FIGURE 7.2

PROCEDURE CHANGE NOTICE (PCN)

PCN No. 01

1. AFFECTED PROCEDURE

   a. Number 2IM-5.02-CND Revision 2

   b. Title Conduit and Conduit Support Design

2. RECOMMENDED CHANGE(S)

   a. Description/Justification for change(s):

      See page 2

   b. Is backfit required as a result of change(s): [X] Yes [ ] No
      (If yes explain) See Page 2

   c. List other procedures affected by change(s): None

   d. Originator/Extension D. Pandya Date 08/13/92

3. PAGE REPLACEMENT INSTRUCTIONS

   a. Remove Existing Pages (specify): 8, 11, 14, 15, 17, 18, 23, 24, 32, 42, 45, 46, 51, 55, 58, 66, 67, 70, 77, 125, 140, 147, 176, 180, 185, 188

   b. Insert New/Revised pages (specify): 8, 11, 14, 15, 17, 18, 23, 24, 32, 42, 45, 46, 51, 55, 58, 66, 67, 70, 77, 125, 140, 147, 176, 180, 185, 188
      Place PCN-01 in front of main text.

4. APPROVAL

Responsible Department Manager(s):

Andres Noriega [signature] / 8/18/92
Date

D. C. Mangha [signature] / 8/18/92
Date

C. M. Abercrombie [signature] / 8-18-92
Date

RMB [signature] / 8/18/92
Date

/
Date

Issue Date: 08 / 18 / 92

Effective Date: 08 / 18 / 92

2a. Continued

Description of Changes

1. Clarifications and corrections of typographical errors.
2. Correction of Prying Factors in Attachment 8.B.
3. Use of maximum allowables for air drops and flexible conduit lengths in lieu of actual lengths.

Justification for Changes

1. No justification required.
2. No backfit required per calculation 0218-CO-0418, Revision 0.
3. Backfit required. Review of issued designs required to determine impact.

TU ELECTRIC

COMANCHE PEAK ENGINEERING

UNIT 2

CONDUIT AND CONDUIT SUPPORT DESIGN

JOB 0217

JOB 0218

D C PANDYA (signature) 7/16/91
Preparer Date

C. G. PUGH (signature) 7/16/91
Design Verification Date

Concurrence:

RMR/ (signature) 7/16/91
TU Electric Date

G. L. ASHLEY (signature) 7.17.91
Approval Date

Issue Date: 07/17/91

Effective Date: 07/22/91

RECORD OF REVISIONS

REVISION 0:

Original issue.

REVISION 1:

Revision was made to provide a complete technical criteria for the design validation of Unit 2 conduit systems. No revision bars are shown for clarity. There is no impact on previous work and no backfit is required.

REVISION 2:

Revision was made to directly incorporate the technical criteria for the design validation of Unit 2 conduit systems in one document rather than by referencing other criteria documents. Revision was also made to address the Pre-Engineered Standard Design (PESD) series of S2-0910 drawing and provide guidelines for the preparation of conduit isometrics and drawings.

This is a major revision to this procedure. No revision bars will be shown for clarity.

There is no impact on previous work and no backfit is required.

TABLE OF CONTENTS

COMANCHE PEAK ENGINEERING

CONDUIT AND CONDUIT SUPPORT DESIGN

1.0 PURPOSE

The purpose of this procedure is to provide guidelines and criteria to be used in the analysis and design of the Unit 2, Class 1E and/or associated Class 1E as well as Non-Class 1E specified to be seismically supported by Specification CPES-E-2004 (all referred to as Train A and B), and Non-Class 1E (referred to as Train C), conduit systems and supports at the Comanche Peak Steam Electric Station.

This procedure implements the use of the referenced TU Electric Unit 1 documents for use by ABB Impell Civil/Structural Raceways Group. The latest revision of all referenced documents is applicable in their entirety with the addition of any clarifications denoted herein.

2.0 APPLICABILITY

The procedure applies to all engineering activities for Unit 2 Trains A, B and C at CPSES with the following clarifications:

All Unit 2 conduit systems required to support Unit 1 operation, as specified in Project Technical Reports PTR-01 and PTR-02, are excluded from the scope of this Procedure.

Unit 2 conduit systems in the Unit 1 and common areas (Unit 2 Recommended Scope) have already been qualified by Ebasco Services under a separate contract with the exception of approximately eighty conduits as listed in EBASCO letter number 2CECO-0132. For the Unit 2 Recommended Scope conduit systems, this procedure shall be applicable to those activities in support of the installation of modifications identified, the validation of those aforementioned conduits, and any miscellaneous closure activities.

The project control and procedural interface requirements are provided in Procedure 2IM-2.00.

The design documents generated under this procedure shall specify the applicable revision of all reference documents as required by the Impell QA manual procedure QP-3.1. In the event that any of the reference documents have been or are in the future revised, the Project Engineer or his designee shall review the revised reference document for potential impact and backfit, if required, of the approved/issued design document.

The installation specification for conduits and conduit supports are CPES-E-2004 and CPES-S-2005.

3.0 REFERENCES

3.1 REFERENCE SPECIFICATION & DRAWINGS

The following sub sections list all the documents from which most of the technical information is derived and specified for this document. Some of these documents, e.g. codes and standards, FSAR sections, DBDs and USNRC Regulatory guides are governing documents. Documents referenced in Miscellaneous Documents are mostly documents used or prepared by TU Electric's contractors while they were responsible for the design of the conduit system. Some specific

information contained in these miscellaneous documents may no longer be applicable and therefore shall not be considered as conflicting with this procedure.

S-0910 and S2-0910 are series of generic drawings for conduit systems. S-0910 series drawings are applicable to Unit 1 and common areas, while S2-0910 are applicable to Unit 2. In addition there are S2-0910 PESD (Pre-Engineered Standard Design) drawings series applicable to both Units. Within S-0910 or S2-0910 there are various suffixes (e.g. LS or JA series) which form a group of drawings pertaining to specific criteria. All these groups of drawings give some specific design (pre-engineered and pre-qualified) criteria for conduit span configurations and their support details. However, if any component of conduit systems do not meet the generic criteria specified in these drawings, then specific evaluations must be made, as described in this Procedure, to determine their acceptability.

3.1.1 CODES AND STANDARDS

The specific codes, standards and regulations identified below have been used for establishing the design basis for conduit and conduit support design.

3.1.2 APPLICABLE CODES

AISC American Institute of Steel Construction, 7th Edition Including Supplements No. 1, 2 and 3.

AISI American Iron and Steel Institute, Cold-Formed Steel Design Manual, 1968 Edition.

AWS D1.1-79	American Welding Society, Structural Welding Code
AWS D1.3-81	American Welding Society, Structural Welding Code
ACI - 318 - 71	American Concrete Institute, Building Code Requirements for Reinforced Concrete
ACI - 318 - 63	American Concrete institute, Building Code Requirements for Reinforced Concrete
ANSI C80.1	Underwriter Laboratory UL-6
WW-C-581d	Federal Specification
AWS A5.1 Class E-70XX	American Welding Society, Structural Welding Code

3.1.3 APPLICABLE USNRC REGULATORY GUIDES

Regulatory Guide 1.29, February, 1976	Seismic Design Classification
Regulatory Guide 1.61, October 1973	Damping Values for Seismic Design of Nuclear Power Plants
Regulatory Guide 1.89, February 1974	Qualification of Class 1E Equipment for Nuclear Power Plants

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Regulatory Guide 1.92, February 1976	Combining Modal Responses and Spatial Components in Seismic Response Analysis
NUREG 0800 July, 1981	Standard Review Plan for the Review of Safety Analysis Reports of Nuclear Power Plants

3.1.4 TU ELECTRIC PROCEDURES AND SPECIFICATIONS

STA-302	Station Records
2EP-5.08	Procedure for Preparation, Approval and Control of Project Calculations
2EP-2.04	Evaluating Unit 1 Post Construction Hardware Validation Program (PCHVP) Results for Applicability to Unit 2
2EP-5.17	Reporting Attachment Loads Information to Civil Engineering
ECE-3.26	Design Engineering Organization Statistical Sampling Plan
ECS-5111	Train C Two Inch Diameter and Smaller Conduit and Conduit Support Design
CQP-EL-122	Installation and Fabrication of Conduit Raceway Systems
CPES-S-2001	Structural Embedments
CPES-E-2004	Electrical Installation
CPES-S-2005	Electrical Raceway Installation
CPES-S-1032G	Floor Response Spectra
CPES-M-2032	**Procurement and Installation of Fire Barrier and Fireproofing Materials**

3.1.5 LICENSING DOCUMENTS FOR COMANCHE PEAK STEAM ELECTRIC STATION

3.1.5.1 Final Safety Analysis Report (FSAR)

The following FSAR sections delineate the commitment pertaining to electrical conduit raceways and the conduit supports:

a. Section 3.2, Classification of Structures, Components and Systems.

b. Section 3.7B, Seismic Design.

c. Section 3.8, Design of Category I Structures.

3.1.6 DESIGN BASIS DOCUMENTS

DBD-CS-90	Conduit and Conduit Support Design Train A, B, and Greater Than Two Inch Diameter Train C Conduits
DBD-CS-19	Building and Secondary Wall Displacements
DBD-CS-15	The Qualification of Embedments In Concrete

DBD-CS-81	General Structural Design Criteria
DBD-CS-92	Seismic Design Parameters and Response Spectra Generations
DBD-CS-93	Seismic Adequacy of Train C conduits (2" Diameter and less)
DBD-CS-111	Conduit and Conduit Support Design

3.1.7 DRAWINGS

S2-0910	Generic Supports Drawing Series for Unit 2 (includes individual sheets as listed on S2-0910 Sh. TC-1 Table of Contents and Sh. PESD-I-A Table of Contents).
S-0910	Generic Supports Drawing Series for Unit 1 (includes individual sheets as listed on S-0910 and Sh. TC-1 Table of Contents)
2323-S-0786	Reinforced Concrete Typical Details and Additional Miscellaneous Details Drawing
2323-E1-1800	Materials List

3.1.8 MISCELLANEOUS DOCUMENTS

SAG.CP10, Ebasco Design Criteria for Seismic Category I Electrical Conduit System

SAG.CP12, Ebasco Design Criteria for Junction Boxes for Seismic Category I Electrical Conduit Systems - Unit 2

SAG.CP17, Ebasco Design Criteria For Junction Boxes For Seismic Category I electrical Conduit System

SAG.CP20, Ebasco Technical Guidelines For System Analysis of Conduit Span Configurations

SAG.CP21, Ebasco Technical Guidelines For Thermal Analysis of Seismic Category I Electrical Conduit System

SAG.CP25, Ebasco Technical Guidelines For Seismic Category I Electrical Conduit Isometric Validation

SAG.CP29, Ebasco General Instructions For Design Verification of Electrical Conduit and Box Supports

SAG.CP35, Ebasco Procedure For Conduit Isometric Design Validation Package Close-Out

SAG.CP2, Ebasco Design Criteria for Seismic Category I Electrical Conduit System - Unit 2

CP-SG.02, Ebasco Technical Guidelines for Seismic Category I Electrical Conduit System - Unit 2

CPE-EB-FVM-CS-002, Design Control of Electrical Conduit Raceways

CPE-EB-FVM-CS-014, Design Control of Electrical Conduit Raceways for Unit 2 Installation in Unit 1 and Common Areas

CPE-EB-FVM-CS-033, Design Control of Electrical conduit Raceways For Unit 1 Installation In Unit 1 and Common Areas

CPE-EB-FVM-CS-056, Design Control of Modifications to Electrical Conduit System in Unit 1 and common Areas

Ebasco Program 2616, User's Manual for Preprocessor of ANSYS Program for Base Plate Analysis, May 1981

Ebasco Calculation Book No. 8 entitled "Electrical Conduit and Box Supports (Support and Span Verification Procedure)"

2-EAP-003, Engineering Assessment Procedure, Unit 2 Conduit Commodities

2-EAP-022, Evaluation of Seismic Category I and II Concrete Embedments and Embedment Plates

QA Manual, ABB Impell Quality Assurance Manual, Revision 18

CCL Report No. A-699-85, Conduit Clamp Test Report, Phase I, dated 12/17/85

CCL Report No. A-702-86, Conduit Clamp Test Report, Phase II, dated 4/7/86

CCL Report No. A-678-85, Seismic Qualification Test Report of Conduit Support systems, Volumes I and II, dated 10/9/85

Anchor Bolt Shear and Tension Stiffness by Teledyne Engineering Services, May 25, 1979

Ebasco Interoffice Memo JPP-86-299, dated November 7, 1986

ABB IMPELL Corp. Calculation No. M-27 Rev. 2, dated 5/5/87, entitled "Thermal Load Evaluation"

Ebasco Calculation Book No. 151, Rev. 1, dated 5/15/87, entitled "Conduit Concrete Embedment Requirement at Penetration" (Sh 9 of 33)

Ebasco Calculation Book No. Supt-0235

TRW (Nelson Stud Welding DIV.) letter from H.A. Chambers to H.S. Yu of Ebasco Services dated 5/20/87

Hilti Fastening System, Inc., File No. H2189-S1, Report No. 8784 dated 1/30/74

Ebasco Calculation Book No. Span 1200, Rev. 0, dated 10/11/87, entitled "Generic Study on Revised Clamp Allowable"

General Engineering Catalog No. 10, Unistrut Building System, 1983

Framing Channel and Pipe Hangers, Superstrut Inc., 1974

Nelson Standard In-Stock Stud Catalog TRW Nelson Division, 1985

Test Report #C-36-A, "Pipe or Conduit Clamps P-2558", Unistrut Corporation dated 5/13/77

Ebasco Interoffice Memo SAGTUG 1.9818 dated December 15, 1987

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Ebasco Calculation Books Span-1002 and Span-1003, "Seismic Spectrum Loading Data Base - 2% and 3%; 4% and 7% Damping"

Ebasco Documentation CP-JB-20, "Grouping of Electrical Seismic Category I Junction Boxes"

Ebasco Documentation CP-JB-21, "Enveloping of Seismic Design Spectra" for Electrical Seismic Category I Junction box Analysis

PD STRUDL Users Manual.

Ebasco Documentation CP-JB-27, "Documentation of STRUDL Input Parameters", for Seismic Design of Electrical Seismic Category I Junction Box Analysis

2IM-2.00, Civil/Structural Project Control and Procedure Interface Instructions

Electrical Conductor Seal Assemblies (ECSAs), Specification No. EC-28 (IMT-2445, Dated July 9, 1987 from Impell Corporation to R. Iotti, Ebasco)

Ebasco Calculation Book No. Supt-0040

Ebasco Calculation Book No. Supt-0231

Ebasco Calculation Book No. EB-CSC-2X-08

Ebasco Calculation Book No. AS-006

Ebasco Calculation Book No. Span-0003

Ebasco Calculation Book No. Span-1012

Ebasco Calculation Book No. Span-1206

Assessment of Conduit Clamps Installed with A-307 bolts, CPSES, By Ebasco Service Inc., May 16, 1989

PTR-01, Unit 2 Support for Unit 1 Electrical/Controls

PTR-02, Unit 2 Required to Support Unit 1

2CECO-0132, Ebasco Letter from George H. Krauss to J. Nandi, dated July 19, 1989, "Unit 2 Recommended Conduit Scope"

QAS-92-073, QA Surveillance Report

ATP-87-01, TU QA Audit Report

ATP-88-112, TU QA Audit Report

ABB Impell Calculation No. 0218-CO-0252

ABB Impell Calculation No. 0218-CO-0006

ABB Impell Calculation No. 0218-CO-0007

ABB Impell Calculation No. 0218-CO-0026

4.0 DEFINITIONS

<u>Generic Support</u>

A generic support is a support which conforms to typical details given in Drawing Series No. S2-0910 or Drawing Series No. S-0910.

Modified Support

A modified support is a support which has minor deviations from typical details given in Drawing Series No. S2-0910 or Drawing Series No. S-0910.

Individually Engineered ("IN") Support

An individually engineered (IN) support does not conform to typical details given in Drawing Series No. S2-0910 or Drawing Series No. S-0910 and is analyzed on a case-by-case basis. It is an unique support designed for specific location and conditions.

P-Delta STRUDL

A finite element structural analysis program which analyzes structures and determines member stresses, and performs code compliance checks.

ISO

Three dimensional isometric drawing of a conduit run showing various pertinent features of the system. Common supports (those which restrain two or more conduits) will be shown on more than one ISO. One ISO will be designated the "primary" ISO drawing. The primary ISO will document the qualification of the common support considering all attached conduit. Remaining ISOs will be designated "secondary" ISOs.

Conduit Drawing

A drawing in a tabular form which specifies all the required inspection attributes including the conduit size, origin, destination, configuration and conduit supports.

LBD

Conduit fitting used to provide a pull point at a 90° bend.

BC

Conduit fitting used to provide a pull point within a straight span.

New Concrete Embedment

A concrete embedment on a conduit or junction box support installed post August 31, 1987.

Existing Concrete Embedment

A concrete embedment on a conduit or junction box support installed on or prior to August 31, 1987.

5.0 RESPONSIBILITIES

Civil/Structural Project Engineer

Responsible for ensuring that personnel assigned to the conduit project comply with this procedure. Reference to the Unit 2 Civil/Structural Project Engineer is equivalent to the ABB Impell Project Manager.

Raceways Lead Discipline Engineer

Responsible for the implementation of this procedure. Reference to the Unit 2 Raceways Lead Discipline Engineer (LDE) is equivalent to the ABB Impell Raceways Project Engineer.

Engineers and Lead Engineers

Engineers and Lead Engineers are responsible for conformance with this procedure.

Engineers shall perform calculations and prepare drawings in accordance with Procedure 2IM-2.00.

6.0 INSTRUCTIONS

6.1 TRAIN A AND B CONDUITS

Train A and B conduit raceways carry electrical cables essential to the safe shutdown of the plant. Therefore, the raceways and associated junction boxes and supports must be capable of withstanding the postulated loads without impairing their performance requirements. Train A and B conduit general design criteria is included in Design Basis Document DBD-CS-090.

Compliance with the performance requirements of trains A and B conduit systems is accomplished by verifying the structural integrity of the conduit system due to the combined dead weight, thermal loads, wind loads, tornado loads and seismic loads. All supports are multidirectional, designed to resist the seismic or wind induced load in three directions. The analytical procedure described hereafter is used to determine loads and structural member stresses. The resulting loads and stresses are then compared to allowables as defined by hardware manufacturers or by applicable codes.

Hand calculations and engineering evaluations may be performed for the design validation of Train A and B conduit systems that do not meet the requirements of Drawings S2-0910 or S-0910.

6.1.1 EVALUATION OF CONDUIT SYSTEM

All Components of a conduit system need individual evaluation for their adequacy. All these components can be evaluated by comparison with generic details/criteria given in S2-0910 & S-0910 series drawings. In the instances when actual values exceed the criteria stipulated in S2-0910 or S-0910 series drawings, this section provides a methodology to re-evaluate these components.

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6.1.1.1 Design Of The Conduit System

Conduit raceway system consists of specific components like clamps, conduit spans, conduit supports, junction boxes and junction box supports. These components need to be designed to their specific design criteria and then, as a system, meet all the functional and technical criteria, stated in this procedure.

6.1.1.2 Evaluation Of Conduit Span

The span evaluation process consists of selecting a generic LS-Series Drawing No. S-0910 (for Unit 1) and LS Series or PESD Series drawings from drawing No. S2-0910 (for Unit 2) that shows a configuration similar to the span being evaluated, and comparing actual spans with allowable spans given in the LS-Series Drawings.

Whenever a conduit changes direction and terminates in an air drop or flex conduit with no support provided between the bend and the air drop and a coupling is present before the conduit bends, the unsupported portion of the conduit may place a torsional moment at the coupling during a seismic event. The inability of the coupling to resist the torsional moment could result in excessive motions at the free end of the conduit. Motions in these free end configurations would then be resisted by the cables. Neither the cables nor the terminations have been specifically designed for the loads imposed by such motions. Therefore, in such cases, additional supports or modification to the existing supports are needed to compensate for the conduit overhang.

Unit 2 conduits bridging across secondary and primary walls shall be evaluated in a fashion similar to the evaluation performed for Unit 1 conduits in EBASCO Calculation SPAN-0003. Unit 1 lessons lea ned shall be utilized to the extent possible.

6.1.1.2.1 Selection Of Conduit Span Configuration

The following shall be considered in the selection of conduit span configuration:

a. A bend less than or equal to 15° may be treated as a straight span.

b. Spans associated with T-condulet fittings shall be treated the same as spans associated with LBD fittings.

c. For S-0910 conduit systems, use allowable spans with BC fittings for the allowable spans with unions.

d. Maximum allowable air drop and flexible conduit lengths per Specification CPES-E-2004 shall be used. If flex conduit length less than the maximum is used, this conduit shall be incorporated in drawing S2-0910 Sh. FLEXL.

6.1.1.2.2 Comparison Of Actual To Allowables Spans

The following shall be considered in the comparison of actual to allowable conduit spans:

a. Span tolerance of +/-3" need not be considered for evaluating spans, supports loads and/or conduit frequency.

b. For LS series drawings, bends shown for conduit runs are schematic only (unless otherwise noted); bends may vary from 15° + to 90°.

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c. The maximum spacing between supports shall not exceed the S1 maximum dimension shown on sheet LS-2 series of Drawing No. S2-0910 and sheet LS-5 series of Drawing No. S-0910 for supports installed in accordance with drawings S2-0910 and S-0910 respectively.

d. For multiple conduit runs of different diameters on common supports, the conduit(s) with the most stringent criteria shall govern the spans and shall be compared accordingly.

e. The minimum number of supports on a run of conduit which enters or exits a supported or unsupported junction box, shall be in accordance with Drawing No. S2-0910 or Drawing No. S-0910.

f. Use the minimum allowable span length among all elevations for conduit runs which may be supported at more than one elevation.

g. If as-built span configuration deviates or exceeds allowable, custom evaluation shall be made per Section 6.1.9 of this procedure or ISO can be conservatively evaluated using 1.5 x Peak "g".

6.1.1.3 Evaluation of Existing Conduits

Existing conduits are those issued for construction during or prior to 1987. Existing Train A and B conduits with completed calculations were issued prior to termination of Unit 2 work in 1987. Since then, all the efforts were put on the completion of Unit 1 work. During this effort, issues and concerns came up through external and internal audits as well as other activities. These issues and concerns were resolved for Unit 1 conduits but not for Unit 2 completed calculations. A review of licensing documents (i.e., SDARs, CARs. CDFs, etc.), TAP audits (ATP-87-01 & ATP-88-112), Project Status Report (PSR), Unit 1 procedures, Unit 2 procedures and Unit 1 lessons learned has been performed. As a result of this review, a checklist of all the items with a potential impact on the existing calculations was generated and is included in Attachment 8.L. These completed calculations shall be design validated by using any or a combination of the approaches presented in Section 6.3 of this procedure. A suggested design validation flow chart is included in Figure 7.40.

Calculation 0218-CO-0252 design validates the existing Ebasco calculations. The calculation also provides guidelines for future use of the Ebasco calculations. These guidelines shall be followed when any information from the Ebasco calculation is used.

For the population of existing Unit 2 Train A and B conduits with incomplete calculations, a suggested design validation flow chart is shown in Figure 7.41. This approach is based on a screening and/or a sampling process. The guidelines presented in Section 6.3 of this procedure shall be followed to the extent possible.

A review of Unit 2 outstanding audits ATP-87-01 and ATP-88-112 indicates that there are walkdown discrepancies between some Unit 2 drawings and as-built conditions. This issue shall be investigated and evaluated if deemed necessary. Evaluation shall be done in accordance with the applicable requirements of Section 6.0 of this procedure.

Existing Unit 2 conduit system in Unit 2 areas have been installed per the S2-0910 series drawing. Existing Unit 2 conduit systems in the Unit 1 and common areas have been installed per the S-0910 series of drawings.

6.1.1.4 Design of New/Modified Conduit Systems

New Train A and B conduit systems shall, in general, be routed per the S2-0910 PESD series of drawings. The PESD series drawings are based on the criteria provided in this procedure. A conduit drawing, as shown in Figure 7.42, shall be prepared for the conduit systems routed per the PESD series drawings. General guidelines to prepare the drawings are included in Attachment 8.K. If required, the S-0910 and S2-0910 series drawings may also be used to route new conduits. In this case, an isometric drawing shall be prepared per the general guidelines provided in Attachment 8.J. Exceptions may be justified on a case-by-case basis.

When an existing conduit run is reworked (e.g. partially rerouted, or support modified), it should be designed using the design series drawings (S-0910 or S2-0910) used for the initial routing or completely qualified using the PESD series drawings. Exceptions may be justified on a case-by-case basis.

6.1.2 CALCULATION OF CONDUIT LOADS (L_L AND L_T)

6.1.2.1 Conduit Loads

a. The determination of Conduit Loads, L_L and L_T for all the supports shall be per "LS" series of Drawing No. S2-0910 or S-0910. If conduit configuration is not contained in LS series of S2-090 drawings but is covered by LS-series dwg of S-0910 then the equations to compute L_L & L_T from drawing S-0910 (and vice-versa) can be used.

b. For double bend configurations, the calculated L_L and L_T loads shall not be less than the contributory weight of 1/2 the span plus all fittings in the entire span.

c. When L_L & L_T cannot be determined from standard span configurations shown on S-0910 or S2-0910, L_L & L_T shall be taken as sum of half the span of conduit on either side of the referenced support and further analyzed by equivalent static method to determine the load on the support.

d. The conduit loads for the first two supports from the supported junction box shall be calculated by considering the conduit between the junction box and the adjacent support as an overhang. This method does not account for the junction box stiffness. This results in conservative loads on the two adjacent supports. For an unsupported junction box, the weight of junction box shall be lumped at the end of the overhang.

There are some cases where the conduit going into the junction box is supported by one or two supports. In these cases, the conduit system shall be evaluated as follows:

1. Support loads shall be conservatively hand calculated by ignoring the junction box stiffness. The total conduit loads (including weights for components such as flexible conduit and fittings) shall be lumped at each support. Otherwise, system analysis shall be performed.

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2. Conduit spans shall be evaluated by considering the in-plane stiffness of the junction box plate. This means that the junction box shall be treated as a restraint in the lateral directions of the conduit. Conduit spans shall be compared to the conduit span allowables presented in Drawings S2-0910 or S-0910. Otherwise, hand or computer calculations shall be performed.

e. The term L_{ADJ} used in the L_T formula for a support represents the conduit load from the adjacent span to the support being evaluated.

f. Conduit load imposed on a supported junction box is equal to half the span to the first support times the weight of conduit(s) entering the box.

g. The wind load effects on conduit systems located outside of the buildings have been generically evaluated in Calculation Book Span-1206 and it concluded that all generic conduit, conduit supports and junction boxes are adequate. The effect of the tornado and tornado related loads on conduit systems located outside of the buildings shall be evaluated on a case by case basis as required, See Section 6.1.10.1.

h. **Air drop and flexible conduit lengths as specified in Section 6.1.1.2.1(d) shall be used.**

6.1.2.2 Additional Conduit Weight Considerations

In addition to the weight of conduit and cables the following additional weight due to the items given below shall be considered in the evaluation of L_L & L_T.

6.1.2.2.1 Firewrap (Thermoblanket)

Firewrap (thermoblanket) may be serving the function of separation barrier and/or radiation energy shield for the conduits (see Specification **CPES-M-2032**).

For thermoblanket, the dry weight only shall be considered in load combinations having OBE or SSE effects. The wet weight shall be considered for dead load without OBE and SSE effects.

For unit weight of thermoblanket, refer to Specification **CPES-M-2032**. These unit weights do not include the conduit and cable weights.

If the exact dimensions on the extent of firewrap coverage are not **available** extend the firewrap to the adjacent support on either end of firewrap shown. If airdrop is partially or fully covered with firewrap, use 4' - 6" length to determine the firewrap weights.

Any conduit run covered by firewrap shall be evaluated **to account for the additional weight.**

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6.1.2.2.2 Thermolag

Thermolag may be serving the function of separation barrier and/or radiation energy shield for the conduit.

a. For unit weight of thermolag refer to specification CPES-M-2032.

b. If the exact dimensions on the extent of thermolag coverage are not available extend the thermolag to the adjacent support on either end of thermolag shown. If airdrop is partially or fully covered with thermolag, use 4' - 6" length to determine the thermolag weight.

Any conduit run covered by thermolag shall be evaluated to account for the additional weight.

6.1.2.2.3 ECSA Evaluation

Electrical Conductor Seal Assembly (ECSA) is mounted on the conduit system to protect the cables from the environment. ECSA itself is qualified by Specification No. EC-28. The peak "g" values used for the qualification of ECSAs and the component weights for ECSAs are given in Figure 7.25.

6.1.2.2.4 Bisco Seal Evaluation

A bisco seal is a "foam rubber type" fireproof substance. It is used to fill a block out in a concrete slab or wall.

The conduit is not supported by the bisco seal and the bisco seal does not contribute any load to the conduit.

6.1.2.3 Load Factors

a. The load factors for various configurations, buildings and elevations are listed in Figure 7.38. NOTE: The load factors listed in Figure 7.38 apply to supports installed to the requirements of S-0910 drawing series. Load factors for supports installed to the requirements of S2-0910 drawing series are not required per Calculation 0218-CO-0006. Unless RSM analysis is performed per Section 6.1.13 or conditions described below are met, these load factors shall be used to multiply the conduit loads (L_L and L_T) obtained in Section 6.1.2 to design verify the adequacy of the conduit support.

b. Under the following condition, the Load Factor need not be applied:

If the conduit system which includes conduit, and conduit supports and junction box supports, is designed by the seismic acceleration of 1.5 times the peak "g" values, from response spectrum curves.

6.1.3 CLAMP EVALUATION

a. Conduit clamps shall be design validated for dead load plus SSE loads based on the conduit safety class, clamp type, bolt or stud size and the material of the fasteners used in clamp.

(1) Trains A and B Conduit Systems

o The following equations shall be satisfied for all clamp connection details except when A-307 or unidentifiable bolts are used in clamp or when 3/8" Ø Nelson studs are used with C-708-S clamps:

$$\frac{T}{Ta} \leq 1.0$$

$$\frac{V}{Va} \leq 1.0$$

$$\frac{L}{La} \leq 1.0$$

where:

T,V,L, — Calculated clamp loads in the transverse, vertical and longitudinal directions.

Ta, Va, La — Clamp allowable loads in the transverse, vertical and longitudinal directions.

Dead weight shall be added by absolute sum to the appropriate seismic load direction. The clamp allowable given in Figures 7.1.1 thru 7.1.10 are for both OBE and SSE load conditions based on test results. The L direction is parallel to the conduit longitudinal axis. For the definition of V & T direction, see Figure 7.2.

o The following equation shall be satisfied for C-708-S clamp with 3/8" Ø Nelson studs or UNISTRUT bolts:

$$\frac{D}{Da} + \sqrt{\left[\frac{L}{La}\right]^2 + \left[\frac{T}{Ta}\right]^2 + \left[\frac{V}{Va}\right]^2} \leq 1.0$$

where D — Dead weight of conduit at clamp

D_a — The allowable clamp load in the direction of dead weight of conduit which is either L_a, T_a or V_a.

L, T, V — Conduit seismic loads in the longitudinal, transverse and vertical directions.

L_a, T_a, V_a — Clamp Allowables in the longitudinal, transverse and vertical directions.

The clamp allowables L_a, T_a, V_a are given in Figures 7.1.1 thru 7.1.10.

- o When clamps are used with A-307 or unidentifiable bolts, the clamp axial allowables shall be reduced to the percentage given below:

  1) 33% of full axial allowable for 1/4" ϕ bolts
  2) 37% of full axial allowable for 3/8" ϕ bolts
  3) 60% of full axial allowable for 1/2" ϕ bolts

b. Clamps shall be evaluated in accordance with Part "a" using the calculated L_1 and L_T and appropriate "g" values. The appropriate "g" values are defined as follows:

   1. In the vertical direction (dead load direction), appropriate "g" value = 1 + g_{max}

   2. In the other directions, appropriate "g" value = g_{max}

   The g_{max} is the maximum "g" value of three component "g" values obtained from the design "g" value table specified in Figures 7.3.1 through 7.3.7. If the conduit system is analyzed by RSM analysis, and the orientations of conduit and supports are known, "g" values can be obtained directly from RSM analysis in each appropriate direction. Also, for conduit systems validated by the seismic acceleration of 1.5 times the peak "g" values, the 1.5 peak "g" values from each appropriate direction can be used.

   Figures 7.4.1 and 7.4.2 specify the size of studs and bolts to be used in conjunction with the clamp allowables. If clamp is not adequate, replace clamp by one with a higher capacity.

c. Clamps in secondary ISO shall not be evaluated in secondary ISO calculation package. These clamps shall be evaluated during the design validation of common supports and included in the primary ISO calculation package. In secondary ISO calculation package, reference shall be made to the primary ISO calculation package for clamp evaluation. When a new conduit system is designed in accordance with the requirements of PESD series of S2-0910 drawings, clamps shall be evaluated along with the conduit evaluation whether it is primary or secondary.

d. Clamp allowables using Unistrut bolts are applicable to clamps with Unistrut type member.

e. Clamp allowables using Hilti bolts are applicable to both HKB and HSKB.

f. Clamp allowables using Nelson studs are also applicable to clamps with A325 and/or A449 bolts.

6.1.4 SUPPORT EVALUATION

For "IN", modified and generic conduit support, the following procedure per SAG.CP29 Section 6.3 shall be used to evaluate bolt hole edge distance and bolt stresses, and to account for the oversized bolt hole effects.

a. Bolt Hole Edge Distance

For connections with more than two (2) bolts, the oversized bolt hole effect need not be considered if the "As-Built" dimensions from center of bolts to free edges (edge distance) meet the edge distance requirement specified in Table 1.16.5 of the AISC Specification (7th Edition).

For two (2) bolt connections, the worst edge distances to free edges of structural member or plate shall be computed as follows:

$$d_w = d - e$$

where: d_w = Worst Edge Distance (From centerline of bolt to nearest free edge)

d = "As-Built" Edge Distance (From centerline of bolt to nearest free edge)

e = Permissible Bolt Hole Oversize Based on Statistical Evaluation are shown below. (Bolt Hole Dia - Bolt Dia)

The minimum d_w shall be considered in the design validation of support.

BOLT DIAMETER (INCH)	BOLT HOLE OVERSIZE (e) (INCH)
3/8	3/16
1/2	3/16
5/8	1/8
3/4	3/16
1	3/8
1 1/4	3/8
1 1/2	3/8

If calculated d_w is equal to or greater than the minimum edge distance specified in Table 1.16.5 of the AISC Specification (7th Edition), the "As-Built" edge distance is acceptable.

For cases where above requirements (as applicable) are not met, the worst edge distance shall be checked to assure that the shear stress in the net section of the connecting part produced by bolt shear load is less than 0.3 Fu. Fu is 58 Ksi for A36 steel.

b. Bolt Stresses for Bolts in Steel to Steel Connections

Allowable bolt stresses for bolts used in steel to steel connections shall be calculated considering the connection as a bearing connection with threads in the plane of shear.

Bolts subjected to combined shear and tension loads shall satisfy the interaction formula specified in AISC Specification, Section 1.6.3.

In calculating the shear in bolts for two bolt connections, the total shear force parallel to an axis common to both bolts (excluding shear due to torsion on the connection which is applied to both bolts) shall be considered as acting on one (1) bolt only.

c. Bolt Stresses for Bolts in Steel to Concrete Connections

Bolts subjected to combined shear and tension shall satisfy the interaction formula specified in Design Basis Document DBD-CS-015 and Specification CPES-S-2001.

In two bolt connections, the total shear force parallel to an axis common to both bolts (excluding shear due to torsion on the connection which is applied to both bolts) shall be considered as acting on one (1) bolt only. However, if the shear ratio (actual shear divided by allowable shear) is less than or equal to 0.25, the oversized bolt hole effect need not be considered.

Attachments to embedded plates shall be evaluated per the requirements provided in Drawing 2323-S-0786. Otherwise, send to the Civil/Structural Group for approval.

6.1.4.1 Support Design Loads

a. Support design loads shall consist of calculated conduit loads L_1 and L_T and weight of shim and/or filler plates. Use CSD-Series drawings of Drawing No. S-0910 and S2-0910 or Figures 7.5.1 through 7.5.2c to calculate weights of standard shim and filler plates when as-built dimensions are not available. Oversize shim and filler plate weights must be calculated per as-built conditions.

b. Use the smaller support capacity from the top and bottom elevations when the support is located between two different elevation groups. For additional clarification, see Figure 7.6.

6.1.4.2 Generic Supports

a. For generic supports, support design loads must be compared directly with the capacity of the particular generic support for appropriate building and elevation.

1. If support loads are within the capacity given in Drawing No. S2-0910 or Drawing No. S-0910 the support is adequate.

2. If calculated loads are larger than the support capacity, custom system evaluation per Section 6.1.13 can be made.

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b. For support analysis using STRUDL computer analysis, see Section 6.1.16.1.

c. Unit 2 CSM-2a-II type conduit supports, carrying 2" ϕ thru 5" ϕ conduits, shall be design validated by assuming 3/8" ϕ Hilti Kwik bolts. This applies to all isometric drawings with revision 0 issued prior to November 6, 1986. For those supports issued after this date, note 4 on S2-0910, sheet CSM-2A-II, Revision 5, shall apply.

6.1.4.3 Modified Supports

A modified support is a support which has minor deviations from typical details given in Drawing No. S2-0910 or Drawing No. S-0910. Modified supports may be design verified by comparison to the generic support by hand calculations provided that all corresponding members and attributes which impact the capacity of the support can be demonstrated to be more conservative than those used for the generic support to meet frequency requirements and acceptance criteria.

6.1.4.4 Individually Engineered (IN) Support

An individually engineered (IN) support is a support which does not conform to typical details given in Drawing No. S-0910 or Drawing No. S2-0910. An IN support shall, in general, be evaluated using STRUDL Computer Analysis per Section 6.1.16.

6.1.4.5 Common Supports

a. When verifying a common support (generic, modified or IN support), loads must be taken from all the conduits supported. Only primary ISO design shall contain calculations for the common support. Secondary ISOs will contain computation for span adequacy, **clamps** and conduit loads L_L and L_T and shall refer to the specific support number and the primary ISO calculation for the structural adequacy of the common support. When a new conduit system is designed in accordance with the requirements of PESD series of S2-0910 drawings, clamps shall be evaluated along with the conduit whether it is primary or secondary.

b. RSM analysis does not need to be performed for all conduits supported by the common support. RSM analysis may be done for the selected conduit or conduits as required. The support must also satisfy the minimum frequency requirement if all conduits are not analyzed by RSM analysis.

6.1.4.6 Frequency Requirements

All conduit and junction box supports shall meet the minimum frequency requirements of 14.45 Hz for S2-0910 supports, 16 Hz for PESD series supports of S2-0910 and as contained in Figure 7.23 for S-0910 supports with consideration of base plate flexibility.

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a. For generic supports which do not meet the minimum frequency requirement, allowable weight of attached conduit (capacity) may be reduced until the frequency requirement of the support is met.

b. For modified and IN supports which do not meet the minimum frequency requirement.

1. Re-evaluate all primary and secondary ISOs attached to that support using the actual support frequency.

OR

2. Modify the support to meet the minimum frequency requirements.

c. A recommended computer input skeleton has been prepared to perform the frequency analysis using the STRUDL program (See Attachments 8.D and 8.E).

6.1.4.7 Longitudinal Load Distribution

Based on Unit 1 design validation experience, documented in EBASCO Calculation AS-006, and similarities in generic support details included in S2-0910 and S-0910 drawing series, it can be concluded that longitudinal load distribution has no significant impact on design of conduit supports. Therefore, longitudinal load distribution due to relative support stiffness need not be considered in the design validation of Unit 2 conduit supports.

6.1.4.8 Rotation Of Design "g" Values

Unless the RSM analysis is performed to determine the actual "g" values and the support orientation is known, the support has to be designed in accordance with the design "g" values given in Figures 7.3.1 through 7.3.7. The design "g" values in each direction shall be rotated to envelope all conduit orientations.

When the actual support orientation is known, the 'g' values need not be rotated if:

1. **1.5 times peak 'g' values are used, or**
2. **design 'g' values from Calculation 0218-C0-0007 are used, or**
3. **'g' values from the appropriate response spectra curves are used.**

6.1.4.9 Evaluation Of Embedment Length For Areas With Floor Topping

For areas with a 2 inch floor topping, embedment length of bolt as measured/calculated from the top of the topping, shall be reduced by 2 inches in design of the support.

To locate areas with 2 inch floor topping, refer to Figure 7.17.

To calculate the "Embedment Length" of bolt, the following formula shall be used:

Embedment length = length of bolt - bolt projection length + nut thickness.

"Embedment length" is the length of Hilti-Kwik bolt extending below the surface of structural concrete prior to setting (tightening).

6.1.4.10 Material Properties

a. Rigid conduit shall conform to ANSI C80.1 and WW-C-581d.

$E = 29 \times 10^6$ psi

$F_y = 25$ ksi

b. The design weight (including cable weight) and sectional properties (per standard weight pipe properties of AISC American Institute of Steel Construction for various conduit sizes are listed in Figure 7.18.

c. Welding electrode shall conform to AWS A5.1 Class E-70XX.

$F = 58$ ksi

d. Concrete 28-day compressive strength shall be 4000 psi having a specific weight of 141 pcf.

e. The modulus of elasticity of concrete shall be 3.46×10^6 psi.

f. Nelson studs shall be CPL or CFL type manufactured by TRW Nelson Division.

$F_y = 50$ ksi

g. Hilti Kwik and Super kwik bolts shall be as manufactured by Hilti Fastening Systems.

h. Unistrut bolts shall be manufactured by Unistrut Corporation and conform to SAE J429 Grade 2, $F_y = 58$ ksi or ASTM A-307, $F_y = 36$ ksi.

i. Richmond inserts shall be as manufactured by Richmond Screw Anchor Co., Inc.

j. Conduit clamps are as manufactured by Unistrut Corporation or Superstrut Inc.

k. Structural steel shall conform to ASTM A-36.

l. Structural tubing (square and rectangular shapes) shall be ASTM A-500 Grade B.

$E = 29 \times 10^6$ psi

$F_y = 46$ ksi

6.1.5 EVALUATION OF JUNCTION BOX CAPACITY AND JUNCTION BOX SUPPORTS

6.1.5.1 Junction Box Design Loads

a. The conduit connections to the junction boxes shall be designed for the applicable load combinations in Section 6.1.10. Figure 7.19 lists the threaded conduit sectional properties and Figure 7.20 provides the conduit to junction box locknut details for connection calculations. The junction box shall be considered adequate if the conduit load on the junction box does not exceed capacity as shown in JA & JS Series drawings of Drawing No. S-0910, or JS-series drawings of Drawing No. S2-0910.

b. The design of the junction box support shall consider the weight of the junction box including its content, conduit and support members. The weight of junction box including its contents and the conduit weight imposed on junction box shall be lumped at the C.G. of box.

   The junction box support shall be considered adequate if the total load on the support does not exceed support capacity of JA-Series and JS-Series drawings of Drawing No. S-0910, or JS-series drawing of Drawing No. S2-0910.

   Further analysis shall be performed when load capacities are exceeded or the junction box does not meet the generic drawing requirements.

c. The weight of contents inside junction box shall be assumed equal to 10 lbs/ft times the largest dimension of junction box.

d. Conduit loads imposed on junction box are equal to one half of the total conduit weight between junction box and the adjacent conduit support and shall be used for the design of junction box support only.

e. For the supported and unsupported boxes, the connection shall consider all forces from the computer analysis. Actual forces/stresses shall be compared to specified code and/or manufacturers allowables.

f. Conduit capacity for the support design of smaller junction boxes can be obtained as follows (smaller junction box has each of its dimensions (L, W and D) equal to or smaller than the corresponding dimension of the junction box from which the conduit capacity of small junction box is derived):

   1. When the anchor bolt location of the junction box support is not affected by junction box size, such as single cantilever type for JS Series:

      New conduit capacity for the smaller junction box size can be obtained conservatively by adding the difference of weight between maximum junction box size and smaller junction box size to the conduit capacity corresponding to the maximum junction box size.

2. When the anchor bolt location of the junction box support is affected by junction box size, such as distance between two MC3 channels shown on JA-12 of drawing S-0910, the conduit capacity for the smaller junction box size can be calculated conservatively as follows:

   a) Add conduit capacity to the corresponding maximum size junction box weight to get total weight (W_T).

   b) Calculate adjusted Wt. $W_A = W_T \times \frac{d\ SML}{d\ MAX}$

      Where:

      d SML and d MAX = Distance between two anchor points for smaller and maximum size junction Box respectively.

   c) The conduit capacity corresponding to the smaller junction box size can be obtained by subtracting the smaller junction box weight from adjusted weight.

3. For evaluation of Non-Nuclear Safety Related Seismic Category II junction box, if it is shown that the conduit lines entering and exiting the junction box do not fail and that the conduit and conduit supports can carry the weight of junction box without catastrophic failure, then this is sufficient to conclude that the junction box will not fail.

For loads and load combinations, see Section 6.1.10.

6.1.5.2 <u>Seismic Inputs</u>

a. Generic Case

In the typical generic case, the seismic loads imposed upon the junction box (from the interfacing conduits) are determined by considering the conduit support flexibility and the flexibility of the junction box conduit interface.

1. The weight of junction box including its contents shall be considered for 1.5 times peak "g" values (Figures 7.8.1 through 7.8.7).

2. The conduit weight and dead weight of support member shall be designed for design "g" values Figures 7.3.1 through 7.3.7.

b. Special and Non-Typical Case

In special and non-typical cases, the seismic input will be obtained by considering the combined system flexibility of the junction box/conduit system and corresponding supports.

c. Response Spectra Enveloping

To avoid extensive analysis by utilizing individual building spectra, floor response spectra can be enveloped within each building and then further enveloped for all buildings in the vertical, north-south, and east-west directions. The application of the seismic input shall account for all possible orientations of the junction boxes within any of the six

buildings. The qualification analysis can proceed using the more conservative overall spectral envelope first, and then using individual building envelopes with individual elevation spectra, if necessary, until qualification is achieved. Refer to Ebasco Documentation CP-JB-21 for enveloping methods.

6.1.5.3 Junction Box Anchorages

6.1.5.3.1 Nelson Studs

a. Nelson Studs shall be evaluated by using the equations in Section 6.1.12.3.

b. Prying action shall be considered for both concrete wall and frame mounted junction boxes. The magnitude of the prying shall be determined by generic analysis, using different generic box sizes, bolt types, and foundation module. The analysis shall consider multiple direction loading and shall factor in the flexibility of the Junction Box and mounting surfaces. A comparison of anchorage tension forces resulting from support conditions with and without baseplate effects will determine maximum prying action factors. (Ebasco Documentation CP-JB-27)

6.1.5.3.2 Hilti Kwik And Super Kwik Bolts

a. New concrete embedments shall be evaluated in accordance with the procedures listed in Design Basis Document DBD-CS-15 and Specification CPES-S-2001. Existing concrete embedments shall be evaluated in accordance with the procedures listed in Revision 2 of Specification 2323-SS-30. For Unit 2 areas, existing concrete embedments may be dispositioned per 2-EAP-022.

b. The actual tension should be amplified by the prying factor.

c. The factors included in load combinations of Section 6.1.10 do not apply to allowables for Hilti bolts.

d. See Figure 7.21 for spring constants for Hilti bolts.

e. For minimum spacing requirements, see Section 6.1.12.4.

