.058	1.701
WT8X25	5	172.101	2.127
WT8X27.5	6	137.672	1.881
WT9X30	30	1032.423	15.365
WT9X38	3	172.009	3.244

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIDING GIRT ESTIMATE IS INCLUDED IN THE S.O.M.
PRESENTED IN THE ITR EDA TASK NO. 28 FINAL REPORT.

[illegible]

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

1.3 DESCRIPTION CONCEPTUAL DESIGN FOR INFORMATION ONLY TO BE USED FOR CONSTRUCTION		APPROVED DATE 12-14-94	TITLE STRUCTURAL ANALYSIS MODEL		DRN FRAME SIZE 1070 x 810 DRN CHK'D D.O.M. T.O. FJC GFB	ITER-EDA NOT FOR PUBLICATION	
1.4 TASK TITLE ITER BUILDING DESIGN (0330-8)		DATE JULY 14, 1995	WORK BREAKDOWN STRUCTURE 6.2.N	NAME OF ORGANIZATION SAN DIEGO J.W.S.		The information on this drawing is confidential and shall remain the property of the U.S. Government. No part of this drawing shall be reproduced or transmitted in any form or by any means electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the U.S. Government.	
1.5 DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		BASELINE VERSION W.B.S. TITLE ASSEMBLY LAYDOWN STORAGE BLDG		THIRD ANGLE PROJECTION		00 0000 0000 2D 00 00 00 00	
04749.05-ES-1009G-3							

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3.6.10 Remote Handling Mockup - 6.2.V / S1010

3.6.10.a Building Design Methodology

The Remote Handling Mockup Building (S1010), as shown on the drawings in section 3.6.10.c, is a large clear span building with multi level roofs. The building dimensions are approximately 96 meters in the north-south direction and 60 meters in the east-west direction. The building consists of 12 - 8 meter bays spanning between column lines A & N. The high roof (El 60m) is between column line A & C (north side). The middle roof (El 45m) is between column lines C & L. The low roof (El 10m) is between column lines L & N. Column line C carries the 60m roof over the clear span of the 1.5 line to the 7.5 lines, a 54m span. In-plane stiffness of the roof is furnished by the addition of in-plane diagonal members, thereby providing diaphragm action to carry the transverse wind and seismic loads to the end walls. At the truss locations on the roof, vertical bracing of the exterior walls provides both stability and a load path to carry the wind and seismic loads to the ground.

The building was analyzed as a three dimensional model. A three dimensional stick model was extracted automatically from CATIA (Geometry and Section Properties) and imported into a STAAD input file. Loading and loading combinations are per section 5.3 and U.B.C. respectively. A comparison of seismic loads versus wind loads indicated that wind governs. Snow drift loads (from high to low roof) were considered in the analysis.

Building S1010 has two cranes, a 5-ton crane and a 100-ton crane. The 5-ton crane spans between column lines A & C and travels in the east-west direction. The 100-ton crane spans between column lines 1.5 and 7.5 and travels between col. lines A & L in the north-south direction. The 100-ton crane was positioned to produce the most critical column load at each possible column location. Thus creating 18 independent load cases. The 5-ton crane load was applied to all columns, in its travel path, simultaneously (only 1 load case). This is done conservatively because of the lack of information on the operation of the 5-ton crane when the 100-ton crane is in use, and because of the relatively small values of the loads imposed by the 5-ton crane.

The load combinations are from the 1994 Uniform Building Code (Section 5.1) and the allowable stress criteria is in accordance with the Allowable Stress Design (Section 5.2). A design limit for member selection at 100 percent of the full allowable stresses with respect to dead plus live and

crane load cases. A code allowable stress increase of 33% was used for the wind load combinations.

The building was modeled in CATIA V4R1.3, which is a 3D modeling software product by IBM. A proprietary CATIA/STRUDL interface program (Section 5.4), developed by Stone & Webster Engineering Corporation, was used to extract the analytical model. This program automatically generated the STRUDL input deck containing joint coordinates, member incidences, member properties and the beta angle constants. This file was then electronically transferred into a format compatible with STAAD-III for development of the 3D structural analysis model.

As for STAAD III results, a print of code check, reactions and selective joint displacements is enclosed in attachment A-1.S1010 section 3.

The stress analysis of the Remote Handling Mockup Building (S1010) is given in Attachment A-1.S1010. This attachment provides the design criteria, applied loads and load combinations. Additionally, the STAAD-III input file along with selected output, including the stress level of members is provided. The Remote Handling Mockup Building (S1010) was analyzed as a three dimensional structure. Roof joists spaced, at approximately 2 meters, are provided on the top level of the roof (in the north-south direction EL 45m, east-west at EL 60m), to carry the roof loading to the girders. While the joists were not included in the model (design of these members are addressed in Attachment A-1.S1000), appropriate parameters were included in the STAAD-III structural model to reflect the lateral support provided to the girders. On the lower level of the roof (EL 10m) a single member in the north-south direction affords lateral bracing and self weight support of the diagonals. The building design is basically simple framing, i.e., the beams and girders are connected for shear only and are free to rotate under load. The base of the columns are considered to be pinned connected.

The STAAD III computer code, Section 5.3, was used for the structural analysis. The stresses for each member are investigated at five equally spaced locations along each member and a code check is performed by the program in accordance with Section 5.2. The results of the code check are given in Attachment A-1.S1010, along with selected joint deflections, and base shears for the columns.

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Building Design D230B

REMOTE HANDLING MOCKUP BUILDING (S1010)

AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
L3X3X1/4	100	394.1	1.0
RAIL.60#	10	354.3	3.6
RAIL.175#	14	524.9	15.3
W10X15	79	853.0	6.3
W10X26	6	72.2	0.9
W10X39	4	92.4	1.8
W10X45	42	895.4	19.1
W10X49	6	167.6	4.1
W10X54	8	169.1	4.5
W10X60	14	239.7	6.6
W10X68	42	546.5	18.4
W12X106	4	104.1	5.5
W12X16	84	1181.1	9.3
W12X40	10	341.2	6.7
W12X45	201	5186.2	113.9
W12X53	22	511.3	13.3
W12X58	28	539.9	11.1
W12X65	47	1049.8	33.5
W12X72	39	677.2	24.0
W12X79	37	983.0	38.3
W12X87	5	135.9	5.8
W12X96	4	104.1	4.9
W14X109	16	456.7	24.7
W14X120	8	311.0	18.5
W14X132	32	1568.2	102.6
W14X145	22	1115.5	80.4
W14X159	16	765.1	60.4
W14X176	12	584.6	51.2
W14X193	22	1406.2	135.1
W14X211	22	1154.9	121.1
W14X22	4	39.4	0.4
W14X30	196	5124.7	76.0
W14X38	154	4022.3	75.4
W14X43	18	374.0	7.8
W14X48	2	18.0	0.4
W14X53	2	65.6	1.7
W14X61	11	577.4	17.3
W14X74	2	63.5	2.3
W14X82	24	571.2	23.1
W14X90	10	350.0	15.6
W16X45	4	65.6	1.5

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Building Design D230B

REMOTE HANDLING MOCKUP BUILDING (S1010)

AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (FL.)	(US)
W16X57	1	52.5	1.5
W16X67	20	360.4	12.0
W18X175	7	1240.2	108.0
W18X211	8	1417.3	149.5
W18X60	28	597.1	17.8
W18X65	11	577.4	18.6
W18X71	5	164.0	5.8
W18X86	5	164.0	7.0
W21X44	16	170.6	3.7
W24X104	20	721.8	37.3
W24X76	8	232.3	8.8
W24X84	8	328.1	13.7
W24X94	16	719.2	33.6
W27X84	10	354.3	14.7
W33X130	2	78.7	5.1
W36X150	3	98.4	7.3
W36X182	22	360.9	32.6
W36X300	20	524.9	78.2
W6X15	20	186.2	1.4
W8X15	277	3195.5	23.7
W8X18	34	551.2	4.9
W8X21	60	1023.6	10.6
W8X24	164	2607.6	30.8
W8X28	18	228.2	3.1
W8X31	94	1906.7	27.0
W8X35	311	8022.8	138.5
W8X40	54	1193.7	20.8
WT10.5X28.5	2	84.0	1.2
WT10.5X31	8	149.6	2.3
WT10.5X34	1	42.0	0.7
WT10.5X36.5	20	390.5	7.1
WT10.5X46.5	20	524.9	12.1
WT10.5X55.5	14	375.2	10.4
WT12X27.5	1	42.0	0.6
WT12X42	2	84.0	1.8
WT13.5X73	8	242.3	8.8
WT13.5X89	8	242.3	10.7
WT3X10	11	42.1	0.2
WT4X14	66	255.8	1.8
WT5X11	78	723.8	3.9
WT6X13	37	736.7	4.7

ITER Task No. 28 Building Design D230B			
REMOTE HANDLING MOCKUP BUILDING (S1010)			
AISC	TOTAL	TOTAL	TONS
SECTION	QUANTITY	LENGTH (Ft.)	(US)
WT6X15	18	354.7	2.6
WT6X17.5	2	18.6	0.2
WT6X20	44	924.3	9.0
WT6X22.5	32	672.2	7.4
WT6X25	40	656.2	8.0
WT6X48	66	361.7	8.6
WT7X19	3	63.0	0.6
WT7X21.5	4	84.0	0.9
WT7X24	20	336.4	4.0
WT8X18	28	519.7	4.6
WT8X25	2	61.9	0.8
WT8X38.5	24	504.2	9.6
WT9X38	2	84.0	1.6
WT9X43	28	630.2	13.5
Sub Total			2116.9
Total tons of girts			160.8
% of est girts to steel			7.6%
Sub Total			2277.7
Est for connections			56.9
% of est conn. to steel			2.5%
Total tonnage of steel			2334.6

3.6.10.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1010

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span< =10 m			C12X20.7 For span> 10 meters		
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons
East Face	16	60	12.18						
	64	45	36.84						
	16	10	2.28						
West Face	16	60	12.18						
	64	45	36.84						
	16	10	2.28						
North Face	10	35	4.52	50	35	30.06	24	10	6.16
	6	10	0.86	30	10	5.69			
South Face	10	10	1.43	50	10	9.48			
Total Tons C8's 109.40 Total Tons C10's 45.24 Total Tons C12's 6.16									
Total tons of girts 160.79									

* Girt Spacing is at 5 feet o.c.

3.6.10.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Remote Handling Mockup Building (S1010):

04749.05-ES-1010A-3 Structural Plan

04749.05-ES-1010B-3 Structural Plan

04749.05-ES-1010C-3 Structural Plan

04749.05-ES-1010D-3 Structural Plan

04749.05-ES-1010E-3 Structural Elevations

04749.05-ES-1010F-3 Structural Elevations

04749.05-ES-1010G-3 Structural Elevations

04749.05-ES-1010H-3 Structural Elevations

04749.05-ES-1010J-3 Structural Elevations

04749.05-ES-1010K-3 Structural Analysis Model

04749.05-ES-1010L-3 Structural Analysis Model

04749.05-ES-1010M-3 Structural Analysis Model

04749.05-ES-1010N-3 Structural Analysis Model

04749.05-ES-1010P-3 Isometric View

3.6.10.d Discussion

The final member sizes are shown on Drawings ES-1010A-3 through ES-1010J-3.

Four Analysis drawing ES-1010K-3 through ES-1010N-3 present partial-iso views of the 3D-stick model with member numbers and joint numbers.

ES-1010P-3 presents the 3D solids model and B.O.M.

All the member sizes shown on the drawings in section 3.6.10.c. have been determined by the stress calculations in Attachment A-1.S1010 to be within the AISC code allowable limits.

The maximum vertical deflection for the roof truss is approximately 3.8 inches. This deflection is equivalent to $L/560$ which is satisfactory.

Selected joint displacements along the outer perimeter and through critical sections are reported in A-1.S1010 section 3. The maximum in-plane deflection in the north-south direction is approximately -5.3 inches (A-line, 45m elevation) and in the east-west direction, approximately -2.2 inches at the 60m roof. The maximum vertical deflection is -3.8 inches mid span within the 45m roof truss (F-line).