6.1.5.3.3 Unistrut Bolts

Unistrut bolts shall be evaluated by the following equations:

$$\left[\frac{T(P.F.)}{Ta}\right]^2 + \left[\frac{S}{Sa}\right]^2 \le 1.0$$

where:

T,S - Actual Tension and Shear in bolt

T_a, S_a - Allowable Tension and Shear in bolt

P.F. - Prying Factor, see Section 6.1.5.3.1.

Allowables are listed in Figure 7.22.

6.1.5.4 Junction Box Frequency

6.1.5.4.1 Supported Junction Box

a. Typical Generic Cases

Only the frequency of the conduits interfacing with the junction boxes are obtained from a 3-D model of a 2 span conduit run, with simulated support springs. The spring constants are based upon a minimum frequency of 14.45 Hz and are applied in three translational directions at conduit support points and at the junction-box/conduit intersection.

b. Special and Non-Typical Generic Cases

The box-support system frequency is obtained directly from the constructed 3-D model of junction box-conduit support system. The stiffness of the adjacent conduit supports shall also be considered and simulated by springs attached to the ends of 3-D model for a minimum support frequency equal to 14.45 Hz in all three directions. Boundary conditions at the points of support (bolt connections), shall properly simulate the stiffness of the support in all 3 directions. The frequency of the junction box support system shall include all modes up to 33 Hz, and will be used to perform the spectra analysis.

6.1.5.4.2 Unsupported Junction Box

A 3-D model of junction box-conduit systems will be constructed. The stiffness of the adjacent conduit supports shall also be considered and simulated by springs attached to the ends of 3-D model for a minimum support frequency equal to 14.45 HZ in all three directions. The frequency of the box-conduit system will be used to perform the spectra analysis and shall include all modes up to 33 Hz.

6.1.5.4.3 Minimum Frequency Requirement

Junction box supports shall meet the minimum conduit support frequency requirement of the building. Therefore, the junction box support members shall be designed for the design "g" values (Figures 7.3.1 through 7.3.7). As an alternative, the junction box support may be designed for 1.5 times peak "g" values listed in Figures 7.8.1 through 7.8.7 for conservatism, provided that the frequency requirement is met.

6.1.5.5 Pull Boxes and Terminal Boxes

The pull and terminal boxes shall be evaluated using the criteria in this section. Attention shall be given to the total box weight (cables and any permanent attachment).

6.1.5.6 Material Properties

a. Steel sheet metal for boxes: $E = 29 \times 10^3$ ksi,

ASTM A-569, $F_y = 25$ ksi, $F_{ult} = 40$ ksi

b. Structural steel for box lugs: ASTM A-36,

$F_y = 36$ ksi, $E = 29 \times 10^3$ ksi

c. Support structure: $E = 29 \times 10^3$ ksi,

ASTM A-36 $F_y = 36$ ksi

ASTM A-570 Grade C - $F_y = 33$ ksi

ASTM A-500 Grade C - $F_y = 46$ ksi

d. Rigid conduit conforms to ANSI C80.1 and WW-C-581d.

e. The design weight (including cable weight) and sectional properties (per standard weight pipe properties of the AISC American Institute of Steel Construction) for various conduit sizes are listed in Figure 7.18.

f. The design weights of flexible conduit are listed in Figure 7.24.

g. Nelson studs are CPL or CFL type manufactured by TRW Nelson Division, $F_y = 50$ ksi.

h. Hilti Kwik and Super Kwik bolts are as manufactured by Hilti Fastening Systems.

i. Unistrut bolts are as manufactured by Unistrut Building System and conform to SAE J429 Grade 2, $F_y = 58.0$ ksi or ASTM A-307, $F_y = 36.0$ ksi.

j. Concrete 28-day compressive strength is 4000 psi, having a specific weight of 141 pcf.

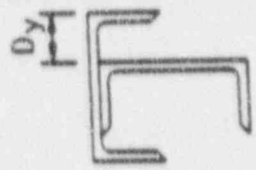
k. Boxes and covers shall be made from steel sheet of thickness not less than the following:

Largest box dimension less than 36"	- 14 U.S. Gage
Largest box dimension equal to or greater than 36" and less than or equal to 48"	- 12 U.S. Gage
Largest box dimension greater that 48"	- 10 U.S. Gage

6.1.6 SHEAR CENTER LOCATION OF COMPOSITE CHANNELS

a. Figure 7.12 is a summary of shear center locations for the following composite sections which consist of two channels:

1. C6 x 8.2 and C6 x 8.2
2. C8 x 11.5 and C6 x 8.2
3. C6 x 8.2 and C4 x 5.4



b. Due to variation of distance "Dy", the above composite sections represent twenty two different sections used at CPSES site.

c. Figure 7.12 also includes the information on C.G. and the area moments of inertia with respect to principal axes as indicated by I1-1 and I2-2.

d. For all other composite sections, the engineer shall determine the shear center.

6.1.7 WELD DESIGN

Allowable stresses for welds shall be as specified in Section 6.1.11.

Provision shall be made for an undersize of 1/32 inch when qualifying fillet welds.

a. Minimum Weld Size

Welds not meeting the AWS code minimum weld size requirements, but found through detailed analysis to have stress within the allowable stress, are acceptable from a design verification standpoint. However, a minimum acceptable structural weld (as shown on the As-Built drawing) shall not be less than 1/8 inch.

Both weld and base metal thickness must be appropriately considered in weld qualification per AISC code requirements except as noted above.

For fillet-welds, the allowable shear stress on the base metal shall not be exceeded (See Section 1.5.3 of AISC American Institute of Steel Construction). The base metal shear stress allowable shall be limited to .4Fy for OBE and .5Fy for SSE. For full penetration welds, the allowable stresses shall be those for the base metal.

b. Warping Stresses in Anchoring Welds

In cases where members are subjected to warping effects (member welded "all around" at embedded plate or anchored plates or other members), the anchorage weld verification shall include warping stresses in addition to other stresses. For such cases, warping will cause two additional stresses in the weld. One of these will be in the same direction as, and must be added to, the shear stresses caused by direct shear. The other warping stress is in the same direction as, and must be added to, normal stresses caused by member axial and bending loads. These two total weld stresses must then be combined by SRSS.

c. The stress on welds between composite channels shall be calculated by the STRUDL program. Long hand calculations are not recommended.

d. For the effective throat thickness of prequalified partial penetration bevel groove welds, see Figure 7.13.

6.1.8 INTERFACE REQUIREMENTS

Conduits are sometimes connected/attached to the supports of subsystems/systems which are in the scope of other disciplines such as Cable Tray Hangers (CTH) and pipe supports.

6.1.8.1 <u>Attachments To CTHs And HVAC Supports</u>

For conduit system which utilizes Cable Tray or HVAC supports, RSM analysis shall be performed for a representative segment of the isometric which includes such Cable Tray or HVAC supports. Representative segment shall include two supports and two spans on both sides of the cable tray or HVAC support. The remaining portion of the ISO shall be qualified in accordance with these guidelines.

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For the RSM analysis, the actual cable tray or HVAC support configuration (stiffness and mass distribution) shall be included in the model. However, if the cable tray or HVAC displacements due to D + T_o + Feqs at the conduit attachment location is less than 0.25" the minimum conduit support frequency requirement and the conduit system can be qualified according to the normal process defined in these guidelines.

This approach is also applicable to the cases when there are less than two supports on either or both sides of the Cable Tray or HVAC support.

The spans and two supports on both sides of the problem support should be qualified for 1.5 times peak "g", unless the actual support stiffnesses are used.

Footprint Loads (FPLs) shall be prepared by conduit design group and provided to CTH or HVAC group for their approval.

Engineering evaluations may be performed in lieu of detailed RSM analysis. The loads shall be distributed appropriately based on the support stiffness.

6.1.8.2 Attachments To Pipe Supports

For the cases when the conduit support is attached to a pipe support, two supports and two spans on both sides of the pipe support should be qualified for 1.5 times peak "g" unless the actual support stiffnesses are used. The remainder of the ISO could be qualified, as outlined in these guidelines. This approach is also applicable to the cases when there are less than two supports and two spans on either side of the pipe support.

For conduits attached to pipe supports, footprint loads (FPL) shall be provided by conduit design group to Pipe Support Group for interdisciplinary review (IDR) and acceptance.

6.1.8.3 Attachments Of Smaller Than 2" Diameter Train C Conduits

Train "C" conduits less than 2" diameter shall not be attached to seismically designed conduit supports without prior engineering approval.

In cases where it is absolutely necessary to attach to these supports, FPLs and displacements (at the support location of Train "C" conduit) shall be provided for acceptance.

6.1.8.4 Attachment To Other Discipline Supports With Junction Box On ISO

The following guidelines apply to junction box support when it is part of an ISO and the conduit is attached to another discipline support at one or more locations.

a. When the support by other discipline is the third support from the junction box, then the junction box shall be qualified according to normal process defined in these guidelines.

b. When the support by other discipline is first or second support from the junction box, then the junction box itself including content of box and tributary conduit load should be qualified for 1.5 times peak "g".

6.1.8.5 Attachment To Steel Platform

For the cases when the conduit support is attached to steel platform, steel platform response spectra shall be used. If this response spectra is not available, then conduit shall be routed to avoid support on the platform and ISO shall be design validated accordingly, or conduit system shall be evaluated in a fashion similar to the evaluation procedure below in Section 6.1.8.6.

6.1.8.6 Attachment To Spread Room Frame (SRF)

When the entire conduit run is attached to SRF, the conduit span frequency shall be equal to or greater than 28 H_z and the conduit and its supports shall be qualified by hand calculations or computer for enveloped 1.5 times peak "g" from floor elevation above and below the framing.

For conduit run partially supported by SRF, the conduit span frequency requirement mentioned above is applicable to the portion of conduit run supported by SRF only. In lieu of performing the frequency analysis for the entire conduit run, the rigid spans given in Figure 7.30 may be used to validate the conduit span frequency requirements.

Since the SRF frame has been analyzed using damping value of 4% for OBE and 7% for SSE, the conduit system may be design validated using 1.5 times peak "g" values from 4% OBE and 7% SSE floor response spectra curves if the entire conduit run is supported by SRF. The 1.5 times peak "g" values are given in the following table:

1.5 Peak "g" Values for
Attachment to Spread Room Framing

Damping	Horizontal N-S	Horizontal E-W	Vertical
OBE-4%	1.5	1.66	1.89
SSE-7%	1.74	1.74	2.55

Footprint loads for supports attached to Cable Spread Room Frame (CSRF) shall be submitted to the Civil/Structural group for approval.

6.1.8.7 Footprint Loads To Civil/Structural Group

As required, footprint loads at conduit support anchorage location shall be calculated and submitted to Civil/Structural Group in accordance with Procedure 2EP-5.17.

As required, footprint loads at various steel locations (i.e., embedded plates, structural steel and containment liner plate) shall be calculated and submitted to the Civil/Structural Group in accordance with Procedure 2EP-5.17.

6.1.9 EVALUATION OF CONDUIT SPAN AND SUPPORT VIOLATIONS

6.1.9.1 'K' Factor Violations

'K' factor is used to compute L_L & L_T and is shown & defined in LS series drawings of S2-0910, or LS Series drawings of S-0910. It is a coefficient to determine reaction of conduits and their supports.

K-factor violations occur when L_L and L_T can not be determined as described in Section 6.1.2. When K-factor cannot be computed for a particular configuration, the following method shall be used:

a. The following method should be used when STRUDL static analysis is employed per Section 6.1.16 to determine L_L and L_T for a conduit support.

   1. One "g" uniform load shall be applied in the system global coordinates X, Y, and Z independently.

   2. The support reactions should be listed for each directional load separately.

   3. When comparing with the support capacity, use the maximum reaction from the values obtained in the static run for that support. Weight of filler plate and shim plate shall be included.

b. The isometric with K-factor violations shall be verified by performing RSM analysis in accordance with Section 6.1.13. Purpose of this analysis is to confirm that the actual "g" values at support with K-factor violation are less than the design "g" values.

6.1.9.2 <u>Span Violations</u>

Span violations occur when actual spans are greater than the allowable spans specified in Drawing No. S2-0910, or Drawing No. S-0910.

a. The following procedure applies to the case when span violations occur but support design loads are adequate:

   1. Run RSM analysis.

   2. Verify the following items:

      a) Support reactions versus clamp allowables.

      b) Actual "g" values versus design "g" values for supports.

      c) Conduit stresses versus allowables.

      d) Maximum resultant displacement (Dead load + Seismic) at tip of rigid overhang shall be limited to one inch (1").

   3. If item 2.a through 2.d pass, the ISO is adequate.

b. The following procedure applies when span violations occur and support design loads exceed the support capacity:

   1. Calculate the actual support frequency for failed supports.

   2. Determine support stiffnesses.

   3. Run RSM analysis.

4. Verify the following items:

   a) Support reactions versus clamp allowables.

   b) Conduit stresses versus allowables.

   c) Evaluate the support for actual "g" values.

   d) Maximum resultant displacement (Dead load + Seismic) at tip of rigid overhang conduit, shall be limited to one inch (1").

6.1.9.3 Support Capacity Violations

These violations occur when the actual calculated support design loads are greater than the conduit support capacity.

The following procedure applies to the cases when the support capacity violations occur but spans are adequate.

a. Verify the problem support with as-built condition for the following items:

   1. Support frequency to meet the minimum frequency requirements.

   2. Support adequacy with design "g" values.

b. If items a.1 and a.2 pass, the ISO is adequate, otherwise, follow the procedure in Section 6.1.9.2.

   When the support capacity violations and span violations occur together, see section 6.1.9.2.

6.1.10 LOADS AND LOAD COMBINATIONS

6.1.10.1 General

Conduit system, in general, shall be designed for all loads and load combinations specified in sections 6.2, 7.5 and 7.6 of DBD-CS-90.

The following design loads and load combinations shall be considered:

a. Load combination for service load conditions.

   1. S = D + Feqo

   2. S = D + W

   3. 1.5S = D + To + Feqo

   4. 1.5S = D + To + W

   where:

   D = Dead weight of conduit, cable, conduit support members including overhang and cover plates and any permanent attachments.

   Feqo = Loads generated by Operating Basis Earthquake (OBE).

To = Thermal effects and loads during normal operating or shutdown conditions, based on the most critical transient or steady state condition. (See Section 6.1.10.2)

S = Allowable stresses. (See Section 6.1.11)

W = Load generated by design wind loads

b. Load combinations for factored load conditions.

1. 1.6S = D + T_o + Feqs

2. 1.6S = D + Ta + Feqo + Pa + Yj

3. 1.6S = D + To + Wt

4. 1.7S = D + Ta + Feqs + Pa + Yj

where:

D, Feqo, To, S = As defined above

Ta = Thermal loads under thermal conditions generated by the postulated pipe break including To. (See Section 6.1.10.2)

Feqs = Loads generated by the Safe Shutdown Earthquake (SSE)

Pa = Pressure equivalent static load within or across a compartment generated by the postulated pipe break including an appropriate dynamic factor to account for the dynamic nature of the load.

Yj = Jet impingement equivalent static load in the structure generated by the postulated pipe break, Including an appropriate dynamic factor to account for the dynamic nature of the load.

Wt = Loads generated by the design tornado. Loads shall include those caused by tornado wind pressure and tornado generated missiles.

c. Load combinations for conduits cast in place in concrete slabs and walls.

1. U = 1.4 D + 1.9 Feqo

2. U = 0.75 [1.4 D + 1.9 Feqo + 1.7 To]

3. U = 1.0 (D + Feqs + To)

4. U = 1.0 (D + Ta + Feqs + Pa + Yj)

5. U = 1.0 (D + Ta + Yj) + 1.25 Pa + 1.25 Feqo

In addition, for conduit systems located outside of buildings, evaluation shall also be made by replacing 1.9 Feqo in equations (1) and (2) with 1.7 W and Feqs in equation (3) with Wt.

where:

U = The section strength required to resist design loads and is based on methods described in Code ACI-318-71. All other numenclature is defined in a and b above.

d. In performing the above load combinations the following shall be considered:

1. Dead load component shall be added to the SRSS of the vertical and horizontal seismic components.

2. For load combinations shown in Section 6.1.10.1.a.3 and 6.1.10.1.a.4 and in Section 6.2.2 of DBD-CS-90, reduction of member stresses and/or reactions by the factor used for increasing the allowables is not permitted.

3. Limitations on allowables for various load combinations are specified in Section 6.4 of DBD-CS-090.

4. Methodology employed to consider the thermal effects on conduit systems is discussed in Section 6.1.10.2.

5. Conduit system subjected to jet impingement load (Y_j) and/or pressure load (Pa) shall be designed on a case by case basis. Presently all trains are isolated and jet impingement loads (Y_j) have not been identified.

Determination of the effect of tornado and wind loads shall be as follows:

1) The dynamic wind pressure, q, is defined as $q=0.00256V^2$ where q is in psf and V, the wind velocity (including the gust factor), is in mph.

2) The tornado wind velocity is not assumed to vary with height above the ground. A 360 mph velocity shall be used for all structures.

3) A load factor of 1.0 is used for tornado loads in the load combinations.

4) The various combinations of tornado effects which the structures must withstand are:

$W_t = W_w$

$W_t = W_p$

$W_t = W_m$

$W_t = W_w + 0.5\ W_p$

$W_t = W_w + 0.5\ W_p + W_m$

where: W_t = total tornado load
W_w = total tornado wind load
W_p = tornado differential pressure load
W_m = equivalent tornado missile load

5) Wind distribution for various height zones above the ground are shown below:

Height Above Ground (ft)	Wind Velocity (mph)
0 to 50	80
50 to 150	95
150 to 400	110
400 to 700	120

A gust factor of 1.1 is applied to the above wind velocities.

6) A static uniform wind load on the conduit system shall be taken as

W_w = C_D q d (for conduit)

W_w = C_D q A (for junction box or conduit support)

where:

W_w = Uniform wind load in lb/ft for conduit or total uniform load in lbs for junction box or conduit support

C_D = Coefficient of Drag (shape factor)

= 1.0 for conduit 2" diameter or less
= 0.8 for conduit greater than 2" diameter
= 1.3 for junction box
= for all other structural shapes, see ASCE Paper #3269 (1962).

d = Diameter (o.d.) of conduit in feet

A = Total area of junction box or conduit support windward face.

7) Since conduit systems are airtight and missile barrier shields are to be employed, W_p and W_m do not need to be considered.

6.1.10.2 Thermal Load Considerations

a. The following criteria shall be used to determine if thermal loads are to be considered:

1. Thermal loads due to normal operating temperature need not be considered if the conduit system meets all the conduit span and conduit support capacity requirements of the LS-Series Drawing of Drawing No. S2-0910, or Drawing No. S2-0910 and the length of the conduit is 75 feet or less between expansion joints (junction box, airdrop, pull sleeve and flexible conduit) in Safeguard, Auxiliary, Electrical control and Fuel Handling Buildings. This is

also applicable to Reactor Building if the length of the conduit is 45 feet or less between expansion joints.

2. In Reactor Building, accident temperature loads shall be considered for conduit runs exceeding 45 feet, between expansion joints or from embedment to expansion joint.

b. The following temperature data shall be used when considering thermal loads:

1. Normal Operating Temperature

a) Temperature differential (Δ T) of 32°F in all buildings except Containment Building.

b) Temperature differential (Δ T) of 50°F in Containment Building.

c) Thermal expansion coefficient of 1.0 x 10^6 per °F. The difference between steel and concrete thermal expansion coefficients is used assuming that steel and concrete both expand in steady state condition.

2. LOCA Temperature

a) Temperature differential (Δ T) of 147°F.

b) Thermal expansion coefficient of 6.5 x 10^6 per °F assuming that concrete expansion is negligible in transient condition.

c) The recommended input skeleton for considering thermal loads in the computer analysis is given in Attachment 8.D.

6.1.10.3 <u>Conduit At Concrete Penetration</u>

Load and load combinations for conduits cast in place in concrete slabs and walls are specified in Section 6.2.3 of DBD-CS-90. However, during final design reconciliation of Unit 1 as-built seismic conduit systems, penetration adequacy was checked to ensure no slippage occurred which could cause the load redistribution in the system. No support modifications resulted from this study. This is documented in EBASCO calculation book no. AS-006. Based on this there is no need to check any new or existing conduits for this type of loading criteria.

6.1.11 **ALLOWABLE STRESSES**

Allowable stresses, S, for conduit and conduit support members including junction boxes and junction box supports shall be in accordance with the requirements specified in the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building" (except for UNISTRUT support members and junction boxes under accident conditions). The 33 percent increase in allowable stresses due to seismic loadings shall not be used. Welding allowables, S, shall be in accordance with AWS D1.1-79, "Structural Welding Code".

For load combinations 6.1.10.1.a.3, 6.1.10.1.a.4 and 6.1.10.1.b.1 through 6.1.10.1.b.4, allowable stresses for conduit, welds, and conduit support members may be increased to 1.5S, 1.6S or 1.7S, respectively. However, the allowable flexural and axial tensile

stresses shall not exceed 0.9 Fy, the allowable axial compressive stress shall not exceed 90 percent of either the ultimate buckling stress or the yield stress and the allowable shear stress shall not exceed 0.5 Fy.

Unistrut members shall be evaluated in accordance with the requirements of the AISI Cold-Formed Steel Design Manual. Unistrut allowables that were established to validate Unit 1 supports shall be used to the extent possible.

Additional design considerations shall be per section 8.0 of DBD-CS-90 and as per the following sections.

6.1.11.1 Punching Shear At Tubular Connections (Main Member Only)

a. The allowables normal weld forces for OBE condition for stepped tubular section connections are listed in Figure 7.10.

The allowables are determined based on the punching shear requirements stipulated in Section 10.5 of Code AWS D1.1-79

The following clarifications are provided in conjunction with the allowable normal weld force table:

1. For formulae used in calculating the punching shear and nomenclature for stepped connection, see Attachment 8.A.

2. SSE allowables shall be 1.6 times OBE allowables provided they do not exceed the following limit:

Limit on SSE Allowables (lbs/in)	Main Member Thickness (inch)
4310	3/16
5750	1/4
7185	5/16
8625	3/8

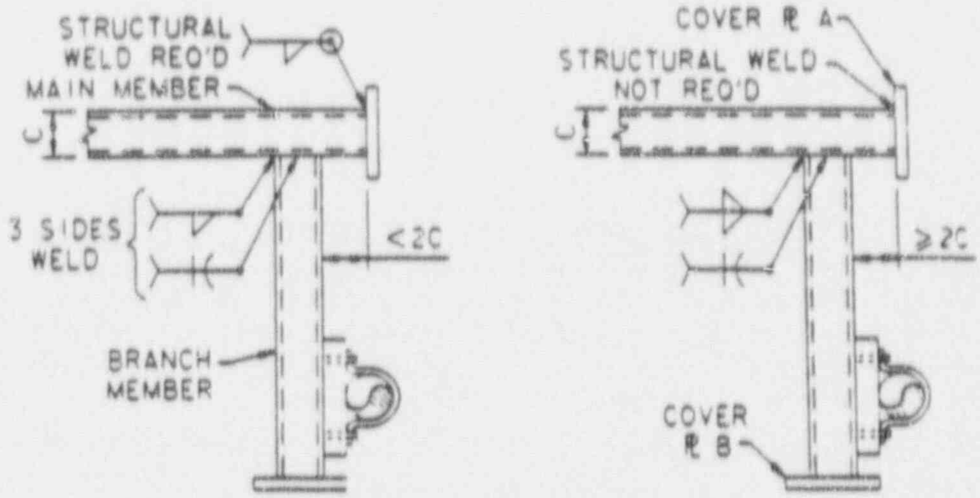
3. When the branch member is adjacent to the open end of the main member (< 2D), only 50 percent of the allowable will be used. If the allowable is exceeded, provide cover plates at the open end of the main member, and weld all around, using a 3/16 minimum fillet weld.

4. Where possible an all around weld between TS members should be used in design.

b. No punching shear requirement for matched box connections whether perpendicular or skew; however, minimum edge distance from the side of branch member to the end of main member shall not be less than 2X Depth D of main member. If minimum edge distance is not met, one of the following shall be satisfied.

1. Structural weld between branch member and main member shall be evaluated by using 3 sided weld.

2. Cover plate shall be welded all around to main member by using a structural weld.



6.1.11.2 Warping Stresses

After the static analysis results are obtained, torsional moments are found in various members. These torsional moments generate warping stresses (both normal and shear) on members with open cross sections which have to be added to the normal and shear stresses obtained from the frame analysis done by computer. A few typical cases where warping stresses shall be considered are illustrated on Figure 7.11.1. For special cases, acceptable engineering principles shall be used. For this purpose, Figure 7.11.2 or any other approved procedure may be used.

6.1.12 ANCHORAGE EVALUATION

New concrete embedments shall be evaluated in accordance with the procedures listed in Design Basis Document DBD-CS-15 and the latest revision of Specification CPES-S-2001. Existing concrete embedments shall be evaluated in accordance with the procedures listed in Revision 2 of Specification 2323-SS-30. For Unit 2 areas, existing concrete embedments may be dispositioned per 2-EAP-022.

6.1.12.1 Hilti Kwik And Super Kwik Bolts

Procedures listed in DBD-CS-15 and CPES-S-2001 shall be used for evaluation.

6.1.12.2 Richmond Inserts

Procedures listed in DBD-CS-15 and CPES-S-2001 shall be used for evaluation.

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6.1.12.3 Nelson Studs

Nelson studs shall be evaluated by the following equations:

a.

$$\left[\frac{T}{Ta}\right]^2 + \left[\frac{S}{Sa}\right]^2 \leq 1.0$$

where:

T,S = Actual tension and resultant shear in stud (Effect of prying factor shall be included for T, if any)

T_a, S_a = Stud tension and shear allowables

b. $T_a = 0.60 \times A_{st} \times F_y$

c. $S_a = 0.30 \times A_{st} \times F_y$

d. A_{st} = Mean Effective Thread Area (META)

e. META = 0.7854 [d - (0.9743/$_N$

where:

d = Nominal Thread Diameter

N = Number of Threads per inch

Figure 7.15 list the allowables for load combination 6.1.10.1.a.1 calculated by the above formulae.

6.1.12.4 Minimum Spacing Requirements

a. For minimum spacing requirements between Hilti bolts, between Hilti bolt and Richmond Screw Anchors, concrete edge, abandoned bolts or between bolt holes, and between Hilti bolt and embedded plate, see the Structural Embedment Specification CPES-S-2001 and Procedure DBD-CS-015.

b. When minimum spacing requirements between Hilti bolts, between Hilti bolts and Richmond screw anchors, concrete edges, abandoned embedded bolts or bolt holes, and between Hilti bolts and embedded plates cannot be met, see the Structural Embedment Specification CPES-S-2001 and Procedure DBD-CS-015 for reduction in allowables capacities. Guidelines provided in 2EP-5.17 may be used to resolve spacing violations between conduit and pipe supports.

6.1.12.5 Base Plate Analysis

Base plate analysis can be performed by hand calculations or by computer analysis. In either method, Hilti bolt interaction and base plate/angle stresses shall be checked.

a. Hand Calculations

The procedure given in Attachment 8.B (approximate method) may be used to evaluate stresses in the base plate, surface angle and anchor bolts. To minimize the number of base plate

analyses, spring constants, prying factors and allowables are provided for different sizes of base plates in Attachment 8.B.

If the anchorage cannot be qualified by hand calculations, or the configuration is not covered in Attachment 8.B, a computer analysis may be performed.

b. Base Plate Finite Element Analysis

The computer analysis for the base plate shall be performed by using the PD STRUDL base plate program (See Attachment 8.C for recommended skeleton) with anchorage loads obtained from the static run. The effect of prying action and anchorage flexibility will be considered.

The input data required to perform the static analysis consist of the base plate geometry, anchor length, locations of load points and loads. The bolt spring constants shall be obtained from the Anchor Bolt Shear and Tension Stiffness report by Teledyne Engineering Services, May 25, 1979 provided in Figures 7.35.1 through 7.35.4. The spring constant for bolts with embedment length, other than those provided by Teledyne, shall be obtained by linear interpolation. Extrapolation is not allowed. Spring constants for Hilti Kwik and Super Kwik Bolts can be conservatively obtained from the table below. For Richmond anchors, use the values shown below.

Bolt Type	Bolt Diameter (in)	Bolt Tension Stiffness (K/in)	Bolt Shear Stiffness (K/in)
Hilti	1/4 to 1.25	461	111
Super Hilti	1/4 to 1.25	461	111
Richmond	1.5	3460	652
Richmond	1	2175	485

The above values are for f'c = 4000 psi.

c. Anchoring with Bolts in Combination with Welds

When welds are used together with Hilti bolts for anchoring the base plate, welds should be designed such that total shear force is resisted by weld alone. Tension force will be distributed between bolts and weld according to their relative axial stiffness. For the design of the Hilti bolts, the shear forces shall be considered to be resisted by the Hilti bolts and welds in proportion to their shear stiffnesses.

6.1.13 PROCEDURE FOR RESPONSE SPECTRUM MODAL ANALYSIS OF CONDUIT SYSTEMS

This Section provides guidelines for the Response Spectrum Modal analysis (RSM) of conduit and support assemblies.

The RSM analysis is used to evaluate the conduit isometrics which do not satisfy the acceptance criteria specified in Drawing No. S2-0910 or S-0910.

When calculated system frequencies, for conduit isometrics that are design verified by RSM analysis, are on the soft side of the floor response spectra peaks, peak spectra values shall be used for those corresponding modes. All existing span allowable studies shall be revisited for the impact of the soft modelling approach. This study was done for Unit 1 conduits and included in EBASCO Calculation Book SPAN-1012. Unit 1 lessons learned shall be utilized to the extent possible when performing the same study for Unit 2 conduits.

6.1.13.1 Design Inputs

The following design inputs are required to perform the RSM analysis:

6.1.13.1.1 Conduit Support Frequencies

Conduit support frequencies in three directions are used to calculate support stiffness. For conservatism, the following minimum frequency in each direction shall be used in the RSM analysis if supports meet the minimum frequency requirement:

1. Minimum support frequency for S2-9010 supports is 14.45 Hz. Also, the minimum conduit span and conduit system frequencies for different groups shall be as follows:

Group No.	Conduit System Frequency (Hz)	Conduit Span Frequency (Hz)
I, II & III	13.68	≥ 33.0
IV	10.24	14.51
V	8.81	11.11
VI	7.36	8.55

For Groups No. I, II, and III, the conduit design is governed by rigid frequency requirement (≥ 33.0 Hz).

2. Minimum support frequency for S2-0910, PESD series, supports is 16 Hz. Design "g" values are included in ABB Impell Calculation 0218-CO-0007.

3. Minimum support frequency for S-0910 supports is provided in Figure 7.23.

6.1.13.1.2 **Conduit Routing**

Conduit routing shall be that shown in the isometric drawing of the Conduit System.

6.1.13.1.3 **Digitized Floor Response Spectra**

For the isometric drawing, enveloped digitized floor response spectra for all elevations of all conduit support locations shall be utilized for seismic inputs. Damping values of 2% for OBE and 3% for SSE shall be used. When a conduit system is spanning between two buildings, then enveloped response spectra of both buildings should be used. If the span between buildings is rigid conduit, differential seismic building displacements will be considered in the qualification.

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When a conduit system is crossing from one building to the other and a flexible conduit is used, then the corresponding response spectra for each building may be used for the evaluation of the conduit portion supported by that building. Differential seismic building displacements may be neglected in the qualification.

6.1.13.1.4 Tributary Conduit Weights

Conduit tributary weights (L_t and L_T) shall be calculated as per Section 6.1.2 or from a static STRUDL analysis.

6.1.13.1.5 Conduit Sectional Properties

For Frequency and response spectra modal analysis, the full sectional properties of conduits as listed in Figure 7.18 shall be used. However, the threaded conduit sectional properties as listed in Figure 7.19 shall be used in the conduit stress evaluation based on the results obtained from RSM analysis.

For cases when the stress check fails, the exact location of the threads should be identified. For spans where there are no fittings, non-threaded section properties can be used.

The conduit including the cable weight shall be represented by the density as shown on the following table:

Conduit Size (Rigid Steel) Nom. dia. (in.)	Wt. per Ft. (Including Cable Wt.) (LBS/FT)	Density (LBS/IN^3) W/cable wt.
3/4	1.5	.375
1	2.0	.337
1 1/2	4.0	.417
2	5.0	.389
3	13.0	.486
4	19.0	.499
5	23.0	.446

Additional weights of BC (Figure 7.26), flexible conduits (Figure 7.24) and LBDs (Figure 7.27) shall be applied as concentrated.

6.1.13.1.6 **Computer Program**

The PD STRUDL computer program (henceforth referred to as "STRUDL") shall be utilized in performing the analysis.

Recommended STRUDL Skeletons for static analysis (Attachments 8.G and 8.H) and RSM analysis (Attachments 8.D and 8.E) shall be used to the extent possible.

The STRUDL computer program includes the following features:

a. Ten percent combination method for closely spaced modes.

b. Missing mass correction for rigid modes (Modal Frequency larger than or equal to 33 Hz.)

c. Comparison of Design "g" values to actual "g" values from response spectra analysis.

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d. Computation of support spring constants using user-input support frequency and conduit tributary weight for L_T or L_L. (See Section 6.1.2)

e. Threaded conduit sectional properties available on STRUDL dataset for AISC code checking conduit stresses.

6.1.13.2 <u>Preparation Of Computer Model For STRUDL</u>

a. ISO computer model shall be easy to read and concise.

b. Joint and Member Designations

1. The starting point may be assigned as point No. 1. The remaining node points should be numbered in sequence (see Section 6.1.13.2.2).

2. The member designation number between (two) nodal points shall be identified. The member number shall be the same as the preceding point number of the two points where possible.

3. A fictitious member and fictitious support joint shall be added to represent the stiffnesses of a conduit support.

4. Fictitious support joint number shall be equal to its associated conduit joint number plus 100 so as to make it readily identifiable.

5. The member designation number for the fictitious member connected to the support joint shall be same as fictitious support joint number.

c. Global Coordinate Axes

In setting up the global coordinates of the model, the Y axis shall be vertical, X & Z axis shall be oriented in N-S or E-W direction according to Figure 7.28.

6.1.13.2.1 Boundary Conditions For Computer Input

a. Three (3) translational spring constants shall be used to simulate the conduit support stiffness.

The spring constant shall be calculated by the following equation:

$$K_i = \frac{(2\Pi\ fi)^2}{386.4} \times w_i = 0.10217 f_i^2 \times w_i$$

where:

K_i = *Spring constants (lbs/in.)*

f_i = *Support frequency (Hz)*

W_i = *Actual conduit weight (lbs) LS series drawings*

for

L_L or L_T (excluding the filler plate or shim plate)

i = (X,Y,Z)

b. Additional weights of BCs (Figure 7.26), unions, flexible conduits (Figure 7.24) and LBDs (Figure 7.27) shall be lumped as concentrated mass or distributed weights as required.

c. In order to remove the computer analysis singularity, torsional restraint may be used. The torsional value obtained from analysis shall be less than 4% of the maximum allowable clamp torsional capacity shown below:

Conduit Diameter (inches)	Torsional Capacity (Ft - lb)
3/4	179
1	219
1 1/2	291
2	747
3	990
4	933
5	726

d. If the torsional value exceeds 4% of the maximum allowable clamp torsional capacity, the following procedure applies:

1. Evaluate bolt/Nelson stud adequacy of the problem support to include force due to torsion using equations in Sections 6.1.12.1 and 6.1.12.3.

2. Evaluate conduit support including torsion per Section 6.1.4 and/or 6.1.13.

e. Conduit Embedded in Concrete

Assume three-way hinge support at the face of concrete. If the conduit system does not pass, fixed end support with torsional moment release at the face of concrete may be assumed. Also, see Section 6.1.10.3.

f. Conduit Attached to a Supported Junction Box

1. The conduit connecting to Junction Box shall be assumed free in all directions for computer analysis purposes, provided the system is stable and the conduit system passes.

   If the system is unstable or the conduit system does not pass, assume the following boundary conditions at the point of connection between junction box and the rigid conduit.

   a) Free to rotate about the three coordinate axes.

   b) Elastically supported in three directions, two transverse and one longitudinal to conduit axis.

2. In the absence of any exact data about the junction box system use the following generic spring constants:

   a) For junction boxes attached to steel supports, k = 523 lbs/in in three orthogonal direction to junction box.

   b) For junction boxes attached directly to concrete, k = 742 lbs/in in three orthogonal directions.

3. The junction box itself need not be designed when the generic JS-Series drawings for the junction box are used to design the box.

   When there is a non-generic junction box and it is necessary to include an elastic support in the RSM analysis model, then the box shall be analyzed.

g. Conduit Attached to Unsupported Junction Box

The conduit shall be assumed free (in all directions) at the end connecting to the Junction box with a concentrated mass equal to the weight of the Junction box divided by the number of conduits entering the junction box.

h. Pull Sleeve

It shall be assumed to be continuous at the end with a threaded coupling and two-way hinge joint (not support) resisting shears transverse to longitudinal axis of conduit at the other end with or without set screws.

i. Conduit Supports

All conduit supports shall be assumed to be three-way hinge (rigid) supports for static analysis.

For RSM analysis, the conduit support shall be assumed to be three-way spring support. A very short member with properties expressed in appropriate stiffness matrix format shall be utilized for computer analysis.

All conduit supports will be modelled as springs aligned parallel or perpendicular to the conduit axis.

6.1.13.2.2 Location Of Conduit Nodal Points

a. For overhang segment, two nodal points shall be specified, one at the tip of the overhang and the other at the midspan.

b. Any segment shall have preferably three equally spaced nodal points between the end points. A segment is defined as straight portion of the conduit run without turns. A single bend has two segments and a double-bend has three segments. The nodal spacing shall not exceed the S_{max} when modelling the ISO:

CONDUIT SIZE	S_{max} (INCH)*
3/4	26.2
1	30.2
1.5	34.8
2	39.7
2.5	43.6
3	45.8
4	51.9
5	59.6

* The maximum nodal spacing, S_{max}, is calculated by the following formula:

$$S_{max} = \frac{1}{2} \times \sqrt{\frac{\pi}{2F}} \times \sqrt[4]{\frac{386.4\ EI}{W}}$$

where:

F = Cut-off frequency = 33.0 Hz

W = Unit weight of conduit (lbs/inch)

E = Modulus of elasticity (lbs/inch^2)

I = Moment of inertia of conduit (in^4)

c. If additional weights, such as BC or LBD are imposed, additional nodal points should be added.

d. Conduit with a bend less than or equal to 15 degrees is considered a straight run.

e. The Nodal Spacing shall not exceed the Smax for conduits covered with fire-protected material when modeling the ISO:

Conduit Size	Smax (inch)		
	Conduit with Dry Blanket	Conduit with Wet Blanket	Conduit with Thermolag
3/4"	23.0	16.8	19.1
1"	27.0	20.2	22.6
1 1/2"	32.6	26.0	28.2
2"	37.5	30.4	32.6
2 1/2"	41.8	35.2	37.2
3"	44.4	38.9	40.5
4"	50.6	45.2	46.6
5"	58.2	52.2	53.5

6.1.13.3 Data Input For Computer Skeletons

a. Mesh coordinates can be used along with joint coordinates.

b. Joint coordinates

1. Fill in coordinates of the conduit routing following the sequence from computer model.

2. Fill in the offset support joints and the corresponding node points on the conduit line.

c. Support joint

Input support joints from computer model.

d. Support Joint Release

1. Do not release torsional moment if this will cause instability such as in straight conduit run.

2. Do not release any moments or forces of support joints where springs are attached.

3. Fill in the number of the applicable conduit support joints.

e. Constants

1. Input modulus of elasticity (E) of 29.0E6. This value is fixed in the skeletons. The user should change this value in the input if it is different from 29.0E6.

2. Input density

Equivalent density of conduit to be used, may be calculated by the following equation:

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$$r_c = \frac{Wc}{12A} \text{ lb/in}^3$$

where:

Wc = Conduit weight including cable (lb/ft)

A = Cross sectional area of conduit (in^2)

r_c = Equivalent density of conduit (lb/in^3) (See Section 6.1.13.1.5)

f. Mesh incidences can be used along with member incidences.

g. Member incidences are as indicated below:

MEMBER	STARTING AT NODE POINT	ENDING AT NODE POINT
1	1	2
2	2	3
3	3	4
,	,	,
,	,	,

h. Mesh incidences are as shown:

105* -- 113*/5 -- 13/105 -- 113

105 & 113 are fictitious support joints.

5 & 13 are corresponding nodal points.

*Fictitious members.

i. Member Properties

1. Member Properties are expressed with respect to local axes.
2. Include additional weight at joints from union, LBD, cable, etc.

j. Digitized floor response spectra are contained in Ebasco Calculation Books Span-1002 and Span-1003.

The file for shock spectrum loading shall be called out as follows:

BIELIXXX - File name for spectral curves saved in spectrum input data disc.

BI - Building I.D. - See Figure 7.29 for identification number for different buildings.

ELI - Elevation I.D. See Figure 7.29 for identification for different elevations in a specific building.

XXX - Loading case and direction; For example, ONS for OBE in the N-S direction and SVT for SSE in the vertical direction

EXAMPLE

Input file name for spectra curves at elevation 790.50' in Safeguards building.

File Name for OBE (N-S direction) case - "SG790ONS"
File Name for SSE (E-W direction) case - "SG790SEW"

6.1.13.4 Output Requirements

In order to complete the ISO design, the following outputs are required as a minimum:

a. support reactions in three directions.

b. Seismic displacements at tip of rigid overhang conduit.

c. Conduit member forces and conduit stresses.

6.1.14 ACCEPTANCE CRITERIA

Acceptance criteria shall be in accordance with this procedure and Drawing No. S2-0910 or Drawing No. S-0910.

In addition, for structural member with open section, the warping stresses due to torsional moment and the reduction of flexural allowable due to lateral torsional buckling shall be considered by hand calculations.

6.1.15 CALCULATION METHOD

6.1.15.1 Evaluation Of Support Loads From RSM Analysis

a. To calculate the actual "g" values, the following steps shall be followed:

   1. Read the computer output of the support reactions.

   2. Determination of actual "g" values.

   Divide the seismic support reactions in three directions by the tributary weight of the conduits to obtain the three actual "g" values. When the support capacity violation occurs, the actual "g" value shall be obtained by dividing the support reactions by the support capacities.

   Alternatively, refined actual "g" values can also be obtained by performing static analysis of conduit system as described in Section 6.1.16.

b. The actual "g" values shall be compared with the design "g" values given in Figures 7.3.1 through 7.3.7. In the comparison, the maximum actual "g" value shall be compared with the maximum design "g" value, the medium actual "g" value shall be compared with medium design "g" value, and the minimum actual "g" value shall be compared with the minimum design "g" value regardless of the direction. This is performed based on the fact that in the support design validation for both OBE and SSE cases, the maximum design "g" value was applied in the weakest direction, the medium design "g" value was applied in

the second weakest direction and the minimum design "g" value was applied in the strongest direction of conduit supports. This is accomplished by rotating conduit support in all possible orientations.

In the cases, where comparison fails, a simple calculation shall be made as follows:

$$(L.F.)_1 = \frac{g_{1A}}{g_{1D}} \qquad IF \qquad g_{1A} > g_{1D}$$

$$(L.F.)_2 = \sqrt{\frac{g^2_{1A} + g^2_{2A}}{g^2_{1D} + g^2_{2D}}} \qquad IF \quad g_{2A} > g_{2d};$$

$$\& \quad \frac{g_{3A}}{g_{3F}} < \sqrt{\frac{g^2_{1A} + g^2_{2A}}{g^2_{1D} + g^2_{2D}}}$$

$$and \quad (L.F.)_3 = A_1 + \frac{1}{1 + C}(B_1 - A_1) \quad IF:$$

$$B_1 = \frac{g_{3A}}{g_{3F}} > (L.F.)_2$$

$$A_1 = (L.F.)_2$$

$$C = \frac{\sqrt{g^2_{1D} + g^2_{2D}}}{g_{3D}}$$

where:

g_{1A}, g_{2A}, g_{3A} - Maximum, Medium and Minimum "g" from Analysis respectively

g_{1D}, g_{2D}, g_{3D} - Maximum, Medium and Minimum "g" are design "g" from Figures

If $(L.F.)_1$, $(L.F.)_2$ and $(L.F.)_3$ are less than one, then the support is adequate based on the Conduit generic capacity from Drawing No. S-0910 and Drawing No. S2-0910 package. Otherwise, select the largest from $(L.F.)_1$, $(L.F.)_2$ and $(L.F.)_3$ as the Load Factor and design validate the support.

If actual "g" values are smaller than ZPA values (Figures 7.3.8 thru 7.3.13), support shall be design verified using the ZPA values.

c. If conduit tributary weight exceeds the support capacity and the actual "g" values are less than the design "g" values, then support capacity can be increased based on the minimum multiplying factor (MMF) provided the support frequency requirement can be met. The (MMF) shall be the lowest value of the following multiplying factor (M_F).

$$M_F = \frac{G_{1D}}{G_{1A}} \text{ or } \frac{1 + G_{1D}}{1 + G_{1A}}$$

$$M_F = \frac{G_{2D}}{G_{2A}} \text{ or } \frac{1 + G_{2D}}{1 + G_{2A}}$$

$$M_F = \frac{G_{3D}}{G_{3A}} \text{ or } \frac{1 + G_{3D}}{1 + G_{3A}}$$

1. Revised support capacity = (support capacity of Generic, Modified or IN support) x MMF.

2. If revised support capacity is greater than support design loads, support is acceptable.

d. If the support capacity is unknown such as for IN or Modified support, the design of the support shall use actual "g" values. If the support orientation is known, the actual "g" values need not be rotated. Otherwise, the actual "g" values shall be rotated in support design.

6.1.15.2 <u>Evaluation Of Conduit Forces And Moments From RSM For Spans</u>

a. The threaded conduit sectional properties as listed in Figure 7.19 shall be used.

b. The actual section properties may be used if there are no fittings in the span to question.

c. In computing the allowable axial compressive stress, the radius of gyration of conduit full section may be used.

d. Find envelope forces and moments of OBE and SSE cases from RSM analysis output.

e. Evaluate conduit stresses by using formulae elaborated in Part 5, Section 1.5 and 1.6 of AISC Specification.

f. Axial Compression and Bending

$$\frac{fa}{Fa} + \frac{fby}{Fby} + \frac{fbz}{Fbz} \leq 1.0 \text{ [when } (fa/Fa) \leq 0.15\text{]}.$$

otherwise follow AISC Specification or use

$$\frac{fa}{Fa} + \left[\left(\frac{fby}{Fby}\right)^2 + \left(\frac{fbz}{Fbz}\right)^2\right]^{½} \leq 1$$

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For (OBE) Load Case

When $kl/r \le C_c$

Alternatively, Fa can be computed using Section 1.5 and Table 1 of Appendix A of the AISC American Institute of Steel Construction.