Max Displacement summary:

West to East

X=+2.17" at joint 2351 EL 50m C & 8 lines

X=-2.2" at joint 2936 EL 60m B & 1 lines

X=-2.27" at joint 2394 EL 50m C & 1 lines

South to North

Y=+3.91" at joint 2101 EL 45m A-4 lines

Y=-4.69" at joint 2373 EL 50m A-5 lines = $1/420$

Y=-5.3" at joint 2074 EL 45m A line mid span between columns 4 & 5

Vertical

Z=-3.84" at joint 2085 EL 45m F line roof truss mid-span
(Roof span = 54m $1/554 = 3.84"$)

Figure 3.10.1 is an elevation of the analytical stick model plotted with the deflected shape for the independent wind load case 300. The displacement is magnified 100 times for added visibility

Although all members are at acceptable stress levels, the above figure shows the flexibility of the end walls (A, C, & L). During the initial phase of this conceptual effort, horizontal stability trusses were added to the building to allow for constructability and needed column splices. After this pre-conceptual analysis, it is apparent that further investigation is required for the horizontal column stability. Do not forget that this figure has amplified displacement 100 times, but additional horizontal trusses would benefit the A line at approximately El 45m, at the C line at El 50. This would greatly reduce horizontal displacement. Alternate method could also be considered. The unique Span of the C line and the high roof adds to this flexibility.

Figure 3.10.1

Also the columns over the door opening on the A line (Ref. ES-1010J-3) would benefit from an additional horizontal truss. This would allow for a field splice and column base

FLOOR PLAN EL 0 M
SCALE: 1/150

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

SHEET NO. 1 OF 1 DESCRIPTION RECONCEPTUAL DESIGN USED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED DATE 1-24-96	TITLE STRUCTURAL PLAN		DWG FRAME SIZE 1070 x 810 DESIGNED BY CKE'D D.C.N. T.O. FAE GFB	ITER-EDA NOT FOR PUBLICATION No alterations to this drawing to be made without the approval of the ITER-EDA. This authorization shall not be given without the approval of the ITER-EDA.	
TASK TITLE ITER BUILDING DESIGN (D230-B)		DATE JULY 14, 1988		WORK BREAKDOWN STRUCTURE 6.2.V BASELINE VERSION W.B.S. TITLE REMOTE HANDLING MOCKUP BUILDING SAN DIEGO J.W.S.			
SR NO.: EP-59-44006 (NOE TASK NO. 38)		TASK NO.: 04749.05-ES-1010A-3		THIRD ANGLE PROJECTION		0000000000200000P

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

ISSUE 1.3 PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED DATE 12-10-78		TITLE STRUCTURAL PLAN		BNC FRAME SIZE 1070 x 810 DMN CHG'D D.O.M. T.O.		ITER-EDA NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the ITER EDA agreement. This information must not be transmitted to anyone who is not authorized to receive it			
TASK NO. ITER-29-40086 (DOC TASK NO. 28)		TASK TITLE: ITER BUILDING DESIGN (D230-8)		DATE JULY 14, 1988 BASELINE VERSION		WERE BREAKDOWN STRUCTURE 6.2.V REMOTE HANDLING MOCKUP BUILDING		SAN DIEGO J.W.S.		THIRD ANGLE PROJECTION	
DRAWING NO. 04749.05-ES-1010D-3		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		0000000000002D0000P---							

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FRAMING TYPICAL (U.O.S.)
FOR COLUMN LINES
1, 2, 7 AND 8 ABOVE EL. 35.3 M.
1, 1.5, 7.5 & 8 ABOVE EL. 35.3 M.
SCALE: 1/150

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION EPTUAL DESIGN FOR INFORMATION ONLY BE USED FOR CONSTRUCTION		APPROVED [Signature] DATE 1-20-46	TITLE STRUCTURAL ELEVATION	DRG FRAM: 312X1070 X 810	ITER-EDA
DATE JULY 14, 1955	WORK RELEASED STEPCIME 6.2.V	FILE EFD	DATE OF OBSERVATION SAN DIEGO J.W.S.	NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the 1947 EDA agreement. This information shall not be transmitted by report and is not to be used in any other way.	
BASELINE VERSION W.B.S. TITLE REMOTE HANDLING MOCKUP BUILDING	DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN	THIRD ANGLE PROJECTION	000000000000	20000000P----	

04749.05-ES-1010E-3

3 - 3
 FRAMING TYPICAL FOR COLUMN LINES 3 THROUGH 6 (U.S.)
 SCALE: 1/150

- NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

DESCRIPTION		APPROVED	TITLE		DRC FRAME SIZE 1070 x 810		ITER-EDA	
PTUAL DESIGN		DATE	STRUCTURAL ELEVATION		DWG		NOT FOR PUBLICATION	
OR INFORMATION ONLY		DATE	DATE MAY 31, 1998		CHK'D		The information on this drawing is confidential	
E USED FOR CONSTRUCTION		DATE	WORK BREAKDOWN STRUCTURE 6.2.V		FJE		under the terms of the ITER EDA agreement.	
TASK TITLE		DATE	W.D.S. TITLE		DATE BY REVISION		This confidential sheet not be transmitted to anyone	
ITER BUILDING DESIGN (0230-8)		DATE	REMOTE HANDLING MOCKUP BUILDING		SAN DIEGO J.W.S.		and is not to be released to anyone	
DO NOT TAKE MEASUREMENTS		DATE	THIRD ANGLE PROJECTION		000000000000200000P----		INTERNATIONAL TECHNOLOGICAL	
USE ONLY DIMENSIONS GIVEN		DATE					EXPERIMENTAL REACTOR	

6 - 6
COLUMN LINE 1
SCALE: 1/150

5 - 5
COLUMN LINE 2
SCALE: 1/150

4 - 4
COLUMN LINE 3
SCALE: 1/150

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

[illegible]

DETAIL A
TYPICAL COLUMN SUPPORT
ALL SIZES AND DIMENSIONS (LATER)
SCALE: 1/50

7 - 7
FRAMING TYPICAL FOR COLUMN LINES D THROUGH K
SCALE: 1/150

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A
 3. ALL CRANE DIMENSIONS CURRENTLY SHOWN ON DRAWING ARE PRELIMINARY.