When $KL/r > Cc$,

$$Fa = \frac{12\pi^2 E}{23(KL/r)^2}$$

$$Fb = 0.6\ Fy$$

$$Cc = \sqrt{\frac{2\pi^2 E}{Fy}}$$

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For (SSE), (To + OBE), (Ta + OBE) and (Ta + SSE) Load Cases where:

Fa - The lesser of following (2) values shall be used:

A) 1.5, 1.6, or 1.7 of (OBE) allowable stresses, but less than 0.9 Fy

B) $\frac{0.9\pi^2 E}{(KL/r)^2}$ Ultimate Buckling Strength

Fb - 0.9 Fy

g. Shear Stress

For (OBE) Load Case

$$fv = \frac{\left[\left(\begin{matrix}Y\\Shear\\Force\end{matrix}\right)^2 + \left(\begin{matrix}Z\\Shear\\Force\end{matrix}\right)^2\right]^{1/2}}{\frac{1}{2}A} + \frac{Mt}{2S} \le 0.4\ Fy$$

(SSE), (To + OBE), (Ta + OBE), (To + SSE) and (Ta + SSE)

$$fv = \frac{\left[\left(\begin{matrix} Y \\ Shear \\ Force \end{matrix}\right)^2 + \left(\begin{matrix} Z \\ Shear \\ Force \end{matrix}\right)^2\right]^{\frac{1}{2}}}{\frac{1}{2}A} + \frac{Mt}{25} \leq 0.5\ Fy$$

h. Effective Length Factor in slenderness ratios for overhang, single and double bends, the unbraced length and its respective K value is given in Attachment 8.F.

The slenderness ratio of the conduit in the STRUDL printout need not be checked except for overhang. For overhang, maximum slenderness ratio (KL/r) for conduits may be taken as 240 when fa/Fa < 0.15 (not applicable for conduit support member).

fa - Computed axial stress

Fa - Allowable axial stress

When fa/Fa > 0.15, maximum slenderness ratio (KL/r) shall not exceed 200.

The SSE allowable shall be used for SSE loads and OBE allowables shall be utilized for OBE loads and if necessary, each conduit span shall be evaluated for corresponding member forces.

6.1.15.3 Common Support

a. Conduit Stresses

Each individual conduit has to satisfy the design requirements stated in the procedure described in Section 6.1.15.2.

b. Support Capacity

For Vertical Direction

$[Ri + W \times (1 + G_{Actual})] \leq 1 + (G_{Design})(L_L \text{ or } L_T)$

For Horizontal Direction

$[Ri + W \times (G_{Actual})] \leq 1 + (G_{Design})(L_L \text{ or } L_T)$

where

Ri - Reaction force from RSM.

G_{Actual} - From RSM.

G_{Design} - Design "g" value (See Figures 7.3.1 through 7.3.7) used in support design.

L_L or L_T = Per generic support capacity tables premodified support capacity calculation (includes weight of filler and shim plate).

W = Weight of filler plate or shim plate.

The above equations are applicable to both OBE and SSE cases.

6.1.16 STATIC ANALYSIS OF CONDUIT SYSTEM

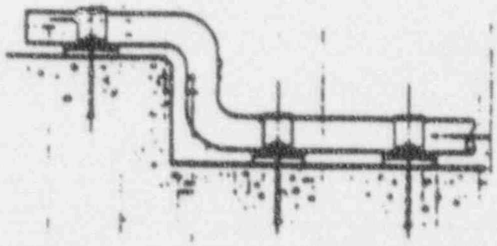
This section provides guidelines to determine the exact values of L_L and L_T at each support location. Same structural model that was used in the RSM analysis shall be utilized in static analysis. Perform a static computer analysis with 1 "g" in each of the three directions and obtain the reactions at the support location (L_L and L_T). Divide the reaction(s) obtained from RSM analysis by the above computed L_L and L_T to determine actual "g" values in all three directions at each support location. These values may then be used to compare capacities as described in Section 6.1.4.

6.1.16.1 Static Analysis Of Supports

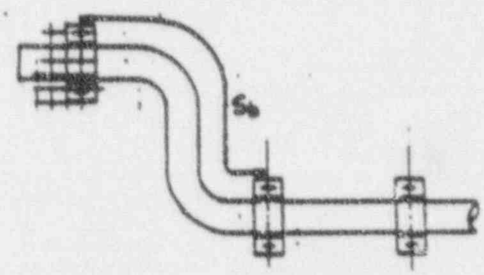
6.1.16.1.1 Generic Support

If support configuration meets all the attributes of generic support detail of Drawing No. S2-0910 or Drawing No. S-0910, it shall be evaluated as per Section 6.1.4.2. If support does not pass, it can be custom evaluated per Section 6.1.13.

The use of the support capacities for support types CA-5a-A, CA-5a-B, CSM-2a-I, CSM-2a-IV, and CSM-2a-V as shown on the S-0910 and S2-0910 generic support drawings is acceptable except when the support is on the overhang portion of a conduit run and the first interior span is a double bend of length greater than S_b shown below with the plane of the bend on the same plane as that of the support base plate.



Acceptable Configuration



Configuration with S_b Limitation

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Conduit Size	Allowable S_b
5"	9'-11"
4"	8'-11"
3"	7'-8"
2"	6'-7"
1.5"	6'-7"

Should the actual span length exceed the allowable S_b, the support shall be design on a case-by-case basis for 100% of the moment induced by the longitudinal conduit load L_L. CA-5A support type can be qualified alternatively per Attachment 8.I.

6.1.16.1.2 Modified Supports

A modified support is a support which has minor deviations from typical details given in Drawing No. S2-0910 or Drawing S-0910.

a. Modified supports may be designed verified by comparison to the generic support by hand calculations provided that all corresponding members and attributes which impact the capacity of the support can be demonstrated to be more conservative than those used for the generic support to meet frequency requirements and acceptance criteria.

b. If only the anchorage of a modified support matches the anchorage of the generic support, the spring rate obtained for the generic support (see Section 6.1.12.5) may be used instead of performing new analysis to calculate the spring rate at anchorage point. The procedure described in Section 6.1.12.5 shall be repeated except when deviations from generic supports are such that the support frequency is not affected, in which case the minimum frequency requirement is satisfied and the frequency analysis need not be repeated.

c. When a modified support is significantly different from generic support, all aspects of the support shall be design verified as follows:

1. Set up structural model with proper boundary conditions (Hinged, fixed, or Spring) and critical dimensions.

2. If spring rate at anchorage point needs to be considered, see Section 6.1.16.5.

3. Fill input data for frequency analysis and static analysis with proper spring rate obtained from item (b).

4. Review the static output to verify that all members pass code check (see Figures 7.9.1 and 7.9.2 for reduction in interaction equation coefficient due to 1/32 undercut). Add warping stresses, and other stresses due to eccentricity not considered in the model. The STRUDL computer program shall be used to calculate member and weld stresses for structures with composite channels (see Ebasco Calculation Book No. Supt-0040 for details).

5. Check anchorage (surface angle, base plate, and bolts) using the procedure given in Section 6.1.12.5.

6. Complete calculations for all welds, gusset plate and members not included in code check performed by STRUDL.

7. Code violations, if any (such as bolt edge distance, bolt spacing, etc.) shall be identified in the calculations.

8. Punching shear shall be checked for TS connections and for allowable normal weld force, see Figure 7.10.

9. All member stresses shall be evaluated including 1/32" undercut at fillet weld locations.

10. Code check performed by STRUDL does not include checking the member for shear stresses due to torsion. Therefore, member shear stress shall be computed by hand calculation.

11. For open sections bending stresses due to torsion shall be considered in evaluating member stresses.

12. Support frequency shall be computed with the consideration of base plate flexibility.

13. Base plate and anchor bolts shall be checked for adequacy.

14. Support shall be checked for all load combinations.

15. The support capacity shall be reduced by 10% for any rotation of TS with respect to embedded plate or base plate from 5° to 85°.

16. A325 bolts may be used instead of Nelson studs on clamps provided the torque applied is not less than that required for Nelson studs.

17. S-0910 modified or IN supports utilizing UNISTRUT members shall be qualified by finite element analysis. A comprehensive finite element analysis of the support shall be performed by using as-built support configuration. Support shall be qualified for SSE loads utilizing allowables listed below:

S-0910 SUPPORT TYPE	MAX. BOLT I.R.	MAX. PLATE STRESS KSI
CA-1	0.76	20.08
CA-2a	0.64	17.00
CA-2b	1.00	24.75
*JA-1	1.00	24.75
*JA-2	1.00	24.75
*JA-3	1.00	24.75

*Maximum stress for plate elements where weld exists, shall not exceed 15.4 ksi for SSE loads.

6.1.16.1.3 "IN" Supports

An individually engineered (IN) support is a support which does not conform to typical details given in Drawing No. S2-0910 or Drawing No. S-0190. The procedures described in Section 6.1.16.1.2.c shall in general be used in the design verification of IN supports.

Consider fixed connections for frame evaluation and use pin connections at base plate to check support frequency.

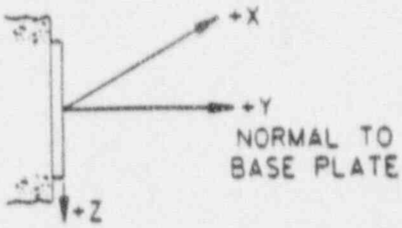
If frequency does not meet the minimum frequency requirement, then use actual spring constants at base plate connections to calculate

actual support frequency. Care should be exercised to assess that the minimum frequency is global or in the components of interest and not localized for complicated supports.

6.1.16.2 Computer Model

A three dimensional STRUDL of the support shall be used with relative eccentricities between interconnected members determined in accordance with guidelines contained herein.

a. For generic supports the model shall be prepared using a global axes where the Y-axis is perpendicular co the base plate or embedded plate as shown below.

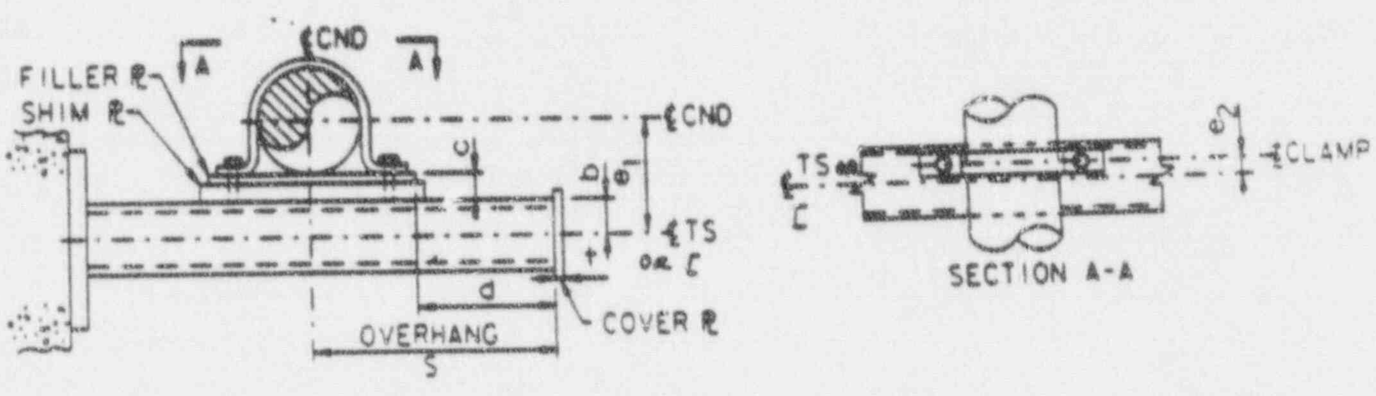


b. For Modified and IN supports the model shall be prepared using a global axes where the Y-axis is vertical, the X & Z axes oriented in the N-S and E-W directions according to Figure 7.28.

6.1.16.3 Eccentricities

Various eccentricities must be considered to realistically account for the application of loads and interconnections between structural members.

a. A rigid member shall be used to represent the eccentricity between the center of gravity of conduit (point of load application) and the center of gravity of supporting member. Any torsional moment from shear center to center of conduit not accounted for by the use of rigid members shall be added to the model as additional torsion.



e_1 = Length of Rigid Link

= 1/2 conduit O.D.* + b + c

S = Overhang

= 1/2 (Conduit Clamp Lengths* + t) + d

* Use 5" Ø max. conduit unless otherwise noted.

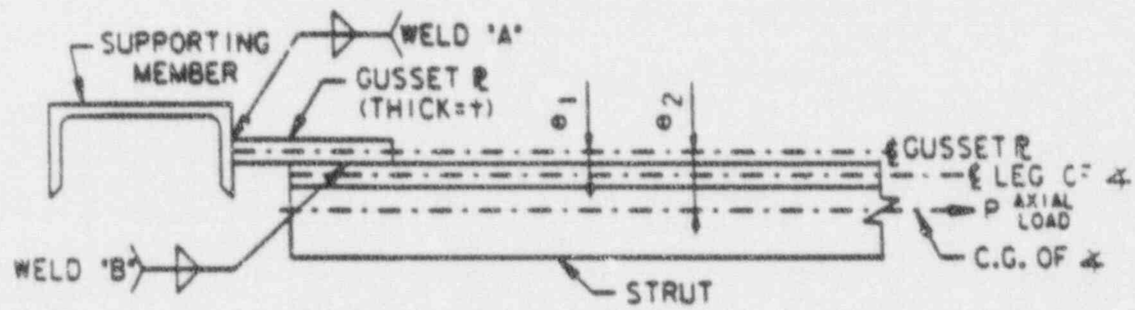
c = Maximum combined thickness of shim plates and filler plate as shown on the drawings. If not specified, use 1-1/14" maximum for S-0910 support details and 2" maximum for S2-0910 support details.

d = Maximum distance between edge of clamp and the tip of tube as shown on the drawings. (Use 2" if not specified).

t = Cover plate thickness. (Weight of the cover plate shall be lumped at the tip of the tube (TS) member).

b. Rigid member from the center of gravity of a member to the center of gravity of a connected member shall be used to represent the eccentricity between members where relative movement is negligible (see Figures 7.31.1 and 7.31.2).

c. For simplicity, the eccentricity between the centerline of gusset plate and center of gravity of connected member (strut) may be excluded from the model and the following procedure used for verifying the members and welds involved:



1. The Moment due to the eccentricity (P x e_2) shall be taken by the strut member. The stresses due to this moment shall be manually added to stresses from computer output due to axial load (P).

2. The gusset plate, weld "A" and weld "B" shall be designed for the axial load (P) plus the moment due to (Pxe_1).

6.1.16.4 Nodal Point

All nodal point connections shall be as follows:

a. For bracing:

   1. Pin connection shall be assumed on connection with plate. (See Figure 7.32.1)

   2. Pin connection shall be assumed for braces welded to back of posts. (See Figure 7.31.2)

      Assume one nodal point if the dimension between the top of the horizontal tier and the bottom of the diagonal brace is within d/2 inches for $\geq 50°$ and d/3 inches for $< 50°$ where "d" is the width of the post to which bracing is welded (see Figure 7.32.2).

b. For post to tiers:

   All shall be fixed connections.

6.1.16.5 Boundary Conditions

Boundary assumptions should reflect the actual anchorage configuration.

Specific conditions for various anchorage configurations shall be as follows:

a. Surface angle or base plate connection to concrete with Hilti bolts or Richmond Inserts.

   The anchorage flexibility shall be considered in the analysis by introducing the spring rate at the connection in order to provide a more realistic distribution of moments throughout the entire frame. The following guidelines apply to Figure 7.7:

   1. Spring rate values may be obtained from the table if the anchorage configuration falls within the range covered by the table.

   2. The distance of the bolt from the end of the angle can vary from 2.5 inches minimum to 4.5 inches maximum.

   3. If the spacing L of the anchorage does not match exactly the spacing in the table, linear interpolation between the immediately higher and lower spacing can be used.

   4. The values shown in the table are acceptable when the centerline of the post is within 6 inches of the centerline of the two bolts, so long as the edge of the channel attachment is not beyond the bolt centerline.

5. It must be noted that the spring rates are given in the local coordinate system of the base angle. They have to be converted to the global coordinate system of each individual STRUDL analysis.

6. If the anchorage configuration does not satisfy steps 1 through 4, then a baseplate analysis run to obtain spring rates for each such plate shall be performed. It must be noted that the spring rates as obtained are given in the local coordinate system of base angle. They have to be converted to the global coordinate system of each individual STRUDL analysis.

7. For steel members welded directly to embedded plates, the joint shall be assumed rigid with all anchorage translations and rotations fixed.

8. Translational stiffnesses for base angle configurations in the table need not be considered in the design verification. Their impact on system frequency is insignificant for frequencies smaller than 33 Hertz for the normal load range. In addition, disregarding translational spring rates in the static analysis yields slightly higher reactions, which is conservative. For marginal cases, where reduction in conservatism is required, translational spring rates can be incorporated in the design, and will be calculated on a case by case basis.

9. For "softer" anchor bolts, (specifically 1" Hilti Kwik bolts and smaller, with an anchorage reaction due to dead load greater than 1 Kip), the impact of the translational stiffness on the frequency may not be negligible. For these cases, translational stiffnesses in all three directions should routinely be incorporated in the design.

10. Spring rate for the base plates of modified or IN supports with anchorage configurations which are similar to generic supports may be obtained from the calculation books of the applicable generic supports.

    The anchorage shall not be modelled in the static analysis model, however, it will be checked as described in Section 6.1.12.5.

b. Welded Connection

If a structural member is welded all around to an embedded plate or containment liner, the connection should be assumed to be fixed in all three (3) directions.

6.1.16.6 KL/r Requirements And K Factors

The following applies to KL/r requirements and K values to be used in slenderness ratio calculations:

a. Compression Member KL/r Requirements

Slenderness ratios (KL/r) for "compression members" shall be limited to 200 in accordance with Section 1.8.4 of the AISC American Institute of Steel Construction. All support members shall conservatively be considered as "compression members" except for vertical posts as noted below.

b. Classification of support vertical post members of Trapeze, LW and L Shape Configurations as a "compression" or "tension" member shall be based upon the axial load component. If there is any static compressive force (due to dead load), the member shall be classified as a "compression member" and the requirement in part (a) above shall be applied.

If a vertical post member is subject to static tension and the combined static plus dynamic load does not lead to a compressive force greater than 50% of the design compressive strength (where KL/r is used to calculate the design compression strength Fa), the member is classified as a "tension member". A maximum slenderness ratio (KL/r) limit of 300 is applied to these members. All other vertical post members shall be classified as " compression members" and the requirements of part (a) above shall be applied.

c. "K" Value Determination for Slenderness Ratio Check

K values shall be determined as specified on Figure 7.33 for KL/r check.

d. Compressive Stress Check Requirement

Regardless of the member classification, a full compressive stress check shall be performed in accordance with AISC American Institute of Steel Construction for any member subject to a compressive load, regardless of the amplitude of the load and whether the load is static or dynamic.

For compression members, the appropriate "K" value shall be used. For "tension members", K=1) shall be used.

6.1.16.7 Additional Notes

a. Whenever open section members are used, hand calculations should be made to check warping stresses. Shear stresses due to torsion are to be checked if not already verified by the STRUDL program.

b. When using rotational stiffness coefficients with the frequency analysis, these spring constants should be included under "joint releases" command (See PD STRUDL Users Manual).

c. For clarification in using Beta Angles, refer to Figure 7.34.

d. In the design verification of L-shaped structural steel members subject to bending and compression such as bracing angle connected with a gusset plate, the required reduction in allowable bending stress about the strong axis of various angle sizes for spans from 24" to 144" are provided in Figure 7.36.1.

In calculating the interaction ratio, the allowable bending stress about the weak axis shall be taken as 0.6 Fy (22 ksi for A36 steel) and the allowable compressive stress (Fa) obtained with consideration of torsional buckling. For this purpose, a table is developed (see Figure 7.36.2) listing the maximum angle lengths of various angle sizes for which torsional buckling needs to be considered.

The allowable load in a 3 x 3 x 3/8 angle bracing for lengths from 36 to 108 inches has been calculated and is provided in

Figure 7.36.3. For sample calculations of angle subject to bending, see Ebasco Calculation Book No. Supt-0235.

e. For all calculations:

E_s (Modulus of elasticity for steel) = 29 x 10^3 ksi

E_c (Modulus of elasticity for concrete) = 3460 ksi

G (Shearing Modulus of elasticity for steel) = 11.2 x 10^3 ksi

f. If any section with a used or unused bolt hole has an interaction equation coefficient larger than 0.75, the section shall be manually verified by reducing the area and moment of inertia to account for the bolt hole.

g. Whenever an as-built drawing shows that a conduit orientation is not perpendicular to a support (skewed), the forces should be appropriately decomposed into components.

h. Principal axes properties shall be used in the design verification of all angle sections.

i. The following shall be used in modelling:

1. The model should be drawn in the calculations.

2. The global axes should be shown.

3. Node points should be circled. The starting point may be assigned as point number 1 and the remaining points numbered in sequence.

4. Members should have the member number indicated by placing a box around the member number.

5. Arrow Heads should indicate the + X Local Axis for the member. (This is determined by the way the member incidences are input).

6.1.16.8 <u>Dead Loads For Generic Supports</u>

Values specified in the capacity table shown on the drawing in Drawing No. S2-0910 or Drawing No. S-0910 which includes the weight of clamps, shim plates, filler plates, connection bolts, etc., shall be used as the dead load of conduit lumped at the C.G. of the conduit.

6.1.16.9 <u>Dead Loads For Modified And "IN" Supports</u>

The determination of tributary conduit loads L_H and L_T shall be done as per "LS" series drawing of Drawing No. S-0910 or "LS" Series and "PESD" Series of Drawing No. S2-0910 for all supports.

The weight of shim and filler plates shall be calculated based on as-built dimensions and added to the conduit loads. When standard shim and filler plates are used, CSD series drawings of Drawing No. S-0910 or Drawing No. S2-0910 shall be used to calculate the weights of the standard shim and filler plates.

The weight of structural members shall be automatically generated by the STRUDL program. The weight of cover plate shall be calculated and input as mass at the tip of the tube. Conduit loads shall be

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applied at the conduit location which produces maximum stress for supports. Where application of load at one location does not produce maximum stress on all structural components, the member where the load was not applied at the most critical location shall be verified manually or by making an additional computer run to print stresses only for the member under investigation.

6.1.16.10 Seismic Loads

The seismic loads are calculated by multiplying the appropriate weights by the applicable accelerations in three orthogonal directions.

a. Generic Supports

The design "g" values given in Figures 7.3.1 through 7.3.7 shall be rotated to account for the most critical loading conditions for the support.

The design "g" values in each direction shall be rotated to envelope all conduit orientations unless otherwise justified. However, "g" values need not be rotated provided the actual orientation of the support is known and considered **and the limitations of Section 6.1.4.8 are met**.

For supports mounted between two floor elevations, the larger of the "g" values of the floors shall be used.

Since "g" values differ for each elevation in each building, the number of analyses required may be reduced by using the most critical set (g_1, g_2, g_3) which will envelope all other sets. A set of enveloped design "g" values thus obtained is provided in Figure 7.37 for each building.

The weight of the junction box including its contents shall be considered for 1.5 times peak "g" values while the weight of conduit and dead weight of the support is designed for the design "g" values. To simplify the STRUDL input, the weight of the junction box and contents may be multiplied by an equivalent coefficient (maximum ratio between 1.5 peak "g" and design "g" in three directions) to convert the weight of the box and contents. The design "g" value is then used to obtain seismic loads for the design verification of junction box supports.

To reduce the number of analyses required, the equivalent coefficients for all the buildings are condensed into three groups based on controlling "g" value and frequency and are provided in Figure 7.16.1. The buildings and elevations in each group are provided in Figure 7.16.2.

When a portion of the ISO is attached to a support by other discipline or to the Spread Room Frame (SRF), the seismic loads on the next and second next supports to other discipline or SRF support shall be calculated based on the enveloped 1.5 times peak "g" values from floor elevation above and below. This may be accomplished by multiplying conduit loads (L_4 and L_7) by a coefficient equal to the ratio of 1.5 peak "g" to design "g" and using the design "g" values in the static analysis of the support.

For the cases when the conduit support is attached to a steel platform, steel platform response spectra should be used instead of regular floor response spectra.

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b. Modified and IN Supports

Unless the RSM analysis is performed to determine the actual "g" values and the support orientation is known, the support has to be design verified in accordance with the design "g" values given in Figures 7.3.1 through 7.3.7. The design "g" values in each direction shall be rotated to envelop all conduit orientations unless otherwise justified. However, "g" values need not be rotated provided the actual orientation of the support is known and considered **and the limitations of Section 6.1.4.8 are met**.

The design "g" values used for IN supports shall be multiplied by a load factor as specified in Section 6.1.2.3, as applicable.

For supports mounted between two floor elevations, the larger of the "g" values of the floors shall be used.

Since "g" values differ for each elevation in each building, the number of analyses required may be reduced by using the most critical set (g_1, g_2, g_3) which will envelop all other sets. A set of enveloped design "g" values thus obtained is provided in Figure 7.37 for each building for S-0910 supports.

The weight of the junction box including its contents shall be considered for 1.5 times peak "g" values while the weight of conduit and dead weight of the support is designed for the design "g" values. To simplify the STRUDL input, the weight of the junction box and contents may be multiplied by an equivalent coefficient (maximum ratio between 1.5 peak "g" and design "g" in three directions) to convert the weight of the box and contents. The design "g" value is then used to obtain seismic loads for the design verification of junction box supports.

To reduce the number of analyses required, the equivalent coefficients for the six buildings are condensed into three groups based on controlling "g" value and frequency and are provided in Figure 7.16.1. The buildings and elevations in each group are provided in Figure 7.16.2. These values are provided for S-0910 supports only.

When a portion of the ISO is attached to a support by other discipline or to the Spread Room Frame (SRF), the seismic loads on the next and second next supports to other discipline or SRF support shall be calculated based on the enveloped 1.5 times peak "g" values from floor elevation above and below. This may be accomplished by multiplying conduit loads (L_1 and L_T) by a coefficient equal to the ratio of 1.5 peak "g" to design "g" and using the design "g" values in the static analysis of the support.

6.1.16.11 <u>Load Combinations</u>

Load Combinations Within STRUDL Computer Analysis

a. Generic Supports

The required load combinations are identified in the computer skeleton for "g" values which require rotation (see Attachment 8.E) and for those which do not require rotation (see Attachment 8.H).

b. Modified and "IN" Supports

Specific load combination for modified and IN supports are identified in the computer input skeletons prepared for "g" values which require rotation (see Attachment 8.G) and for those which do not require rotation (see Attachment 8.H).

6.1.17 FOOT PRINT LOADS

Footprint loads shall be transmitted to the Civil/Structural Group and other disciplines as per the requirements of Procedure 2EP-5.17.

6.1.18 HAND CALCULATIONS

Hand calculations and engineering evaluations may be perfor[illegible] in lieu of computer analysis for the design validation of con[illegible] systems that do not meet the generic requirements of S-091[illegible] [illegible] S2-0910 Drawings.

6.1.19 MISCELLANEOUS INFORMATION

a. Collecting as-built data and/or additional information to update isometrics shall be as per Engineering Assessment Procedure 2-EAP-003.

b. Public domain computer programs, such as STRUDL, or ABB Impell computer programs that are approved by ABB Impell Corporation QA program, such as NEWCOND, shall be utilized in performing the analysis. Any computer program used must meet the quality assurance requirements of Section QP-6.0 of the Impell QA manual.

c. For Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawing, refer to Design Basis Document DBD-CS-111 for the design criteria.

6.2 **TRAIN C CONDUITS**

The Train C conduit systems and supports are not safety-related and do not have to remain functional or operable during an earthquake. Although the Train C Conduit Systems and supports are not safety-related, they must not impede the operability of Seismic Category I components that are safety-related and may be required to remain operable during a Safe Shutdown Earthquake. Train C Conduit general design criteria is included in Design Basis Document DBD-CS-090 for greater than 2-inch diameter conduits and Design Basis Document DBD-CS-093 for 2-inch diameter and smaller conduits.

Existing Unit 2 Train C Conduit systems and supports will be validated by the Unit 2 Civil/Structural II over I program using a "comparison to experience database" type of approach. This approach will validate a large number of these conduit systems and supports through a rapid walkdown screening process. Conduit systems and supports that do not pass this screening process (outliers) will be validated by the Unit 2 Civil/Structural Electrical Raceway Group through verifying their structural integrity due to the combined dead weight and seismic loads. Also falling under the Electrical Raceway Group scope is the evaluation of the new Train C Conduit systems and supports that cannot be installed as per the generic drawings as specified in Specification CPES-S-2005.

The guidelines, criteria and procedures to be used in the analysis and design of Unit 2 Train conduit systems and supports, requiring

systems and supports that cannot be installed as per the generic drawings as specified in Specification CPES-S-2005.

The guidelines, criteria and procedures to be used in the analysis and design of Unit 2 Train conduit systems and supports, requiring structural integrity verification, shall be as provided in Engineering Technical Procedure ECS-5111 for 2-inch diameter and smaller conduits, and Section 6.1 of this procedure for greater than 2-inch diameter conduits.

The following clarifications apply to larger than 2-inch diameter conduits:

The following interaction equation shall be satisfied for all clamp connection details except when A-307 or unidentifiable bolts are used in clamp or when 3/8" Ø Nelson studs or UNISTRUT bolts are used with C-708-S clamp.

$$\frac{L}{L_u} + \frac{T}{T_u} + \frac{V}{V_u} \leq 0.5$$

where:

L, T, V = Calculated clamp loads in the axial, transverse and vertical directions

L_u, T_u, V_u = Clamp static ultimate capacities in the axial, transverse and vertical directions.

Dead weight shall be added by absolute sum to the appropriate seismic load direction.

The clamp ultimate capacities are given in Figures 7.1.11 through 7.1.15. For convenience, allowable clamp loads of equal magnitude in all three directions are also given in these tables. If the calculated clamp load in all three directions are less than the allowable load, the clamp is adequate and there is no need to evaluate the clamp by the interaction equation.

For C-708-S clamp, 3/8" Ø Nelson studs and UNISTRUT bolts, the clamp adequacy shall be evaluated in accordance with the criteria for Trains A and B conduit systems.

When clamps are used with A-307 or unidentifiable bolts, the clamp adequacy shall be evaluated in accordance with the criteria for Trains A and B conduit systems.

The adequacy for clamp types not covered herein shall be validated based on the vendor supplied test data for clamp allowables and the acceptable method by industry.

The following clarifications apply to 2-inch diameter and smaller conduits:

a. The following supersedes Section 6.4 of ECS-5111:

   Collecting as-built data shall be as per Engineering Assessment Procedure 2-EAP-003.

b. In Section 6.6.1.4 of ECS-5111, the following paragraph is added:

Field Print Load (FPL) transmittals shall be prepared in accordance with Engineering Procedure 2EP-5.17 and submitted to Civil/Structural Group for approval.

New Train C conduit systems and supports shall be design validated based on the guidelines and criteria provided in this procedure.

6.3 **GENERIC EVALUATION GUIDELINES**

This section establishes the guidelines for recommended approaches in performing generic type evaluations of conduit systems and supports. These evaluations shall be utilized in place of performing detailed individual evaluations.

- Design Validation of Conduit Systems and Supports by Comparison/Similarity

  Unit 2 conduit systems and supports may be design validated based on comparison/similarity for Unit 1 and Unit 2 Recommended design validated systems and supports. Unit 1 lessons learned shall be utilized as much as possible.

- Design Validation of Conduit Systems and Supports Using Sampling Techniques

  Sampling can be performed in accordance with the guidelines of Procedure ECE-3.26 (Attachment 8.B of ECE 3.26, Sampling Plan D) to resolve issues such as procedural compliance, audit issues, component qualification, existing documentation, etc.. **The population shall be considered design validated if the selected sample is demonstrated to conform with the current design basis.**

- Design Validation of Conduit Systems and Supports Using Representative/Envelope Case

  A representative case(s) can be selected for detailed rigorous analysis. The representative case(s) shall be the most critical in the population in order to extrapolate the results into the rest of the population. The selection of the most critical case(s) shall be based on conduit size, conduit configuration, clamp type, support configuration, G values, design margin, etc..

The engineer, depending on the subject/issue, shall decide on the appropriate applicable approach/combination to be used. The approach/combination used, as well as the logic behind it, shall be documented in a generic calculation/report. The generic evaluation shall be based on the guidelines and criteria provided in this procedure.

6.4 **EVALUATION OF UNIT 1 PCHVP RESULTS FOR APPLICABILITY TO UNIT 2**

Evaluation of Unit 1 Post Construction Hardware Validation Program (PCHVP) results for applicability to Unit 2 shall be done in accordance with Unit 2 Procedure 2EP-2.04. This evaluation will consider the results and lessons learned during the implementation of the Unit 1 PCHVP; will develop the basis for identifying any required field verifications of the attributes in Unit 2; and, will specify the method to be used for those reverifications (i.e., backfit requirements to specifications, engineering assessment procedures, etc.).

6.5 **FORMAT OF CALCULATION**

Procedure 2IM-2.00 in conjunction with Procedure 2EP-5.08 shall govern the preparations, approval and control of project calculations.

6.6 **FORMAT OF DRAWINGS**

Procedure 2IM-2.00 shall govern the preparations, approval and control of project drawings.

6.7 **CHECKING CRITERIA**

The checking criteria in QP 3.6 of ABB Impell Quality Assurance Manual shall be utilized for checking of project calculations and other applicable documents. The following general criteria shall be used:

a. Originator followed defined procedures.

b. Title, purpose, and function of the work checked are adequately described.

c. Work method clearly stated and appropriate.

d. Assumptions identified. Open items flagged for subsequent verification where necessary.

e. Technical bases and references current and correctly selected and incorporated.

f. Technical inputs properly selected and adequately identified. Any specific inputs to be excluded are adequately identified.

g. Applicable codes, standards and regulatory requirements identified and properly used.

h. Analytical steps can be verified without recourse to originator.

i. Each page of the work identified and traceable to originator, date and job control number.

j. All marking legible and identifiable.

k. Work clearly references any final supporting computer runs.

l. Final computer runs include input listing and output. Correct inputs used.

m. Final computer runs contain unique number identifier.

n. Results consistent with inputs, technical procedures and other project criteria.

o. Results are reasonable.

p. Revisions are clearly documented.

q. Technical interface requirements in the Project Quality Plan have been satisfied.

r. Appropriate quality and quality assurance requirements specified.

The checker shall perform the review using the criteria provided in this procedure. As part of the check, the checker shall trace the impact of any identified errors or discrepancies throughout the item being checked.

When permitted by the format of the item being checked, the checker shall line through or otherwise clearly identify any numerical or procedural discrepancies and indicate the correct values or steps.

When the checking is completed, the checker shall return the originals and any check-copies to the originator. The originator shall resolve any comments and make any necessary changes to the engineering work.

After all items are resolved to the satisfaction of the checker, the checker shall initial and date the original work in the space provided.

7.0 FIGURES

The following figures are part of this document.

8.J GUIDELINES FOR PREPARATION OF CONDUIT ISOMETRICS

8.K GUIDELINES FOR PREPARATION OF CONDUIT DRAWINGS

8.L CALCULATION REVIEW CHECKLIST

9.0 RECORDS

When completed, documents generated in response to this procedure shall be dispositioned in accordance with the Records Management Program manual as directed by STA-302. Document turnover requirements are defined by "Category", assigned by TU Electric Records Management, to provide the requirements for each record type. Turnover categories are defined as follows:

- <u>Category "A"</u> - turnover to TU Electric Records Management required within 60 days of completion of work associated with a document or work package;
- <u>Category "B"</u> - turnover as scheduled by TU Electric Records Management;
- <u>Category "C"</u> - retained by the releasing/generating organization; and,
- <u>Category "D"</u> - turnover not required (non-records).

All calculations are Category "A".

FIGURE 7.1.1

CLAMP TRANSVERSE ALLOWABLES (LBS.) USING UNISTRUT BOLTS

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CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE				
	STD BOLT P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	STD BOLT C-708-S
3/4	210	340	320	X	X
1	100	160	450	X	X
1-1/2	290	260	460	X	X
2	420	560	600	580	480
3	450	230	1050	640	500
4	450	235	865	630	550
5	560	240	680	620	600

NOTES:
1. For "oversize bolt" size see Figure 7.4.1
2. Above data taken from SAG.CP10, Table 1.1.

FIGURE 7.1.2

CLAMP AXIAL ALLOWABLES (LBS.) USING UNISTRUT BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE				
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	C-708-S
3/4	90 (30)	520 (192)	280 (168)	X	X
1	180 (60)	160 (59)	480 (288)	X	X
1-1/2	200 (66)	340 (125)	360 (216)	X	X
2	560 (207)	750 (450)	500	640	480 (288)
3	400 (148)	650 (390)	1000	600	480 (288)
4	400 (148)	625 (375)	1000	600	530 (318)
5	400 (148)	600 (360)	1000	600	580 (348)

NOTES:

1. IF A-307 OR UNIDENTIFIABLE BOLTS ARE USED, THE CLAMP AXIAL ALLOWABLES AS SHOWN IN PARENTHESIS SHALL BE USED.
2. For "oversize bolt" size, see Figure 7.4.1
3. Above data taken from SAG.CP10, Table 1.2.

FIGURE 7.1.3

CLAMP VERTICAL ALLOWABLES (LBS.) USING UNISTRUT BOLTS

CONDUIT NOMINAL DIAMETER (IN)	CLAMP TYPE				
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	C-708-S
3/4	200	320	700	X	X
1	180	400	540	X	X
1-1/2	280	280	440	X	X
2	400	520	1080	600	480
3	440	1000	1000	640	440
4	340	1000	760	620	490
5	240	1000	520	600	540

NOTES: 1. For "oversize bolt" size, see Figure 7.4.1

2. Above data taken from SAG.CP10, Table 1.3.

FIGURE 7.1.4

CLAMP TRANSVERSE ALLOWABLES (LBS.) USING NELSON STUDS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE				
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	C-708-S
3/4	145	534	640	X	X
1	150	520	900	X	X
1 1/2	100	334	819	X	X
2	665	860	1475	830	806
3	512	1112	1506	1000	900
4	631	1325	1400	950	850
5	750	1538	1300	880	800

NOTES: 1. For "oversized bolt" size, see Figure 7.4.1

2. Above data taken from SAC.CP10, Table 1.4.

FIGURE 7.1.5

CLAMP AXIAL ALLOWABLES (LBS.) USING NELSON STUDS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE				
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	C-708-S
3/4	196 (64)	450 (166)	920 (552)	X	X
1	124 (40)	368 (136)	606 (363)	X	X
1-1/2	310 (102)	440 (162)	760 (456)	X	X
2	972 (359)	1100 (660)	675	1100	886 (531)
3	433 (160)	1084 (650)	785	925	750 (450)
4	554 (205)	1354 (812)	770	925	700 (420)
5	675 (249)	1624 (974)	800	1000	650 (390)

NOTES:

1. IF A -307 OR UNIDENTIFIABLE BOLTS ARE USED, THE CLAMP AXIAL ALLOWABLES AS SHOWN IN PARENTHESIS SHALL BE USED.
2. For "oversized bolt" size, see Figure 7.4.1
3. Above data taken from SAG.CP10, Table 1.5.

FIGURE 7.1.6

CLAMP VERTICAL ALLOWABLES (LBS.) USING NELSON STUDS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE				
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S (OVERSIZED BOLT)	C-708-S
3/4	196	534	450	X	X
1	128	393	900	X	X
1-1/2	100	334	819	X	X
2	665	760	1475	830	806
3	512	1063	1600	1040	1000
4	576	1300	1600	850	1000
5	640	1538	1600	680	1000

NOTES: 1. For "oversize bolt" size, see Figure 7.4.1

2. Above data taken from SAG.CP10, Table 1.6.

FIGURE 7.1.7

CLAMP TRANSVERSE ALLOWABLES (LBS.) USING HILTI KWIK BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE			
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S
3/4	100	205	480	X
1	125	220	360	X
1-1/2	80	240	310	X
2	240	320	X	660
3	360	1288	X	1000
4	[illegible]	1200	X	660
5	[illegible]	1185	X	320

NOTES: 1. For "oversize bolt" size, see Figure 7.4.1

2. Above data taken from SAG.CP10, Table 1.7.

FIGURE 7.1.8

CLAMP AXIAL ALLOWABLES (LBS.) USING HILTI KWIK BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE			
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S
3/4	70	360	660	X
1	125	230	648	X
1-1/2	130	120	780	X
2	250	525	X	700
3	280	800	X	625
4	230	800	X	625
5	180	800	X	1150

NOTES: 1. For "oversize bolt" size, see Figure 7.4.1

2. Above data taken from SAG.CP10, Table 1.8.

FIGURE 7.1.9

CLAMP VERTICAL ALLOWABLES (LBS.) USING HILTI KWIK BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CLAMP TYPE			
	P-2558 OR C-708-U	P2558 (OVERSIZED BOLT) & C-708N-U	C-708N-U (OVERSIZED BOLT)	C-708-S
3/4	275	200	510	X
1	95	180	290	X
1-1/2	120	240	360	X
2	300	560	X	620
3	260	1288	X	1000
4	260	1200	X	630
5	260	1184	X	260

NOTES: 1. For "oversize bolt" size, see Figure 7.4.1

2. Above data taken from SAG.CP10, Table 1.9.

FIGURE 7.1.10

CLAMP ALLOWABLES (LBS) FOR C-708-S WITH 3/8" Ø UNISTRUT BOLTS OR NELSON STUDS

CONDUIT NOMINAL DIAMETER (IN.)	ALLOWABLE LOADS(lbs)		
	L_a	T_a	V_a
2	353 (130)	1067	1217
3	842 (311)	1167	1292
4	520 (192)	1980	1640

NOTES:
1. If A-307 or unidentifiable bolts are used, the clamp axial allowables as shown in parenthesis shall be used.
2. Above data taken from SAG.CP10, Table 1.6a.

FIGURE 7.1.11

CLAMP ALLOWABLES (LBS) FOR TRAIN C CONDUITS WITH P-2558 CLAMPS AND STANDARD BOLT SIZES

CONDUIT NOMINAL DIAMETER (IN.)	CONNECTION TYPE											
	UNISTRUT BOLTS				NELSON STUDS				HILTI KWIK BOLTS			
	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u
3/4	320	1581 (521)	2160	2160	199	642	1746	1746	198	532	3143	3143
1	424	1651 (544)	2447	6178	130	371	1184	3353	202	532	3763	3100
1- 1/2	320	1309 (432)	2520	2520	168	1033	1002	1002	157	400	2983	2983
2	767	2216 (819)	7622	14471	846	2918	8058	8058	404	1046	7640	6684
3	798	3031 (1121)	6755	6755	461	1301	5034	8592	577	2058	5273	5273
4	1059	3983 (1473)	7695	11033	591	1905	4922	8558	620	2079	5647	6763
5	1303	4936 (1826)	8635	15322	690	2510	4811	8524	654	2100	6022	8254

NOTES:

1. IF A-307 OR UNIDENTIFIABLE BOLTS ARE USED, THE ALLOWABLES SHALL NOT BE USED. INSTEAD, THE CLAMP ULTIMATE LOAD IN THE LONGITUDINAL DIRECTION, Lu, AS SHOWN IN PARENTHESIS SHALL BE USED IN THE INTERACTION EQUATION.
2. Above valves taken from SAG.CP10, Table 1.10.

FIGURE 7.1.12

CLAMP ALLOWABLES (LBS) FOR TRAIN C CONDUITS WITH P-2558 CLAMPS AND OVERSIZED BOLTS AND WITH C-708N-U AND C-708-U AND STANDARD BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CONNECTION TYPE											
	UNISTRUT BOLTS				NELSON STUDS				HILTI KWIK BOLTS			
	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u
3/4	534	1631 (603)	6220	6220	476	1351	6474	6474	448	1253	6308	6308
1	432	1309 (484)	6100	4377	392	1104	6158	4879	308	775	6388	5669
1-1/2	450	1782 (659)	3640	3640	399	1323	4049	4049	283	715	5499	5499
2	747	3168 (1900)	5656	5656	1268	4655	11151	11151	945	2640	13333	13333
3	1042	3030 (1818)	10266	19244	1085	4337	8900	8499	1039	2988	14402	13030
4	1130	3223 (1933)	12770	18602	1400	6272	9120	11386	1352	4680	12054	13668
5	1208	3417 (2050)	15275	17961	1672	8208	9341	14273	1515	6372	9707	14306

NOTES:

1. IF A-307 OR UNIDENTIFIABLE BOLTS ARE USED, THE ALLOWABLES SHALL NOT BE USED. INSTEAD, THE CLAMP ULTIMATE LOAD IN THE LONGITUDINAL DIRECTION, Lu, AS SHOWN IN PARENTHESIS SHALL BE USED IN THE INTERACTION EQUATION.
2. For "oversize bolt" size. See Figure 7.4.1
3. Above data taken from SAG.CP10, Table 1.11.

FIGURE 7.1.13

CLAMP ALLOWABLES (LBS) FOR TRAIN C CONDUITS WITH C-708N-U AND C-708-U CLAMPS WITH OVERSIZE BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CONNECTION TYPE											
	UNISTRUT BOLTS				NELSON STUDS				HILTI KWIK BOLTS			
	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u
3/4	465	1138 (682)	10189	10189	945	2800	11659	11659	736	1992	11214	11214
1	631	1783 (1069)	9227	8190	716	2303	10457	5974	566	1521	8899	8899
1-1/2	621	1978 (1186)	6700	6700	781	2280	9936	9936	689	2360	6632	6632
2	1066	2765	16099	22163	825	2026	17890	17890	-	-	-	-
3	1044	3038	13393	13393	1035	2854	12602	18903	-	-	-	-
4	1515	4631	17266	17880	1347	4595	10031	18637	-	-	-	-
5	1978	6225	21139	22367	1443	6337	7461	18372	-	-	-	-

NOTES:

1. IF A-307 OR UNIDENTIFIABLE BOLTS ARE USED, THE ALLOWABLES SHALL NOT BE USED. INSTEAD, THE CLAMP ULTIMATE LOAD IN THE LONGITUDINAL DIRECTION, Lu, AS SHOWN IN PARENTHESIS SHALL BE USED IN THE INTERACTION EQUATION.
2. For "oversize bolt" size, see Figure 7.4.1
3. Above data taken from SAG.CP10, Table 1.12.

FIGURE 7.1.14

CLAMP ALLOWABLES (LBS) FOR TRAIN C CONDUITS WITH C-708-S CLAMPS WITH STANDARD BOLTS

CONDUIT NOMINAL DIAMETER (IN.)	CONNECTION TYPE											
	UNISTRUT BOLTS				NELSON STUDS				HILTI KWIK BOLTS			
	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u
3/4	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-
1-1/2	-	-	-	-	-	-	-	-	-	-	-	-
2	1216	3910 (2346)	12872	12872	861	2660	9776	9776	1227	3820	13742	13742
3	1601	6376 (3825)	12872	12872	1361	4766	13451	12041	1173	4008	13681	9658
4	1486	6324 (3794)	11226	11226	1334	4557	13084	12720	1299	4636	12930	10919
5	1357	6272 (3763)	9581	9581	1304	4349	12717	13399	1411	5265	12180	12180

NOTES:

1. IF A-307 OR UNIDENTIFIABLE BOLTS ARE USED, THE ALLOWABLES SHALL NOT BE USED. INSTEAD, THE CLAMP ULTIMATE LOAD IN THE LONGITUDINAL DIRECTION, Lu, AS SHOWN IN PARENTHESIS SHALL BE USED IN THE INTERACTION EQUATION.
2. Above data taken from SAG.CP10, Table 1.13.

FIGURE 7.1.15

CLAMP ALLOWABLES (LBS) FOR TRAIN C CONDUITS WITH C-708-S CLAMPS WITH OVERSIZED BOLTS

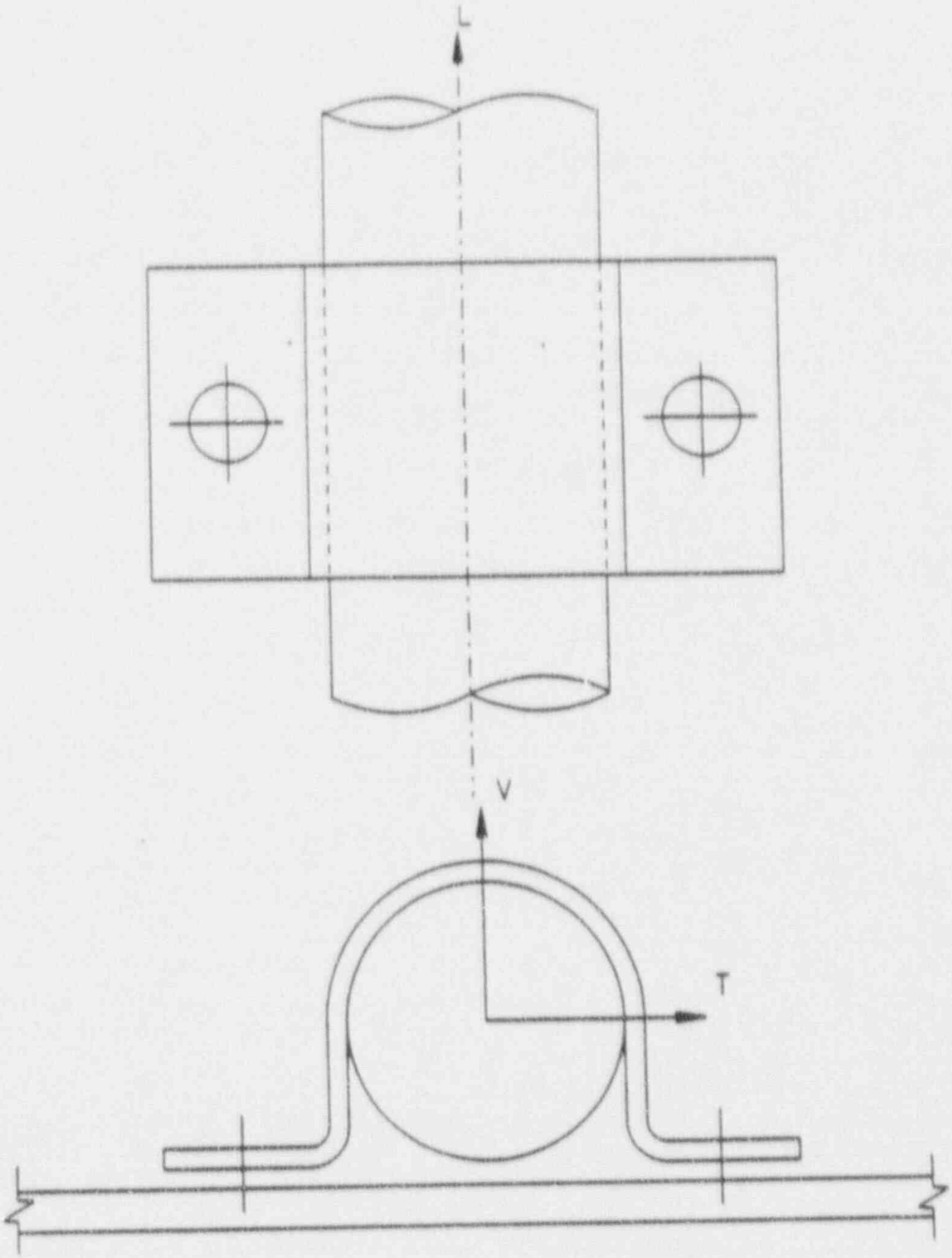
CONDUIT NOMINAL DIAMETER (IN.)	CONNECTION TYPE											
	UNISTRUT BOLTS				NELSON STUDS				HILTI KWIK BOLTS			
	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u	ALLOWABLES	L_u	T_u	V_u
3/4	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-
1-1/2	-	-	-	-	-	-	-	-	-	-	-	-
2	1216	3328	18085	18085	975	3620	8464	8464	-	-	-	-
3	2277	8644	19259	19259	1371	4700	13172	13172	-	-	-	-
4	1906	6694	17723	17723	1582	4823	18413	18413	-	-	-	-
5	1495	4744	16187	16187	1743	4947	23654	23654	-	-	-	-

NOTES:

1. For "oversize bolt" size, see Figure 7.4.1
2. Above data taken from SAG.CP10, Table 1.14.

FIGURE 7.2

DEFINITION OF L, V AND T DIRECTIONS FOR CONDUIT CLAMP



NOTE: Above figure taken from SAG.CP10, Figure 1.

FIGURE 7.3.1

DESIGN "g" VALUES FOR CONDUIT SUPPORTS-ELECTRICAL CONTROL BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
873'-4"	1.73	1.19	1.98	2.50	1.82	3.00
854'-4"	1.90	1.15	1.98	2.50	1.63	3.03
830'-0"	2.12	0.99	1.85	1.94	1.32	2.75
807'-0"	1.58	0.75	1.88	2.25	1.13	2.88
778'-0"	1.07	0.62	1.92	1.65	1.04	3.10

Minimum conduit support frequency for this building is 12 Hz. with the exception at elevation 807.00', 778.00' to be 14 Hz, 16 Hz, respectively.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Electrical Control Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.2

DESIGN "g" VALUES FOR CONDUIT SUPPORTS - FUEL BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
918'-0"	4.22	5.34	2.20	4.16	5.40	3.18
899'-6"	2.67	4.70	2.22	3.44	4.76	3.30
860'-0"	2.43	2.43	2.01	3.57	3.47	3.03
841'-0"	2.07	1.83	1.83	3.17	2.84	2.85
825'-0"	1.79	1.53	1.79	2.75	2.43	2.75
810'-6"	1.53	1.38	1.65	2.31	2.06	2.60

Minimum conduit support frequency for this building is 16 Hz.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Fuel Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.3a.

DESIGN "g" VALUES FOR CONDUIT SUPPORTS - UNIT 1 SAFEGUARDS BUILDING
INCLUDING DIESEL GENERATOR BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
896'-6"	2.73	1.95	3.27	4.13	2.88	4.25
873'-6"	2.27	1.79	3.53	3.20	2.47	4.83
852'-6"	2.40	1.35	2.60	2.91	2.09	3.91
831'-6"	1.71	1.00	2.29	2.38	1.56	3.44
810'-6"	1.47	0.94	2.14	1.99	1.41	3.44
790'-6"	0.81	0.73	2.20	1.23	1.04	3.42
785'-6"	0.78	0.68	2.13	1.18	0.94	3.31
773'-6"	0.71	0.65	1.99	1.10	1.07	3.09

Minimum conduit support frequency for this building is 16 Hz.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Unit 1 Safeguards Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.3b

DESIGN "g" VALUES FOR CONDUIT SUPPORTS - UNIT 2 SAFEGUARDS BUILDING INCLUDING DIESEL GENERATOR BUILDING

Floor Elevation	DESIGN "g" - VALUES					
	1/2 SSE, 2% Damping			SSE, 3% Damping		
	Horizontal		Vertical	Horizontal		Vertical
	N-S	E-W		N-S	E-W	
896'-6"	3.96	2.30	3.27	4.46	3.08	4.28
873'-6"	3.75	2.08	3.54	4.24	2.78	4.19
852'-6"	2.81	1.58	2.59	3.23	2.01	3.92
831'-6"	1.69	0.95	2.31	2.41	1.45	3.50
810'-6"	1.23	0.88	2.21	1.83	1.56	3.43
790'-6"	0.81	0.70	2.21	1.23	1.09	3.42
785'-6"	0.77	0.65	2.13	1.19	1.01	3.32
773'-6"	0.71	0.54	1.98	1.10	1.07	3.09

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S2-0910 drawings in the Unit 2 Safeguards Building. They do not apply to conduits that are designed in accordance with the requirements of the PESD series of S2-0910 drawings.

3. Above data taken from SAG.CP2, Table A.3.2.

FIGURE 7.3.4

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
AUXILIARY BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
899'-6"	1.88	1.79	4.08	2.64	2.30	4.87
886'-6"	1.53	1.38	3.86	2.44	2.01	4.50
873'-6"	1.48	1.22	2.76	2.26	1.64	3.65
852'-6"	1.74	1.14	2.55	2.30	1.72	3.40
831'-6"	1.83	0.89	2.19	2.50	1.34	3.29
810'-6"	1.16	0.75	2.06	1.71	1.18	3.31
790'-6"	1.11	0.87	2.08	1.68	1.34	3.29

Minimum conduit support frequency for this building is 12 Hz with the exception at elevation 790.50' to be 14 Hz.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Auxiliary Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.5a

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
UNIT 1 CONTAINMENT BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
1000'-6"	1.41	1.56	3.63	1.79	2.19	4.25
950'-7"	1.10	1.36	3.03	1.46	2.03	3.51
905'-9"	1.13	1.25	2.66	1.55	1.78	3.44
860'-0"	1.31	1.06	1.69	1.61	1.61	2.19
805'-6"	0.95	0.94	1.94	1.50	1.69	2.81
783'-7"	0.90	0.75	2.25	1.04	1.56	3.38

Minimum conduit support frequency for this building is 12 Hz.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Unit 1 Containment Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.5b

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
UNIT 2 CONTAINMENT BUILDING

Floor Elevation	DESIGN "g" - VALUES					
	1/2 SSE, 2% Damping			SSE, 3% Damping		
	Horizontal		Vertical	Horizontal		Vertical
	N-S	E-W		N-S	E-W	
1000'-6"	1.44	1.58	3.63	1.79	2.19	4.27
950'-7"	1.16	1.36	2.84	1.48	1.98	3.51
905'-9"	0.91	1.23	2.20	1.30	1.79	2.84
860'-0"	0.69	1.10	1.64	1.04	1.60	2.16
805'-6"	0.98	0.94	1.40	1.22	1.40	2.15
783'-7"	0.84	0.84	1.18	1.07	1.27	1.94

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S2-0910 drawings in the Unit 2 Containment Building. They do not apply to conduits that are designed in accordance with the requirements of the PESD series of S2-0910 drawings.

3. Above data taken from SAG.CP2, Table A.3.3.

FIGURE 7.3.6a.

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
UNIT 1 INTERNAL STRUCTURES OF REACTOR BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
905'-9"	2.14	2.14	2.24	3.13	3.13	3.29
885'-6"	1.86	2.09	1.88	2.81	2.81	2.84
860'-0"	1.88	1.61	1.51	2.29	2.29	2.42
832'-6"	1.78	1.38	1.38	1.98	1.56	2.25
808'-0"	0.84	1.20	2.42	1.11	1.36	2.93
783'-7"	0.74	1.05	2.25	1.07	1.55	3.36

Minimum conduit support frequency for this building is 12 Hz.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Unit 1 Reactor Building.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.6b

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
UNIT 2 INTERNAL STRUCTURES OF REACTOR BUILDING

Floor Elevation	DESIGN "g" - VALUES					
	1/2 SSE, 2% Damping			SSE, 3% Damping		
	Horizontal		Vertical	Horizontal		Vertical
	N-S	E-W		N-S	E-W	
905'-9"	1.75	1.83	2.24	2.61	2.65	3.24
885'-6"	1.44	1.53	1.93	2.15	2.24	2.80
860'-0"	1.61	1.61	1.54	2.16	2.22	2.24
832'-6"	0.93	1.05	1.11	1.28	1.45	1.65
808'-0"	0.83	0.96	1.39	1.07	1.64	2.16
783'-7"	0.49	1.05	1.26	0.82	1.55	1.95

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S2-0910 drawings in the Unit 2 Reactor Building. They do not apply to conduits that are in designed accordance with the requirements of the PESD series of S2-0910 drawings.

3. Above data taken from SAG.CP2, Table A.3.4.

FIGURE 7.3.7

DESIGN "g" VALUES FOR CONDUIT SUPPORTS
SERVICE WATER INTAKE STRUCTURE

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
838'-0"	4.23	2.40	1.35	4.50	2.85	2.20
817'-0"	2.80	1.80	1.31	3.11	2.12	2.10
796'-0"	1.00	1.00	1.20	1.36	1.14	1.92
782'-0"	0.52	0.50	1.02	0.82	0.82	1.67

Minimum conduit support frequency for this building is not applicable because Design "g" values are 1.5 x peak "g" value.

NOTES:

1. The design "g" values in this table have lost their directionality during the design verification cycle. Therefore, they shall be rotated for the design of all conduit supports.

2. The design "g" values in this table apply to Unit 2 conduits that are designed in accordance with the requirements of S-0910 drawings in the Service Water Intake Structure.

3. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3.8

ZPA VALUES FOR CONDUIT SUPPORTS

ELECTRICAL BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
873'-4"	0.25	0.27	0.46	0.39	0.42	0.74
854'-4"	0.21	0.24	0.42	0.34	0.37	0.67
830'-0"	0.17	0.18	0.30	0.28	0.29	0.54
807'-0"	0.15	0.16	0.27	0.27	0.26	0.50
778'-0"	0.12	0.11	0.27	0.21	0.20	0.50

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.3.9

ZPA VALUES FOR CONDUIT SUPPORTS

FUEL BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
918'-0"	0.39	0.37	0.37	0.69	0.67	0.51
899'-6"	0.30	0.33	0.34	0.57	0.60	0.50
860'-0"	0.20	0.17	0.21	0.35	0.31	0.39
841'-0"	0.17	0.16	0.19	0.30	0.29	0.36
825'-0"	0.13	0.14	0.18	0.24	0.26	0.35
810'-0"	0.12	0.13	0.17	0.23	0.24	0.34

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.3.10

ZPA VALUES FOR CONDUIT SUPPORTS

SAFEGUARDS & DIESEL GENERATOR BUILDINGS

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
896'-6"	0.61	0.53	0.77	0.82	0.79	1.12
873'-6"	0.45	0.41	1.03	0.75	0.69	1.46
852'-6"	0.43	0.38	0.86	0.67	0.60	1.25
831'-6"	0.33	0.32	0.59	0.50	0.47	0.90
810'-6"	0.21	0.22	0.45	0.38	0.36	0.74
790'-6"	0.15	0.18	0.29	0.27	0.32	0.54
785'-6"	0.15	0.18	0.27	0.26	0.30	0.51
773'-6"	0.14	0.16	0.25	0.24	0.28	0.46

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.3.11

ZPA VALUES FOR CONDUIT SUPPORTS

AUXILIARY BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
899'-6"	0.34	0.42	0.50	0.55	0.65	0.77
886'-6"	0.30	0.35	0.45	0.49	0.55	0.69
873'-6"	0.27	0.29	0.43	0.44	0.45	0.67
852'-6"	0.25	0.24	0.37	0.38	0.39	0.61
831'-6"	0.22	0.19	0.31	0.34	0.31	0.59
810'-6"	0.15	0.14	0.29	0.25	0.24	0.57
790'-6"	0.12	0.11	0.26	0.22	0.20	0.48

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.3.12

ZPA VALUES FOR CONDUIT SUPPORTS

CONTAINMENT BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
1000'-6"	0.43	0.43	0.55	0.74	0.74	0.84
950'-7"	0.34	0.35	0.45	0.60	0.60	0.69
905'-9"	0.27	0.28	0.36	0.47	0.48	0.57
860'-0"	0.19	0.21	0.27	0.34	0.35	0.44
805'-6"	0.12	0.14	0.19	0.21	0.24	0.33
783'-7"	0.10	0.10	0.15	0.16	0.19	0.28

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.3.13

ZPA VALUES FOR CONDUIT SUPPORTS

INTERNAL STRUCTURES OF REACTOR BUILDING

FLOOR ELEVATION	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
905'-9"	0.43	0.49	0.74	0.64	0.73	1.20
885'-6"	0.37	0.41	0.64	0.53	0.62	0.99
860'-0"	0.28	0.31	0.46	0.41	0.48	0.72
832'-6"	0.18	0.21	0.27	0.29	0.34	0.44
808'-0"	0.12	0.12	0.19	0.21	0.22	0.33
783'-7"	0.08	0.08	0.15	0.15	0.17	0.28

NOTE: Above data taken from SAG.CP20, Attachment P.

FIGURE 7.4.1

STANDARD AND OVERSIZE BOLT/STUD DIAMETER (IN)
FOR VARIOUS TYPES OF CLAMPS

CLAMP SIZE (IN.)	CLAMP TYPE					
	P-2558 OR C-708-U		C-708N-U		C-708-S	
	STANDARD BOLT/STUD	OVERSIZED BOLT/STUD	STANDARD BOLT/STUD	OVERSIZED BOLT/STUD	STANDARD BOLT/STUD	OVERSIZED BOLT/STUD
3/4	1/4	3/8	3/8	1/2	X	X
1	1/4	3/8	3/8	1/2	X	X
1-1/4	1/4	3/8	3/8	1/2	X	X
1-1/2	1/4	3/8	3/8	1/2	X	X
2	3/8	1/2	1/2	5/8	1/2	5/8
2-1/2	3/8	1/2	1/2	5/8	1/2	5/8
3	3/8	1/2	1/2	5/8	1/2	5/8
4	3/8	1/2	1/2	5/8	1/2	5/8
5	3/8	1/2	1/2	5/8	1/2	5/8

NOTE: Above data taken from SAG.CP25, Attachment G.

FIGURE 7.4.2

HILTI BOLT DIAMETER FOR VARIOUS TYPES OF CLAMPS

CLAMP SIZE (IN)	CLAMP TYPE				
	P-2558 OR C-708-U		C-708N-U		C-708-S
	STANDARD HILTI	OVERSIZED HILTI	STANDARD HILTI	OVERSIZED HILTI	STANDARD HILTI
3/4	1/4	3/8	3/8	1/2	X
1	1/4	3/8	3/8	1/2	X
1-1/4	1/4	3/8	3/8	1/2	X
1-1/2	1/4	3/8	3/8	1/2	X
2	3/8	1/2	1/2	5/8	1/2
2-1/2	3/8	1/2	1/2	5/8	1/2
3	3/8	1/2	1/2	5/8	1/2
4	3/8	1/2	1/2	5/8	1/2
5	3/8	1/2	1/2	5/8	1/2

NOTE: Above data taken from SAG.CP25, Attachment H.

FIGURE 7.5.1

FILLER PLATE AND SHIM PLATE WEIGHTS - P2558/C-708-U CLAMP
FOR S-0910 SUPPORTS

CLAMP SIZE	WEIGHT (lb) "A"	1/4" FILLER PLATE W(in)xL(in)	WEIGHT (lb) "B"	1" FILLER PLATE W(in)xL(in)	WEIGHT (lb) "C"	1"SHIM PLATE W(in)xL(in)	WEIGHT (lb) "D"	FOR NELSON STUDS A+B+D (lb)	FOR HILTI ANCHOR BOLTS A+C+D (lb)
3/4"	.26	3 X 7-3/16"	1.53	3X7-3/16"	6.11	3X11-3/16"	9.52	11.31	15.89
1"	.31	3X7-15/32"	1.59	3X7-15/32"	6.35	3X11-15/32"	9.76	11.66	16.42
1-1/4"	.35	3X7-13/16"	1.66	3X7-13/16"	6.65	3X11-13/16"	10.05	12.06	17.05
1-1/2"	.39	3 X 8-1/32"	1.71	3X8-1/32"	6.83	3X12-1/32"	10.23	12.33	17.45
2"	.94	3X9-25/32"	2.08	3X9-25/32"	8.32	3X13-25/32"	11.72	14.74	20.98
2-1/2"	1.14	3X10-9/32"	2.19	3X10-9/32"	8.75	3X14-9/32"	12.15	15.48	22.04
3"	1.33	3X10-29/32"	2.32	3X10-29/32"	9.28	3X14-29/32"	12.68	16.33	23.29
4"	1.76	3X11-29/32"	2.53	3X11-29/32"	10.13	3X15-29/32"	13.53	17.82	25.42
5"	1.98	3X12-31/32"	2.76	3X12-31/32"	11.03	3X16-31/32"	14.44	19.18	27.45

NOTES:

1. This table applies to conduit supports that are designed in accordance with the requirements of S-0910 drawings.

2. Above data taken from SAG.CP25, Attachment V.

FIGURE 7.5.2a

FILLER PLATE AND SHIM PLATE WEIGHTS - C-708-S CLAMP
FOR S-0910 SUPPORTS

CLAMP SIZE	WEIGHT (lb) "A"	1/4" FILLER PLATE W(in) x L(in)	WEIGHT (lb) "B"	1" FILLER PLATE W(in)x L(in)	WEIGHT (lb) "C"	1" SHIM PLATE W(in)xL(in)	WEIGHT (lb) "D"	FOR NELSON STUDS A+B+D (lb)	FOR HILTI ANCHOR BOLTS A+C+D (lb)
3/4"	....	....	....	....	....	....	....	....	....
1"	....	....	....	....	....	....	....	....	....
1-1/4"	....	....	....	....	....	....	....	....	....
1-1/2"	....	....	....	....	....	....	....	....	....
2"	1.41	3X10-9/16"	2.25	3X10-9/16"	8.99	3X14-9/16"	12.39	16.05	22.76
2-1/2"	1.59	3X11-1/16"	2.33	3X11-1/16"	9.41	3X15-1/16"	12.81	16.75	23.81
3"	1.81	3X11-11/16"	2.49	3X11-11/16"	9.94	3X15-11/16"	13.36	17.63	25.10
4"	3.37	3-1/4X16-7/16"	3.79	3-1/4X16-7/16"	15.15	3-1/4X20-7/16"	18.83	25.99	37.35
5"	3.90	3-1/4X17-3/4"	4.09	3-1/4X17-3/4"	16.36	3-1/4X21-3/4"	20.04	28.03	40.30

NOTES:

1. This table applies to conduit supports that are designed in accordance with the requirements of S-0910 drawings.

2. Above data taken from SAG.CP25, Attachment V.

FIGURE 7.5.2b

MAXIMUM WEIGHT - INDIVIDUAL FILLER PLATE FOR S2-0910 SUPPORTS (LBS)

FILLER TYPE	(a) STANDARD		(b) PER SH. CSM-2A-II		(c) PER SH. LLS-7	
CONDUIT SIZE	CLAMP TYPE		CLAMP TYPE		CLAMP TYPE	
	P2558	C-708-S	P2558	C-708-S	P2558	C-708-S
3/4" Ø	6.5	-	10.0	-	8.0	-
1" Ø	7.0	-	10.0	-	8.0	-
1½" Ø	8.0	-	11.0	-	9.0	-
2" Ø	10.6	13.4	15.0	16.0	12.0	13.0
3" Ø	12.4	15.4	17.0	19.0	14.0	15.0
4" Ø	14.0	20.0	19.0	21.0	16.0	17.0
5" Ø	15.6	22.1	21.0	23.0	17.0	19.0

NOTES:

1. For Sh. LLS-5, Wfiller plate = $5\frac{1}{4} \times 5\frac{1}{4} \times \frac{1}{4} \left(\frac{490}{12 \times 12 \times 12}\right) = 2\#$.

2. For Sh. CSM-2a-III, weight of alternate common filler plate shall be calculated individually on a case by case basis.

3. Weight calculations for other non standard filler plates, if any, shall be done individually.

4. For filler plate details, see following sheet.

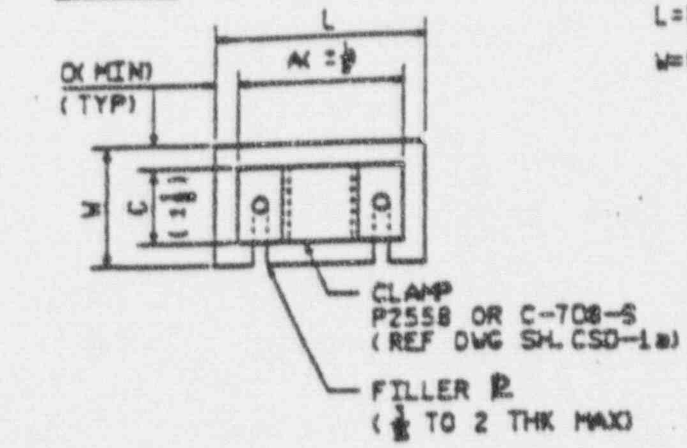
5. This table applies to conduit supports that are designed in accordance with the requirements of S2-0910 drawings.

6. Above data taken from CP-SG-02, Table 1.

FIGURE 7.5.2b
(Continued)

FILLER PLATE DETAILS FOR S2-0910 SUPPORTS

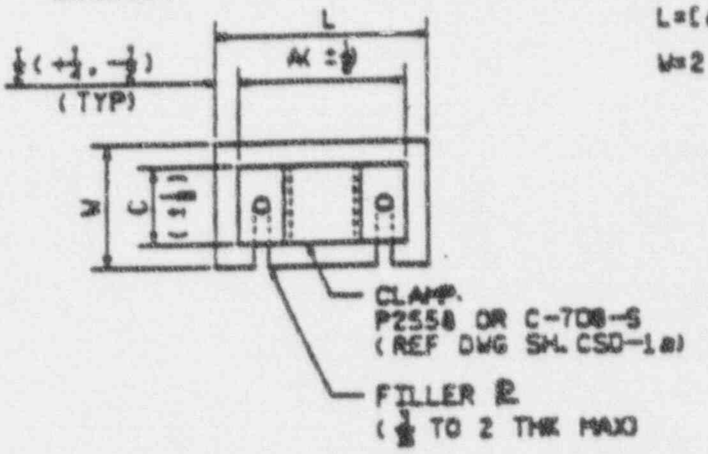
TYPE (a): STANDARD FILLER PLATE



$L = [A(\pm\frac{1}{8})] + (+1, -0)$

$W = [C(\pm\frac{1}{8})] + (+1, -0)$

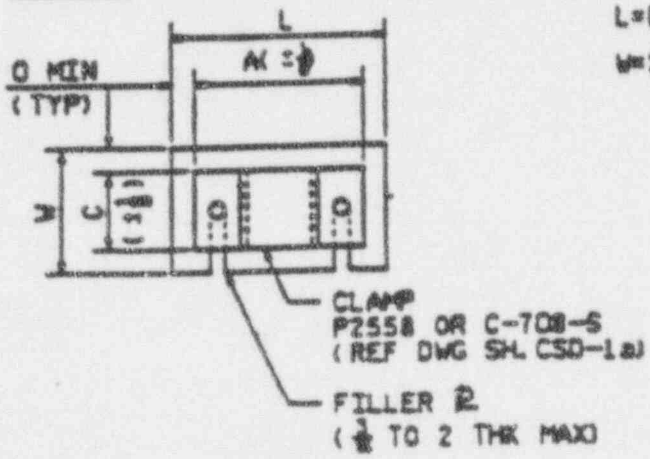
TYPE (b): FILLER PLATE PER SH. CSM-2a-II



$L = [A(\pm\frac{1}{8})] + 2\,[\frac{1}{2}(+\frac{1}{4}, -\frac{1}{2})]$

$W = 2$ TO $3\frac{1}{2}$

TYPE (c): FILLER PLATE PER SH. LLS-7



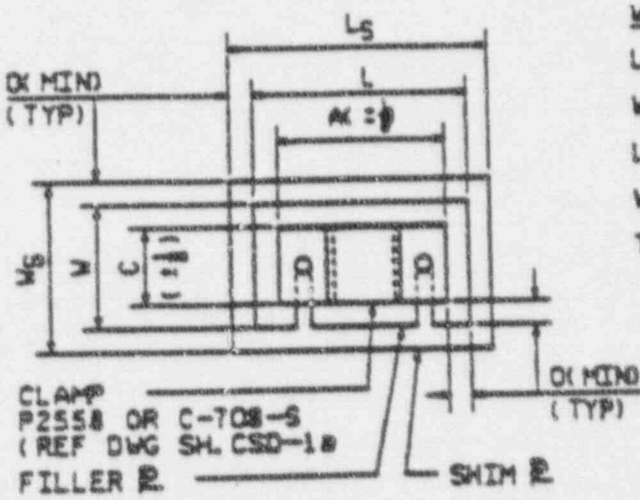
$L = [A(\pm\frac{1}{8})] + (+1, -0)$

$W = 2(+1, -0)$

FIGURE 7.5.2c

MAXIMUM WEIGHT - STANDARD FILLER PLATE AND STANDARD SHIM PLATE
FOR S2-0910 SUPPORTS

MAX COMBINED WT OF FILLER (1/4 THK) AND SHIM (1-3/4 THK)(LBS)		
CONDUIT SIZE	CLAMP TYPE	
	P2558	C-700-S
3/4" ø	8.4	-
1" ø	9.0	-
1-1/2" ø	10.0	-
2" ø	13.0	16.2
3" ø	15.2	18.2
4" ø	17.0	23.5
5" ø	19.0	25.8



WHERE

L = [A(± 1/8)] + (+1, -0)

W = [C(± 1/8)] + (+1, -0)

L_S = L(+1/2, -0)

W_S = W(+1/2, -0)

THK (FILLER PL + SHIM PL) ≤ 2

STANDARD FILLER & SHIM PLATE DETAIL

NOTES:

1. Weight calculations of shim plates for Sh. CSD-5a-I, Sh. CSD-5a-II, Sh. CSD-5a-V, Sh.CSD-5c-I and Sh. CSD-5c-II shall be done individually on a case by case basis.

2. Weight calculations for other non-standard filler plates, if any, shall be done individually.

3. This table applies to conduit supports that are designed in accordance with the requirements of S2-0910 drawings.

4. Above data taken from CP-SG-02, Table 2.

FIGURE 7.6

DEFINITION OF SEISMIC INPUT

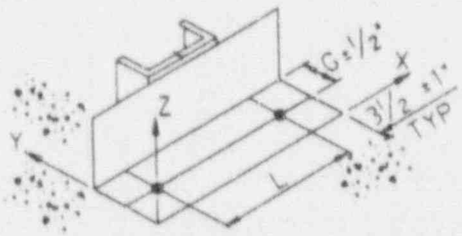
Case	When the conduit support is attached to:	Applicable "g" values	
		For hand calculations or static analysis	For response spectra analysis
A	Floor	Floor g's	Floor g's
B	Ceiling	Ceiling g's	Ceiling g's
C	Floor & wall	Enveloped g's from floor elevation above and below the support	g's from the floor elevation above the support
D	Wall	- do -	- do -
E	Wall & Ceiling	- do -	- do -
F	Spread Room Framing	Enveloped 1.5 x g peak from floor elevation above & below the framing	Not applicable
G	Steel Platform, Steel Stair, etc.	Obtain Steel Platform response spectra and design in accordance with this procedure. If these response spectra are not available, assume the support non-existent and evaluate the ISO.	
H	Pipe Support, cable tray support & similar structures	Use 1.5 x g peak of applicable Floor response spectra	

NOTE: Above data taken from SAG.CP25, Attachment J.

FIGURE 7.7

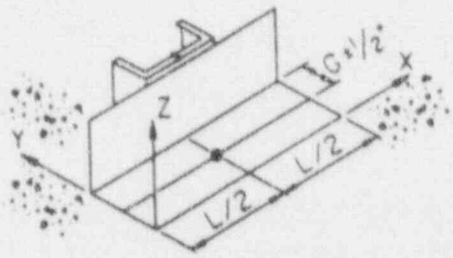
SPRING RATES FOR TYPICAL BASEPLATE CONFIGURATION

CASE 1: 2 BOLT PATTERN



ANGLE SIZE	L (in.)	KMX (in. k/deg.)		KMY (in. k/deg.)		KMZ (in. k/deg)	
		1.25 dia. SU. HILTI	1.5 dia. INSERT	1.25 dia. SU. HILTI	1.5 dia. INSERT	1.25 dia. SU. HILTI	1.5 dia. INSERT
L5x5x.75	12	20	41	277	651	113	171
	18	21	48	417	904	152	193
	24	22	49	544	1084	172	206
	30	22	49	653	1187	180	206
	36	22	48	740	1229	184	202
L6x6x.75	12	27	39	295	606	107	156
	18	30	48	457	878	144	182
	24	32	50	612	1081	163	192
	30	33	52	749	1237	172	195
	36	33	52	863	1323	176	194
L8x8x.75	12	28	33	286	497	94	129
	18	33	40	431	771	128	153
	24	36	46	601	1021	145	166
	30	39	50	764	1229	155	173
	36	40	52	914	1396	160	175

CASE 2: 1 BOLT PATTERN



ANGLE SIZE	L (in.)	KMX (in. k/deg.)		KMY (in. k/deg.)		KMZ (in. k/deg)	
		1.25 dia. SU. HILTI	1.5 dia. INSERT	1.25 dia. SU. HILTI	1.5 dia. INSERT	1.25 dia. SU. HILTI	1.5 dia. INSERT
L5x5x.75	12	14	27	86	180	---	---
	8	13	22	55	113	---	---
L6x6x.75	12	16	28	80	165	---	---
	8	14	21	53	103	---	---
L8x8x.75	12	18	22	72	134	---	---
	8	14	17	47	85	---	---

* Rotational degree of freedom about Z axis must be fully released for these configurations.

NOTE: Above data derived from SAG.CP29, Attachment I.

FIGURE 7.8.1

PEAK "g" VALUES x 1.5
ELECTRICAL CONTROL BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE 3%, DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
873.33	3.28	3.81	2.89	4.10	4.63	4.36
854.33	2.87	3.33	2.87	3.60	4.06	4.32
830.00	2.16	2.36	2.66	2.71	2.91	4.01
807.00	1.53	1.49	2.77	2.25	1.89	4.16
778.00	1.07	0.62	2.63	1.62	1.00	4.15

NOTE: Above data taken from SAG.CP10, Table A.5.1.

FIGURE 7.8.2

PEAK "g" VALUES x 1.5
FUEL BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
918.00	4.22	5.34	2.20	6.26	5.77	3.20
899.50	3.60	4.69	2.23	5.35	6.20	3.32
860.00	2.38	2.34	2.01	3.60	3.53	3.07
841.00	2.09	1.86	1.85	3.17	2.83	2.85
825.00	1.79	1.55	1.78	2.73	2.42	2.74
810.50	1.52	1.29	1.62	2.33	2.07	2.56

NOTE: Above data taken from SAG.CP10, Table A.5.2.

FIGURE 7.8.3

PEAK "g" VALUES x 1.5
SAFEGUARDS BUILDING INCLUDING DIESEL GENERATOR BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
896.50	4.89	4.94	3.27	5.52	6.38	4.28
873.50	4.63	4.49	3.54	5.26	5.81	5.07
852.50	3.50	3.46	3.26	4.01	4.50	4.73
831.50	2.07	2.46	2.84	3.11	3.22	4.25
810.50	1.47	1.51	2.74	2.19	2.27	4.11
790.50	0.81	0.91	2.20	1.22	1.41	3.42
785.50	0.77	0.82	2.13	1.18	1.29	3.31
773.50	0.71	0.65	1.99	1.10	1.07	3.09

NOTE: Above data taken from SAG.CP10, Table A.5.3.

FIGURE 7.8.4

PEAK "g" VALUES x 1.5
AUXILIARY BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
899.50	4.53	5.68	4.08	5.92	6.86	5.54
886.50	4.14	4.91	3.85	5.46	5.98	5.52
873.50	3.76	4.16	3.58	5.02	5.18	5.64
852.50	3.25	3.38	3.54	4.20	4.30	5.57
831.50	2.54	2.41	3.39	3.38	2.98	5.10
810.50	1.52	1.27	3.18	2.09	1.64	4.64
790.50	1.11	0.87	2.87	1.68	1.34	4.51

NOTE: Above data taken from SAG.CP10, Table A.5.4.

FIGURE 7.8.5

PEAK "g" VALUES x 1.5
CONTAINMENT BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
1000.50	5.55	5.54	5.17	6.52	6.51	6.05
950.58	4.28	4.28	4.03	5.09	5.08	4.84
905.75	3.15	3.14	3.02	3.80	3.79	4.34
860.00	1.99	1.99	2.71	2.49	2.49	4.01
805.50	1.17	1.29	2.44	1.68	1.72	3.60
783.58	1.05	1.17	2.26	1.54	1.56	3.35

NOTE: Above data taken from SAG.CP10, Table A.5.5.

FIGURE 7.8.6

PEAK "g" VALUES x 1.5
INTERNAL STRUCTURES OF REACTOR BUILDING

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
905.75	5.49	6.35	3.26	5.83	7.51	4.78
885.50	4.55	5.18	3.07	4.88	6.16	4.51
860.00	3.37	3.71	2.85	3.68	4.46	4.19
832.50	2.11	2.12	2.62	2.39	2.62	3.86
808.00	1.06	1.20	2.43	1.57	1.64	3.59
783.58	0.74	1.06	2.25	1.07	1.55	3.35

NOTE: Above data taken from SAG.CP10, Table A.5.6.

FIGURE 7.8.7

PEAK "g" VALUES x 1.5
SERVICE WATER INTAKE STRUCTURE

FLOOR ELEVATION (FT.)	"g" VALUES (1.5 X PEAK "g")					
	1/2 SSE, 2% DAMPING			SSE, 3% DAMPING		
	HORIZONTAL		VERTICAL	HORIZONTAL		VERTICAL
	N-S	E-W		N-S	E-W	
838.00	4.23	2.40	1.35	4.50	2.85	2.20
817.00	2.80	1.80	1.31	3.11	2.12	2.10
796.00	1.00	1.00	1.20	1.36	1.14	1.92
782.00	0.52	0.50	1.02	0.82	0.82	1.67

NOTE: Above data taken from SAG.CP10, Table A.5.7.

FIGURE 7.9.1

MEMBER STRENGTH LOSS DUE TO 1/32" UNDERCUT
TUBULAR SECTION

PCN-01

	PERCENTAGE LOSS		
MEMBER SIZE	AREA	SECT. MOD.	ADJUSTED INTERACTION RATIO
TS 2 X 2 X 0.25	14.06	14.79	0.852
TS 3 X 3 X 0.25	13.49	13.80	0.862
TS 4 X 4 X 0.25	13.23	13.40	0.866
TS 5 X 5 X 0.25	13.07	13.18	0.868
TS 6 X 6 X 0.25	12.97	13.05	0.870
TS 6 X 6 X 0.375	12.97	8.96	0.870
TS 4 X 2 X 0.25	13.49	13.97	0.860
TS 8 X 4 X 0.375	8.90	9.00	0.910
TS 8 X 6 X 0.375	8.80	8.80	0.911

NOTE: Above data taken from SAG.CP29, Attachment F.

FIGURE 7.9.2

MEMBER STRENGTH LOSS DUE TO 1/32" UNDERCUT
CHANNEL SECTION

	PERCENTAGE LOSS			
MEMBER SIZE	"A" AREA	"SX" SECT. MOD.	"SY" SECT. MOD.	ADJUSTED INTERACTION RATIO
C4 X 5.4	27.64	24.07	26.40	0.724
C5 X 9	19.35	27.40	21.08	0.726
C6 X 8.2	25.15	21.45	23.01	0.748
C8 X 11.5	22.81	19.47	20.29	0.772
C10 X 15.3	20.89	17.73	18.18	0.791
MC3 X 7.1	19.58	18.08	21.27	0.787
MC6 X 16.3	15.23	13.77	15.72	0.843

NOTE: Above data taken from SAG.CP29, Attachment F.

FIGURE 7.10

ALLOWABLE NORMAL WELD FORCE FOR STEPPED TUBULAR SECTION CONNECTION

MAIN MEMBER t_c x D	(B-b)/D	ALLOWABLE NORMAL WELD FORCE LBS/"	MAIN MEMBER t_c x D	(B-b)/D	ALLOWABLE NORMAL WELD FORCE LBS/"	MAIN MEMBER t_c x D	(B-b)/D	ALLOWABLE NORMAL WELD FORCE LBS/"
3/16 X 4	.5 .625 .75 .875	792 845 1055 1811	1/2 X 5	.4 .5 .6 .7 .8	4507 4507 4695 5366 7042	5/16 X 7	.43 .57 .71 .86	1257 1282 1527 2611
1/4 X 4	.5 .625 .75 .875	1408 1502 1878 3219	3/16 X 6	.33 .5 .67 .83	528 528 597 835	3/8 X 7	.43 .57 .71 .86	1811 1847 2199 3760
5/16 X 4	.5 .625 .75 .875	2200 2347 2935 5030	1/4 x 6	.33 .5 .67 .83	939 939 1061 1664	3/16 x 8	.375 .5 .625 .875	396 396 422 905
3/16 x 5	.4 .5 .6 .7 .8	634 634 660 754 990	5/16 x 6	.33 .5 .67 .83	1467 1467 1659 2600	1/4 x 8	.375 .5 .625 .875	704 704 751 1609
1/4 x 5	.4 .5 .6 .7 .8	1127 1127 1173 1341 1760	3/8 x 6	.33 .5 .67 .83	2112 2112 2389 3743	5/16 x 8	.375 .5 .625 .875	1100 1100 1173 2515

NOTE: Above data taken from SAG.CP25, Attachment C.

FIGURE 7.10 (CONT'D)

ALLOWABLE NORMAL WELD FORCE FOR STEPPED TUBULAR SECTION CONNECTION

MAIN MEMBER t_c X D	B-$\frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE LBS/"	MAIN MEMBER t_c X D	B-$\frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE LBS/"	MAIN MEMBER t_c x D	B-$\frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE LBS/"
5/16 X 5	.4 .5 .6 .7 .8	1760 1760 1833 2095 2751	3/16 X 7	.43 .57 .71 .86	452 462 549 940	3/8 X 8	.375 .5 .625 .875	1584 1584 1690 3622
3/8 x 5	.4 .5 .6 .7 .8	2535 2535 2641 3018 3961	1/4 x 7	.43 .57 .71 .86	804 820 977 1671	1/2 x 8	.375 .5 .625 .875	2817 2817 3004 6438

b - Minor width of structural tube branch member (in.)

t_b - Thickness of branch member (in.)

D - Width of structural tube main member (in.)

t_c - Thickness of main member (in.)

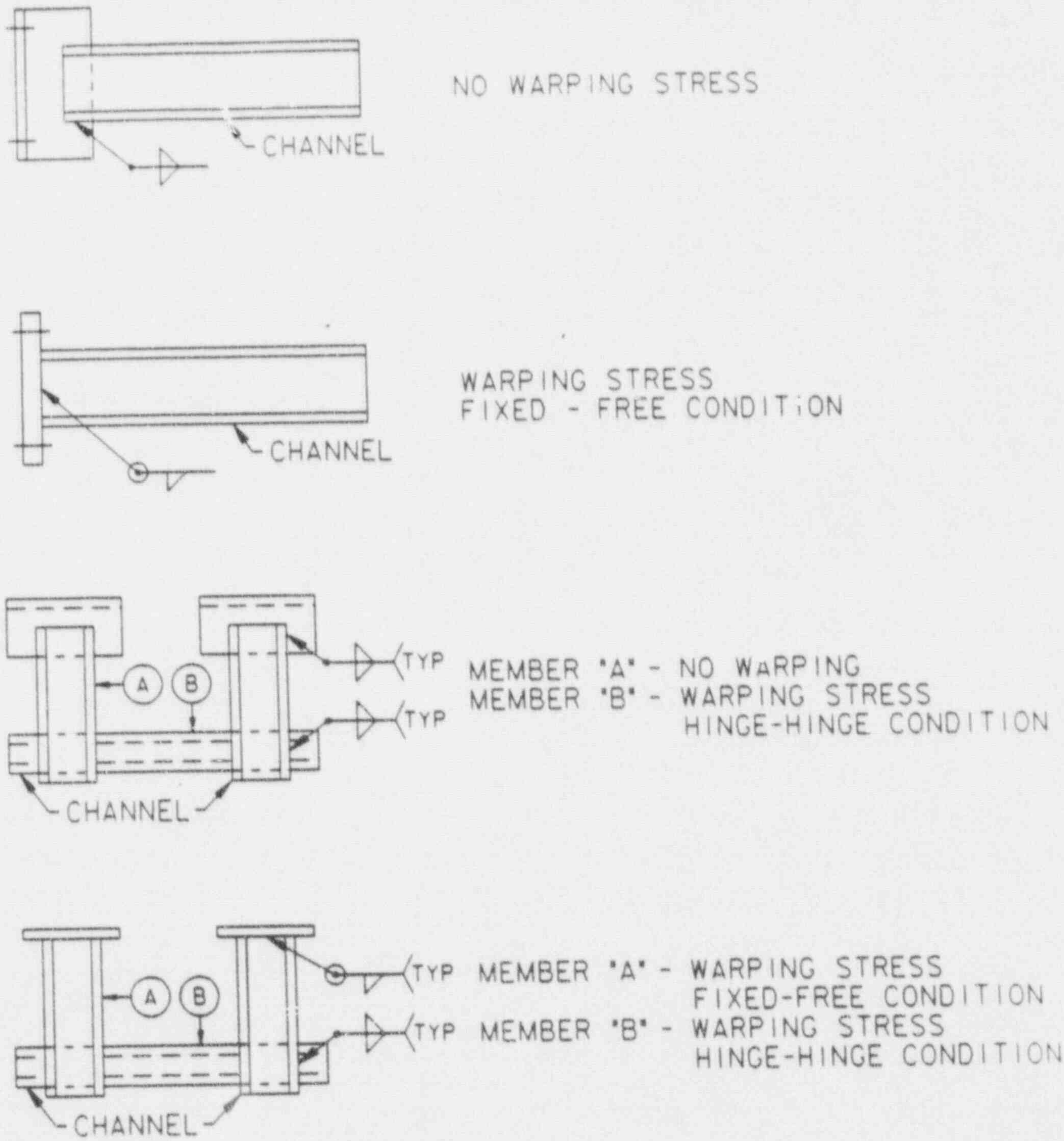
B - Beta ratio, (b/D) box sections

C - Depth of structural tube main member (in.)