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. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.		DESCRIPTION CONCEPTUAL DESIGN FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		APPROVED DATE 1/16/10		TITLE STRUCTURAL ELEVATIONS		DATE MAY 31, 1993 WORK BREAKDOWN STRUCTURE 6.2.V V.D.S. TITLE REMOTE HANDLING MOCKUP BUILDING		DATE OF REVISION SAN DIEGO J.W.S.		ITER-EDA NOT FOR PUBLICATION Any information on this drawing is confidential unless the terms of the ITER EDA agreement. This information must not be retransmitted or copied and is not to be used for construction.		INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR	
04749.05-ES-1010H-3		TASK TITLE ITER BUILDING DESIGN (0236-B)		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000200000P		0000000000200000P		0000000000200000P

ISOMETRIC VIEW EL 0 TO 15M LOOKING NORTH-EAST
SCALE: NONE

ISSUE	3	DESCRIPTION
PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		
TASK NO.: ITER-SW-HOORE (DOE TASK NO. 28)	TAS 11E	
DRAWING NUMBER	04749.05-ES-1

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A -

APPROVED 	TITLE STRUCTURAL ANALYSIS MODEL		DAG FRAME SIZE 1070 x 810		ITER-EDA <small>NOT FOR PUBLICATION</small> <small>The information on this drawing is confidential and its use is limited to the ITER EDA agreement. This information must not be disseminated to anyone else in the ITER organization.</small>	
DATE 17-11-90	MOORE BREAKDOWN STRUCTURE 6.2.V		DESIGN FJE	CHECKED GFB		
DESIGN (0230-8)	BASIS W.D.S. TITLE REMOTE HANDLING MOCKUP BLDG	SAN DIEGO J.W.S.		ITER-EDA		
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN	THIRD ANGLE PROJECTION		000000000000200000P----

ISOMETRIC VIEW EL 15M TO 30M LOOKING NORTH-EAST
SCALE: NONE

ISSUE 1.3		DESCRIPTION
PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION		
TASK NO.: 17E2-28-400E (DOE TASK NO.28)	TASK TITLE ITER BUILD	
DRAWING NUMBER 04749.05-ES-101

- NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

APPROVED DATE SIGN (0230-B)		TITLE STRUCTURAL ANALYSIS MODEL		SHEET FRAME SIZE 1070 x 810 DESIGNER CHK'D D.C.H. T.O. FJE CFB		ITER-EDA NOT FOR PUBLICATION The information on this drawing is confidential under the terms of the ITER EDA agreement. First publication must not be permitted by anyone who is not authorized to release it.			
DATE JULY 14, 1988		WORK BREAKDOWN STRUCTURE 6.2.V		SHEET BY SAN DIEGO J.W.S.					
BASELINE VERSION		V.D.S. TITLE REMOTE HANDLING MOCKUP BLDG		THIRD ANGLE PROJECTION		000000000000200000P

ISOMETRIC VIEW EL 30M TO 45M LOOKING NORTH-EAST
SCALE: NONE

ISSUE		DESCRIPTION
3		PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
TASK NO.: ITER-SW-400RE (DOE TASK NO.28)	TASK TITLE: ITER BUILDING	
DRAWING NUMBER		04749.05-ES-1010M

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

APPROVED <i>[Signature]</i>		TITLE STRUCTURAL ANALYSIS MODEL		SHEET FRAME SIZE 1070 x 810		ITER-EDA
DATE JULY 16, 1993		WORK BREAKDOWN STRUCTURE 6.2.V		SHEET SIZE FJE CPD		ITER-EDA			
BASELINE VERSION		V.S.T. TITLE REMOTE HANDLING MOCKUP BLDG		SHEET BY SAN DIEGO J.W.S.		NOT FOR PUBLICATION			
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		00 0000 0000 2D 00 00 P

ISOMETRIC VIEW EL 45M TO 60M LOOKING NORTH-EAST
SCALE: NONE

ISSUE		DESCRIPTION
1	3	PRECONCEPTUAL DESIGN ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION
TASK NO.:	11ER-20-000AC (DOE TASK NO.28)	TASK 11ER 11ER 0011
DRAWING NUMBER	04749.05-ES-101C

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

APPROVED <i>[Signature]</i>	TITLE STRUCTURAL ANALYSIS MODEL		BKG FRAME SIZE 1070 X 810		ITER-EDA		
DATE 7-16-46	WORK BREAKDOWN STRUCTURE 6.2.V		FJE CFB		NOT FOR PUBLICATION		
SIGN (0230-B)	BASELINE VERSION		BASE AT SIGHTING		The information on this drawing is confidential and its use is limited to the project for which it was prepared. This information shall not be distributed to anyone else without the approval of the project manager.		
DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		00 0000 0000 2D 0000 P----