NOTE: Above data taken from SAG.CP25 Attachment C.

FIGURE 7.11.1

TYPICAL CASES FOR WARPING CONSIDERATION



NOTE: Above data taken from SAG.CP29, Figure 2.

FIGURE 7.11.2

SUMMARY OF WARPING STRESS TABLES

A. Channel Sections

Warping stress table for channel sizes listed below have been developed for different points (0,1,2,3 see below) on the channel section for various cases (3,6,& 9) depending on the end condition. These tables are compiled in Ebasco Calculation Book No. Supt-0040.

CHANNEL SIZE	CASE
C6 x 8.2	9
C4 x 7.25	9
C6 x 8.2	6
C4 x 7.25	6
MC3 x 7.1	6
MC6 x 12	6
MC6 x 18	6
MC3 x 7.1	9
MC6 x 12	9
MC6 x 18	9
C6 x 8.2	3
C4 x 7.25	3

END CONDITIONS

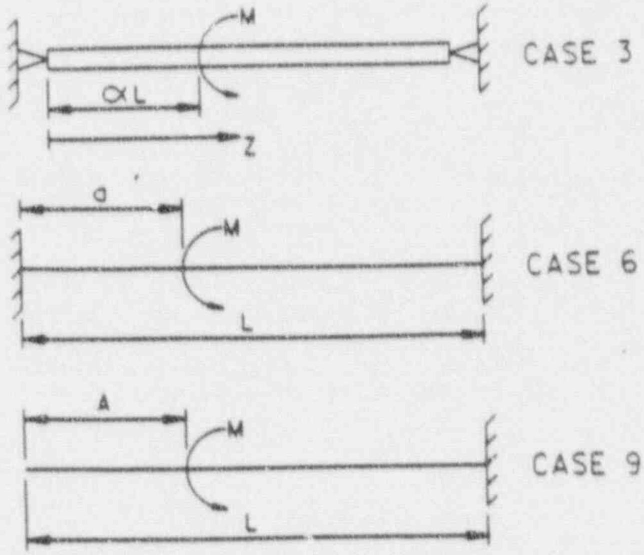
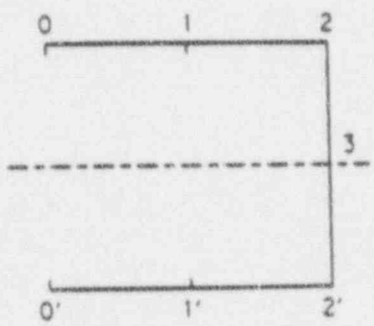


Figure 1: Stresses of the following points are calculated:



WARPING NORMAL STRESSES

σ_{w0} (SIGW0) at point 0
σ_{w2} (SIGW2) at point 2

WARPING SHEAR STRESSES

τ_{w1} (TAUW1) at point 1
τ_{w2} (TAUW2) at point 2
τ_{w3} (TAUW3) at point 3

NOTE: Above data taken from SAG.CP29, Attachment M.

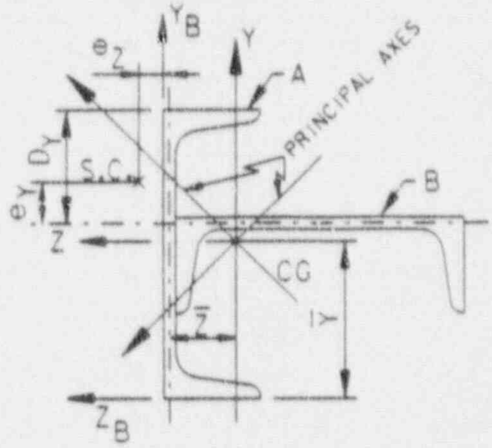
FIGURE 7.11.2 (CONT)

B. Composite Channel Sections

Warping stress tables for composite channel sections are compiled in Ebasco Calculation Book No. Supt-0040.

FIGURE 7.12

SHEAR CENTER LOCATION OF COMPOSITE CHANNELS



NOTE: Iy-y is moment of inertia about the y-y axis.

Iz-z is moment of inertia about the z-z axis.

SECTIONS		D_Y	COMPOSITE C.G.					COMPOSITE S.C.	
A	B	(in)	$\bar{Y}$ in.	$\bar{Z}$ in.	I_{ZZ} in^4	I_{YY} in^4	I_{YZ} in^4	e_Y in.	e_Z in.
C6×8.2	C6×8.2	3.837	2.344	-1.888	15.946	22.088	4.100	0.698	0.494
C6×8.2	C6×8.2	3.000	2.762	-1.888	14.164	22.088	1.486	0.664	0.480
C6×8.2	C6×8.2	2.000	3.262	-1.888	14.221	22.088	-1.636	0.626	0.476
C6×8.2	C6×8.2	1.000	3.762	-1.888	16.659	22.088	-4.759	0.585	0.487
C6×8.2	C6×8.2	0.443	4.041	-1.888	19.048	22.088	-6.498	0.560	0.498
C6×8.2	C6×8.2	2.524	3.000	-1.888	13.895	22.088	0.000	0.645	0.476
C6×8.2	C6×8.2	2.324	3.100	-1.888	13.942	22.088	-0.625	0.638	0.475
C6×8.2	C6×8.2	2.424	3.050	-1.888	13.906	22.088	-0.312	0.642	0.475
C6×8.2	C6×8.2	2.624	2.950	-1.888	13.906	22.088	0.312	0.649	0.476
C8×11.5	C6×8.2	5.790	3.059	-1.715	40.433	23.894	8.115	0.832	0.716
C8×11.5	C6×8.2	4.000	3.802	-1.715	33.603	23.894	1.705	0.662	0.708
C8×11.5	C6×8.2	5.000	3.387	-1.715	36.319	23.894	5.286	0.756	0.710
C8×11.5	C6×8.2	3.000	4.218	-1.715	33.670	23.894	-1.877	0.569	0.712
C8×11.5	C6×8.2	2.000	4.633	-1.715	36.520	23.894	-5.458	0.473	0.721
C8×11.5	C6×8.2	1.000	5.048	-1.715	42.153	23.894	-9.039	0.374	0.733
C8×11.5	C6×8.2	0.490	5.260	-1.715	46.098	23.894	-10.866	0.321	0.739
C6×8.2	C4×5.4	4.165	2.371	-1.220	15.804	7.163	2.429	0.741	0.616
C6×8.2	C4×5.4	4.000	2.437	-1.220	15.336	7.163	2.176	0.716	0.615
C6×8.2	C4×5.4	3.000	2.834	-1.220	13.600	7.163	0.643	0.570	0.616
C6×8.2	C4×5.4	2.000	3.230	-1.220	13.752	7.163	-0.890	0.422	0.631
C6×8.2	C4×5.4	1.000	3.627	-1.220	15.792	7.163	-2.423	0.263	0.657
C6×8.2	C4×5.4	0.435	3.851	-1.220	17.779	7.163	-3.290	0.168	0.672

FIGURE 7.12 (CONT'D)

SECTIONS		TOTAL AREA IN^2	COMPOSITE C.G. - PRINCIPAL AXIS		
A	B		I_{1-1} in 4	I_{2-2} in 4	Ø, (DEG.)
C6 X 8.2	C6 X 8.2	4.760	24.140	13.895	-25.581
C6 X 8.2	C6 X 8.2	4.760	22.358	13.895	-10.281
C6 X 8.2	C6 X 8.2	4.760	22.415	13.895	11.294
C6 X 8.2	C6 X 8.2	4.760	24.852	13.895	30.148
C6 X 8.2	C6 X 8.2	4.760	27.242	13.895	38.417
C6 X 8.2	C6 X 8.2	4.760	22.088	13.895	0.000
C6 X 8.2	C6 X 8.2	4.760	22.136	13.895	4.359
C6 X 8.2	C6 X 8.2	4.760	22.100	13.895	2.182
C6 X 8.2	C6 X 8.2	4.760	22.100	13.895	-2.182
C8 X 11.5	C6 X 8.2	5.731	43.749	20.577	22.230
C8 X 11.5	C6 X 8.2	5.731	33.893	23.603	9.674
C8 X 11.5	C6 X 8.2	5.731	38.263	21.949	20.196
C8 X 11.5	C6 X 8.2	5.731	34.018	23.546	-10.502
C8 X 11.5	C8 X 8.2	5.731	38.552	21.861	-20.423
C8 X 11.5	C6 X 8.2	5.731	45.871	20.176	-22.357
C8 X 11.5	C6 X 8.2	5.731	50.530	19.461	-22.192
C6 X 8.2	C4 X 5.4	3.945	16.440	6.527	14.675
C6 X 8.2	C4 X 5.4	3.945	15.879	6.620	14.020
C6 X 8.2	C4 X 5.4	3.945	13.663	7.100	5.651
C6 X 8.2	C4 X 5.4	3.945	13.870	7.045	-7.560
C6 X 8.2	C4 X 5.4	3.945	16.426	6.529	-14.661
C6 X 8.2	C4 X 5.4	3.945	18.716	6.227	-15.894

NOTES:
1. I_{1-1} and I_{2-2} are the maximum and minimum moments of Inertia, respectively, about the principal axes 1-1 and 2-2.
2. The angle Ø is measured from the axis with the maximum moment of Inertia (either y-y or z-z) to the 1-1 principal axis. Ø should always be between +45° and -45°. Ø sign convention - +.
3. $\bar{Y}$ and $\bar{Z}$ are measured in Y_B and Z_B coordinate system.
4. ey and ez are computed from the channel webs and define the location of shear center of the composite section.
5. Above data taken from SAG.CP29, Attachment E.

FIGURE 7.13

EFFECTIVE THROAT THICKNESS OF PREQUALIFIED PARTIAL PENETRATION BEVEL GROOVE WELDS

I. Flare Bevel Groove Weld

The following effective throat shall be used for prequalified partial penetration flare bevel groove welds between cold formed rectangular/square tubes and:

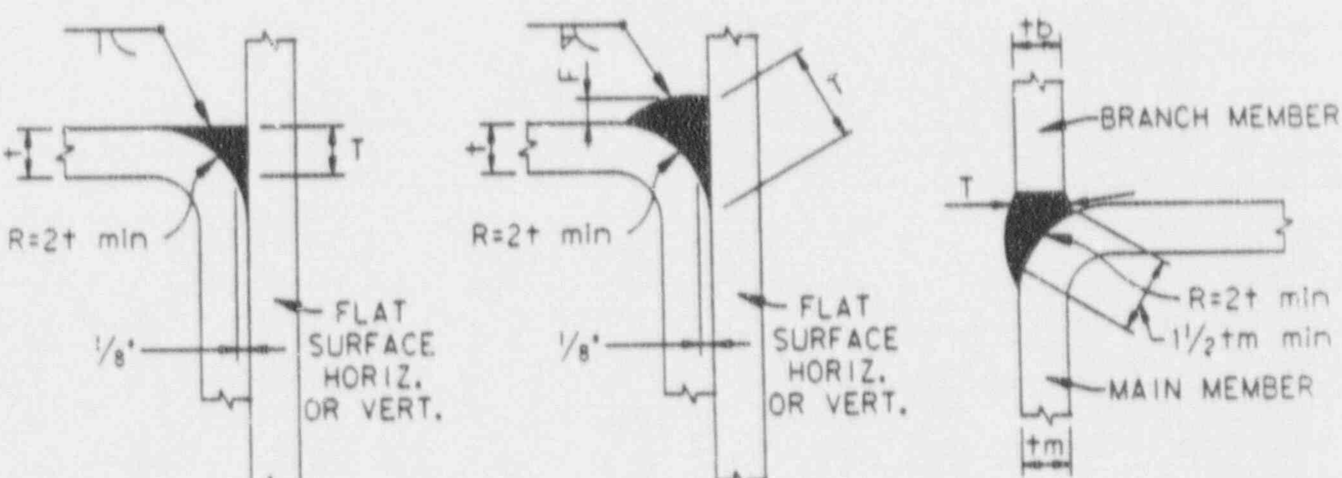
A. Flat plate surfaces (such as embedded plate, anchorage angle, etc.) with or without reinforcing fillet weld.

B. Tube to tube matched box connections.

t = Thickness of the thinner tube
T = Effective throat thickness
R = minimum corner radius of the tube = 2t

Effective Throat Thickness T(in)

Tube thickness t (in.)	Minimum radius R (in.)	(A) Flat Surface			(B) Matched Box (3) T(in.)
		w/o reinf. fillet (1) T (in.)	w/ reinforcing fillet (2)		
			size of fillet F (in.)	T (in.)	
1/4	1/2	0.16	3/16	0.29	0.25
5/16	5/8	0.31	1/8	0.35	0.31
3/8	3/4	0.37	1/8	0.40	0.37
1/2	1	0.5	1/8	0.62	0.5
5/8	1-1/4	0.62	...	...	0.62



1. W/O REIN. FILLET 2. WITH REIN. FILLET 3. MATCHED BOX CONN.

FIGURE 7.13 (CONT)

NOTES: (For table on previous page)

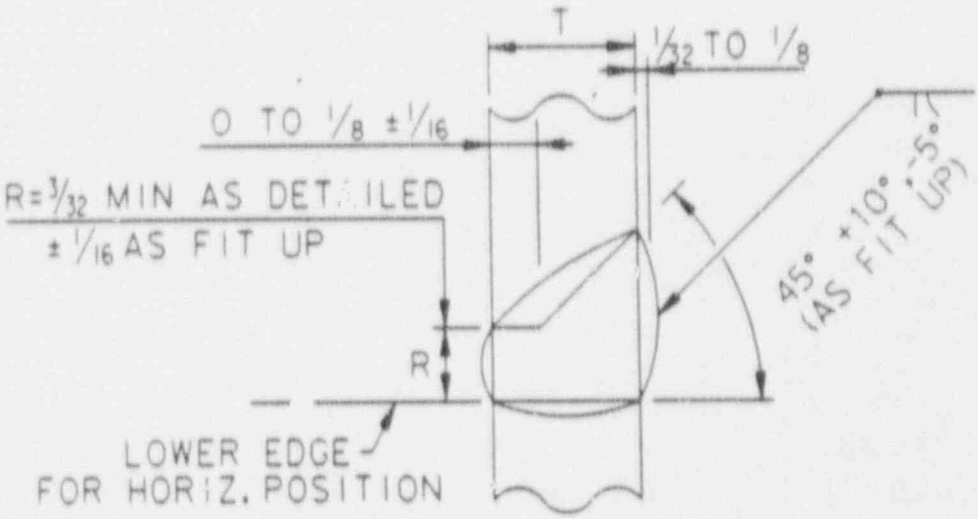
1. As per AWS-D.1.1 Table 2.3.1.4 for t ≤ 1/4", T = 5/16" R.
   As per AWS-D.1.1 Figure 10.13.3B and test results, for t≥ 5.16", T = t.

2. As per geometric proportions with weld penetration to the 1/8" groove width level.

3. As per AWS-D.1.1 Figure 10.13.3B.

4. Data taken from SAG.CP29, Attachment H.

II. Single-Bevel-Groove Welds:



BTC-P4a JOINT DETAIL (ALL WELDING POSITIONS)

Single-bevel-groove welds for butt joints, T-joints and corner joints welded for one side only having base metal thickness ("T") of 1/4 inch up to 1/2 inch shall have effective throats equal to "T"-1/8 inch, where ("T-1/8 inch) ≤ T/2. The above shall not be used for the qualification of welded standard tray clamp plates.

NOTE: Above data taken from SAG.CP29, Attachment H.

FIGURE 7.15

THREADED NELSON STUD TENSION AND SHEAR ALLOWABLES

STUD DIAMETER (INCHES) AND THREADS PER INCH	META (in^2)	SERVICE LOAD CONDITIONS OBE	
		TENSION (lbs)	SHEAR (lbs)
		S - Ta	S - Sa
1/4-20	0.032	960	480
3/8-16	0.078	2340	1170
1/2-13	0.142	4260	2130
5/8-11	0.226	6780	3390

NOTE: Above data taken from SAG-CP10, Table 2.

FIGURE 7.16.1

EQUIVALENT COEFFICIENT AND "g" VALUE GROUPING
FOR JUNCTION BOX SUPPORTS

GROUP	DESCRIPTION	OBE (2% DAMPING)			SSE (3% DAMPING)		
		MAX	MED	MIN	MAX	MED	MIN
I_A & I_B	1.5 X PEAK "g"	6.35	5.54	4.15	7.51	6.51	4.78
	DESIGN "g"	4.08	3.55	2.66	4.87	4.23	3.11
	EQUIVALENT COEF.	1.56	1.56	1.56	1.54	1.54	1.54
II_A & II_B	1.5 X PEAK "g"	3.81	3.28	2.89	5.10	4.36	3.50
	DESIGN "g"	2.43	2.43	2.01	3.57	3.47	3.03
	EQUIVALENT COEF.	1.57	1.35	1.44	1.43	1.26	1.16
III_A & III_B	1.5 X PEAK "g"	2.77	2.36	2.10	4.16	2.91	2.71
	DESIGN "g"	2.12	1.85	1.60	3.10	2.31	2.02
	EQUIVALENT COEF.	1.31	1.28	1.31	1.34	1.26	1.34

NOTES:

1. Use coefficient with underlines to multiply weight of junction box and its contents to obtain equivalent weight to be used in static analysis with design "g" values.

2. Above data taken from SAG.CP29, Table 3B.

FIGURE 7.16.2
BUILDING AND ELEVATION GROUPS FOR
JUNCTION BOX SUPPORTS

GROUP NO.	I_A	I_B	II_A	II_B	III_A	III_B
MIN. SUPT. FREQUENCY REQ'D (Hz)	12	16	12	16	12	16
ELEC CONTROL BLDG (ELEV)	-	-	873.33" 854.33'	-	830.00'	807.00' 778.00'
FUEL BLDG (ELEV)	-	-	-	860.00' 841.00' 825.00'	-	810.50'
SAFEGUARDS BLDG (ELEV)	-	896.50' 873.50' 852.50'	-	831.50' 810.50' 790.50' 785.50'	-	773.50'
AUXILIARY BLDG (ELEV)	899.50' 886.50' 873.50' 852.50'	-	831.50' 810.50'	790.50'	-	-
CONTAINMENT BLDG (ELEV)	1000.50' 950.58' 905.75'	-	783.58'	860.00' 805.50'	-	-
INTERNAL STRUCTURE (ELEV)	905.75' 885.50'	-	860.00' 832.50' 808.00' 783.58'	-	-	-
DIESEL GENERATOR BLDG (ELEV)	-	844.0'	-	810.50'	-	-

NOTES: 1. This table applies to junction box supports that are designed in accordance with the requirements of S-0910 drawings.

2. Above data taken from SAG.CP29, Table 3A.

FIGURE 7.17

BUILDING AREAS W/ 2" FLOOR TOPPING ON FLOOR SLABS

(Areas where topping occurs are shown on Structural Design (S-, S1-, and S2-series) Drawings. Posted changes, including DCA 65035 for Unit 1 and Common and DCA 93604 for Unit 2, shall be considered when referencing these drawings).

FIGURE 7.18

CONDUIT DESIGN WEIGHT AND SECTIONAL PROPERTIES

PCN-01

CONDUIT NOMINAL DIAMETER (INCHES)	CONDUIT OUTSIDE DIAMETER (IN)	CONDUIT WEIGHT* (LBS PER FOOT)	PROPERTIES			
			A (IN^2)	I (IN^4)	S (IN^3)	R (IN)
3/4	1.05	1.5	.333	.037	.071	.334
1	1.315	2.0	.494	.087	.133	.421
1-1/2	1.90	4.0	.799	.310	.326	.623
2	2.375	5.0	1.07	.666	.561	.787
3	3.5	13.0	2.23	3.02	1.72	1.16
4	4.5	19.0	3.17	7.23	3.21	1.51
5	5.563	23.0	4.30	15.2	5.45	1.88

* Including cable weight inside conduit.

NOTE: Above data taken from SAG.CP10, Table 4.

FIGURE 7.19

THREADED CONDUIT SECTIONAL PROPERTIES

CONDUIT DIAMETER (IN)	S (IN^3)	A (IN^2)
3/4	0.038	0.184
1	0.070	0.265
1-1/2	0.184	0.454
2	0.330	0.636
2-1/2	0.573	0.925
3	0.981	1.275
4	1.952	1.935
5	3.439	2.720

NOTE: Above data taken from SAG.CP10, Table 6.

FIGURE 7.20

CONDUIT TO JUNCTION BOX LOCKNUT DETAILS

CONDUIT DIAMETER (IN)	A (INCHES) (OUTSIDE DIA)	B (INCHES) (THICKNESS)
3/4	1.438	0.250
1	1.750	0.281
1-1/2	2.406	0.281
2	2.938	0.313
2-1/2	3.500	0.375
3	4.188	0.375
4	5.344	0.438
5	6.625	0.500

NOTE: Above data taken from SAG.CP17, Table 9.

FIGURE 7.21

HILTI BOLT SPRING CONSTANTS

BOLT SIZE/EMBEDMENT	k_t (k/in)	k_s (k/in)
3/8' Ø HKB 4-5/8" EMB	124.0	34.375
1/2" Ø HKB 6-1/4" EMB	630.0	130.0
3/4" Ø HKB 9-1/4" EMB	87.5	67.14

NOTE: Above data taken from SAG.CP17, Table 10.

FIGURE 7.22

UNISTRUT BOLT TENSION AND SHEAR ALLOWABLES

BOLT SIZE DIA(in)	TENSILE AREA (in^2)	SHEAR AREA (in^2)	TENSION ALLOWABLES (lb)				SHEAR ALLOWABLES (LBS)			
			D+OBE	D+OBE+To	D+SSE	D+SSE+To	D+OBE	D+OBE+To	D+SSE	D+SSE+To
1/4	0.032	0.027	640	960	960	1024	270	405	405	432
3/8	0.078	0.068	1560	2340	2340	2496	680	1020	1020	1088
1/2	0.142	0.126	2000*	3000*	3000*	3200*	1260	1890	1890	2016

* Values limited by Unistrut Nut Strength in pullout and slip as specified in the Unistrut General Engineering Catalog.

NOTE: Above data taken from SAG.CP17, Table 8.

FIGURE 7.23

MINIMUM SUPPORT FREQUENCY OF S-0910 CONDUIT SUPPORTS

Building	Elevation	Support Frequency (Hz)
SG	873'-6"	16
AB	899'-6"	12
CB	1000'-6"	12
IS	905'-9"	12
SG	899'-6"	16
AB	873'-6"	12
SG	852'-6"	16
IS	885'-6"	12
AB	886'-6"	12
CB	950'-7"	12
FB	918'-0"	16
AB	852'-6"	12
SG	831'-6"	16
FB	899'-6"	16
EC	873'-4"	12
IS	860'-0"	12
CB	905'-9"	12
EC	854'-4"	12
SG	810'-6"	16
AB	831'-6"	12
EC	830'-0"	12
AB	810'-6"	12
IS	832'-6"	12
FB	860'-0"	16
EC	807'-0"	14
CB	860'-0"	12
AB	790'-6"	14
SG	790'-6"	16
EC	776'-0"	16
FB	841'-0"	16
IS	806'-0"	12
CB	805'-6"	12
SG	765'-6"	16
FB	825'-0"	16
IS	783'-7"	12
CB	783'-7"	12
SG	773'-6"	16
FB	810'-6"	16

NOTES:

1. This table applies to conduits that are designed in accordance with the requirements of S-0910 drawings.

2. Above data taken from SAG.CP17, Table 7.

FIGURE 7.24

DESIGN WEIGHT FOR FLEXIBLE CONDUIT SIZES

CONDUIT DIAMETER (IN)	WEIGHT* LBS/FT
3/4	0.73
1	1.19
1 1/2	2.40
2	2.73
2 1/2	3.76
3	8.78
4	12.64
5	15.36

* Including cable weight inside flexible conduit.

NOTE: Above data taken from SAG.CP17, Table 3.

FIGURE 7.25

"g" VALUES FOR THE QUALIFICATION OF ECSAs

ECSA CONNECTED TO	CONAX PART NUMBER	SEALBODY IMO MPT	ECSA WT. (lb)	ACCESSORIES WT. (2 COUPLINGS) AND 1 CLOSE NIPPLE) (lb)	"g" VALUES					
					OBE			SSE		
					A_x	A_y	A_z	A_x	A_y	A_z
ASCO SOVs	N-11122-11	3/4"	2.250	0.450	5.5	3.45	6.45	6.45	4.8	7.5
CONAX RTDs	N-11097-17	3/4"	2.500	0.450	5.5	3.45	6.45	6.45	4.8	7.5
NAMCO LIMIT SWITCHES	N-11222-01	1"	4.500	0.800	5.5	3.45	6.45	6.45	4.8	7.5
MAGNETROL LEVEL SWITCHES, VALCOR SOV's, TARGET ROCK SOV's	N-11067-11	3/4"	3.500	0.450	5.5	3.45	6.45	6.45	4.8	7.5

PCN-01

NOTE: Above data taken from SAG.CP25, Attachment R.

FIGURE 7.26

B.C. DESIGN WEIGHTS AND DIMENSIONS

CONDUIT NOMINAL DIAMETER (in.)	B.C. SIZE (in.)	B.C. WEIGHT* (lbs.)	B.C. LENGTH (in.)
3/4	1-1/2	9.5	13.75
1	1-1/2	9.7	13.75
1-1/2	1-1/2	10.8	13.75
2	2	11.6	13.75
3	3	28.9	18.375
4	4	53.3	23.75

* B.C. design weight includes conduit and cable weight inside B.C.

NOTE: Above data taken from SAG.CP10, Table 8.

FIGURE 7.27

LBD DESIGN WEIGHTS AND DIMENSIONS

CONDUIT NOMINAL DIAMETER (in.)	LBD SIZE (in)	LBD WEIGHT* (lbs)	l_1 DIM (in)	l_2 DIM (in)
3/4	1 1/2	13	11 1/4	2 1/4
1	1 1/2	13	11 1/4	2 1/4
1 1/2	1 1/2	13	11 1/4	2 1/4
2	2	15	11	2 1/2
3	3	45	16	5 1/2
4	4	100	23 1/2	7 1/2
5	5	128	29	5 1/2

* LBD design weight includes the actual LBD weight plus cable weight.

NOTE: Above data taken from SAG.CP10, Table 7.

FIGURE 7.28

ORIENTATION OF BUILDING GLOBAL COORDINATES

BUILDING	VERTICAL	N-S	E-W
REACTOR BUILDING INTERNAL STRUCTURES	Y	X	Z
SAFEGUARDS BUILDING	Y	Z	X
ELECTRICAL BUILDING	Y	Z	X
AUXILIARY BUILDING	Y	Z	X
FUEL BUILDING	Y	Z	X
CONTAINMENT BUILDING	Y	X	Z

NOTE: Above data taken from SAG.CP29, Table 1.

FIGURE 7.29

IDENTIFICATION NUMBERS OF BUILDINGS AND FLOOR ELEVATIONS

BUILDING (BLDG)	B[illegible] ID NO	ELEVATION (ELV)	ELV ID NO
Reactor Building Internal Structure	RB	905.75	905
		885.50	885
		860.00	860
		832.50	832
		808.00	808
		783.58	783
SafeGuards Building	SG	896.50	896
		873.50	873
		852.50	852
		831.50	831
		810.50	810
		790.50	790
		785.50	785
Electrical Building	EB	778.50	778
		873.33	873
		854.33	854
		830.00	830
		807.00	807
		778.00	778
Auxiliary Building	AB	899.50	899
		886.50	886
		873.50	873
		852.50	852
		831.50	832
		810.50	810
Fuel Building	FB	790.50	790
		918.00	918
		899.50	899
		880.00	880
		841.00	841
		825.00	825
		810.50	810
Containment Building	CB	1000.50	100
		950.58	950
		905.75	905
		880.00	880
		805.50	805
		783.58	783

FIGURE 7.30

RIGID CONDUIT SPAN

CASE NUMBER	CONDUIT CHARACTERISTICS		CONDUIT SIZE 3/4" Ø	1" Ø	1-1/2" Ø	2" Ø	3" Ø	4" Ø	5" Ø	REMARKS see notes
1	STRAIGHT RUN		4'-3"	4'-11"	5'-8"	6'-7"	7'-7"	8'-8"	9'-3"	
2	SINGLE BEND W/CONT. RUN		3'-1"	3'-7"	4'-1"	6'-7"	7'-7"	7'-3"	6'-0"	
3	DOUBLE BEND W/CONT. RUN		3'-10"	4'-6"	5'-2"	6'-7"	7'-7"	8'-8"	9'-3"	
4	OVERHAND W/AIRDROP		0'-9"	0'-10"	1'-0"	2'-5"	2'-8"	3'-0"	3'-8"	(1), (3), (6), (9), (10)
5	SINGLE BEND NEXT TO OVERHANG		2'-5"	2'-10"	3'-5"	6'-7"	7'-7"	7'-3"	6'-0"	(1), (2), (3), (4), (14)
6	SINGLE BEND, EMBEDDED END		3'-1"	3'-7"	4'-1"	4'-8"	5'-5"	6'-1"	7'-0"	(1), (2)
7	SINGLE OR DOUBLE BEND EMBEDDED, W/OVERHANG		2'-5"	2'-10"	3'-5"	3'-11"	4'-6"	5'-5"	6'-6"	(1), (2), (14)
8	DOUBLE BEND W/EMBEDDED END		3'-10"	4'-6"	5'-2"	5'-11"	6'-10"	7'-9"	8'-10"	(14)
9	DOUBLE BEND NEXT TO OVERHANG		2'-5"	2'-10"	3'-5"	3'-11"	4'-6"	5'-5"	6'-6"	(1), (2), (3), (4), (14)
10	FIRST SPAN FROM JB		2'-0"	2'-4"	2'-6"	3'-0"	1'-6"	1'-6"	1'-6"	(7)
11	SECOND SPAN FROM JB, STRAIGHT RUN		3'-9"	4'-3"	5'-0"	5'-8"	6'-7"	7'-5"	8'-6"	
12	SECOND SPAN FROM JB, W/SINGLE OR DOUBLE BEND		2'-5"	2'-10"	3'-5"	3'-11"	4'-9"	5'-7"	6'-6"	(14)
13	RIGID ITEM W/OVERHANG	E_{max}	0'-6"	0'-8"	0'-10"	6" 1'-0" 1'-6"	6" 1'-0" 1'-6"	6" 1'-0" 1'-6"	6" 1'-0" 1'-6"	(9), (10)
		f_{max}	4'-0"	4'-0"	4'-0"	10'-0" 8'-0" 4'-6"	6'-0" 5'-0" 4'-6"	6'-0" 5'-0" 4'-6"	4'-6" 4'-0" 3'-6"	(8)

FIGURE 7.30 (CONT)

RIGID CONDUIT SPAN

CASE NUMBER	CONDUIT CHARACTERISTICS	CONDUIT SIZE 3/4" ø	1" ø	1-1/2" ø	2" ø	3" ø	4" ø	5" ø	REMARKS see notes
14	STRAIGHT RUN W/BC	2'-11"	3'-9"	5'-1"	6'-0"	6'-0"	6'-0"	.....	(1), (2)
15	SINGLE BEND W/BC	1'-6"	2'-2"	3'-2"	6'-0"	6'-0"	6'-0"	.....	(1), (2)
16	DOUBLE BEND W/BC	1'-10"	2'-8"	3'-7"	6'-0"	6'-0"	6'-0"	.....	(1), (2), (14)
17	STRAIGHT RUN W/UNION	4'-1"	4'-10"	5'-5"	6'-0"	6'-11"	8'-1"	8'-7"	
18	SINGLE BEND W/UNION	2'-9"	3'-4"	3'-9"	6'-0"	6'-11"	6'-8"	5'-4"	
19	DOUBLE BEND W/UNION	3'-5"	4'-1"	4'-8"	6'-0"	6'-11"	8'-1"	8'-7"	(14)
20	CONTINUOUS RUN W/LBD (a + b)	0'-2"	0'-9"	1'-10"	2'-3"	2'-3"	1'-9"	1'-6"	(10), (11) (12)
21	SADDLE	4'-2"	4'-11"	5'-8"	6'-7"	7'-7"	8'-8"	9'-3"	

SPECIAL CONDITIONS

		3/4" ø	1" ø	1-1/2" ø	2" ø	3" ø	4" ø	5" ø
[illegible]	DISTANCE TO FIRST BEND CASE 5, 7, 8, 9 & 12	1'-9"	2'-0"	2'-4"	2'-8"	3'-0"	3'-4"	3'-10"
B	DISTANCE TO FIRST BEND CASE 16	0'-10"	1'-2"	1'-7"	1'-11"	2'-4"	2'-8"	.....
C	DISTANCE TO FIRST BEND CASE 19	1'-6"	1'-9"	2'-1"	2'-4"	2'-9"	3'-2"	3'-8"

FIGURE 7.30 (CONT)

GENERAL NOTES:

(1) Figure 7.30 data taken from SAG.CP25, Attachment N.

(2) For rigid spans (13) of conduit configurations not covered in this table, use allowable spans from:

S2-0910 SH. LS-Series for Group I, II, III

SPECIFIC NOTES:

(1) For union in the span reduce table values by 6" for 3/4" Ø to 1-1/2" Ø and 8" for 2" Ø to 5" Ø conduits.

(2) If union is within 6" of support, no reduction in table values is necessary.

(3) If B.C. within 6" of support, no reduction in table values is necessary.

(4) For B.C. in the span reduce table values by 8" for 3/4" Ø to 1-1/2" Ø and 12" for 2" Ø to 4" Ø conduits.

(5) Span length next to overhang shall be 1'-6" min. for 2" Ø to 5" Ø conduits.

(6) For overhangs on both sides of single span, table values are not applicable.

(7) d' not applicable for 3" Ø to 5" Ø conduits.

(8) $\ell_{min.}$ = 1'-3" for 3" Ø to 5" Ø conduits.

(9) Need not be a straight run.

(10) Allowable span lengths shall be determined by conduit run characteristic (i.e., S1 for straight runs, S8' for bends etc.)

(11) Table values are applicable for all cases on Drawing S-0910 SH. LS-11e.

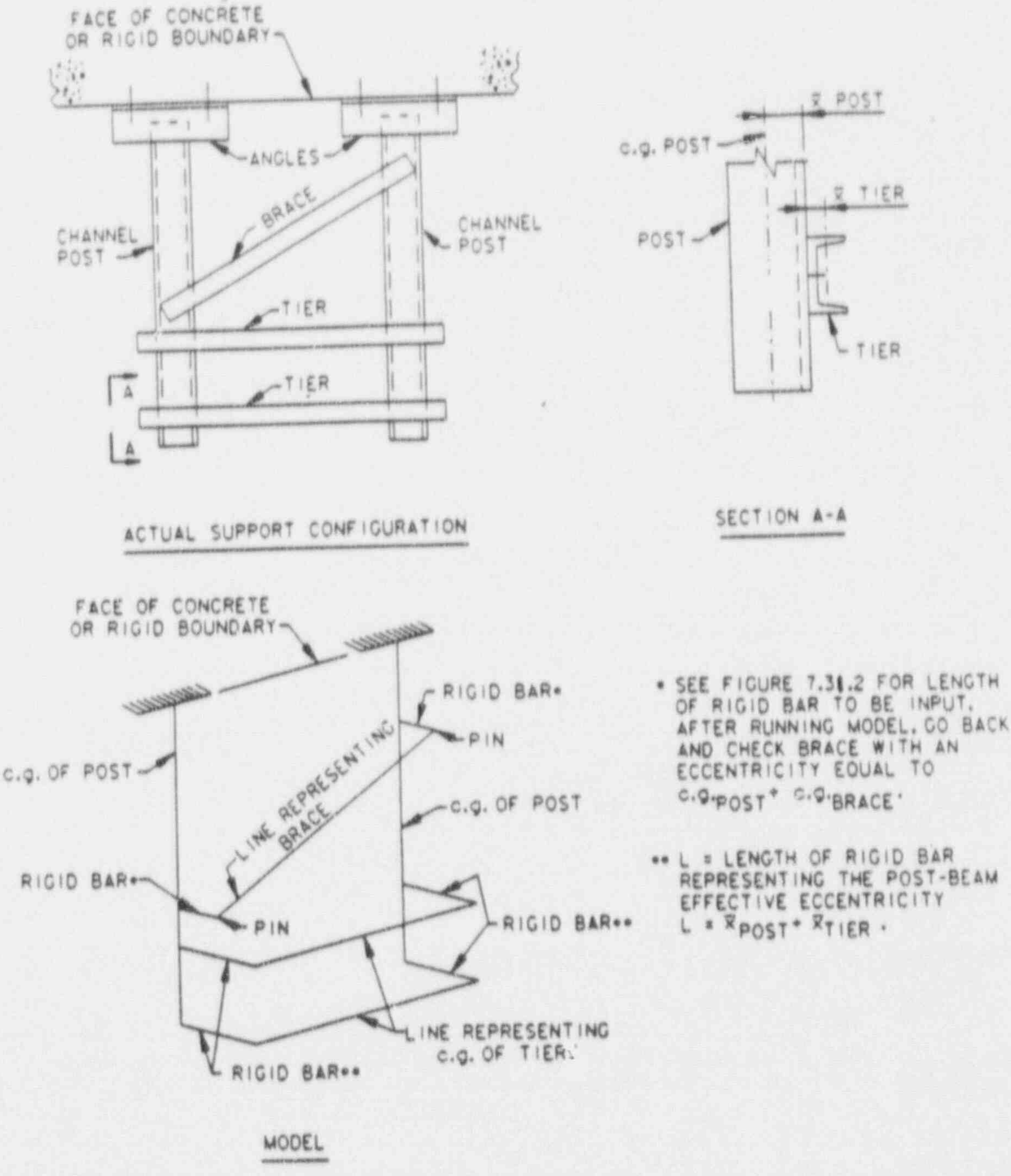
(12) For 5" Ø conduit if (a+b) is 6" to 1'6" - first span is 4'-0 max. in straight run.

(13) Rigid conduit span means frequency is greater than 33 Hz.

(14) See conditions A, B, and C as applicable on sheet 11 of 13 of Reference Ebasco Calculation EB-CSC-2X-08 for max. dist. (x or y max).

FIGURE 7.31.1

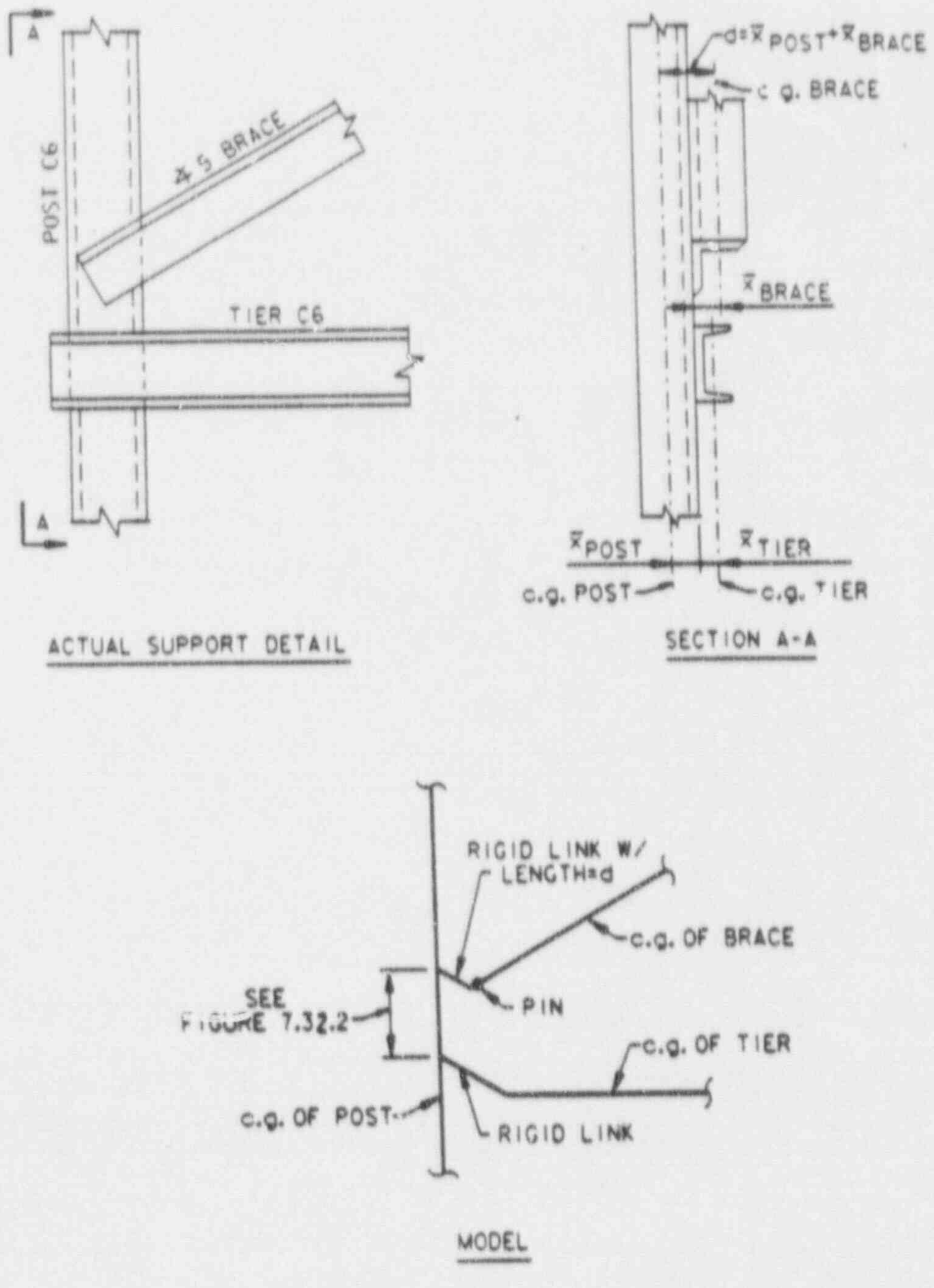
MEMBER ECCENTRICITIES



NOTE: Above data taken from SAG.CP29, Attachment B1.

FIGURE 7.31.2

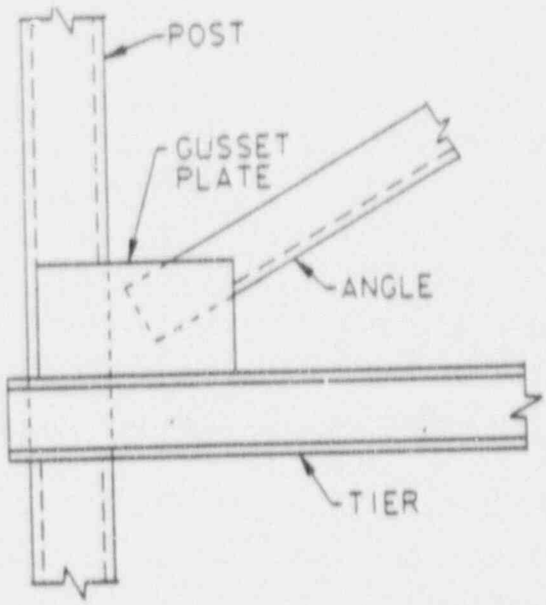
ECCENTRICITIES FOR BRACES WELDED TO THE BACK OF VERTICAL POST



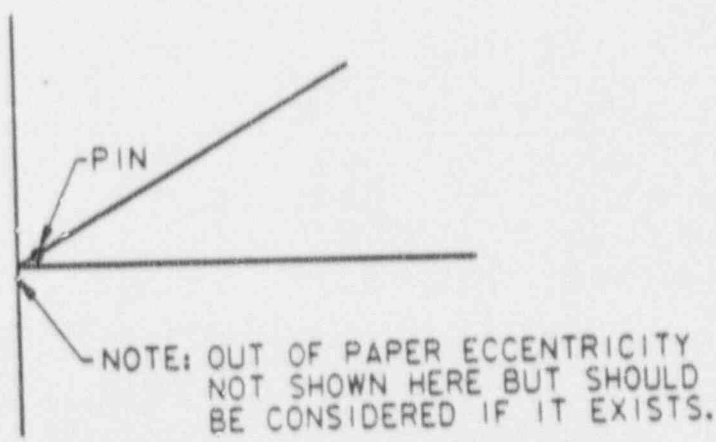
NOTE: Above data taken from SAG.CP29, Attachment B2.

FIGURE 7.32.1

WORKING POINT ECCENTRICITY FOR BRACE WITH GUSSET PLATES



ACTUAL SUPPORT DETAIL

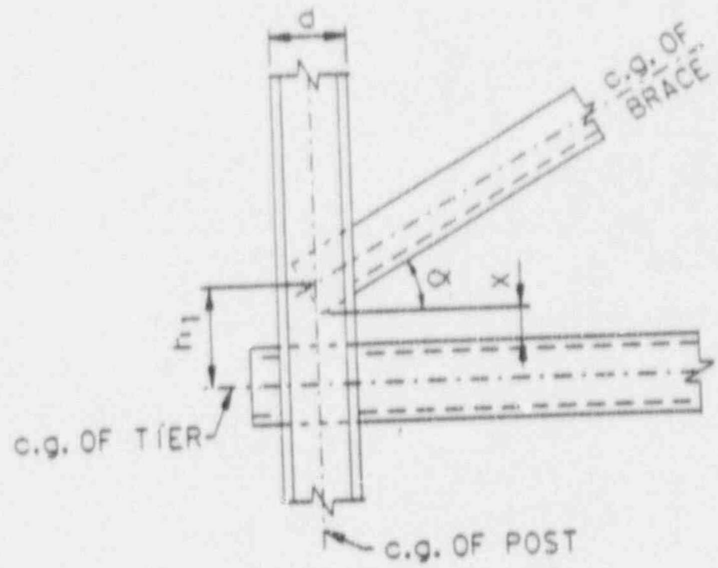


COMPUTER MODEL INPUT

NOTE: Above data taken from SAG.CP29, Attachment B3.

FIGURE 7.32.2

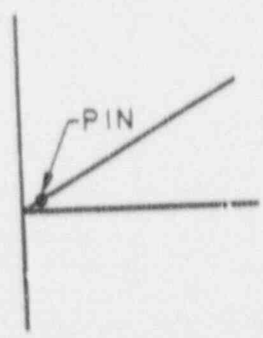
WORKING POINT ECCENTRICITY FOR BRACE WITHOUT GUSSET PLATES



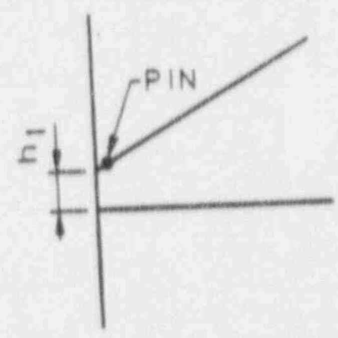
ACTUAL SUPPORT DETAIL

CONDITIONS: $x < \frac{d}{2}$ FOR $\alpha \geq 50°$

$x < \frac{d}{3}$ FOR $\alpha < 50°$



MODEL WHEN CONDITIONS ARE MET



MODEL WHEN CONDITIONS ARE NOT MET

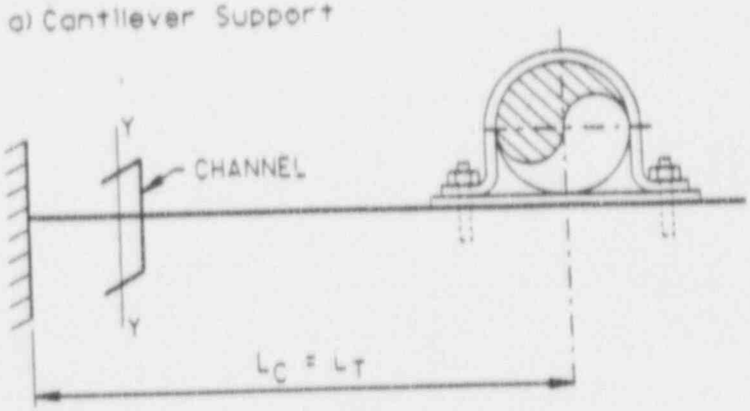
(SEE FIGURE 7.31.2)

NOTE: Above data taken from SAG.CP29, Attachment B4.

FIGURE 7.33

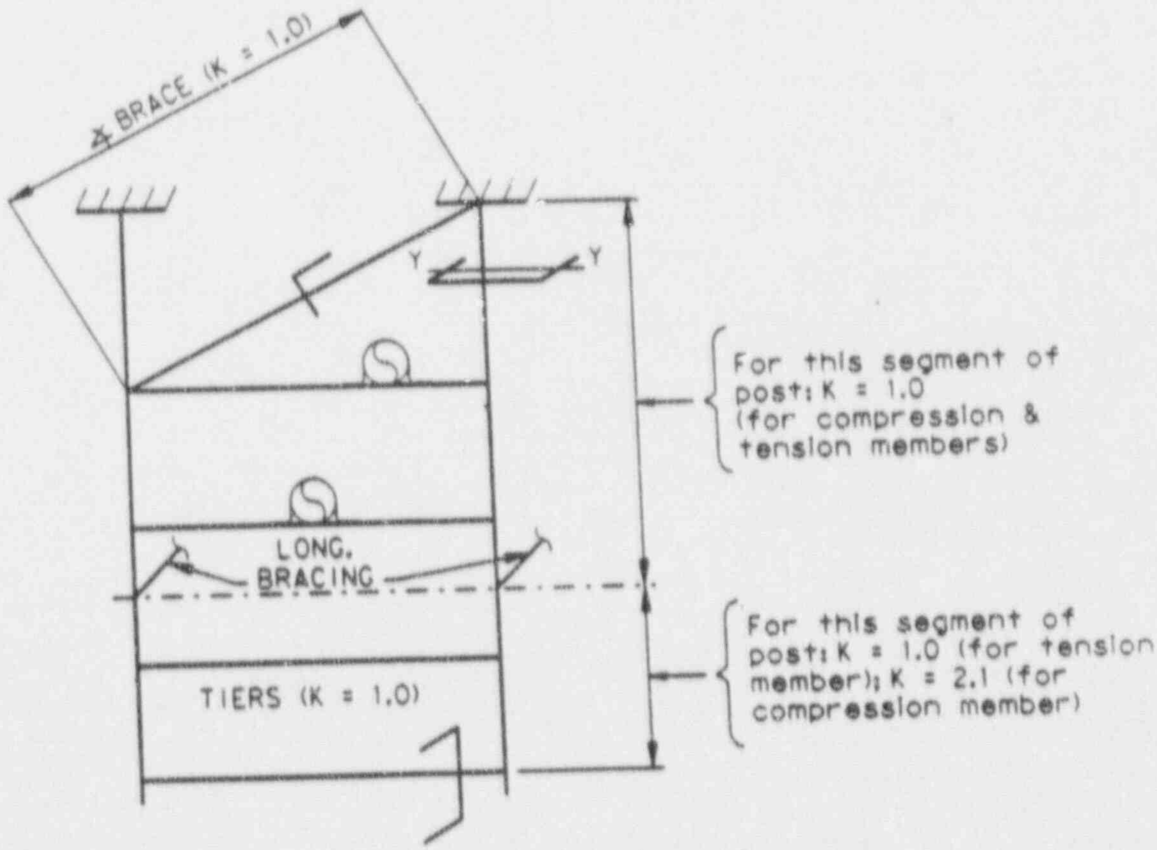
K FACTOR

a) Cantilever Support



K = 2.0 For compression members

b) Trapeze Support with Out-of-Plane Bracing



NOTE: Above data taken from SAG.CP29, Attachment C.

FIGURE 7.34

BETA ANGLES FOR ANGL.., CHANNEL AND TUBE SECTION

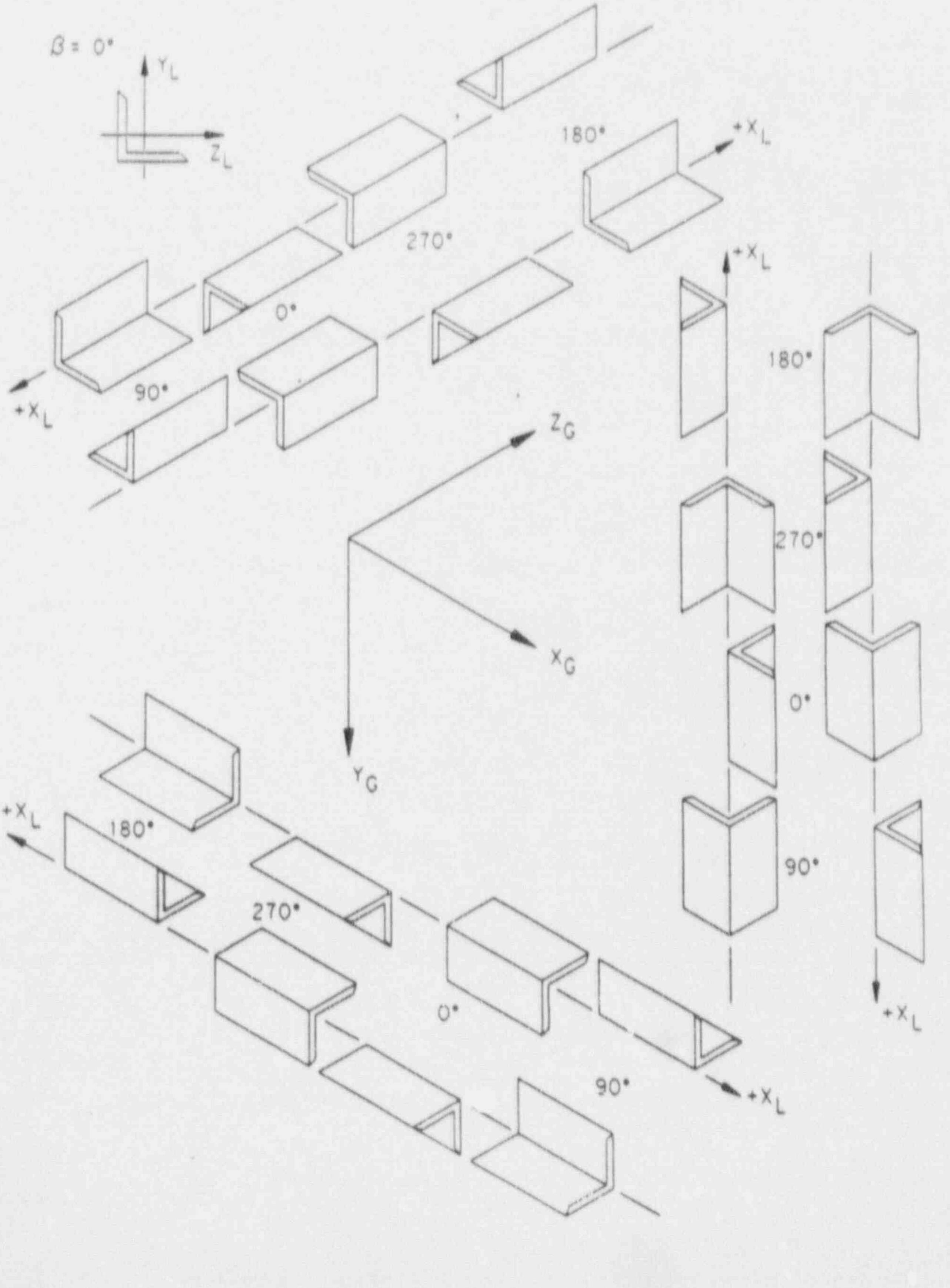


FIGURE 7.34 (CONT)

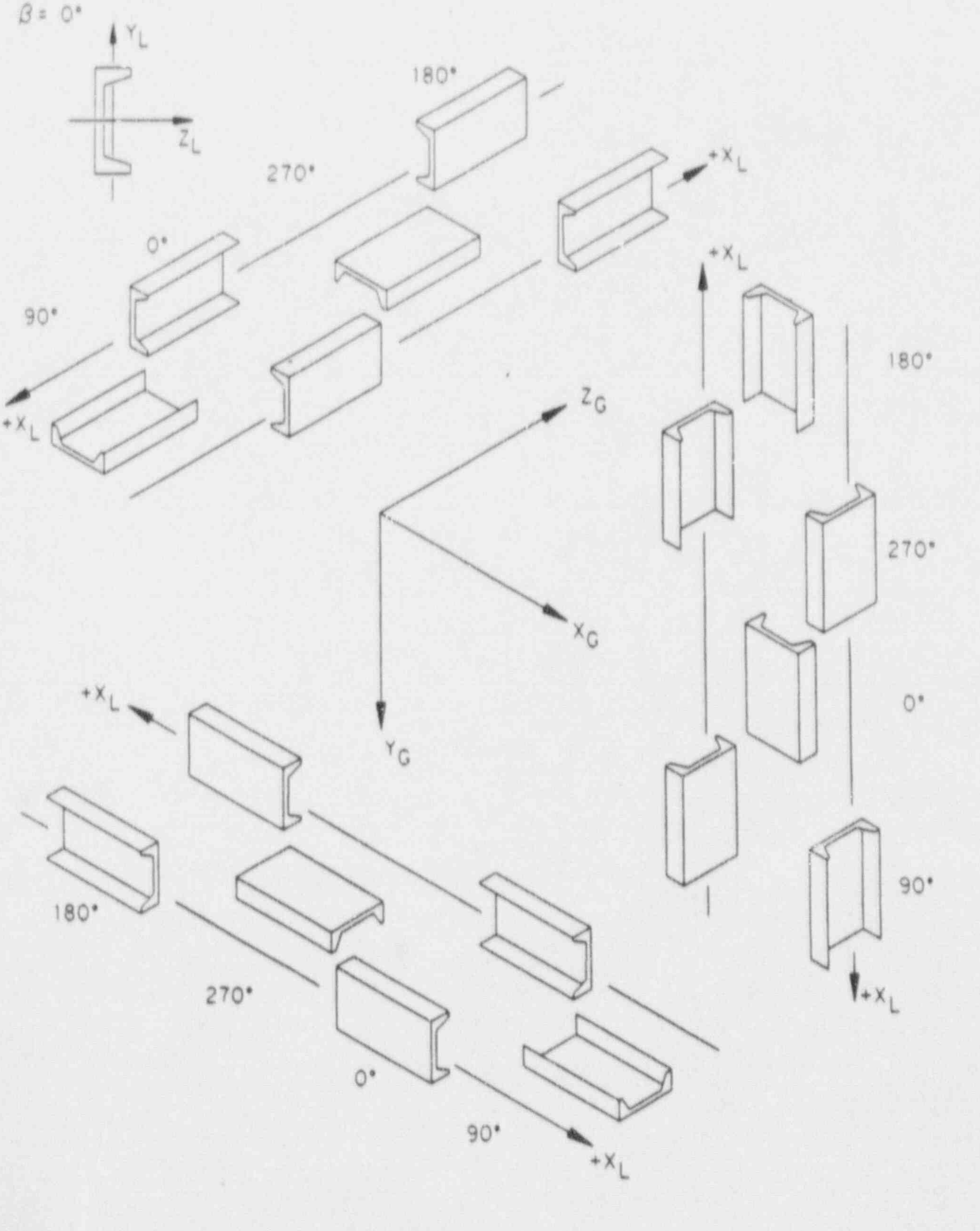
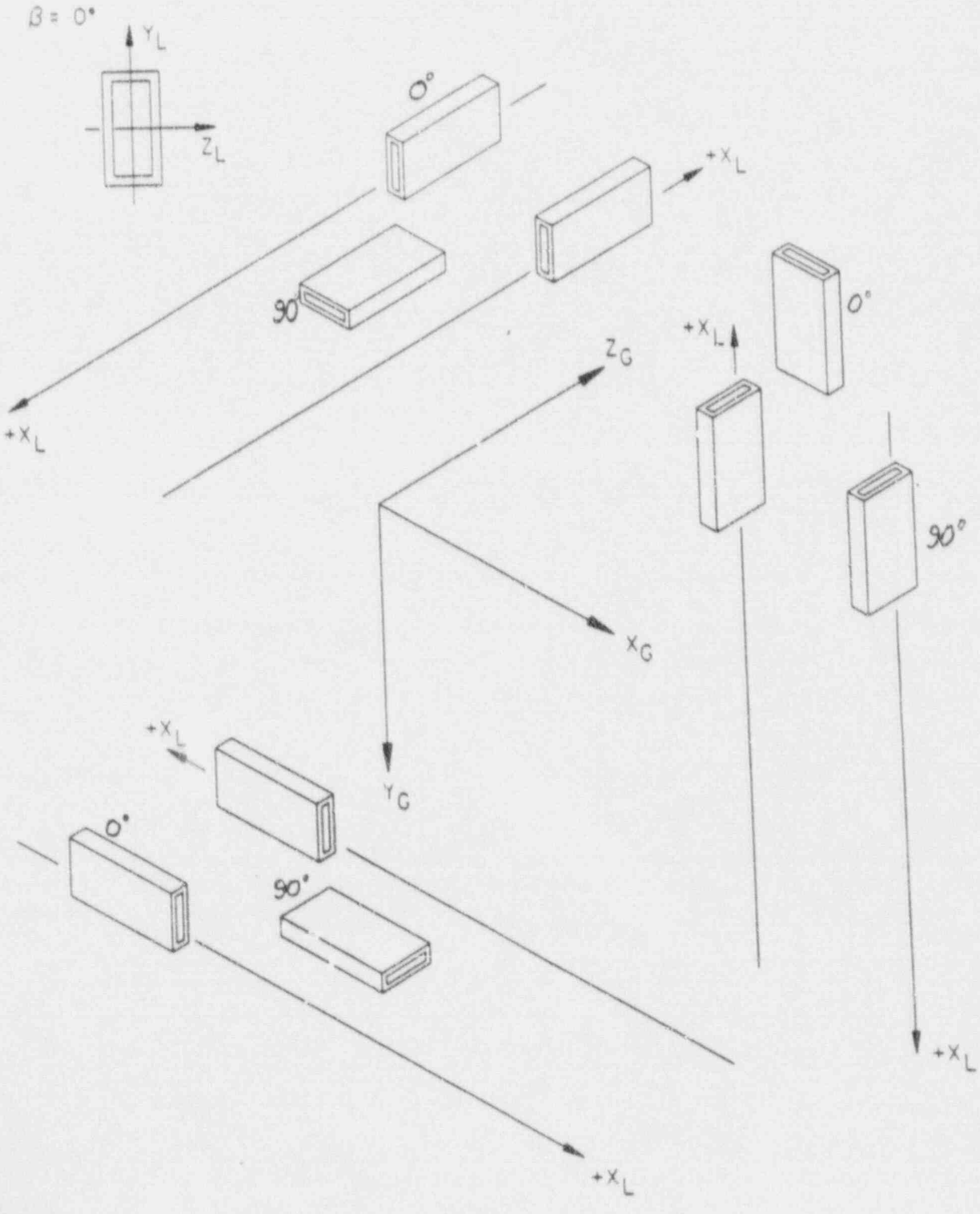


FIGURE 7.34 (CONT)



NOTE: Figure 7.34 data taken from SAG.CP29, Attachment D.

FIGURE 7.35.1

SPRING CONSTANT FOR ANCHOR BOLTS
HILTI KWIK BOLTS - TENSION

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	Δ @ $\frac{Pu}{4}$ (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
1/4	1 1/8	2000	940	235	0.019	12,370	21,000	9,290	105 (.005)
		4000	1475	370	0.0039	94,900	180,000	65,500	180 (.001)
		6000	1760	440	0.008	55,000	45,700	120,000	320 (.007)
	2 5/8	2000	2925	730	0.03	24,300	12,000	86,000	300 (.025)
		4000	3350	840	0.004	210,000			
		6000	3225	806	0.007	115,000	167,000	76,500	500 (.003)
1/8	1 5/8	2000	2160	540	0.018	30,000	13,300	68,500	160 (0.012)
		4000	2300	575	0.005	115,000	210,000	51,700	420 (0.002)
		6000	2840	710	0.006	118,000			
	4 5/8	2000	3350	8'0	0.046	18,300	10,530	55,000	400 (0.038)
		4000	4950	1240	0.010	124,000			
		6000	4700	1175	0.012	97,920			
1/2	2 1/4	2000	4720	1180	0.041	28,780	14,300	60,000	400 (0.028)
		4000	5650	1412	0.015	94,200	73,080	231,250	950 (0.013)
		6000	6850	1712	0.008	214,062			
	6 1/4	2000	9600	2400	0.067	35,820	16,000	47,600	400 (0.025)
		4000	12600	3150	0.005	630,000			
		6000	15500	3875	0.040	96,880	285,710	56,820	2000 (0.007)

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.35.1 (CONT)

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	Δ @ $\frac{Pu}{4}$ (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
5/8	2 3/4	2000	6000	1500	0.015	10000			
		4000	6900	1725	0.016	107800			
		6000	8200	2050	0.006	341700			
	7 3/4	2000	10000	2500	0.025	100000			
		4000	17000	4250	0.030	141700			
		6000	21000	5250	0.105	50000	138200	18710	3800 (.0275)
3/4	3 1/4	2000	8200	2050	0.007	292900			
		4000	10500	2625	0.023	114100			
		6000	10700	2675	0.018	148600	30000	296900	300 (.01)
	9 1/4	2000	15700	3925	0.10	38250	700000	3421	3500 (0.005)
		4000	24500	6125	0.070	87500	262500	17500	5250 (0.02)
		6000	22375	5594	0.03	186500			
1.0	4 1/2	2000	14300	3575	0.019	188200			
		4000	16200	4050	0.01	405000			
		6000	21600	5430	0.025	216000			
	10 1/2	2000	16500	4125	0.02	206250			
		4000	27000	6750	0.045	150000	400000	53846	5000 (0.012)
		6000	35750	8937	0.23	38900	650000	11100	6500 (0.01)
1 1/4	5 1/2	2000	18400	4610	0.099	51111	75000	32000	3000 (0.04)
		4000	23800	5950	0.165	36060			
		6000	33500	8375	0.180	46527	160000	28226	4000 (0.025)
	10 1/2	2000	26000	6500	0.160	40625	88888	21739	4000 (0.045)
		4000	40500	10125	0.26	38942	225000	23437	4500 (0.02)
		6000	45000	11250	0.095	118421	340000	39285	8500 (0.025)

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.35.2

SPRING CONSTANT FOR ANCHOR BOLTS
HILTI KWIK BOLTS-SHEAR

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	Pu/4 (lbs)	△ @ Pu/4 (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
1/4	1 1/8	2000	2230	577	0.090	6,194	80,000	4,511	160 (.002)
		4000	3480	870	0.066	13,182	20,000	12,241	160 (.008)
		6000	4050	1012	0.042	24,107			
	2 5/8	2000	1750	437	0.070	6,250	29,167	4,094	175 (0.006)
		4000	2700	675	0.018	37,500	130,000	25,937	260 (.002)
		6000	2300	575	0.014	41,071	80,000	34,583	160 (.002)
3/8	1 5/8	2000	3904	976	0.080	12,200	30,357	8,348	425 (.014)
		4000	5100	1275	0.044	28,977	220,000	19,881	440 (.002)
		6000	6200	1550	0.048	32,292	75,000	28,410	300 (.004)
	4 5/8	2000	3400	850	0.019	44,737	266,700	25,700	400 (.0015)
		4000	5500	1375	0.040	34,375	181,250	18,054	725 (.004)
		6000	6600	1650	0.026	63,461	125,000	52,300	500 (.004)
1/2	2 1/4	2000	7400	1850	0.069	26,810	15,500	86,400	900 (0.058)
		4000	8300	2075	0.024	86,460	366,700	46,470	1100 (.003)
		6000	9100	2275	0.056	40,630	19,440	78,750	700 (.036)
	6 1/4	2000	8900	2225	0.089	25,000	14,470	86,540	1000 (.076)
		4000	10600	2600	0.020	130,000	600,000	77,780	1200 (.002)
		6000	11500	2875	0.022	130,700	255,000	76,790	1800 (.008)
5/8	2 3/4	2000	12200	3050	0.072	42,360			
		4000	11800	2950	0.011	268,200	1,000,000	195,000	1000 (.001)
		6000	12900	3225	0.025	129,000	81,820	166,100	900 (.011)

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.35.2 (CONT)

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	△ @ $\frac{Pu}{4}$ (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
5/8	7 3/4	2,000	12,900	3,225	.096	33,590	18,000	50,540	900 (.050)
		4,000	15,400	3,850	.026	148,100	850,000	89,580	1,700 (.002)
		6,000	15,000	3,750	.018	208,300	850,000	128,100	1,700 (.002)
3/4	3 1/4	2,000	13,200	3,300	.037	89,200			
		4,000	17,600	4,400	.020	220,000	550,000	137,500	2,200 (.004)
		6,000	18,000	4,500	.068	66,200	23,530	108,800	800 (.034)
	9 1/4	2,[illegible]	[illegible]	3,850	.042	91,670	120,000	65,910	2,400 (.020)
		4,000	18,800	4,700	.070	67,140	250,000	56,100	1,000 (.004)
		6,000	21,200	5,300	.028	189,300			
1	4 1/2	2,000	30,000	7,500	.066	113,640	1,000,000	185,900	2,000 (.002)
		4,000	27,000	6,750	.038	177,600	700,000	148,600	1,400 (.002)
		6,000	30,500	7,625	.021	363,100	1,500,000	243,400	3,000 (.002)
	10 1/2	2,000	27,750	6,937	.120	57,810			
		4,000	35,000	8,750	.105	83,300	600,000	57,500	3,000 (.005)
		6,000	37,000	9,250	.043	205,600	650,000	150,000	3,250 (.005)
1 1/4	5 1/2	2,000	37,000	9,250	.072	128,500	333,300	109,800	2,000 (.006)
		4,000	41,000	10,250	.088	116,500	312,500	96,880	2,500 (.008)
		6,000	45,500	11,375	.044	258,500	1,750,000	187,500	3,500 (.002)
	10 1/2	2,000	40,500	10,125	[illegible]	77,880	33,330	116,100	2,000 (.060)
		4,000	31,500	7,875	[illegible]	92,650			
		6,000	49,500	12,375	.080	154,700	400,000	138,300	2,000 (.005)

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.35.3

SPRING CONSTANT FOR ANCHOR BOLTS
HILTI SUPER KWIK BOLTS - TENSION

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	Δ @ $\frac{Pu}{4}$ (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
1/2	3 1/4	1,500	6,350	1,587	.014	113,400			
		4,000	9,200	2,300	.015	153,300			
		6,000	13,600	3,400	.023	147,800	75,000	227,300	900 (.012)
	6 1/4	1,500	9,600	2,400	.050	48,000			
		4,000	15,000	3,750	.015	250,000			
		6,000	15,000	3,750	.010	375,000			
1	6 1/2	2,000	21,400	5,350	.019	281,600	800,000	203,000	2,000 (.0025)
		4,000	35,000	8,750	.019	460,500			
		6,000	37,500	9,375	.020	468,800			
	10 1/2	2,000	35,000	8,750	.140	62,500	240,000	23,910	6,000 (.025)
		4,000	48,500	12,125	.045	269,400			
		6,000	57,500	14,375	.030	479,200			
1 1/4	8 1/8	2,000	28,541	7,135	.165	43,240	440,000	17,650	4,400 (.010)
		4,000	43,000	10,750	.045	238,800			
		6,000	47,000	11,750	.090	130,600	300,000	65,380	7,500 (.025)
	13 1/8	2,000	41,500	10,375	.275	37,730	240,000	17,500	5,700 (.025)
		4,000	65,500	16,375	.045	363,900			
		6,000	73,000	18,250	.060	304,200	387,500	137,500	15,500 (.040)

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.35.4

SPRING CONSTANT FOR ANCHOR BOLTS
HILTI SUPER KWIK BOLTS - SHEAR

BOLT SIZE (in.)	EMBED. DEPTH (in.)	CONCRETE STRENGTH (psi)	Pu (lbs)	Pu/4 (lbs)	△ @ Pu/4 (in.)	LINEAR K (lbs/in)	BILINEAR K (lbs/in) K_1	K_2	LOAD (DEFL.) AT CHANGE IN SLOPE FOR BILINEAR K (lbs)
1/2	3 1/4	1500	10,000	2,500	.015	166,700			
		4000	11,800	2,950	.025	118,000			
		6000	14,000	3,500	.012	291,700			
	6 1/4	2000	11,800	2,950	.025	118,000	400,060	47,500	2000 (0.005)
		4000	15,400	3,850	.050	77,000			
		6000	10,700	2,675	.005	535,000			
	6 1/2	2000	19,200	4,800	.056	85,710	800,000	59,260	1600 (0.002)
		4000	26,250	6,562	.059	111,200	312,500	79,660	2500 (0.008)
		6000	34,000	8,500	.062	137,100	1,000,000	77,590	4000 (0.004)
	10 1/2	2000	27,000	6,750	.075	90,000			
		4000	32,750	8,187	.058	141,200	500,000	107,700	2500 (0.005)
		6000	34,000	8,500	.055	154,500			
1 1/4	8 1/8	2000	52,420	13,105	.200	65,530			
		4000	42,000	10,500	.030	350,000	916,700	208,300	5500 (0.006)
		6000	39,000	9,750	.035	278,600			
	13 1/8	2000	38,000	9,500	.055	172,700			
		4000	47,000	11,750	.058	202,600			
		6000	47,000	11,750	.065	180,800			

NOTE: Above data taken from SAG.CP29, Attachment P.

FIGURE 7.36.1

ALLOWABLE BENDING STRESS FOR ANGLE ABOUT AXIS 1-1

MEMBER SIZE & PROPERTIES	$\frac{18000\, r\, C_c}{\ell I_1}\sqrt{J I_2}$	SPAN ℓ (Inch)	Fcr (KSI)	F_e'(equiv) $\frac{12}{23}$ Fcr	The Equiv $\frac{K\ell}{r}$	F_b AXIS 1-1 (KSI)
L3 x 3 x 3/8	11893	24	495.5	258.5	24	20.4
I_1 = 2.793 in^4		48	247.8	129.3	34	19.7
I_2 = .724 in^4		72	165.2	86.2	41.6	19.1
J = .1055 in^4		96	123.9	64.6	48.1	18.5
C_c = 2.121"		120	99.1	51.7	53.8	18
		144	82.6	43.1	58.9	17.4
L3 1/2 X 3 1/2 X 3/8	11619	24	484.1	252.6	24.4	20.3
I_1 = 4.57 in^4		48	242.1	126.3	34.4	19.6
I_2 = 1.17 in^4		72	161.4	84.2	42.1	19
J = .123 in^4		96	121	63.1	48.7	18.5
C_c = 2.475"		120	96.8	50.5	54.4	18
		144	80.7	42.1	59.6	17.5
L 4 X 4 X 3/8	11508	24	479.5	250.2	24.5	20.3
I_1 = 6.944 in^4		48	239.8	125.1	34.6	19.6
I_2 = 1.776 in^4		72	159.8	83.4	42.3	19
J = .1406 in^4		96	119.[illegible]	62.6	48.9	18.4
C_c = 2.828"		120	95.9	50	54.7	17.9
		144	79.9	41.7	59.9	17.4
L 4 X 4 X 1/2	15838	24	659.9	344.3	20.8	20.5
I_1 = 8.827 in^4		48	330	172.2	29.5	20
I_2 = 2.293 in^4		72	220	114.8	36.1	19.5
J = .3333 in^4		96	165	86.1	41.7	19.1
C_c = 2.828"		120	132	68.9	46.6	18.6
		144	110	57.4	51	18.3
L 5 X 5 X 3/8	11309	24	471.2	245.8	24.7	20.3
I_1 = 13.94 in^4		48	235.6	122.[illegible]	34.9	19.6
I_2 = 3.539 in^4		72	157.1	82	42.5	19
J = .1758 in^4		96	117.8	61.5	49.3	18.4
C_c = 3.535"		120	94.2	49.1	55.1	17.9
		144	78.5	41	60.3	17.4

NOTE: Above data taken from SAG.CP29, Attachment Q.

FIGURE 7.36.1 (CONT)

MEMBER SIZE & PROPERTIES	$\frac{18000\pi C_c}{\ell I_1}\sqrt{JI_2}$	SPAN ℓ (Inch)	Fcr (KSI)	F_a'(equiv) $\frac{12}{23}$ Fcr	The Equiv $\frac{K\ell}{r}$	F_b AXIS 1-1 (KSI)
L 5 x 5 x 1/2	15350	24	639.6	333.7	21.2	20.5
I_1 = 18.01"in4		48	319.8	166.9	29.9	19.9
I_2 = .4.59"in4		72	213.2	111.2	36.6	19.4
J = .4167"in4		96	159.9	83.4	42.3	19
C_c = 3.535"		120	127.9	66.7	47.3	18.6
		144	106.6	55.6	51.8	18.2
L 5 X 5 X 3/4	24548	24	1022.8	533.6	16.7	20.8
I_1 = 24.8in^4		48	511.4	266.8	23.7	20.4
I_2 = 6.597in^4		72	340.9	177.9	29	20
J = 1.406in^4		96	255.7	133.4	33.5	19.7
C_c = 3.535"		120	204.6	106.7	37.4	19.4
		144	170.5	89	41	19.1
L 6 X 6 X 3/4	23618	24	984.1	513.4	17.1	20.8
I_1 = 44.847in^4		48	492	256.7	24.1	20.3
I_2 = 11.554in^4		72	328	171.1	29.6	20
J = 1.6875in^4		96	246	128.3	34.1	19.6
C_c = 4.242"		120	196.8	102.7	38.1	19.3
		144	164	85.6	41.8	19

NOTE: Above data taken from SAG.CP29, Attachment Q.

FIGURE 7.36.2

TORSIONAL BUCKLING OF ANGLE MEMBERS

The following lists the maximum angle lengths for which torsional buckling needs to be considered. If the actual angle length is less than or equal to the length listed, the L/r shown shall be used to calculate the allowable compressive stress F(a). For lengths greater than those shown, torsional buckling is not critical.

ANGLE SIZE	LENGTH (L)	L/r
L 2 X 2 X 0.250	16"	41
L 2 X 2 X 0.375	12"	31
L 2.5 X 2.5 X 0.375	16"	33
L 3 X 3 X 0.250	37"	61
L 3 X 3 X 0.375	25"	42
L 3 X 3 X 0.500	19"	31
L 3.5 X 3.5 X 0.375	33"	47
L 4 X 4 X 0.250	65"	81
L 4 X 4 X 0.375	42"	53
L 4 X 4 X 0.500	31"	39
L 5 X 5 X 0.375	67"	67
L 5 X 5 X 0.500	49"	49
L 5 X 5 X 0.625	39"	39
L 5 X 5 X 0.750	33"	33
L 6 X 6 X 0.375	97"	81
L 6 X 6 X 0.500	72"	61
L 6 X 6 X 0.625	56"	47
L 6 X 6 X 0.750	46"	39
L 8 X 8 X 0.500	131"	82
L 8 X 8 X 0.625	103"	65
L 8 X 8 X 0.750	84"	53
L 8 X 8 X 1.000	63"	40

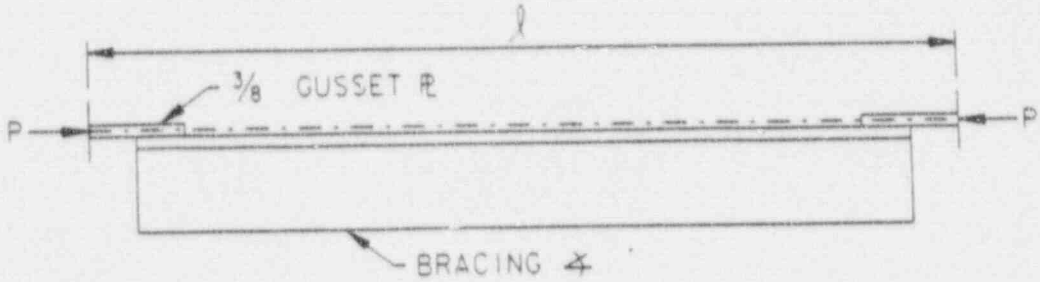
If the angle fails using the above values, more rigorous analysis may be required.

The equations and tabular values presented above apply to equal leg angles only. Unequal leg angles shall be addressed on a case-by-case basis.

NOTE: Above data taken from SAG.CP29, Attachment Q.

FIGURE 7.36.3

ALLOWABLE LOAD IN ANGLE BRACING WITH GUSSET PLATE CONNECTION



ANGLE SIZE	SPAN L (in)	ALLOWABLE LOAD P (KIPS)
L 3 X 3 X 3/8	36	16
	48	14
	60	13
	72	11
	84	9
	96	7
	108	6

NOTES:

1. Allowable load shown on the table is for OBE load combination.
2. 1.6 times allowable load shall be used for SSE load combination.
3. For calculation of allowable load, see Ebasco Calculation Book No. Supt-0235.
4. Linear interpolation is acceptable.
5. Above data taken from SAG.CP29, Attachment Q.

FIGURE 7.37

ENVELOPED DESIGN "g" VALUES

BUILDING	2% DAMPING OBE			3% DAMPING SSE			F_{supt} (Min.)
	S_X	S_Y	S_Z	S_X	S_Y	S_Z	
Electrical Control	1.19*	1.98*	2.12*	1.82*	3.10*	2.50*	16Hz
Safeguards	1.95	3.53	2.73	2.88	4.87+	4.13	16Hz
Auxiliary	1.79	4.08	1.88	2.30*	4.87*	2.64*	14Hz
Internal Structure	2.14*	2.42*	2.14*	3.13*	3.36*	3.13*	12Hz
Containment	1.41*	3.63*	1.56*	1.79*	4.25*	2.19*	12Hz
Fuel (below El 860.00')	2.43*	2.01*	2.43*	3.47*	3.03*	3.57*	16Hz

* "g" value may be enveloped by other building.

+ Original value 4.83 was increased to 4.87 to envelope other building.

The Diesel Generator Building is contained within the Safeguard Building.

NOTES:

1. This table applies to conduits that are designed in accordance with the requirements of S-0910 drawings.
2. Above data taken from SAG.CP10, Appendix 7.

FIGURE 7.3b

LOAD FACTORS (LF) FOR VARIOUS CONFIGURATIONS

BUILDING	CONFIG. / S-0910 DWG. / ELEV.	REF: CALC. SPAN-1195		REF: CALC SPAN-1196			
		W/ LBD	DOUBLE BEND W/LBD	DOUBLE BEND	SINGLE BEND	STRAIGHT RUN	3,4' SADDLE
		LS-11e CASE I→VII, LS-11j, LS-11K, LS-14a, LS-14c	LS-11e CASE VIII→X	LS-2B, LS-2C, LS-2D, LS-10, LS-10-A	LS-1b-A, LS-1c-C, LS-3a-A, LS-10, LS-10-A	LS-1b-A, LS-1c-C, LS-3a-A, LS-3a-B, LS-10, LS-10-A	LS-1b-A
CONTAINMENT	≥ 950'-7"	1.22	1.37	1.31	1.37	———	———
	≥ 860'-0"	1.16	1.09	1.23	1.08	———	———
SAFEGUARDS & DIESEL GENERATOR	896'-6"	1.12	1.27	———	———	———	———
	875'-6"	1.15	1.25	1.14	1.07	———	———
	852'-6"	1.18	1.42	1.13	1.09	———	———
	831-6", 810'-6"	———	1.05	———	———	———	———
AUXILIARY	≥ 886'-6"	1.05	1.16	1.07	1.06	———	———
	873'-6"	1.13	1.41	1.16	1.09	———	———
	852'-6"	1.20	1.39	1.37	1.19	———	1.18
	831'-6"	1.15	1.40	1.30	1.13	———	1.19
	810'-6"	———	———	———	———	———	———
REACTOR BLDG INTERNAL	905'-9"	1.18	1.35	1.32	1.34	1.10	1.25
	885'-6"	1.25	1.39	1.08	1.20	1.05	1.05
	860'-0"	1.28	1.20	1.16	1.16	1.08	1.13
ELECTRICAL CONTROL	≥ 854'-4"	1.18	1.33	1.32	1.17	———	1.17
	830'-0"	1.11	1.08	1.13	———	———	1.05

NOTES:

1. Load factors (LF) tabulated on this sheet are for the LS series application only. LF is 1.0 for building elevations not shown.

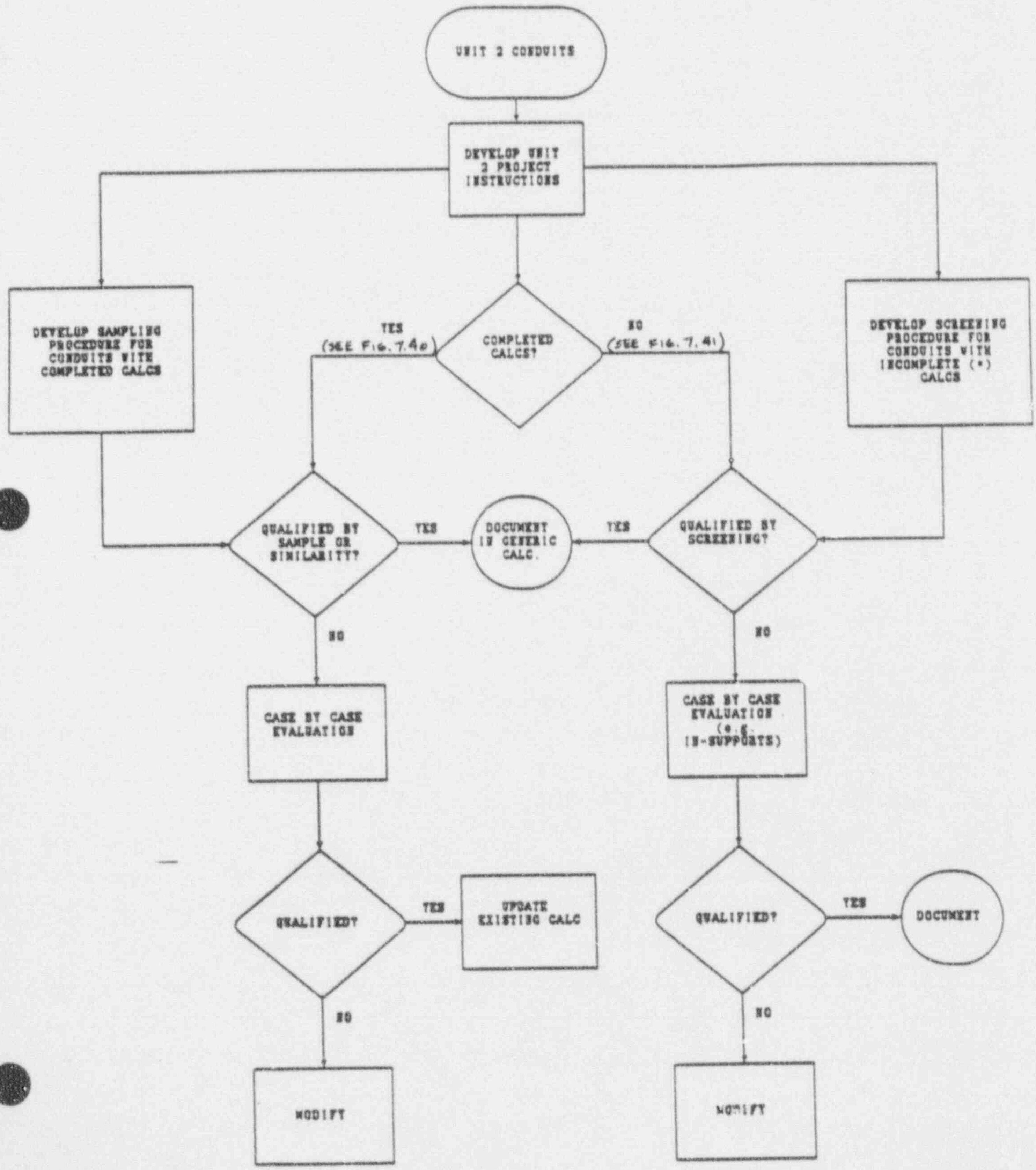
2. If a conduit isometric comprises any one of the configurations listed, then the LF for the configuration shall be applied at all supports for the entire run.

3. If a conduit isometric comprises more than one tabulated configuration, then the largest LF shall be applied.

4. ________ indicates LF = 1.0.

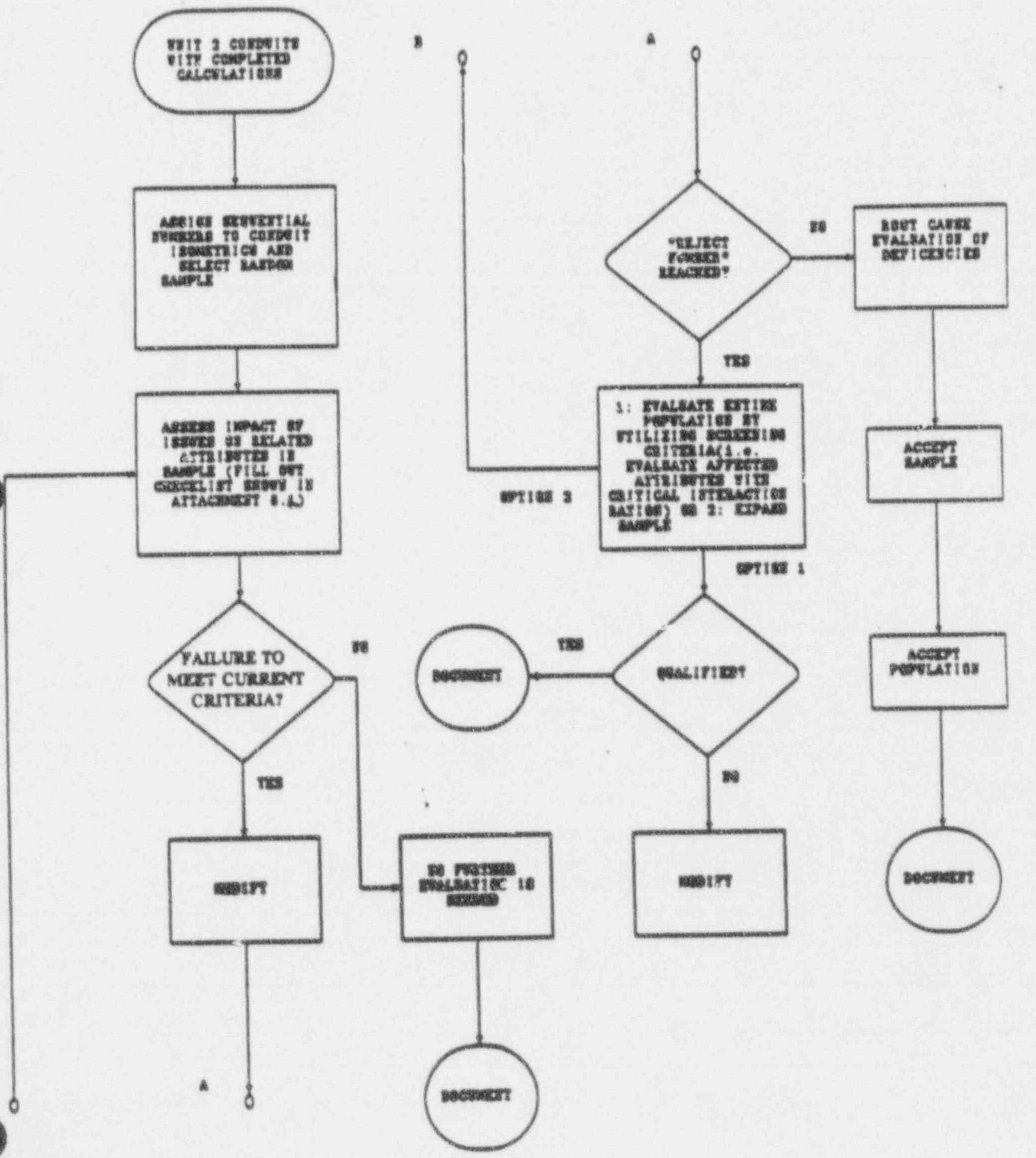
5. Above data taken from SAG.CP25, Attachment S.