ISOMETRIC VIEW LOOKING NORTH-EAST
SCALE: NONE

JANUARY 29, 1986 15.14.34

ITER TASK D2109

04749.0500.1010.503.00.C\$ REMOTE HANDLING MOCKUP BUILDING STRU

AISC SECTION	QUANTITY	LENGTH (FT)	TONS (US)
L3X3X1/4	100	394.121	.984
RAIL.60	10	354.331	3.584
W10X15	79	833.018	6.289
W10X26	8	72.178	.225
W10X38	4	92.441	1.770
W10X45	42	895.388	19.058
W10X49	8	187.640	4.054
W10X54	8	149.094	4.492
W10X80	14	239.717	6.584
W10X88	42	546.491	18.377
W12X106	4	104.120	3.463
W12X16	84	1181.102	9.516
W12X40	10	341.207	6.655
W12X45	201	5188.178	113.884
W12X53	22	511.288	13.273
W12X58	28	539.928	11.061
W12X65	47	1049.811	33.535
W12X72	39	677.191	23.984
W12X79	37	982.979	38.274
W12X87	5	135.880	5.840
W12X96	4	104.120	4.940
W14X109	18	456.893	24.659
W14X120	8	511.024	18.528
W14X132	32	1588.241	102.620
W14X149	22	1115.488	80.390
W14X159	18	785.092	60.441
W14X178	12	584.646	51.189
W14X193	22	1408.168	135.074
W14X211	22	1154.858	121.122
W14X222	4	39.370	.428
W14X30	188	5124.872	75.932
W14X38	154	4022.310	75.448
W14X43	18	374.018	7.838
W14X48	2	17.998	.424
W14X53	2	85.917	1.708
W14X61	11	577.428	17.309
W14X74	2	83.319	2.321
W14X82	24	571.210	23.080
W14X90	10	390.001	18.579
W16X45	4	85.617	1.465
W16X57	1	52.493	1.485
W16X67	20	580.378	11.979
W18X178	7	1246.137	107.885
W18X211	8	1417.323	149.511
W18X240	28	597.113	17.773
W18X265	11	577.428	18.434
W18X271	5	164.042	5.780
W18X286	5	184.042	7.024
W21X44	18	170.904	3.705
W24X104	20	721.785	37.338
W24X78	8	232.283	8.755
W24X84	8	328.084	13.473
W24X94	18	719.180	33.628
W27X84	10	354.331	14.738
W33X130	2	78.740	8.075
W36X180	3	98.425	7.325
W36X182	22	380.892	32.420
W36X200	20	524.954	78.152
W42X15	20	188.228	1.386
W42X15	277	3193.538	23.716
W42X18	34	551.181	4.863
W42X21	60	1025.022	10.599
W42X24	184	2607.641	30.803
W42X28	18	228.152	3.148
W42X31	84	1808.678	27.049
W42X35	311	8925.305	138.548
W42X40	34	1193.693	20.849
WT10.8X28.5	2	84.031	1.181
WT10.8X31	8	149.647	2.296
WT10.8X34	1	42.015	.709
WT10.8X36.5	20	390.522	7.065
WT10.8X48.5	20	524.872	12.110
WT10.8X58.5	14	375.224	10.382
WT12X27.5	1	42.015	.671
WT12X42	2	84.031	1.251
WT13.8X73	8	242.288	8.784
WT13.8X89	8	242.288	10.710
WT13X10	11	42.110	.208
WT4X14	88	255.751	1.764
WT5X11	78	723.810	3.946
WT6X13	37	736.487	4.745
WT6X16	18	354.652	2.630
WT6X17.5	2	18.559	.182
WT6X20	44	924.336	9.014
WT6X22.5	32	872.244	7.381
WT6X25	40	836.168	8.026
WT6X48	68	381.686	8.581
WT7X19	3	83.023	.881
WT7X21.5	4	84.031	.881
WT7X24	20	336.415	3.881
WT8X18	28	519.659	4.612
WT8X25	2	81.903	.789
WT8X38.5	24	504.183	9.639
WT8X38	2	84.031	1.588
WT8X43	28	830.228	13.493

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

REVISION	DATE	TITLE	ITER-EDA	
05-ES-10103-3	1-29-76	ISOMETRIC VIEW	ITER-EDA	
DATE: JULY 14, 1980		WORK DESCRIPTION: STRUCTURE 6.2.V	ITER-EDA	
DRAWING VERSION		REMOTE HANDLING MOCKUP BLDG	ITER-EDA	
TASK TITLE: ITER BUILDING DESIGN (R238-8)		THIRD ANGLE PROJECTION	ITER-EDA	
DO NOT TAKE MEASUREMENTS		DO NOT TAKE MEASUREMENTS	ITER-EDA	

3.6.11 Auxiliary Building - NBI Power Conversion - 6.2.E / S1011

3.6.11.a Building Design Methodology

The Auxiliary Building - NBI Power Conversion (S1011) is a single floor steel structure. This building is similar to the Auxiliary Building - Magnet Power Supply Switching Network in that it also has eight bays in the east-west direction of 10 meters each. In the north-south direction there are four spans of 12.5 meters as opposed to the five bays of 11 meters for the Auxiliary Building - Magnet Power Supply Switching Network. The Auxiliary Building - NBI Power Conversion is a one floor structure, 12 meters high, while the second story of the Auxiliary Building - Magnet Power Supply Switching Network is 11 meters.

Consequently, for this design the member sizes for the Auxiliary Building - NBI Power Conversion are the same as the second story of the Auxiliary Building - Magnet Power Supply Switching Network. This is true except for the roof girders in the north-south direction.

Since the Auxiliary Building - NBI Power Conversion is smaller in height than the Auxiliary Building - Magnet Power Supply Switching Network, the wind loads and consequently the member sizes are conservative.

ITER Task No. 28 Building Design D230B			
NBI POWER CONVERSION BUILDING (S1011)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (FL)	TONS (US)
W12X53	36	1290.2	33.5
W14X43	184	6036.7	126.5
W14X90	21	826.8	36.8
W14X99	24	944.9	46.4
W24X68	16	524.9	17.7
W24X94	8	328.1	15.3
W33X141	28	1148.3	80.4
W8X24	32	1312.3	15.5
WT10.5X55	4	210.1	5.8
WT10.5X66	2	105.0	3.4
WT13.5X47	1	52.5	1.2
WT6X17.5	11	288.9	2.5
WT9X25	1	52.5	0.6
WT9X38	1	52.5	1.0
WT9X43	2	105.0	2.2
Sub Total			389.0
Total tons of girts			65.7
% of est girts to steel			16.9%
Sub Total			454.7
Est for connections			11.4
% of est connections to steel			2.5%
Total tonnage of steel			466.1

3.6.11.b (cont.)

Bill of Materials for Siding Girts
BUILDING S1011

LOCATION	C8X11.5 For spans 8 meter or less			C10X15.3 For 8 m< span<=10 m			C12X20.7 For span> 10 meters			
	L (m)	H (m)	Tons	L (m)	H (m)	Tons	L (m)	H (m)	Tons	
East Face							50	12	15.06	
West Face							50	12	15.06	
North Face				80	12	17.81				
South Face				80	12	17.81				
Total Tons C8's			Total Tons C10's			35.62	Total Tons C12's			30.12
Total tons of girts									65.74	

* Girt Spacing is at 5 feet o.c.