FIGURE 7.39
OVERALL DESIGN VALIDATION PROCESS



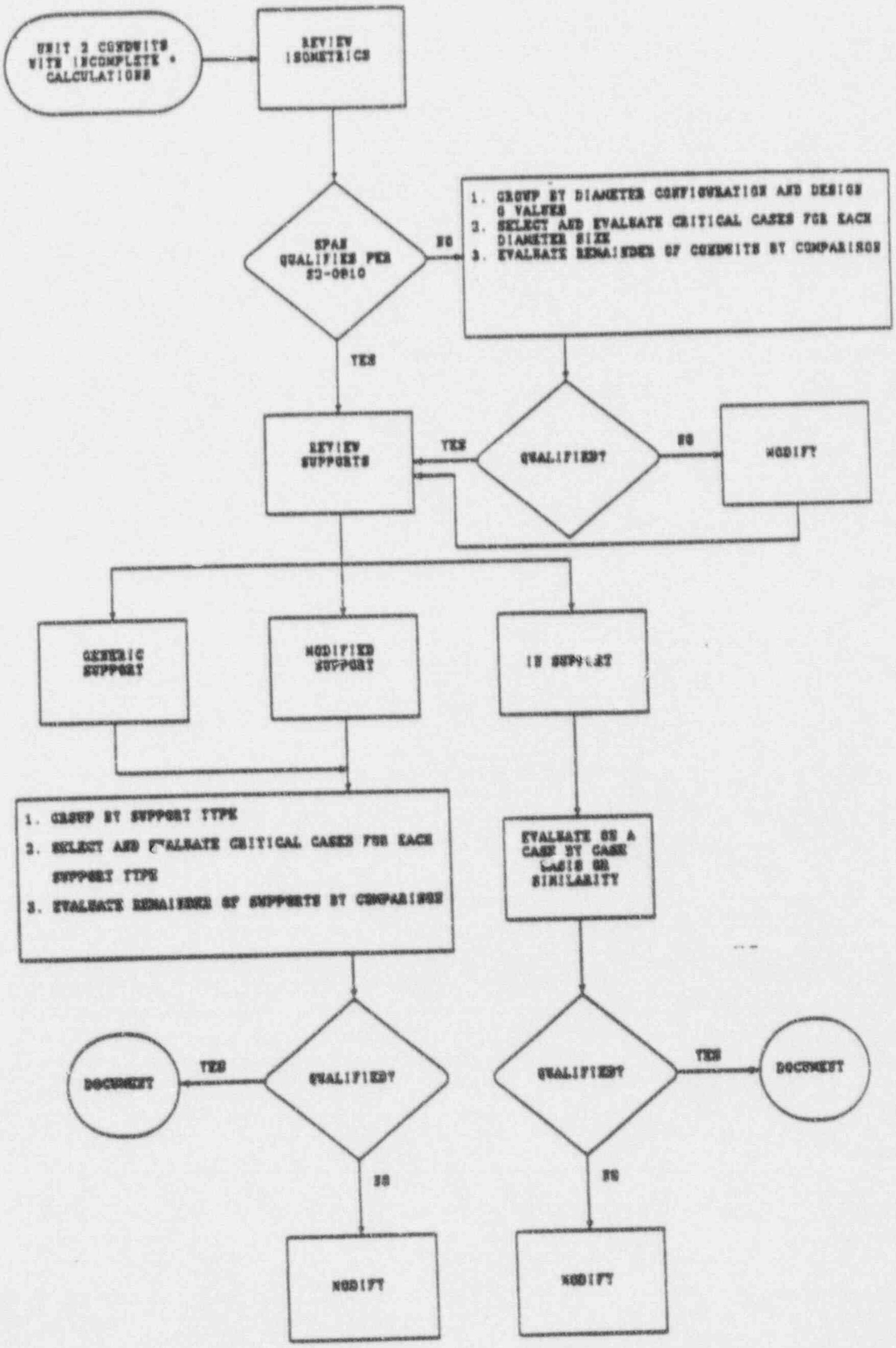
* INCLUDES CONDUITS WITH NO CALCULATIONS

FIGURE 7.40
DESIGN VALIDATION FLOW CHART FOR CONDUITS
WITH COMPLETED CALCULATIONS



PCN-01

FIGURE 7.41
DESIGN VALIDATION FLOW CHART FOR CONDUITS
WITH INCOMPLETE CALCULATIONS



* INCLUDES CONDUITS WITH NO CALCULATIONS

FIGURE 7.42
CONDUIT DRAWING

CONDUIT DRAWING

SUP NO	SUP TYPE	MAX SPAN	SPAN TYPE	FITT	REMARKS

NOTES:

REV	DWG CHKD	RE LDE	DV	APVD	REMARKS

GROUP/ ORGANIZATION					COND NO. DIAM:
REVIEWER INITIAL AND DATE					TU ELECTRIC CPSES GLEN ROSE, TEXAS CONDUIT DRAWING
CLASS I NUCLEAR SAFETY RELATED					DWG NO. / SH NO / REV

FIGURE 7.42 (CONT'D)

CONDUIT DRAWING

NOTES:

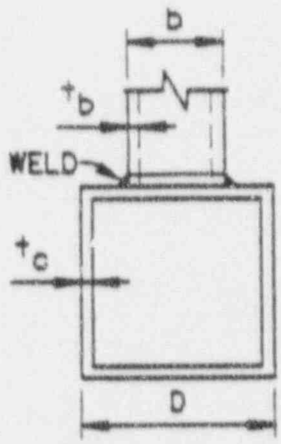
REV	DWG CHKD	RE LDE	DV	APVD	REMARKS

GROUP/ ORGANIZATION					COND NO.	DIAM:
REVIEWER INITIAL AND DATE					TU ELECTRIC CPSES GLEN ROSE, TEXAS CONDUIT DRAWING	
CLASS I NUCLEAR SAFETY RELATED					DWG NO.	SH NO ___ / REV

ATTACHMENT 8.A

FORMULAS FOR FINDING PUNCHING SHEAR

CASE 1: TUBULAR STEEL SECTION CONNECTION



STL A 500 GR. B

$F_Y = 46^{KSI}$ OR

2/3 OF MIN. TENSILE STRENGTH

$= 2/3\ (58^{KSI}) = 38.67^{KSI}$

* 1.22 FOR '79 CODE
USE 1.2 & U = 1.0
TO ENVELOPE THE
ALLOWABLES IN THE
TABLE CONSERVATIVELY, OR

REF: A.W.S. D1·1-79 SECT 10.5

ALLOWABLE PUNCHING SHEAR STRESS

$V_p = Q_q \cdot Q_f \cdot (\text{basic } V_p)$

WHERE

$\text{basic } V_p = \frac{F_y}{0.6\gamma} = \frac{F_y}{.6(D/2t_c)} = \frac{3.33 t_c F_y}{D}$

$\gamma = \frac{D}{2t_c}$, $\beta = \frac{b}{D}$

$Q_q = 1.0$ FOR $\beta \leq .5$

$= \frac{.25}{\beta(1-\beta)}$ FOR $\beta > .5$

$Q_f = 1.0$ FOR $U \leq .44$

$= 1.2^* - .5U$ FOR $U > .44$

FOR CONSERVATIVE DESIGN, USE
$Q_f = 0.7$ FOR ALL U VALUES

$U = \frac{(fa+fb)}{(0.6xFy)}$ WHERE fa AND fb ARE DEFINED ON PAGE 181 PCN-01

$$V_p = (1)(.7)\left(\frac{3.333 t_c \times 38.67}{D}\right) = 90.22\,\frac{t_c}{D} \text{ FOR } \beta \leq .5$$

$$V_p = \frac{.25}{\beta(1-\beta)} \times (0.7) \times \frac{128.9\ t_c}{D} = \frac{22.55}{\beta(1-\beta)} \times \frac{t_c}{D} \text{ FOR } \beta > .5$$

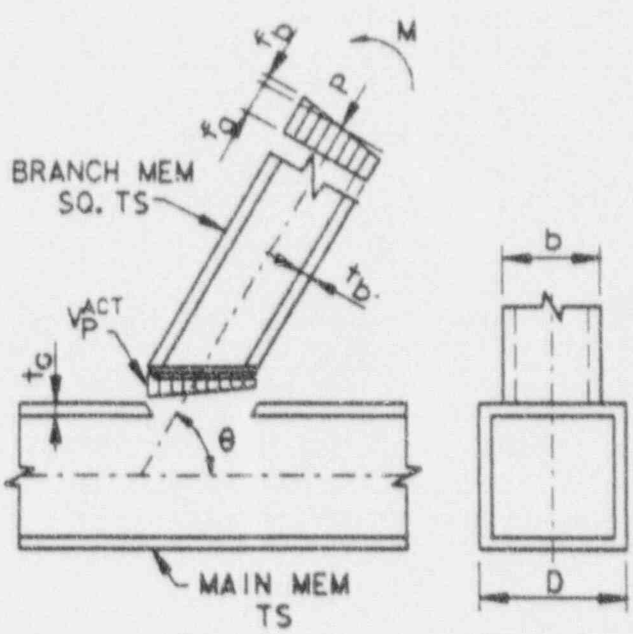
ALLOWABLE NORMAL WELD FORCE FOR CONN $= t_c V_p$ (lbs/")

NOTES: FOR $\beta > .8$, REFER TO AWS D1·1, SECTION 10.5.
THE COMPUTED SHEAR STRESS IS THE ALLOWABLE LOCAL SHEAR STRESS. IT IS STILL REQUIRED TO MEET AISC ALLOWABLE SHEAR STRESS.

NOTE: Above data taken from SAG.CP29, Attachment L.

ATTACHMENT 8.A (CONT)

CASE 2: STEPPED TUBULAR STEEL SECTION CONNECTION



ACTING PUNCHING SHEAR STRESS IN MAIN MEMBER

$$V_P^{ACT} = \frac{t_b}{t_c}\left(\frac{f_a \sin\theta}{K_a} + \frac{f_b}{K_b}\right)$$

WHERE $f_a = \frac{P}{A_b}$ AXIAL STRESS

$f_b = (f_{bY}^2 + f_{bZ}^2)^{1/2}$ BENDING STRESS

(IF APPLICABLE FOR OUT OF PLANE BENDING)

$$K_a = \frac{1+\sin\theta}{2\sin\theta}$$

$$K_b = \frac{1+3\sin\theta}{4\sin^2\theta}$$

(K_b: USE ENVELOPE)

A_b = AREA OF CROSS SECTION OF BRANCH MEMBER

f_{bY} AND f_{bZ} ARE THE MAXIMUM BENDING STRESSES IN BRANCH MEMBER DUE TO BENDING MOMENTS ABOUT Y AND Z AXES OF BRANCH MEMBER

AFTER SUBSTITUTION, THEN

$$V_P^{ACT} = \frac{t_b}{t_c}\sin^2\theta\left(\frac{2f_a}{1+\sin\theta} + \frac{4f_b}{1+3\sin\theta}\right)$$

CALCULATED ACTING PUNCHING SHEAR FORCE IN MAIN MEMBER

$(V_P^{ACT})\,t_c \leq t_c V_p$ (ALLOWABLE NORMAL WELD FORCE - SEE CASE 1)

REF: AWS CODE D1.1-79 SECT 10.5

NOTE: Above data taken from SAG.CP29, Attachment L.

ATTACHMENT 8.A (CONT)

ALLOWABLE NORMAL WELD FORCE PER INCH FOR STEPPED TUBULAR SECTION CONNECTION

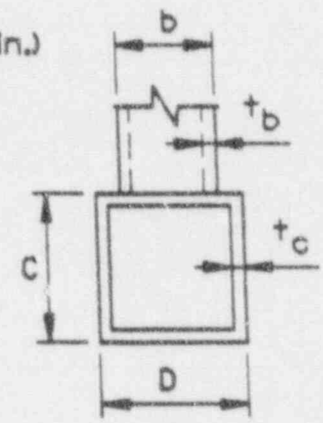
MAIN MEMBER $t_c \times D$	$\beta = \frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE lbs/inch
3/16 × 4	.500	792
	.625	835
	.750	1055
	.875	1811
1/4 × 4	.500	1408
	.625	1502
	.750	1878
	.875	3219
5/16 × 4	.500	2200
	.625	2347
	.750	2935
	.875	5030
3/16 × 5	.400	634
	.500	634
	.600	660
	.700	754
	.800	990
1/4 × 5	.400	1127
	.500	1127
	.600	1175
	.700	1341
	.800	1760
5/16 × 5	.400	1760
	.500	1760
	.600	1833
	.700	2085
	.800	2751
3/8 × 5	.400	2535
	.500	2535
	.600	2541
	.700	3018
	.800	3961

MAIN MEMBER $t_c \times D$	$\beta = \frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE lbs/inch
1/2 × 5	.400	4507
	.500	4507
	.600	4695
	.700	5366
	.800	7042
3/16 × 6	.330	528
	.500	528
	.670	597
	.830	835
1/4 × 6	.330	939
	.500	939
	.670	1061
	.830	1664
5/16 × 6	.330	1467
	.500	1467
	.670	1659
	.830	2600
3/8 × 6	.330	2112
	.500	2112
	.670	2389
	.830	3743
3/16 × 7	.430	452
	.570	462
	.710	549
	.860	940
1/4 × 7	.430	804
	.570	820
	.710	[illegible]
	.860	1671

MAIN MEMBER $t_c \times D$	$\beta = \frac{b}{D}$	ALLOWABLE NORMAL WELD FORCE lbs/inch
5/16 × 7	.430	1257
	.570	1282
	.710	1527
	.860	2611
3/8 × 7	.430	1811
	.570	1847
	.710	2199
	.860	3760
3/16 × 8	.375	396
	.500	[illegible]
	.625	[illegible]
	.875	905
1/4 × 8	.375	704
	.500	704
	.625	751
	.875	1609
5/16 × 8	.375	1100
	.500	1100
	.625	1173
	.875	2515
3/8 × 8	.375	1584
	.500	1584
	.625	1690
	.875	3622
1/2 × 8	.375	2817
	.500	2817
	.625	3004
	.875	6438

NOMENCLATURE FOR STEPPED TUBULAR CONNECTION:

- b - MINOR WIDTH OF STRUCTURAL TUBE BRANCH MEMBER (In.)
- t_b - THICKNESS OF BRANCH MEMBER (In.)
- D - WIDTH OF STRUCTURAL TUBE MAIN MEMBER (In.)
- t_c - THICKNESS OF MAIN MEMBER (In.)
- β - BETA RATIO, (b/D) BOX SECTIONS
- C - DEPTH OF STRUCTURAL TUBE MAIN MEMBER (In.)



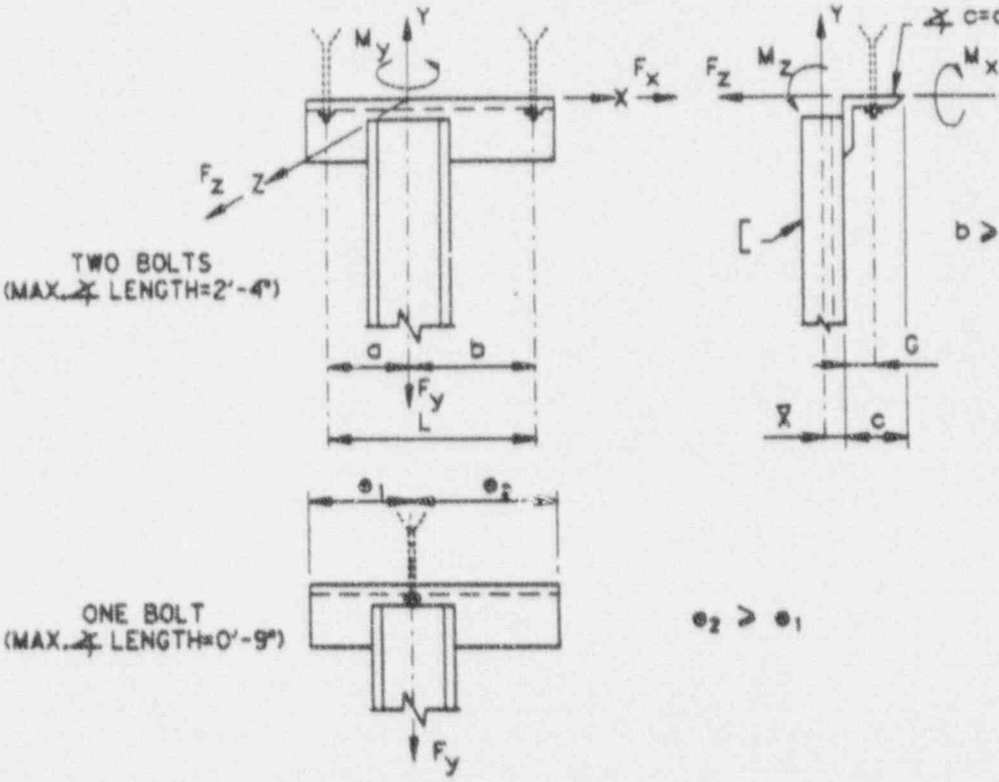
NOTE: Above data taken from SAG.CP29, Attachment L.

ATTACHMENT 8.B

EVALUATION OF STRESSES IN BASEPLATES, SURFACE ANGLES AND ANCHOR BOLTS

VERIFICATION OF HILTI ANCHOR BOLTS FOR SURFACE ANGLE CONNECTIONS
ANGLE IS MIN. 3/4 INCH THICK
(APPLIES TO BOTH HILTI KWIK AND HILTI SUPERKWIK)

THE TENSION FORMULAS BELOW ARE CONSERVATIVE.



FORCES AND MOMENTS FROM COMPUTER OUTPUT

F_x F_y F_z M_x M_y M_z CALCULATE $M'_z = M_z + F_y\left(b - \frac{L}{2}\right)$

MAXIMUM BOLT TENSION

$$T = 2.15\,\frac{M'_z}{L} + \frac{1}{(c-G)}\left[1.15\,\frac{F_y b(c+\bar{X})}{L} + 1.1\,\frac{M_x b}{L}\right]$$ FOR TWO BOLTS c = 8 INCHES

$$T = 1.81\,\frac{M'_z}{L} + \frac{1}{(c-G)}\left[1.15\,\frac{F_y b(c+\bar{X})}{L} + 1.1\,\frac{M_x b}{L}\right]$$ FOR TWO BOLTS c = 6 INCHES

$$T = 1.15\,\frac{M_z}{e_1} + \frac{1.1}{(c-G)}\left[F_y\,(c+\bar{X}) + M_x\right]$$ FOR ONE BOLT

MAXIMUM BOLT SHEAR (FOR TWO BOLTS)

$$S = \left[\left(\frac{M_y + F_z \cdot b + F_x(c+\bar{X})}{L}\right)^2 + \left(\frac{F_x}{2}\right)^2\right]^{1/2}$$

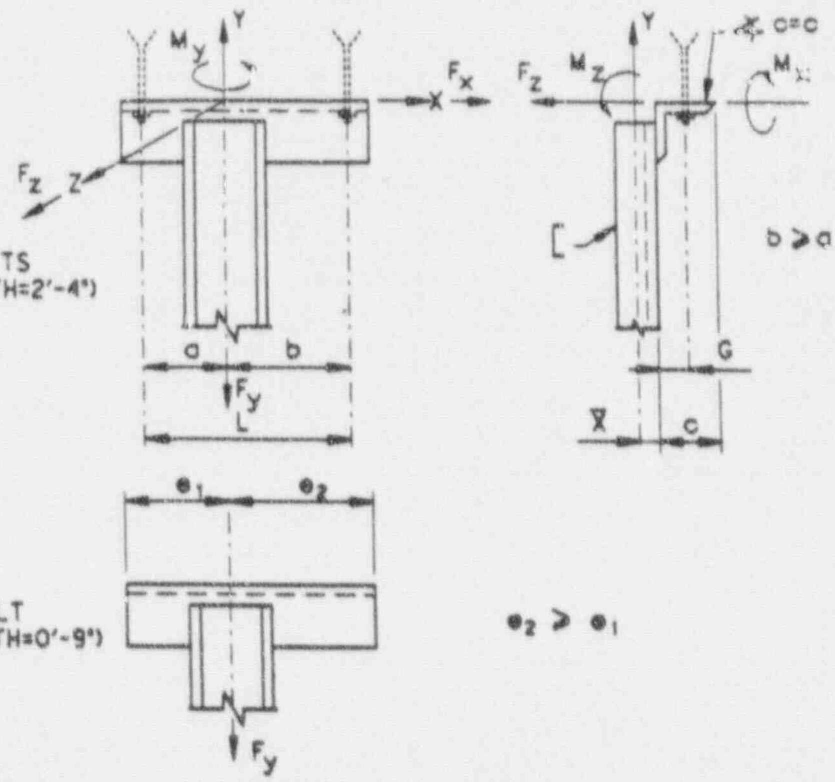
NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

VERIFICATION OF RICHMOND ANCHOR BOLTS FOR SURFACE ANGLE CONNECTIONS
ANGLE IS MIN. 3/4 INCH THICK
(APPLIES TO ALL DIAMETERS OF RICHMOND ANCHORS)

TWO BOLTS
(MAX. ℄ LENGTH=2'-4")

ONE BOLT
(MAX. ℄ LENGTH=0'-9")



FORCES AND MOMENTS FROM COMPUTER OUTPUT

F_x F_y F_z M_x M_y M_z CALCULATE $M'_z = M_z + F_y\left(b - \frac{L}{2}\right)$

MAXIMUM BOLT TENSION

$$T = 3.20\frac{M'_z}{L} + \frac{1}{(c-G)}\left[1.20\frac{F_y b(c+\bar{X})}{L} + 1.25\frac{M_x b}{L}\right]$$ FOR TWO BOLTS c = 8 INCHES

$$T = 2.70\frac{M'_z}{L} + \frac{1}{(c-G)}\left[1.20\frac{F_y b(c+\bar{X})}{L} + 1.25\frac{M_x b}{L}\right]$$ FOR TWO BOLTS c = 6 INCHES

$$T = 1.70\frac{M_z}{e_1} + \frac{1.2}{(c-G)}\left[F_y(c+\bar{X}) + M_x\right]$$ FOR ONE BOLT

MAXIMUM BOLT SHEAR (FOR TWO BOLTS)

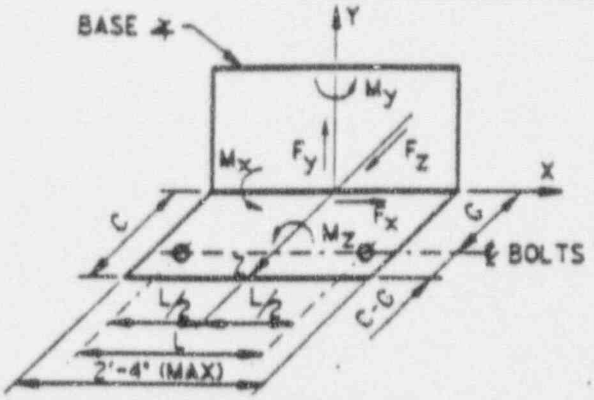
$$S = \left[\left(\frac{M_y + F_z \cdot b + F_x(c+\bar{X})}{L}\right)^2 + \left(\frac{F_x}{2}\right)^2\right]^{1/2}$$

NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

VERIFICATION OF ANCHOR BOLTS SECURING SURFACE ANGLES

BASE ANGLE WITH TWO ANCHOR BOLTS



NOTES:

1. FOR a_1, a_2, a_3 SEE TABLE. PAGE 186
2. L, C & G ARE IN INCHES.
3. M_x, M_y & M_z ARE IN K-INCHES & F_x, F_y & F_z ARE IN KIPS.
4. $M'_y = M_y + F_x G$
5. TRANSFER THE FORCES AND MOMENTS FOR A CO-ORDINATE SYSTEM SHOWN HERE.

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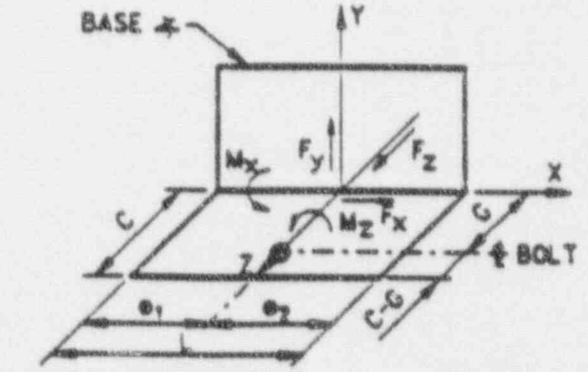
FOR TWO BOLTS IN TENSION:

$$T = a_1\left(\frac{M_x}{2(C-G)}\right) + a_2\left(\frac{M_z}{L}\right) + a_3\left(\frac{C \cdot F_y}{2(C-G)}\right)$$

BOLT SHEAR:

$$S = \left[\left(\frac{F_x}{2}\right)^2 + \left(\frac{F_z}{2} + \frac{M'_y}{L}\right)^2\right]^{1/2}$$

BASE ANGLE WITH ONE ANCHOR BOLT



NOTES:

1. FOR a_1, a_2, a_3 SEE TABLE. NEXT PAGE
2. e_1, e_2, C & G ARE IN INCHES.
3. M_x & M_z ARE IN K-INCHES & F_x, F_y & F_z ARE IN KIPS.
4. e' = THE SMALLER DIMENSION OF e_1 or e_2.

FOR ONE BOLT IN TENSION:

$$T = a_1\left(\frac{M_x}{C-G}\right) + a_2\left(\frac{M_z}{e'}\right) + a_3\left(\frac{C \times F_y}{C-G}\right)$$

BOLT SHEAR:

$$S = (F_x^2 + F_z^2)^{1/2}$$

NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

PRYING ACTION FACTORS FOR BASE ANGLES WITH TWO BOLTS

TYPE & SIZE OF BOLTS	BASE ANGLE	L	C (INCHES)	Prying action factors a_1	a_2	a_3
ALL SIZES OF HILTI KWIK &	L8 X 6 X 3/4	1'-9" MAX	8.	1.12	2.00	1.09
SUPER KWIK 1/4", 3/8",	L6 X 6 X 3/4	"	6.	1.09	1.69	1.06
1/2", 5/8", 1 1/4"	L5 X 5 X 3/4	"	5.	1.09	1.69	1.06
1 1/2" DIA. RICHMOND	L8 X 6 X 3/4	"	8.	1.27	3.07	1.23
INSERT	L6 X 6 X 3/4	"	6.	1.26	2.56	1.21
	L5 X 5 X 3/4	"	5.	1.26	2.56	1.21
1" DIA. RICHMOND	L8 X 6 X 3/4	"	8.	1.23	2.88	1.19
INSERT	L6 X 6 X 3/4	"	6.	1.22	2.38	1.16
	L5 X 5 X 3/4	"	5.	1.22	2.38	1.16

NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

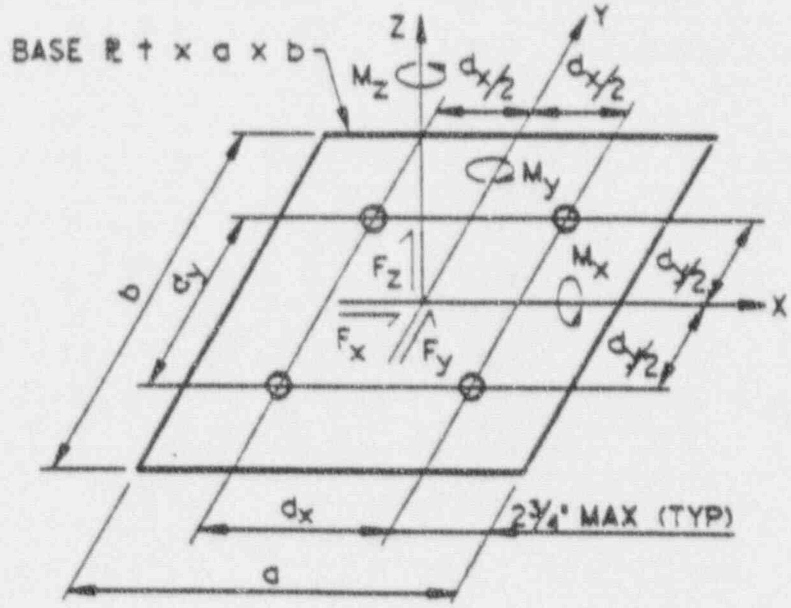
PRYING ACTION FACTORS FOR BASE ANGLES WITH ONE BOLT

TYPE & SIZE OF BOLTS	BASE ANGLE	L	C (INCHES)	Prying action factors a_1	a_2	a_3
ALL SIZES OF HILTI KWIK & SUPER KWIK 1/4", 3/8", 1/2", 5/8", 3/4", 1", 1 1/4"	L8 X 6 X 3/4	0'-9 MAX	8.	1.11	1.15	1.08
	K6 X 6 X 3/4	"	6.	1.10	1.11	1.04
	L5 X 5 X 3/4	"	5.	1.10	1.11	1.04
1 1/2" DIA. RICHMOND INSERT	L8 X 6 X 3/4	"	8.	1.20	1.67	1.15
	L6 X 6 X 3/4	"	6.	1.19	1.56	1.12
	L5 X 5 X 3/4	"	5.	1.19	1.56	1.12
1" DIA. RICHMOND INSERT	L8 X 6 X 3/4	"	8.	1.17	1.55	1.12
	L6 X 6 X 3/4	"	6.	1.16	1.47	1.11
	L5 X 5 X 3/4	"	5.	1.16	1.47	1.11

NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

BASE PLATE WITH 4 ANCHOR BOLTS



BOLT TENSION:

$$T = a_1 \frac{Mx}{2dy} + a_2 \frac{My}{2dx} + a_3 \frac{Fz}{4}$$

BOLT SHEAR:

$$S = \left\{ \left(\frac{F_x}{4} + \frac{M_z d_y}{2(d_x^2 + d_y^2)} \right)^2 + \left(\frac{F_y}{4} + \frac{M_z d_x}{2(d_x^2 + d_y^2)} \right)^2 \right\}^{1/2}$$

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TYPE & SIZE OF BOLTS	BASE PLATE DIMs (in)			PRYING ACTION FACTORS		
	t	dx	dy	a_1	a_2	a_3
All sizes of Hilti Kwik & Super Kwik	1.0 min	18-1/2 max	18-1/2 max	1.22	1.22	1.30
1-1/2" Ø Richmond Insert	1.0 min	18-1/2 max	18-1/2 max	2.16	2.16	2.09
1" Ø Richmond Insert	1.0 min	18-1/2 max	18-1/2 max	1.95	1.95	1.90

NOTE: Above data taken from SAG.CP29, Attachment G.

ATTACHMENT 8.B (CONT)

STANDARD BASE PLATE ALLOWABLES

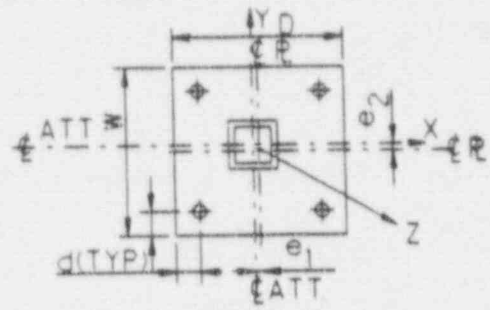


TABLE 1
PROPERTIES OF BASE PLATES

BASE PLATE TYPE	BASE PLATE SIZE (IN) D**	W**	t	ANCHOR BOLT TYPE	SIZE	ATTACHMENT SIZE	MAXIMUM ECCENTRICITY (IN) e_1 OR e_2	$e_1 + e_2$	EDGE DISTANCE d (IN)
1	9 1/2	9 1/2	1/2	HKB	1/2" Ø X 5 1/2	TS 2 X 2 X 0.250	2	2 1/2	1 1/4 ± 1/2
2	9 1/2	9 1/2	3/4	HKB	1/2" Ø X 5 1/2	TS 3 X 3 X 0.250	2	2 1/2	1 1/4 ± 1/2
3	10 1/2	10 1/2	1/2	HKB	3/4" Ø X 5 *	TS 3 X 3 X 0.250	2	2 1/2	1 1/2 ± 1/2
4	10 1/2	10 1/2	3/4	HKB	3/4" Ø X 5 *	TS 3 X 3 X 0.250	2	2 1/2	1 1/2 ± 1/2
5	12	12	3/4	HKB	1/2" Ø X 5 1/2	TS 3 X 3 X 0.250	2	2 1/2	1 3/4 ± 1
6	12	12	3/4	HKB	3/4" Ø X 5 *	TS 4 X 4 X 0.250	2	2 1/2	2 ± 1
7	12	12	1	HKB	3/4" Ø X 5 *	TS 4 X 4 X 0.250	2	2 1/2	2 ± 1
8	15	15	1	HKB	3/4" Ø X 5 *	TS 6 X 4 X 0.250	2	2 1/2	2 ± 1
9	15	15	1	HKB	1" Ø X 7	TS 6 X 6 X 0.375	2	2 1/2	2 1/4 ± 1
10	15	15	1 1/4	HKB	3/4" Ø X 5 *	TS 6 X 6 X 0.375	2	2 1/2	2 ± 1
11	15	15	1 1/4	HKB	1" Ø X 7	TS 6 X 6 X 0.375	2	2 1/2	2 1/4 ± 1
12	9 1/2	9 1/2	1/2	HSKB	1/2" Ø X 3 1/4	TS 2 X 2 X 0.250	2	2 1/2	1 1/4 ± 1/2
13	9 1/2	9 1/2	3/4	HSKB	1/2" Ø X 3 1/4	TS 3 X 3 X 0.250	2	2 1/2	1 1/4 ± 1/2
14	12	12	3/4	HSKB	1/2" Ø X 3 1/4	TS 3 X 3 X 0.250	2	2 1/2	1 3/4 ± 1
15	15	15	1	HSKB	1" Ø X 6 1/2	TS 6 X 6 X 0.375	2	2 1/2	2 1/4 ± 1
16	15	15	1 1/4	HSKB	1" Ø X 6 1/2	TS 6 X 6 X 0.375	2	2 1/2	2 1/4 ± 1

*MAXIMUM EMBEDMENT SHALL NOT EXCEED 7IN ** TOLERANCE: + 1/2, -0

ATTACHMENT 8.B (CONT)
STANDARD BASE PLATE ALLOWABLES

TABLE 2
BASE PLATE ALLOWABLES, SPRING CONSTANTS AND PRYING FACTORS

BASE PLATE TYPE	ALLOWABLES (KIPS, IN-KIP)						STIFFNESS (LB/IN, IN-LB/RAD)			PRYING FACTOR	
	$F_{x'}$	$F_{y'}$	$F_{z'}$	$M_{x'}$	$M_{y'}$	$M_{z'}$	$K_{Fz} \times 10^5$	$K_{Mz} \times 10^6$	$K_{My} \times 10^6$	α_1	α_2
1	7.50	7.50	3.71	13.0	13.0	51.2	2.25	3.368	3.368	2.60	2.87
2	7.50	7.50	4.46	17.7	17.7	51.2	6.416	12.45	12.45	2.16	2.11
3	12.82	12.82	7.49	22.6	22.6	91.5	1.60	3.838	3.838	2.02	1.91
4	12.79	12.79	8.70	49.9	49.9	91.7	2.49	8.242	8.242	1.90	1.37
5	7.68	7.68	4.15	18.9	18.9	63.3	3.667	11.73	11.73	2.32	2.37
6	12.67	12.67	8.18	56.1	56.1	99.8	2.33	10.29	10.29	2.02	1.32
7	12.63	12.63	8.72	66.6	66.6	99.8	2.933	14.77	14.77	1.89	1.11
8	13.68	13.68	9.40	78.3	78.3	135.5	2.49	17.75	17.75	1.76	1.27
9	21.20	21.20	12.63	92.4	92.4	203.6	5.974	37.29	37.29	1.86	1.49
10	13.68	13.68	9.94	92.5	92.5	135.5	3.231	27.54	27.54	1.56	1.07
11	21.20	21.20	13.19	107.7	107.7	203.6	7.422	51.57	51.57	1.78	1.28
12	8.39	8.39	4.55	16.5	16.5	57.2	1.65	2.942	2.942	2.19	2.34
13	8.39	8.39	4.86	23.1	23.1	57.2	3.295	8.574	8.574	2.06	1.67
14	8.59	8.59	4.55	24.6	24.6	70.8	2.454	9.368	9.368	2.19	1.88
15	21.72	21.72	18.21	123.5	123.8	208.6	5.794	37.29	37.29	1.92	1.66
16	21.72	21.72	19.04	143.8	143.8	208.6	7.422	51.57	51.57	1.84	1.43

NOTES:

1. FOR SIMULTANEOUS LOADS THE FOLLOWING INTERACTION FORMULA SHALL BE SATISFIED.

$$\frac{F_X}{F_X'} + \frac{F_Y}{F_Y'} + \frac{F_Z}{F_Z'} + \frac{M_X}{M_X'} + \frac{M_Y}{M_Y'} + \frac{M_Z}{M_Z'} \leq 1$$

WHERE F_x, F_y AND F_z ARE FORCES IN KIPS, M_x, M_y AND M_z ARE MOMENTS IN IN-KIP ON THE BASE PLATE.

ATTACHMENT 8.B (CONT)

STANDARD BASE PLATE ALLOWABLES

TABLE 2
BASE PLATE ALLOWABLES, SPRING CONSTANTS AND PRYING FACTORS

2. TO CALCULATE BOLT TENSION USE FOLLOWING FORMULA:

$$T = \frac{Fz}{4} \times a_1 + \frac{Mx}{2d_2} \times a_2 + \frac{My}{2d_1} \times a_2$$

d_1 = MINIMUM BOLT TO BOLT DISTANCE ALONG X-AXIS

d_2 = MINIMUM BOLT TO BOLT DISTANCE ALONG Y-AXIS

3. ALLOWANCES AND MOMENTS ON THE BASE PLATE SHALL BE FOR SSE LOAD COMBINATION AND CALCULATED AT THE C.G OF THE ATTACHMENT.

4. CAPACITIES SHOWN ON TABLE 2 DO NOT INCLUDE SELF-WEIGHT OF THE BASE PLATE.

5. STANDARD BASEPLATE ALLOWABLE DATA TAKEN FROM SAG.CP25, ATTACHMENT CC.

ATTACHMENT 8.C

SKELETON FOR BASEPLATE ANALYSIS

NOTE: Attachment 8.C skeleton taken from DBD-CS-111, Attachment 8.E.

```
$ PLEASE USE 'IS5B4B--.SKL' AS THE SKELETON FOR BASE PLATE ANALYSIS
$ INPUT FILE NO. _______.___  DISK ID: ______     DATE:__________
$ USER :_________   DANNER NAME :______
$ CPSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS.
$ BASEPLATE FORM CMD-5B4B STATIC RUN
STRUDL 'BASEPL' 'COMANCHE PEAK #1 _______.___'
TYPE SPACE FRAME
UNITS INCHES DEGREES KIPS
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
GRID POINT MULTIPLIERS I 10000 J 100 K 1
BASEPLATE GRID LINE DEFINITION
I LINES 1 TO 9     X_________
J LINES 1 TO 4     Y_________
K LINES 1 TO 9     Z_________
END
$
BASEPLATE BASE GENERATION TYPE 'BSQ2' POISSON  0.3  THICKNESS ___-
      E 29000 E FOUNDATION 3460
GRID LINES  I 1 TO 9  J 1  K 1 TO 9
END OF BASE GENERATION
$
BASEPLATE BOLT PROPERTIES KFX _____ KFY _____ KFZ _____ -
      PRETENSION  0.0  ALLOWABLE AXIAL _____ SHEAR _____ DIA _____
1 AT COORDINATE  X ____  Z ____
2 AT COORDINATE  X ____  Z ____
3 AT COORDINATE  X ____  Z ____
4 AT COORDINATE  X ____  Z ____
END OF BOLT PROPERTIES
$
BASEPLATE GUS GEN OVER 1 E 29000 POI 0.3 TYPE 'BSQ2'  THI___
GRID LINE  I 2 TO 4  J 1 TO 3 K 5
GRID LINE  I 6 TO 8  J 1 TO 3 K 5
GRID LINE  I 5  J 1 TO 3   K 2 TO 4
GRID LINE  I 5  J 1 TO 3   K 6 TO 8
END
$
BASEPLATE ATT GEN OVER 2 E 29000 POI 0.3 TYPE 'BSQ2'  THI___
GRID LINE  I 4 TO 6  J 1 TO 4  K 4
GRID LINE  I 4       J 1 TO 4  K 4 TO 6
GRID LINE  I 4 TO 6  J 1 TO 4  K 6
GRID LINE  I 6       J 1 TO 4  K 4 TO 6
END
$
$ USE FOLLOWING CAP IF LOADS ARE NOT GIVEN AT STRUCTURAL POINT
BASEPLATE CAP GEN OVER 4 TYPE 'BSQ2'  THI 2.0  E 0.1  POI .3
GRID LINE  I 4 TO 6  J 2       K 4 TO 6
END
BASEPLATE CAP GEN OVER 5 TYPE 'BSQ2'  THI 2.0 E 29000000  POI .3
GRID LINE  I 4 TO 6 J 4  K 4 TO 6
END
$
LOADING 1001  'DL+OBE'
BASEPLATE LOADS
GRID POINT I   J   K    FOR X   Y    K     MOM  X    -
$ GRID POINT I___ J___ K___ FOR X___ Y___ Z___ MOM  X___-
$            Y___ Z___ TRANS TO GRID POINT  I___J___ K
$ GRID POINT I___ J___ K___ FOR X___ Y___ Z___ MOM  X___-
$            Y___ Z___ TRANS TO GRID POINT  I___J___ K
$ GRID POINT I___ J___ K___ FOR X___ Y___ Z___ MOM  X___-
$            Y___ Z___ TRANS TO GRID POINT  I___J___ K
END OF BASEPLATE LOADS
$
LOADING 2001  'DL+SSE'
BASEPLATE LOADS
```

ATTACHMENT 8.C (CONT)

```
GRID POINT I   J   K    FOR X   Y   K     MOM  X    -
$ GRID POINT I___ J___ K___ FOR X___ Y___ Z___ MOM X___-
$            Y___ Z___ TRANS TO GRID POINT I___J___K
$ GRID POINT I___J___K___ FOR X___ Y___ Z___ MOM X___-
$            Y___ Z___ TRANS TO GRID POINT I___J___K
$ GRID POINT I___J___K___ FOR X___ Y___ Z___ MOM X___-
$            Y___ Z___ TRANS TO GRID POINT I___J___K
END OF BASEPLATE LOADS
$
BASEPLATE PARAMETERS
DIRECTION OF NORMAL +Y
INTERMEDIATE PRINT OFF
CONVERGENCE TOLERANCE  8  PERCENT
NUMBER OF CYCLE  15
OUTPUT FORMAT SUMMARY LEVEL  3
SHEAR TREATMENT STANDARD
FACTORS FOR INT EQU AXI ___ SHE ___
COMMENT  'PREP  BY:________________________     DATE:________        '
COMMENT  '                                                           '
COMMENT  '                                                           '
COMMENT  'CHKD  BY:________________________     DATE:________        '
END OF BASEPLATE PARAMETERS
$
PRINT BASEPLATE ALL DATA
PLOT DEVICE PRINTER WID 12 LEN 12
PLOT FORMAT ORIENTATION Y UP
PLOT PLANE X EQ ____
PLOT PLANE Z EQ ____
PLOT FORMAT BASEPLATE
PLOT PLANE Y EQ 0.0
BASEPLATE ANALYSES WITHOUT DISTORTIONS WITH GROSS RESULTS
GROUP '&ELEMBP' DEFINITION
ELEMENTS ALL ACTIVE BASEPLATE BASE
END OF GROUP DEFINITION
$ FOLLOWING PERMITS DIFFERENT BOLT ALLOWABLES FOR OBE AND SSE
LOAD LIST 1001
LIST BASEPLATE ALL RESULTS
LIST DISPLACEMENTS ALL
LIST PRINCIPAL STRESSES '&ELEMBP'
CHANGES
BASEPLATE BOLT PROPERTIES KFX _____ KFY _____ KFZ _____ -
          PRETENSION 0.0 ALLOWABLE AXIAL _____SHEAR _____DIA_____
1 GRID POINT I___ J 1 K___
2 GRID POINT I___ J 1 K___
3 GRID POINT I___ J 1 K___
4 GRID POINT I___ J 1 K___
$ 5 GRID POINT I___ J 1 K___
$ 6 GRID POINT I___ J 1 K___
END OF BOLT PROPERTIES
LOAD LIST 2001
LIST BASEPLATE ALL RESULTS
LIST DISPLACEMENTS ALL
LIST PRINCIPAL STRESSES '&ELEMBP'
FINISH NOMESSAGES
```

ATTACHMENT 8.D

SKELETON FOR RESPONSE SPECTRUM ANALYSIS OF CONDUIT SYSTEMS INCLUDING THERMAL EFFECTS

NOTE: Attachment 8.D skeleton taken from DBD-CS-111, Attachment 8.F.

```
$** SKELETON -'ISOSKEL.DT' FOR RSM W/THERMAL USING MODIFIED ENVELOPED SPECT *
STRUDL 'ISO_______' 'ISO EVALUATION BY SYSTEM R.S.M W/THERMAL ISO _________'
$---- ISO NO. : _______                      SKETCH NO. : _________
$---- CPSES - UNIT-1        BLDG :____       LOCATION : _____________RM :______
$---- INPUT FILE NAME :________             DISK #:              BANNER :_______
$---- PREPARED BY : _______________          FILE CREATED ON : _______________
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISION
UNITS INCHES,LBS,DEGREES,FAHRENHEIT,LBM,SECONDS
$****************************************************************************
$*** THE STATEMENTS STARTING WITH '$' SIGN ARE EITHER COMMENTS OR OPTIONAL  ***
$*** 'STRUDL' COMMANDS.                                                     ***
$*** IF THE USER NEEDS TO USE ANY OPTIONAL COMMANDS , THE '$' SIGNS         ***
$*** IN THE 1st COL. OF COMMANDS  SHOULD BE REMOVED                         ***
$****************************************************************************
$***                      MODEL GEOMETRY INPUT                              ***
$*** THE GLOBAL COORDINATES SHOULD BE SET UP AS FOLLOWING :                 ***
$***                                         VRT      N-S       E-W         ***
$*** (I)  IN AB , EB , FH , & SG BUILDINGS    Y        Z         X          ***
$*** (II) IN RB , CB & SW   BUILDINGS         Y        X         Z          ***
$****************************************************************************
$*** IF NECESSARY, USER MAY USE CYLINDRIC COORD - R, THETA & H
$***                            OR SPHERICAL COORD - R, P1 & P2
$****************************************************************************
$***                      SHIFT COORDINATES INPUT                            **
$*** THE SHIFT COORDINATES ARE DEFINED WITH RESPECT TO THE GLOBAL COORDINATES**
$*** BY SHIFTING THE COORDINATES TRANSLATIONALLY  X , Y & Z AND ROTATIONALLY **
$*** R1 ,R2 & R3 AND THEN , THE MESH COORDINATES OR JOINT COORDINATES CAN BE **
$*** DEFINED WITH RESPECT TO THE SHIFT COORDINATES                           **
$****************************************************************************
$***CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC***
$*** THE START OF CONDUIT LINE MODEL GEOMETRY INPUT *************************
CONSTANTS
E   29.0E+06  ALL ; G  11.15E+06  ALL ; POISSON 0.3 ALL ; FYLD 2500C. ALL
DENS           ALL
CTE            ALL
$SHIFT COOR SYST 101 TRA       X                 Y                Z
$                    ROT      R1                R2               R3
$MESH COOR SHIFT BY  101
$   TO      X        INC          Y         INC           Z           INC
$JOINT COOR SHIFT 101
$           X             Y          Z
$SHIFT COOR SYST 102 TRA       X                 Y                Z
$                    ROT      R1                R2               R3
$MESH COOR SHIFT BY  102
$   TO      X        INC          Y         INC           Z           INC
$JOINT COOR SHIFT 102
$           X             Y          Z
MESH COORDINATES
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
      TO          X        INC        Y        INC        Z        INC
 JOINT COORDINATES
```