3.6.11.c Building Structural Drawings - Final Issue (11" x 17")

The following drawings are for the Auxiliary Building - NBI Power Conversion (S1011):

04749.05-ES-1011A-3 Structural Plan

04749.05-ES-1011B-3 Structural Plan

04749.05-ES-1011C-3 Structural Elevations

04749.05-ES-1011D-3 Isometric View

3.6.11.d Discussion

Refer to 3.6.11.a above.

- NOTES:
1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A

E 3 DESCRIPTION CONCEPTUAL DESIGN USED FOR INFORMATION ONLY TO BE USED FOR CONSTRUCTION		APPROVED 	TITLE STRUCTURAL PLAN		SHEET FRAME SIZE 1070 x 810 SHEET NO. 010 SHEET DATE 010	ITER-EDA NOT FOR PUBLICATION THE INFORMATION ON THIS DRAWING IS UNCLASSIFIED UNLESS THE OWNER OF THE ITER OR ITS SUCCESSORS THIS INFORMATION SHALL NOT BE TRANSMITTED TO ANYONE WHO IS NOT AUTHORIZED TO RECEIVE IT		
DATE JULY 14, 1988		WORK BREAKDOWN STRUCTURE 6.2.E		BASELINE VERSION W.S.S. TITLE NBI POWER SUPPLY BUILDING		SITE OF ORGANIZATION SAN DIEGO J.W.S.		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN
TASK TITLE: ITER BUILDING DESIGN (0230-B)		THIRD ANGLE PROJECTION		0000000000002D000000P				

ISSUE	PRECED	ISSUED	11/28/88	11/28/88	11/28/88
11/28/88	11/28/88	11/28/88	11/28/88	11/28/88	11/28/88
11/28/88	11/28/88	11/28/88	11/28/88	11/28/88	11/28/88

ROOF PLAN EL 12.1

1 - 1
FRAMING TYPICAL FOR COLUMN LINES 1 AND 9
EXCEPT AS NOTED
SCALE: 1/150

2 - 2
FRAMING TYPICAL FOR COLUMN LINES 2 THROUGH 8
SCALE: 1/150

3 - 3
FRAMING TYPICAL FOR COLUMN LINES A AND E
EXCEPT AS NOTED
SCALE: 1/150

4 - 4
FRAMING TYPICAL FOR COLUMN LINES B THROUGH D
SCALE: 1/150

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A

3		DESCRIPTION		APPROVED		DATE		16-30-45		100	
CONCEPTUAL DESIGN		FOR INFORMATION ONLY		DO NOT BE USED FOR CONSTRUCTION		DATE		16-30-45		100	
TASK TITLE:		ITER BUILDING DESIGN (0230-8)		TASK TITLE:		ITER BUILDING DESIGN (0230-8)		TASK TITLE:		ITER BUILDING DESIGN (0230-8)	
04749.05-ES-1011C-3											
TITLE		STRUCTURAL ELEVATIONS		DOE FRAME SIZE 1070 x 810		DOE		ONE" B		D.O.W. T.O.	
DATE		JULY 14, 1998		WORK BREAKDOWN STRUCTURE 6.2.L		FJE		478			
BASELINE VERSION		W.S.S. TITLE		NAME OF ORGANIZATION		SAN DIEGO J.W.S.					
DO NOT TAKE MEASUREMENTS		USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000		20000000		P---	
ITER-EDA		NOT FOR PUBLICATION		The information in this drawing is confidential and the name of the ITER EDA program. This information must not be transmitted in any way other than as authorized by the ITER EDA program.		ITER-EDA		NOT FOR PUBLICATION		ITER-EDA	
ITER-EDA		NOT FOR PUBLICATION		The information in this drawing is confidential and the name of the ITER EDA program. This information must not be transmitted in any way other than as authorized by the ITER EDA program.		ITER-EDA		NOT FOR PUBLICATION		ITER-EDA

OCTOBER 30, 1995 08.48.19

ITER TASK 02308

04749.0500.1011.501.00.00 NBI POWER SUPPLY BUILDING STRU

AISC SECTION	QUANTITY	LENGTH	TONS
V12X53	36	1290.236	33.495
V14X43	184	6036.745	126.513
V14X90	21	826.772	36.802
V14X99	24	944.682	46.351
W24X68	16	524.934	17.730
W24X94	6	328.084	15.340
W33X141	28	1148.294	80.360
WBX24	32	1312.336	15.502
WT10.5X55	4	210.076	5.801
WT10.5X56	2	105.036	3.449
WT13.5X47	1	52.519	1.222
WT6X17.5	11	288.055	2.521
WT9X25	1	52.519	.649
WT9X38	1	52.519	.990
WT9X43	2	105.038	2.249

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A
3. SIDING GIRT ESTIMATE IS INCLUDED IN THE B.O.M. PRESENTED IN THE ITER EDA TASK NO. 28 FINAL REPORT.

ISOMETRIC VIEW
LOOKING NORTH-EAST
SCALE: NONE

DESCRIPTION ITER BUILDING DESIGN (02308-0)		DATE 12-14-95		TITLE ISOMETRIC VIEW		SHEET NO. 001070 x 810		ITER-EDA		
TASK TITLE ITER BUILDING DESIGN (02308-0)		DATE JULY 14, 1990		PROJECT NBI POWER SUPPLY BUILDING		SHEET NO. 001070 x 810		SAN DIEGO J.W.S.		
NO. 253		DO NOT SCALE DIMENSIONS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		001000010000200000P		001000010000200000P		
5-ES-1011D-3										

3.6.12 RF Heating Power Conversion Building -6.2.J /S1012

3.6.12.a Building Design Methodology

The RF Heating Power Conversion Building (S1012) is a two floor steel structure with an approximate floor plan of 45 x 110 meters. The long dimension of the building is orientated parallel to the east-west direction of the site. The structural elements of this building are shown on the drawings in Section 3.6.12.c.

The building has twelve (12) transverse frames running in the north-south direction and spaced at 10 meters. A typical transverse frame has five (5) spans from elevation 0.00 to elevation 6.00: 1) four (4) spans at ten (10) meters each (between column lines A - B - C and D - E - F); 2) one (1) span at five (5) meters (between column lines C - D). Above the elevation 6.00 meters the columns located in lines B and E disappeared and the frame has only three (3) spans: 1) two (2) spans at twenty (20) meters each (between column lines A - C and D - F); 2) one (1) span at five (5) meters (between column lines C - D). The roof of the building is located at elevation 21.00 meters.

The RF Heating Power Conversion Building has two (2) industrial cranes with a lifting capacity of 20 tons each, spanning over each one of the twenty (20) meter bays. The cranes geometric requirements and the loads induced by them are detailed in Sections 3.3 and 3.4.

From a structural point of view, the RF Heating Power Conversion Building is designed and analyzed using the methodology discussed in Section 3.1. The typical transverse frame is a perfectly symmetrical steel structure with the lower portion, from elevation 0.00 to elevation 6.00, more rigid than the upper portion. The columns are considered as fixed at the concrete floor. The cross-section of the columns varies with the elevation. The columns located on lines A, C, D and F, are heavier and support the industrial cranes. At the first floor level they have a constant cross-section and are realized from a W33x201 steel profile. The cross-section of the same columns located on the second floor level changes twice: first, above elevation 7.00 meters where a W 33x118 is used and second, above elevation 15.30 meters with a W 27x84. The typical corbels (W 24x76) are attached at elevation 15.30 meters to support the rail and crane girder. The shorter columns, located on lines B and E, at the first floor level only, have a W 33x118 constant cross-section.

The horizontal component of the frame at the roof level is composed of a planar-symmetrical truss system. On the lateral spans the truss, generically denoted "Truss B", is made of two parallel W 16x36 cords (in the connection panels a W 16x50 is used), nine W 6x9 vertical members and ten pairs of MC 6x15.1 diagonal members. "Truss C", located in the central area of the transverse frame, has two very strong W 24x76 cords and two pairs of MC 6x15.1 diagonal members. A W 24x76 horizontal member is located in the central span at elevation 15.30 meters. The concrete and steel floor, located for structural reasons at elevation 6.00 meters, is supported by the steel girder generically denoted "Girder A". This structural element is moment connected into the adjoining columns and has a variable cross-section. At the locations near the column connection a much stronger W 33x201 is employed. In the center of the ten (10) meter spans the cross-section is realized by a W 30x116 steel profile. In the central span, between column line C and D, the girder has a constant cross-section using a W 33x116. The typical transverse frame is designed with the intention of creating a rigid central core capable of taking the majority of the horizontally acting forces (wind and snow). The vertical loads are carried exclusively by the lateral portion of the frame.

Taking advantage of the perfect symmetry of the structure, one typical frame was created in the longitudinal direction and placed along the center line of the columns on lines A, C, D and F. This frame has a longitudinal "K" type vertical bracing system which is located near the roof level. It is realized from pairs of WT 3x7.5 steel members. Two rigid portals are placed along each column line. The bracing located at the first floor level is typically 2 WT 4x33.5. The bracing located above the 6.00 meter elevation is lighter being a 2WT 4x15.5. The horizontal beams making up the typical longitudinal frame are 2C 12x25 which are located at all the elevations above 6.00 meters and 2C 15x50 at the floor elevation. All the horizontal members are considered hinge connected into the adjoining columns.

The bracing system for the roof is designed using WT 5x11 steel members. All are considered truss elements in the structural analysis. Three repetitive type structural elements (roof purlins, floor joists and the crane supporting structure) are employed in the RF Heating Power Conversion Building. The roof has a number of typical W14x48 purlins. The crane girders are designed as indicated in Section 3.5.1. These crane girders are W 27x146 for each of the 20 ton cranes.

The structural analysis using the STAAD III computer code is detailed in the Attachment A-1.S1008. The attachment provides all the pertinent information regarding the applied load magnitudes, load combinations

used and design parameters required for code checking calculations. All the calculations were performed in accordance with the AISC Code.

The analysis shows that the maximum horizontal displacements are 1.459 inches for the transverse frame and 0.135 inches for the longitudinal frame. This is acceptable.

Using the geometric requirements provided by the JCT and the sizes resulting from analysis for all the structural steel members, a final three-dimensional CATIA V4R1.3 generated model was created. The two-dimensional drawings were created from the three-dimensional model. A bill of material was automatically extracted from the model and is included in Section 3.6.8.b.

ITER Task No. 28 Building Design D230B			
RF AUX HEATING POWER CONVERSION BUILDING (S1012)			
AISC SECTION	TOTAL QUANTITY	TOTAL LENGTH (Ft.)	TONS (US)
C12X25	120	3937.0	49.0
C15X50	118	4112.0	102.4
MC6X15.1	506	3961.2	29.3
W12X25	88	2887.1	35.9
W12X40	44	1443.6	28.2
W14X48	220	7217.8	176.1
W16X36	48	2519.7	43.6
W16X50	108	826.8	20.6
W24X76	72	664.1	24.5
W24X84	220	7217.8	304.3
W27X146	44	1443.6	103.6
W27X84	48	897.6	37.3
W30X116	60	1108.1	63.8
W33X118	72	1700.4	99.1
W33X201	122	1691.2	168.8
W6X9	216	1131.8	5.1
W8X31	35	2238.8	34.2
WT3X7.5	176	3130.4	11.6
WT4X15.5	96	2003.9	15.3
WT4X33.5	32	774.8	12.9
WT5X11	116	4065.3	22.2
SubTotal			1387.7
Total tons of girts			138.8
% of est girts to steel			10.0%
Sub Total			1526.5
Est for connections			38.2
% of est conn. to steel			2.5%
Total tonnage of steel			1564.7

3.6.12.c Building Structural Drawings - Final Issue (11"x17")

The following drawings are for the RF Auxiliary Heating Power Conversion Building:

04749.05-ES-1012A-3	Structural Plans
04749.05-ES-1012B-3	Structural Sections
04749.05-ES-1012C-3	Isometric View

the structural analysis model drawings are included in the Attachment A-1.

3.6.12.d Discussion

The RF Heating Power Conversion Building is a perfectly symmetric structure and was designed in accordance with the methodology discussed in Section 3.1. No special structural problems were encountered. The typical transverse frame is designed with the intention of creating a rigid central core capable of taking the majority of the horizontally acting forces (wind and snow) . The vertical loads are carried exclusively by the lateral portions of the frame.

FLOOR PLAN ELEVATION 0.00 M

SCALE 1/300

CRANE PLAN ELEVATION 17.00 M
(TOP OF RAIL 16.14 M)

SCALE 1/300

- NOTES:
1. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED.
 2. FOR GENERAL NOTES, SEE DRAWING 1001A.
 3. THE LONGITUDINAL PURLINS C 12X25 AND JOISTS C 15X50 PLACED IN PAIRS SHOULD BE BRACED TOGETHER EVERY 1.5 M

ISSUE 31		DESCRIPTION		APPROVED		TITLE		DIN FRAME SIZE 1070 x 810		ITER-EDA	
PRECONCEPTUAL DESIGN		ISS		DATE		DATE DECEMBER 01, 1995		DN		NOT FOR PUBLICATION	
ISSUED FOR INFORMATION ONLY		DATE		DATE		DATE		DN		NOT FOR PUBLICATION	
NOT TO BE USED FOR CONSTRUCTION		DATE		DATE		DATE		DN		NOT FOR PUBLICATION	
TASK NO. 1		TASK TITLE:		V.B.S. TITLE		NAME OF ORGANISATION		NAME OF ORGANISATION		NAME OF ORGANISATION	
ITER-SM-4008E (ODE TASK NO. 28)		ITER BUILDING DESIGN (0230-B1)		RF HEATING POWER CONVERSION BLDG		SAN DIEGO J.V.S.		SAN DIEGO J.V.S.		SAN DIEGO J.V.S.	
DRAWING NUMBER		04749.05-ES-1012A-3		DO NOT TAKE MEASUREMENTS		THIRD ANGLE PROJECTION		0000000000		2000000P

NOTES:

1. ALL DIMENSIONS IN millimeters UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES, SEE DRAWING 1001A.

ISSUE 3	DESCRIPTION	APPROVED	TITLE		END FRAME SIZE 1070 x 810	ITER-EDA NOT FOR PUBLICATION No information on this drawing is to be released under any terms of the ITER-EDA agreement. This information shall not be transmitted to others nor be used to reproduce it.				
PRELIMINARY DESIGN (ISSUED FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION)		ISS	STRUCTURAL PLANS AND ELEVATIONS		DN			CHK'D	D.G.M.	T.O.
TASK NO.: ITER-SM-4000E (CODE TASK NO.26)		DATE 12/01/95	DATE: DECEMBER 01, 1995		ISS			ISS	NAME OF ORGANISATION SAN DIEGO J.W.S.	
TASK TITLE: ITER BUILDING DESIGN (0230-B1)			WORK BREAKDOWN STRUCTURE 6.2.E		V.D.S. TITLE RF HEATING POWER CONVERSION BLDG					
DRAWING NUMBER 04749.05-ES-1012B-3		DO NOT TAKE MEASUREMENTS USE ONLY DIMENSIONS GIVEN		THIRD ANGLE PROJECTION		0000000000		200000P---

4. Conclusions and Recommendations

4.1 Conclusions

This Report contains a detailed structural description of all of the ITER Project's "steel-frame on concrete slab" buildings. The work was done by U.S. ITER Consortium members, Raytheon Engineers and Constructors and Stone & Webster Corporation. The supportive collaboration of the JCT - San Diego JWS personnel was essential to the successful completion of the work.

Starting with the first meeting on May 18, 1995 and throughout completion of the work, a continuous stream of technical information was successfully transmitted between parties. The significant portion of data transfer was done electronically.

An important part of the task was the functional description and evaluation of the industrial cranes. From the information available at the present time, additional data is necessary to identify all the crane lifting and geometric requirements. Service requirements must also be better defined in order to assign the correct crane classification as required by CMAA specification.

Despite the magnitude of the design loads and the unusual dimensional requirements of some of the buildings, the technical solutions detailed in this Report show viable and economical configurations developed in accordance with international practice and United States building codes. The design process evolved around the three-dimensional modeling capability of CATIA software. This approach created a better understanding of the structural conditions and facilitated electronic exchange between parties. It will also permit easier future structural modifications (as dictated by the evolution of other discipline requirements). The CATIA data-base was used to automatically provide the structural steel material take-off for all buildings.

In conclusion, the initial design of the twelve "steel-frame on concrete slab" buildings was a very focused and successful effort.

4.2 Recommendations

It is recommended that the ITER "steel-frame on concrete slab" building design process continue for the following reasons:

- The initial structural design satisfies the task requirements, however, little time was available to look into structural options or to optimize the existing solutions. Additional work in these areas will result in more cost-effective designs.

-
- Design of building services in conjunction with architectural and civil requirements is necessary to increase the accuracy of cost estimates and provide realistic construction schedules.
 - Once the building functions are established, a parallel building design which includes continuous interface with the process design will lead to economical solutions such as sharing utilities, space, support and penetrations.
 - The building services design should consider the entire set of ITER Buildings. It will be economical to use common utilities (water, electric, gas, etc.) and design features.

5. References

The following are referenced in the previous sections of this report:

1. Building Design Conditions for Task B of 230 (1995, May 18th), ITER JCT.
2. The 1994 Uniform Building Code (UBC).
3. The Ninth Edition of the American Institute of Steel Construction (AISC).
4. Building Code Requirements for Reinforced Concrete, American Concrete Institute (ACI) 318 (Revised 1992).
5. STAAD III/ISDS Computer Program - Version 20, Research Engineers, Inc., Orange CA, Run on Gateway 2000, P5-90, SWEC Work Station No. 001.0190.
6. SWEC CATIA/STRUDL Interface Extraction Program, ST403 Ver/Level 00/00.
7. Crane Condition for Design Task D230 - B, E-Mail from E. Tanaka to Postmaster, Dated 5/25/95.
8. Specification for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes, GMAA Specification #70, Latest Edition.
9. Harnischfeger - P&H, Crane Manufacturer, Milwaukee, WI, USA.
10. American Crane & Equipment Corporation - ACECO, Cranes & Hoists, Douglassville, PA.