ATTACHMENT 8.D (CONT)

```
$*****************************************************************************
$*** THE FOLLOWING MESH COORDINATES COMMANDS MAY BE USED TO DEFINED NODES     **
$*** WHICH ARE SHIFTED FROM OTHER NODES BY GLOBAL COORDINATES X , Y & Z       **
$*****************************************************************************
$ MESH COOR
$                    SAME AS                   SHIFT BY 201  TRANS  -
$ X           Y              Z
$                    SAME AS                   SHIFT BY 202  TRANS  -
$ X           Y              Z
$                    SAME AS                   SHIFT BY 203  TRANS  -
$ X           Y              Z
$DIVIDE LINE
$     TO     ;       TO     ;       TO     ;       TO     ;       TO
$*****************************************************************************
MESH INCIDENCES
             /          /
             /          /
             /          /
             /          /
MEMBER INCIDENCES


$*** USER SHOULD USE SPRING MEMBERS TO SUPPORT THE MODELS FOR RSN RUNS ***
SUPPORT JOINT -

$JOINT RELEASE
$            FOR          MOM
$            KFX       KFY       KFZ       KMX       KMY       KMZ
$MEMBER RELEASE
$                      STA FOR X Y Z MOM X Y Z  END FOR X Y Z MOM X Y Z
MEMBER PROPERTIES
             TABLE  'AISCPIPE' '          '
$*****************************************************************************
$* THE FOLLOWING MEMB PROPERTIES CAN BE USED TO INPUT SPRING MEMBER STIFFNESS.
$*****************************************************************************
MEMBER PROPERTIES
                     STIFFNESS MATRIX -
DIAGONAL DX       DY        DZ        RX        RY        RZ
$                    STIFFNESS MATRIX -
$DIAGONAL DX       DY        DZ        RX        RY        RZ
$                    STIFFNESS MATRIX -
$DIAGONAL DX       DY        DZ        RX        RY        RZ
$                    STIFFNESS MATRIX -
$DIAGONAL DX       DY        DZ        RX        RY        RZ
$                    STIFFNESS MATRIX -
$DIAGONAL DX       DY        DZ        RX        RY        RZ
$
$
$*****************************************************************************
$*** INERTIA OF JOINTS COMMANDS ARE USED TO INPUT  CONCENTRATED WEIGHTS    ***
$*****************************************************************************
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR 1 ADD
                              LINEAR X          Y            Z
                              LINEAR X          Y            Z
                              LINEAR X          Y            Z
                              LINEAR X          Y            Z
                              LINEAR X          Y            Z
PRINT STRUCTURE DATA
PRINT DYNAMIC JOINT INERTIA
STEEL TAKE OFF ITEMIZE
PLOT DEVICE PRINTER WIDTH 10 LENGTH 10
```

ATTACHMENT 8.D (CONT)

```
PLOT FORMAT TOLERANCE 5.
PLOT PROJECTION XY
PLOT PROJECTION XZ
PLOT PROJECTION YZ
$***$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$***
$*** USER INSERT SUPPORT MODEL FILES HEREAFTER ********************************
$*** END OF SUPPORT MODEL FILES INPUT *****************************************
$***$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$***
GROUP '&TM' DEFINITION
MEMBER ALL ACTIVE
END
$--- DEAD LOAD CASE WITH + Y-AXIS IN THE UPWARD VERTICAL DIRECTION ---
LOADING 'DY' 'DEAD LOAD IN GLOBAL - Y-AXIS DIRECTION'
DEAD LOAD COMPONENT GLO Y -1.0 BY JOINTS
LOAD 'TO'   ' NORMAL OPERATING THERMAL LOAD'
$*** REPLACE DT? IN THE FOLLOWING COMMAND WITH THE TEMPERATURE DIFFERENTIAL
$*** FOR TEMPERATURE DIFFERENTIAL SEE SAG.CP10 & CP25
MEMBER TEMPERATURE LOAD  FRA LA 0.0 LB 1.0 AXIAL DT?
'&TM'
$LOAD 'TA'   ' ACCIDENTAL THERMAL LOAD'
$MEMBER TEMPERATURE LOAD  FRA LA 0.0 LB 1.0 AXIAL DT?
$'&TM'
$
LOAD LIST   'DY' 'TO'
$LOAD LIST   'DY' 'TO' 'TA'
STIFFNESS ANALYSIS REDUCED BAND
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST REACTIONS  ALL
OUTPUT DECIMAL 5
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$CHANGES
$INERTIA OF JOINTS FACTOR 1 ADD
$                              LINEAR X            Y              Z
$                              LINEAR X            Y              Z
$                              LINEAR X            Y              Z
$                              LINEAR X            Y              Z
$ADDITIONS
$PRINT DYNAMIC JOINT INERTIA
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 33.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
$*****************************************************************************
$*** THE USER MERGES THE SHOCK SPECTRUM LOADS HEREAFTER, SEE UNIT 1  ***
$*** CONDUIT SPAN VERIFICATION BOOK NO. SPAN-1002 FOR DETAILED        ***
$*** DESCRIPTION OF USING THE SHOCK SPECTRUM LOADING DATABASE FILES.  ***
$*****************************************************************************
$*** EXTRACT LOADING FILES FROM DATABASE USING NAMES,FOR   MPLE:      ***
$*** OBE - FILE NAME =BLDG I.D.+EL. I.D.+O2M =AB852O2M FO   L 852'-6 ***
$*** IN AUXILIARY BUILDING                                            ***
$*** SSE - FILE NAME =BLDG I.D.+EL. I.D.+S3M =AB852S3M FOR EL 852'-6 ***
$*** IN AUXILIARY BUILDING                                            ***
```

ATTACHMENT 8.D (CONT)

```
$*********************************************************************
$*** TO ENVELOP THE SPECTRA AT TWO BUILDING ELEVATIONS, USER IDENTIFIES
$*** BUILDING I.D. & EL. I.D. IN THE BLANKS BEFORE O2M & S3M
$***LOADINGID
$***      O2M+      S3M
$***      O2M+      S3M
$*********************************************************************
$*** IF SPECTRA TO BE ENVELOPED ARE FOR MORE THAN TWO ELEVATIONS,
$*** USER NEEDS TO IDENTIFY MORE THAN TWO SETS OF (     O2M +      S3M)
$---------------------------------------------------------------------
$*** THE FOLLOWING COMMANDS ARE PREPARED FOR ENVELOPING SPECTRA
$*** AT TWO BUILDING ELEVATIONS.
$*** IF THE STRUCTURAL SYSTEM IS ANCHORED AT MORE THAN TWO BUILDING
$*** ELEVATIONS, USER NEEDS TO MODIFY THE COMMANDS BY USING SIMILAR BUT
$*** EXPANDED COMMANDS.
$-----------------------------------------------------------------
ENVELOPE SHOCK SPECT FILES ON D07 FACT 1.0 DUMP
$*** INPUT BLDG ID+EL1 ID & BLDG ID+EL2 ID IN THE FOLLOWING BLANKS
$*** e.g., 'ENVOBEVT' FROM COMP FILES 'AB8520VT' 'AB8730VT'
'ENVOBEVT' FROM COMP FILES '_____OVT' '_____OVT'
'ENVOBENS' FROM COMP FILES '_____ONS' '_____ONS'
'ENVOBEEW' FROM COMP FILES '_____OEW' '_____OEW'
'ENVSSEVT' FROM COMP FILES '_____SVT' '_____SVT'
'ENVSSENS' FROM COMP FILES '_____SNS' '_____SNS'
'ENVSSEEW' FROM COMP FILES '_____SEW' '_____SEW'
$*** ENVELOPED SPECTRA LOADS ARE INPUT THROUGH FOLLOWING LOAD CASES ***
DAMP 0.02 100
SHOCK SPECTRUM LOAD 101 'Y-VERT OBE ENVELOPE'
SPECTRUM TRANS Y 1.0 FILE 'ENVOBEVT' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 102 'Z-NS OBE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVOBENS' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 103 'X-EW OBE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVOBEEW' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 105 'X-NS OBE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVOBENS' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 106 'Z-EW OBE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVOBEEW' D07
END OF DYNA LOAD
DAMP 0.03 100
SHOCK SPECTRUM LOAD 201 'Y-VERT SSE ENVELOPE'
SPECTRUM TRANS Y 1.0 FILE 'ENVSSEVT' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 202 'Z-NS SSE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVSSENS' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 203 'X-EW SSE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVSSEEW' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 205 'X-NS SSE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVSSENS' D07
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 206 'Z-EW SSE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVSSEEW' D07
END OF DYNA LOAD
LOAD LIST ALL
MISSING MASS CORR TO BE APP RIGID FW 33.0
DYNA RESP ANA WITH REA
$
$ DYNAMIC ANALYSIS
$
```

ATTACHMENT 8.D (CONT)

```
PSEUDO STATIC SHOCK LOAD  1101  TEN  101
PSEUDO STATIC SHOCK LOAD  1102  TEN  102
PSEUDO STATIC SHOCK LOAD  1103  TEN  103
PSEUDO STATIC SHOCK LOAD  1105  TEN  105
PSEUDO STATIC SHOCK LOAD  1106  TEN  106
PSEUDO STATIC SHOCK LOAD  2201  TEN  201
PSEUDO STATIC SHOCK LOAD  2202  TEN  202
PSEUDO STATIC SHOCK LOAD  2203  TEN  203
PSEUDO STATIC SHOCK LOAD  2205  TEN  205
PSEUDO STATIC SHOCK LOAD  2206  TEN  206
$
$  COMBINE ALL SHOCK LOADINGS
$
LOAD COMB  'OBEYZX'  RMS  1101  1102  1103
LOAD COMB  'OBEYXZ'  RMS  1101  1105  1106
LOAD COMB  'SSEYZX'  RMS  2201  2202  2203
LOAD COMB  'SSEYXZ'  RMS  2201  2205  2206
$
DAMP 0.02 100
GENERATE RESULTS FOR LOADING  1101  1102  1103  'OBEYZX'
GENERATE RESULTS FOR LOADING  1101  1105  1106  'OBEYXZ'
$------------------------------------------------------
DAMP 0.03 100
GENERATE RESULTS FOR LOADING  2201  2202  2203  'SSEYZX'
GENERATE RESULTS FOR LOADING  2201  2205  2206  'SSEYXZ'
$------------------------------------------------------
UNITS DEGREES
OUTPUT BY JOINT ; OUTPUT BY MEMBERS
$ OBE  RESULTS
LOAD LIST 'OBEYZX' 'OBEYXZ'
OUTPUT DECIMAL 1
LIST REACTION   ALL
OUTPUT DECIMAL 3
LIST DISP ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBERS
UNIT RADIANS
SPECIAL UNIT CONVERSION FACTOR LENGTH 386.4
LIST ACCEL ALL
UNIT INCHES,DEGREES
$ SSE  RESULTS
LOAD LIST 'SSEYZX' 'SSEYXZ'
OUTPUT DECIMAL 1
LIST REACTION   ALL
OUTPUT DECIMAL 3
LIST DISP ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
UNIT RADIANS
SPECIAL UNIT CONVERSION FACTOR LENGTH 386.4
LIST ACCEL ALL
UNIT INCHES,DEGREES
$---------------------------------------------------------------------
$--- DEAD LOAD +OR- OBE AND DEAD LOAD +OR- SSE COMBINATIONS ----------
LOAD COMB 'D+OBE'  'DEAD LOAD +OBE' COMB 'DY' 1.0 'OBEYZX'  1.0
LOAD COMB 'D-OBE'  'DEAD LOAD -OBE' COMB 'DY' 1.0 'OBEYZX' -1.0
LOAD COMB 'D+OBA' 'DEAD LOAD +OBEA' COMB 'DY' 1.0 'OBEYXZ'  1.0
LOAD COMB 'D-OBA' 'DEAD LOAD -OBEA' COMB 'DY' 1.0 'OBEYXZ' -1.0
LOAD COMB 'D+SSE'  'DEAD LOAD +SSE' COMB 'DY' 1.0 'SSEYZX'  1.0
LOAD COMB 'D-SSE'  'DEAD LOAD -SSE' COMB 'DY' 1.0 'SSEYZX' -1.0
LOAD COMB 'D+SSA' 'DEAD LOAD +SSEA' COMB 'DY' 1.0 'SSEYXZ'  1.0
LOAD COMB 'D-SSA' 'DEAD LOAD -SSEA' COMB 'DY' 1.0 'SSEYXZ' -1.0
```

ATTACHMENT 8.D (CONT)

```
$
$--- DEAD LOAD+NORMAL THERMAL +OR- OBE ,OR +OR- SSE COMBINATIONS ------
LOAD COMB 'D+TO+OBE'  'DL+NORMAL  T+OBE' COMB 'DY' 1.0 'TO' 1.0 'OBEYZX' 1.0
LOAD COMB 'D+TO-OBE'  'DL+NORMAL  T-OBE' COMB 'DY' 1.0 'TO' 1.0 'OBEYZX' -1.0
LOAD COMB 'D+TO+OBA' 'DL+NORMAL  T+OBEA' COMB 'DY' 1.0 'TO' 1.0 'OBEYXZ'  1.0
LOAD COMB 'D+TO-OBA' 'DL+NORMAL  T-OBEA' COMB 'DY' 1.0 'TO' 1.0 'OBEYXZ' -1.0
LOAD COMB 'D+TO+SSE'  'DL+NORMAL  T+SSE' COMB 'DY' 1.0 'TO' 1.0 'SSEYZX'  1.0
LOAD COMB 'D+TO-SSE'  'DL+NORMAL  T-SSE' COMB 'DY' 1.0 'TO' 1.0 'SSEYZX' -1.0
LOAD COMB 'D+TO+SSA' 'DL+NORMAL  T+SSEA' COMB 'DY' 1.0 'TO' 1.0 'SSEYXZ'  1.0
LOAD COMB 'D+TO-SSA' 'DL+NORMAL  T-SSEA' COMB 'DY' 1.0 'TO' 1.0 'SSEYXZ' -1.0
$--- DEAD LOAD+ACCIDENTAL THERMAL +OR- OBE ,OR +OR- SSE COMBINATIONS ------
$LOAD COMB 'D+TA+OBE'  'DL+ACCID.  T+OBE' COMB 'DY' 1.0 'TA' 1.0 'OBEYZX' 1.0
$LOAD COMB 'D+TA-OBE'  'DL+ACCID.  T-OBE' COMB 'DY' 1.0 'TA' 1.0 'OBEYZX' -1.0
$LOAD COMB 'D+TA+OBA' 'DL+ACCID.  T+OBEA' COMB 'DY' 1.0 'TA' 1.0 'OBEYXZ'  1.0
$LOAD COMB 'D+TA-OBA' 'DL+ACCID.  T-OBEA' COMB 'DY' 1.0 'TA' 1.0 'OBEYXZ' -1.0
$LOAD COMB 'D+TA+SSE'  'DL+ACCID.  T+SSE' COMB 'DY' 1.0 'TA' 1.0 'SSEYZX'  1.0
$LOAD COMB 'D+TA-SSE'  'DL+ACCID.  T-SSE' COMB 'DY' 1.0 'TA' 1.0 'SSEYZX' -1.0
$LOAD COMB 'D+TA+SSA' 'DL+ACCID.  T+SSEA' COMB 'DY' 1.0 'TA' 1.0 'SSEYXZ'  1.0
$LOAD COMB 'D+TA-SSA' 'DL+ACCID.  T-SSEA' COMB 'DY' 1.0 'TA' 1.0 'SSEYXZ' -1.0
$
LOAD LIST  'D+OBE'  'D-OBE' 'D+OBA' 'D-OBA' -
           'D+SSE'  'D-SSE' 'D+SSA' 'D-SSA' -
$          'D+TA+OBE'  'D+TA-OBE' 'D+TA+OBA' 'D+TA-OBA' -
$          'D+TA+SSE'  'D+TA-SSE' 'D+TA+SSA' 'D+TA-SSA' -
           'D+TO+OBE'  'D+TO-OBE' 'D+TO+OBA' 'D+TO-OBA' -
           'D+TO+SSE'  'D+TO-SSE' 'D+TO+SSA' 'D+TO-SSA'
COMBINE ALL
OUTPUT BY JOINT
OUTPUT DECIMAL 1
LIST REACTIONS ALL
LOAD LIST  'D+OBE' 'D-OBE' 'D+OBA' 'D-OBA'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2   0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
LOAD LIST  'D+SSE' 'D-SSE' 'D+SSA' 'D-SSA'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2   0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
LOAD LIST  'D+TO+OBE' 'D+TO-OBE' 'D+TO+OBA' 'D+TO-OBA'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2   0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
LOAD LIST  'D+TO+SSE' 'D+TO-SSE' 'D+TO+SSA' 'D+TO-SSA'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2   0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$LOAD LIST  'D+TA+OBE' 'D+TA-OBE' 'D+TA+OBA' 'D+TA-OBA'
$OUTPUT BY JOINT ;OUTPUT BY MEMBER
$OUTPUT DECIMAL 3
$LIST DISPLACEMENT ALL
$LIST FORCES ALL
$SECTION FR NS 2   0.0  1.0
```

ATTACHMENT 8.D (CONT)

```
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$LOAD LIST  'D+TA+SSE' 'D+TA-SSE' 'D+TA+SSA' 'D+TA-SSA'
$OUTPUT BY JOINT ;OUTPUT BY MEMBER
$OUTPUT DECIMAL 3
$LIST DISPLACEMENT ALL
$LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$
$*****************************************************************
$***              CODE CHECKING                                  *
$*** LY & LZ ARE UNBRACED LENGTHS FOR BUCKLING ABOUT MEMBER Y & Z AXES
$*** KY & KZ ARE EFFECTIVE LENGTH FACTORS FOR BUCKLING ABOUT Y & Z AXES *
$*** CMY & CMZ ARE REDUCTION COEFFICIENTS FOR BENDING ABOUT MEMBER Y& Z *
$*****************************************************************
CHANGES
$--- PROPERTIES FOR ELEMENTS WITH THREADED SECTION ---
MEMBER PROP TABLE 'CMDPIPE' TYPE 'PIPE'
            TABLE  'CMDPIPE' '        '
ADDITIONS
PRINT MEMBER PROPERTIES
SECTION FR NS 2  0.0  1.0
$----------------------------------------------------------------
PARAMETERS
'CODE' 'AISC' ALL; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL; 'CB' 1.0 ALL
'ASF' 1.0 FOR LOAD 'D+OBE' 'D-OBE' 'D+OBA' 'D-OBA'
'ASF' 1.5 FOR LOAD 'D+TO+OBE' 'D+TO-OBE' 'D+TO+OBA' 'D+TO-OBA'
'ASF' 1.6 FOR LOAD 'D+SSE' 'D-SSE' 'D+SSA' 'D-SSA'
'ASF' 1.6 FOR LOAD 'D+TO+SSE' 'D+TO-SSE' 'D+TO+SSA' 'D+TO-SSA'
$'ASF' 1.6 FOR LOAD 'D+TA+OBE' 'D+TA-OBE' 'D+TA+OBA' 'D+TA-OBA'
$'ASF' 1.7 FOR LOAD 'D+TA+SSE' 'D+TA-SSE' 'D+TA+SSA' 'D+TA-SSA'
'CMY'  1.0   ALL
'CMZ'  1.0   ALL
'FBMAX' 0.6 ALL
'FSHMAX' 0.40 ALL
'FACMAX' 0.6 ALL
'FATMAX' 0.6 ALL
$
'KY'         MEMBER
'KZ'         MEMBER
'KY'         MEMBER
'KZ'         MEMBER
$
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
'LY'         MEMBER                    ;  'LZ'        MEMBER
$
LOAD LIST  'D+OBE' 'D-OBE' 'D+OBA' 'D-OBA'
CHECK CODE FOR MEM                    BER TRACE 6 RESULTS FOR FAILING MEMBERS
$CHECK CODE FOR MEM                    BER TRACK 6 RESULTS FOR FAILING MEMBERS
CHANGES
PARAMETERS
'FBMAX' 0.9 ALL
'FSHMAX' 0.50 ALL
'FACMAX' 0.9 ALL
'FATMAX' 0.9 ALL
ADDITIONS
```

ATTACHMENT 8.D (CONT)

```
LOAD LIST  'D+TO+OBE' 'D+TO-OBE' 'D+TO+OBA' 'D+TO-OBA'  -
$          'D+TA+OBE' 'D+TA-OBE' 'D+TA+OBA' 'D+TA-OBA'  -
$          'D+TA+SSE' 'D+TA-SSE' 'D+TA+SSA' 'D+TA-SSA'  -
           'D+SSE' 'D-SSE' 'D+SSA' 'D-SSA' -
           'D+TO+SSE' 'D+TO-SSE' 'D+TO+SSA' 'D+TO-SSA'
CHECK CODE FOR MEM                     GEN TRACE 6 RESULTS FOR FAILING MEMBERS
$CHECK CODE FOR MEM                     GEN TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGE
```

ATTACHMENT 8.E

SKELETON FOR RESPONSE SPECTRUM ANALYSIS OF CONDUIT SYSTEMS

NOTE: Attachment 8.E skeleton taken from DBD-CS-111, Attachment 8.H.

```
$** SKELETON -'ISOSKEL.DM' FOR RESP SPECT ANAL USING MODIFIED ENVELOPED SPECT *
STRUDL 'ISO______' 'ISO EVALUATION BY SYSTEM R.S.A        ISO ________'
$---- ISO NO. : ______                   SKETCH NO. : ________
$---- CPSES - UNIT-1     BLDG :___       LOCATION : __________
$---- INPUT FILE NAME :__________        DISK #: ______    BANNER :________
$---- PREPARED BY : ____________         FILE CREATED ON : ____________
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISION
UNITS INCHES,LBS,DEGREES,FAHRENHEIT,LBM,SECONDS
$ ****************************************************************************
$*** THE STATEMENTS STARTING WITH '$' SIGN ARE EITHER COMMENTS OR OPTIONAL   ***
$*** 'STRUDL' COMMANDS.                                                      ***
$*** IF THE USER NEEDS TO USE ANY OPTIONAL COMMANDS , THE '$' SIGNS          ***
$*** IN THE 1st COL. OF COMMANDS  SHOULD BE REMOVED                          ***
$*****************************************************************************
$***                    MODEL GEOMETRY INPUT                                 ***
$*** THE GLOBEL COORDINATES SHOULD BE SET UP AS FOLLOWING :                  ***
$***                                         VRT      N-S      E-W           ***
$*** (i)  IN AB , EB , FH , & SG BUILDINGS    Y        Z        X            ***
$*** (ii) IN RB , CB & SW BUILDINGS           Y        X        Z            ***
$*****************************************************************************
$*****************************************************************************
$***                       SHIFT COORDINATES INPUT                            **
$*** THE SHIFT COORDINATES ARE DEFINED WITH RESPECT TO THE GLOBAL COORDINATES**
$*** BY SHIFTING THE COORDINATES TRANSLATIONALLY  X , Y & Z AND ROTATIONALLY **
$*** R1 , R2 & R3 AND THEN , THE MESH COORDINATES OR JOINT COORDINATES ARE    **
$*** DEFINED WITH RESPECT TO THE SHIFT COORDINATES                            **
$*****************************************************************************
$SHIFT COOR SYST 101 TRA      X ________     Y ________    Z ________  -
$                    ROT     R1 ________    R2 ________   R3 ________
$MESH COOR SHIFT BY  101
$___ TO ___ X ___ INC ______ Y _______ INC _______ Z ______ INC ______
$JOINT COOR SHIFT 101
$___ X ______ Y ______ Z _______
$SHIFT COOR SYST 102 TRA      X ________     Y ________    Z ________  -
$                    ROT     R1 ________    R2 ________   R3 ________
$MESH COOR SHIFT BY  102
$___ TO ___ X ___ INC ______ Y _______ INC _______ Z ______ INC ______
$JOINT COOR SHIFT 102
$___ X ______ Y ______ Z _______
MESH COORDINATES
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
     TO       X        INC        Y        INC        Z        INC
$JOINT COORDINATES
$
$
$
$*****************************************************************************
$*** THE FOLLOWING MESH COORDINATES COMMANDS MAY BE USED TO DEFINED NODES     **
$*** WHICH ARE SHIFTED FROM OTHER NODES BY GLOBAL COORDINATES X , Y & Z       **
$*****************************************************************************
$ MESH COOR
```

ATTACHMENT 8.E (CONT)

```
$ ______________ SAME AS ______________ SHIFT BY 201  TRANS  -
$ X ________ Y ________ Z ____________ SHIFT BY 202  TRANS  -
$ ______________ SAME AS ______________
$ X ________ Y ________ Z ____________ SHIFT BY 203  TRANS  -
$ ______________ SAME AS ______________
$ X ________ Y ________ Z ____________
$DIVIDE LINE
$ ____ TO ____ ; ____ TO ____ ; ____ TO ____ ; ____ TO ____ ; ____ TO ____
$*********************************************************************
$*** IF SPRINGS ARE USED TO REPRESENT THE SUPPORT , THE ADDITIONAL NODES    ***
$*** DEFINING THE SPRING MEMBER AXES SHOULD BE AT THE CONDUIT LONGITUDINAL  ***
$*** AXES. FOR EXAMPLE , IF A CONDUIT SEGMENT IS SUPPORTED AT NODE 3 AND    ***
$*** THE ADDITIONAL NODE 1003 IS A NODE AT THE LONGITUDINAL AXIS OF THAT    ***
$*** SEGMENT.  THEN , LINE CONNECTING 3 & 1003 DEFINES THE X-AXIS OF THE    ***
$*** SPRING MEMBER 1003 AND IS ALONG THE LONGITUDINAL AXIS OF THAT SEGMENT. ***
$*********************************************************************
SUPPORT JOINT -
______________
$JOINT RELEASE
$ ____________ FOR ____ MOM ____
$ ____________ KFX ____ KFY ____ KFZ ____ KMX ____ KMY ____ KMZ ____
$ ____________ KMX ____ KMY ____ KMZ ____
CONSTANTS
E   29.0E+06  ALL ; G  11.15E+06  ALL ; POISSON 0.3 ALL ; FYLD 25000. ALL
DENS ______ ALL
$
MESH INCIDENCES
________ / ________ / ________
$
MEMBER INCIDENCE
______ _____ ______
______ _____ ______
______ _____ ______
              ______
MEMBER PROPERTIES
          TABLE  'AISCPIPE' ' ________'
$*********************************************************************
$* THE FOLLOWING MEMBER PROPERTIES ARE USED TO INPUT SPRING MEMBER STIFFNESS.*
$* 1.0E12 MAY BE USED TO REPRESENT RIGID STIFFNESS .  RX IS USED TO INPUT    *
$* TORSIONAL RESTRAINT , IF THE SPRING MEMBER X-AXIS IS PARALLEL TO CONDUIT  *
$* LONGITUDINAL AXIS AND TORSION RESTRAINT IS REQUIRED TO REMOVE ANALYSIS    *
$* SINGULARITY                                                                *
$*********************************************************************
MEMBER PROPERTIES
______________ STIFFNESS MATRIX -
DIAGONAL DX 1.E12 DY 1.E12 DZ 1.E12
$MEMBER PROPERTIES
$ ______________ STIFFNESS MATRIX -
$DIAGONAL DX 1.E12 DY 1.E12 DZ 1.E12  RX ______
$*********************************************************************
$**** THE FOLLOWING STIFFNESS MATRIX COMMANDS ARE USED TO INPUT SPRING      *
$**** CONSTANTS OTHER THAN 1.0E12 , E.G. SPRINGS PROVIDED BY JUNCTION BOX.  *
$*********************************************************************
$MEMBER PROPERTIES
$ ______________ STIFFNESS MATRIX -
$DIAGONAL DX _____ DY _____ DZ _____
$
PLOT DEVICE PRINTER WIDTH 10 LENGTH 10
PLOT FORMAT TOLERANCE 5.
PLOT PLANE XY THROUGH JOINT ________
PLOT PLANE XZ THROUGH JOINT ________
PLOT PLANE YZ THROUGH JOINT ________
$
*********************************************************************
```

ATTACHMENT 8.E (CONT)

```
$*** INERTIA OF JOINTS LUMPED COMMAND IS USED TO INPUT  CONCENTRATED WEIGHTS *
$*****************************************************************************
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR 1 ADD
               LINEAR X ________  Y ___________  Z ___________
_____________  LINEAR X ________  Y ___________  Z ___________
_____________  LINEAR X ________  Y ___________  Z ___________
_____________
$
PRINT STRUCTURE DATA
STEEL TAKE OFF ITEMIZE
$--- FOR POSITIVE Y-AXIS IN THE UPWARD VERTICAL DIRECTION ---
LOADING 'DY' '1.0 G      IN GLOBAL Y-AXIS DIRECTION'
DEAD LOAD COMPONENT GLO Y -1.0 BY MEMBER
LOADING 'DX' '1.0 G      IN GLOBAL X-AXIS DIRECTION'
DEAD LOAD COMPONENT GLO X 1.0 BY MEMBER
LOADING 'DZ' '1.0 G      IN GLOBAL Z-AXIS DIRECTION'
DEAD LOAD COMPONENT GLO Z 1.0 BY MEMBER
$
LOAD LIST   'DY' 'DX' 'DZ'
STIFFNESS ANALYSIS REDUCED BAND
LOAD LIST 'DX' 'DY' 'DZ'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST REACTIONS  ALL
OUTPUT DECIMAL 5
LIST DISPLACEMENT ALL
LIST FORCES ALL
$*****************************************************************************
$*** THE FOLLOWING COMMANDS ARE USED TO GENERATE  TRIBUTARY WEIGHTS FROM   ***
$*** THE SUPPORT SPRING FORCES INTRODUCED BY THE THREE 1-G LOADING CASES   ***
$*** 'DX' , 'DY' & 'DZ'                                                    ***
$*** ____________________________________________________________________**
$*** FORM 1 METHOD- USE THE LARGEST OF THREE FORCE COMPONENTS FROM THE     ***
$***                THREE 1-G LOADING CASES AS LL OR LT TRIBUTARY          ***
$***                WEIGHT.                                                ***
$*** ____________________________________________________________________***
$*** INPUT TO LOCAL MAX SHEAR FREQ :                                       ***
$*** ---------------------------                                           ***
$*** (1) IF RIGID SUPPORT - INPUT 33.0 OR HIGHER                           ***
$*** (2) IF SUPPORT FREQ IS 12 HZ or OTHER , INPUT 12.0 or OTHER           ***
$*****************************************************************************
UNITS CYCLES
GENERATE LINEAR SUPPORT SPRING USING FORM    1  -
LOCAL MAXIMUM SHEAR FREQ X _____    Y _____  Z _____
                            TRIB WEIGHT FROM LOAD X 'DX' Y 'DY' Z 'DZ'
$*** USER INPUT SUPPORT NO. ; TRIB. WEIGHTS WX WY WZ OR
$*** TRIB  WEIGHTS &  FREQ
$__________ TRIB WEI DIRECT ____  ____ ____
$__________ TRIB WEI DIRECT ____  ____ ____
$__________ TRIB WEI DIRECT ____  ____ ____ LOCAL MAX FREQ ___ ___ ___
END OF GENERATE
SUPPORT SPRING MEMBER PROPERTIES LOCAL LINEAR AS GENERATED
$*** INPUT SUPPORT NO. FOR GENERATING SPRING CONSTANTS

$*** USER MAY NEED THE FOLLOWING COMMANDS TO INPUT SUPPORT SPRINGS ***
$SUPPORT SPRING MEMBER PROPERTIES LOCAL LINEAR AS GENERATED ROT KMX
$*** INPUT SUPPORT NO. FOR GENERATING SPRING CONSTANTS
$
$SUPPORT SPRING MEMBER PROPERTIES LOCAL LINEAR KFX     KFY     KFZ    -
$ROTATIONAL KMX     KMY     KMZ
$*** INPUT SUPPORT NO. FOR USER INPUT SPRING CONSTANTS
$
PRINT MEMBER PROPERTIES
$
```

ATTACHMENT 8.E (CONT)

```
$***********************************************************************
$*** COMPARISON OF AVERAGE G-VALUES AND DESIGN G-VALUES, FOR
$*** DETAILED DESCRIPTION,SEE CPSES1 SAG.CP20 AND SAG.CP25
$***********************************************************************
$*** DESIGN  G-VALUES FOR CONDUIT SUPPORTS IN DIFFERENT BUILDINGS AND
$*** OF DIFFERENT FREQUENCIES ARE SHOWN IN TABLES A.7.1 THRU A.7.6,
$*** SAG.CP.10, OR OTHER UP-TO-DATE GUIDELINES & DATA
$***********************************************************************
G COMPARISON SET 1 'YZX & YXZ CASES FOR ALL SIX BUILDINGS'
G COMPARISON DESIGN G VALUES OBE VER ____ NS ____ EW ____
                             SSE VER ____ NS ____ EW ____
G COMPARISON TRIBUTARY WEIGHT
_____________________________ AS GENERATED
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 33.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
$
$***********************************************************************
$*** THE USER MERGES THE SHOCK SPECTRUM LOADS HEREAFTER, SEE UNIT 1  ***
$*** CONDUIT SPAN VERIFICATION BOOK NO. SPAN-1002 FOR DETAILED       ***
$*** DESCRIPTION OF USING THE SHOCK SPECTRUM LOADING DATABASE FILES. ***
$***********************************************************************
$***
$***********************************************************************
$*** EXTRACT LOADING FILES FROM DATABASE USING NAMES,FOR EXAMPLE:    ***
$*** OBE - FILE NAME =BLDG I.D.+EL. I.D.+O2M =AB852O2M FOR EL 852'-6 ***
$*** IN AUXILIARY BUILDING                                           ***
$*** SSE - FILE NAME =BLDG I.D.+EL. I.D.+S3M =AB852S3M FOR EL 852'-6 ***
$*** IN AUXILIARY BUILDING                                           ***
$***********************************************************************
$-----------------------------------------------------------------------
$*** TO ENVELOP THE SPECTRA AT TWO BUILDING ELEVATIONS, USER IDENTIFIES
$*** BUILDING I.D. & EL. I.D. IN THE BLANKS BEFORE O2M & S3M
$***LOADINGID
$***      O2M+      S3M
$***      O2M+      S3M
$***********************************************************************
$-----------------------------------------------------------------------
$*** IF SPECTRA TO BE ENVELOPED ARE AT MORE THAN TWO ELEVATIONS,
$*** USER NEEDS MORE THAN TWO SETS OF (      O2M +      S3M)
$*** FILES  TO BE IDENTIFIED
$***********************************************************************
$-----------------------------------------------------------------------
$*** THE FOLLOWING COMMANDS ARE PREPARED FOR ENVELOPING SPECTRA
$*** AT TWO BUILDING ELEVATIONS.
$*** IF THE STRUCTURAL SYSTEM IS ANCHORED AT MORE THAN TWO BUILDING
$*** ELEVATIONS, USER NEEDS TO MODIFY THE COMMANDS BY USING SIMILAR BUT
$*** EXPANDED COMMANDS.
$-----------------------------------------------------------------
ENVELOPE SHOCK SPECT FILES ON D07 FACT 1.0 DUMP
$*** INPUT BLDG ID+EL1 ID & BLDG ID+EL2 ID IN THE FOLLOWING BLANKS
$*** e.g., 'ENVOBEVT' FROM COMP FILES 'AB852OVT' 'AB873OVT'
'ENVOBEVT' FROM COMP FILES '_____OVT' '_____OVT'
'ENVOBENS' FROM COMP FILES '_____ONS' '_____ONS'
'ENVOBEEW' FROM COMP FILES '_____OEW' '_____OEW'
```

ATTACHMENT 8.E (CONT)

```
'ENVSSEVT' FROM COMP FILES '_____SVT' '_____SVT'
'ENVSSENS' FROM COMP FILES '_____SNS' '_____SNS'
'ENVSSEEW' FROM COMP FILES '_____SEW' '_____SEW'
$*** ENVELOPED SPECTRA LOADS ARE INPUT THROUGH FOLLOWING LOAD CASES ***
DAMP 0.02 100
SHOCK SPECTRUM LOAD 101 'Y-VERT OBE ENVELOPE'
SPECTRUM TRANS Y 1.0 FILE 'ENVOBEVT' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 102 'Z-NS OBE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVOBENS' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 103 'X-EW OBE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVOBEEW' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 105 'X-NS OBE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVOBENS' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 106 'Z-EW OBE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVOBEEW' DD7
END OF DYNA LOAD
DAMP 0.03 100
SHOCK SPECTRUM LOAD 201 'Y-VERT SSE ENVELOPE'
SPECTRUM TRANS Y 1.0 FILE 'ENVSSEVT' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 202 'Z-NS SSE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVSSENS' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 203 'X-EW SSE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVSSEEW' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 205 'X-NS SSE ENVELOPE'
SPECTRUM TRANS X 1.0 FILE 'ENVSSENS' DD7
END OF DYNA LOAD
SHOCK SPECTRUM LOAD 206 'Z-EW SSE ENVELOPE'
SPECTRUM TRANS Z 1.0 FILE 'ENVSSEEW' DD7
END OF DYNA LOAD
LOAD LIST ALL
MISSING MASS CORR TO BE APP RIGID FR 33.0
DYNA RESP ANA WITH REA
$
$ DYNAMIC ANALYSIS
$
PSEUDO STATIC SHOCK LOAD  1101  TEN  101
PSEUDO STATIC SHOCK LOAD  1102  TEN  102
PSEUDO STATIC SHOCK LOAD  1103  TEN  103
PSEUDO STATIC SHOCK LOAD  1105  TEN  105
PSEUDO STATIC SHOCK LOAD  1106  TEN  106
PSEUDO STATIC SHOCK LOAD  2201  TEN  201
PSEUDO STATIC SHOCK LOAD  2202  TEN  202
PSEUDO STATIC SHOCK LOAD  2203  TEN  203
PSEUDO STATIC SHOCK LOAD  2205  TEN  205
PSEUDO STATIC SHOCK LOAD  2206  TEN  206
$
$  COMBINE ALL SHOCK LOADINGS
$
LOAD COMB  'OBEYZX'  RMS  1101  1102  1103
LOAD COMB  'OBEYXZ'  RMS  1101  1105  1106
LOAD COMB  'SSEYZX'  RMS  2201  2202  2203
LOAD COMB  'SSEYXZ'  RMS  2201  2205  2206
$
GENERATE RESULTS FOR LOADING  1101  1102  1103  'OBEYZX'
GENERATE RESULTS FOR LOADING  1101  1105  1106  'OBEYXZ'
$---------------------------------------------------------
GENERATE RESULTS FOR LOADING  2201  2202  2203  'SSEYZX'
```

ATTACHMENT 8.E (CONT)

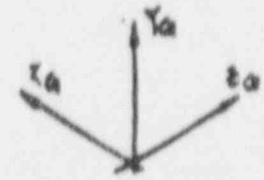
```
GENERATE RESULTS FOR LOADING  2201  2205  2206  'SSEYXZ'
$-------------------------------------------------------
UNITS DEGREES
OUTPUT BY JOINT ; OUTPUT BY MEMBERS
$ OBE  RESULTS
LOAD LIST 'OBEYZX' 'OBEYXZ'
OUTPUT DECIMAL 1
LIST REACTION   ALL
OUTPUT DECIMAL 3
LIST DISP ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBERS
UNIT RADIANS
SPECIAL UNIT CONVERSION FACTOR LENGTH 386.4
LIST ACCEL ALL
UNIT INCHES,DEGREES
$ SSE  RESULTS
LOAD LIST 'SSEYZX' 'SSEYXZ'
OUTPUT DECIMAL 1
LIST REACTION.  ALL
OUTPUT DECIMAL 3
LIST DISP ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
UNIT RADIANS
SPECIAL UNIT CONVERSION FACTOR LENGTH 386.4
LIST ACCEL ALL
UNIT INCHES,DEGREES
$
$--- COMPARISON OF G-VALUES-------------------
$
G COMP LOAD TYPE FIXED
G COMP LOAD ORIENTATION FIXED
G COMP TABULATE
$-------------------------------------------------------
$-------------------------------------------------------------------
$--- DEAD LOAD +OR- OBE AND DEAD LOAD +OR- SSE COMBINATIONS ----------
LOAD COMB 'DL+OBE'  'DEAD LOAD +OBE' COMB 'DY' 1.0 'OBEYZX'  1.0
LOAD COMB 'DL-OBE'  'DEAD LOAD -OBE' COMB 'DY' 1.0 'OBEYZX' -1.0
LOAD COMB 'DL+OBEA' 'DEAD LOAD +OBEA' COMB 'DY' 1.0 'OBEYXZ'  1.0
LOAD COMB 'DL-OBEA' 'DEAD LOAD -OBEA' COMB 'DY' 1.0 'OBEYXZ' -1.0
LOAD COMB 'DL+SSE'  'DEAD LOAD +SSE' COMB 'DY' 1.0 'SSEYZX'  1.0
LOAD COMB 'DL-SSE'  'DEAD LOAD -SSE' COMB 'DY' 1.0 'SSEYZX' -1.0
LOAD COMB 'DL+SSEA' 'DEAD LOAD +SSEA' COMB 'DY' 1.0 'SSEYXZ'  1.0
LOAD COMB 'DL-SSEA' 'DEAD LOAD -SSEA' COMB 'DY' 1.0 'SSEYXZ' -1.0
$
LOAD LIST 'DL+OBE'  'DL-OBE' 'DL+OBEA' 'DL-OBEA' -
 'DL+SSE' 'DL-SSE'  'DL+SSEA' 'DL-SSEA'
COMBINE ALL
OUTPUT BY JOINT
OUTPUT DECIMAL 1
LIST REACTIONS ALL
LOAD LIST  'DL+OBE' 'DL-OBE' 'DL+OBEA' 'DL-OBEA'
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$
$----------------------------------------
LOAD LIST  'DL+SSE' 'DL-SSE' 'DL+SSEA' 'DL-SSEA'
```

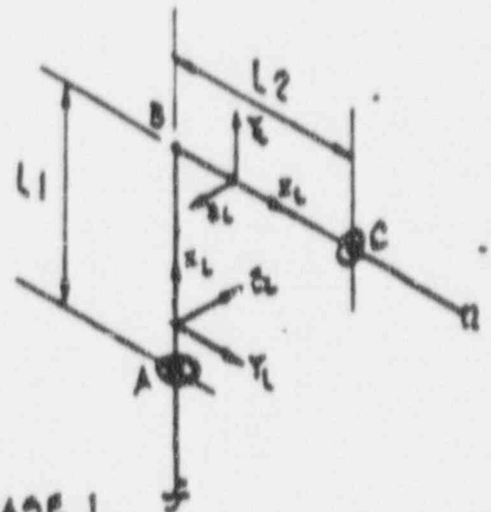
ATTACHMENT 8.E (CONT)

```
OUTPUT BY JOINT ;OUTPUT BY MEMBER
OUTPUT DECIMAL 3
LIST DISPLACEMENT ALL
LIST FORCES ALL
$SECTION FR NS 2    0.0  1.0
$LIST SECTION STRESSES ALL ACTIVE MEMBER
$
$*********************************************************************
$***           CODE CHECKING                                         *
$*** LY & LZ ARE UNBRACED LENGTHS FOR BUCKLING ABOUT MEMBER Y & Z AXES *
$*** KY & KZ ARE EFFECTIVE LENGTH FACTORS FOR BUCKLING ABOUT Y & Z AXES *
$*** CMY & CMZ ARE REDUCTION COEFFICIENTS FOR BENDING ABOUT MEMBER Y& Z *
$*********************************************************************
CHANGES
$--- PROPERTIES FOR ELEMENTS WITH THREADED SECTION ---
MEMBER PROP TABLE 'CNDPIPE' TYPE 'PIPE'
_______     TABLE  'CNDPIPE' '_______'
ADDITIONS
PRINT MEMBER PROPERTIES
SECTION FR NS 2  0.0  1.0
$--------------------------------------------------------------------
PARAMETERS
'CODE' 'AISC' ALL; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL; 'CB' 1.0 ALL
'ASF' 1.0 FOR LOAD 'DL+OBE' 'DL-OBE' 'DL+OBEA' 'DL-OBEA'
'ASF' 1.6 FOR LOAD 'DL+SSE' 'DL-SSE' 'DL+SSEA' 'DL-SSEA'
'CMY'  1.0   ALL
'CMZ'  1.0   ALL
'FBMAX' 0.6 ALL
'FSHMAX' 0.40 ALL
'FACMAX' 0.6 ALL
'FATMAX' 0.6 ALL
$
'KY' ____  MEMBER ___________
'KZ' ____  MEMBER ___________
'KY' ____  MEMBER ___________
'KZ' ____  MEMBER ___________
$
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
'LY' _____  MEMBER _______________  ;  'LZ' _____  MEMBER _______________
$
LOAD LIST  'DL+OBE' 'DL-OBE' 'DL+OBEA' 'DL-OBEA'
CHECK CODE FOR MEM _______________  GEN TRACE 6 RESULTS FOR FAILING MEMBERS
CHANGES
PARAMETERS
'FBMAX' 0.9 ALL
'FSHMAX' 0.50 ALL
'FACMAX' 0.9 ALL
'FATMAX' 0.9 ALL
ADDITIONS
LOAD LIST  'DL+SSE' 'DL-SSE' 'DL+SSEA' 'DL-SSEA'
CHECK CODE FOR MEM _______________  GEN TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGE
```

ATTACHMENT 8.F

UNBRACED LENGTH AND K-VALUES FOR INPUT IN STRUDL SKELETON





CASE 1

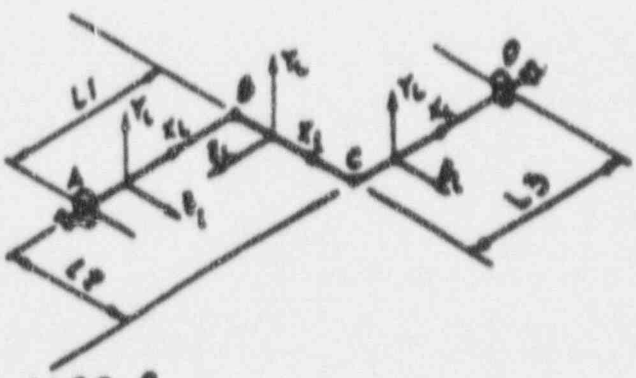
CASE 1

FOR MEMBER AB :

$KY_L = 2.10$
$KZ_L = 2.10$
$LY = LZ = L1$

FOR MEMBER BC :

$KY_L = 2.10$
$KZ_L = 2.10$
$LY = LZ = L2$



CASE 2

CASE 2

FOR MEMBER AB :

$KY_L = KZ_L = 2.10$
$LY = LZ = L1$

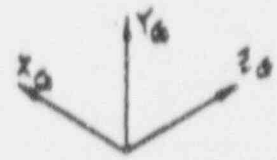
FOR MEMBER BC :

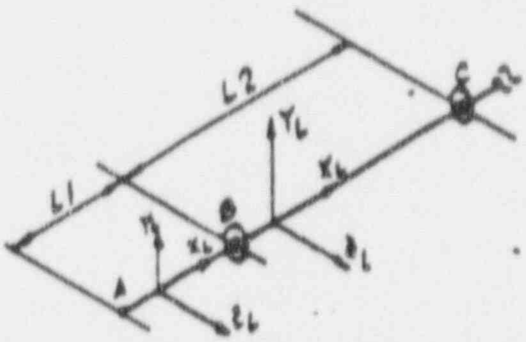
$KY_L = KZ_L = 1.2$
$LY = LZ = L2$

FOR MEMBER CD :

$KY_L = KZ_L = 2.10$
$LY = LZ = L3$

ATTACHMENT 8.F (CONT)

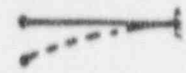




CASE 3 & CASE 4

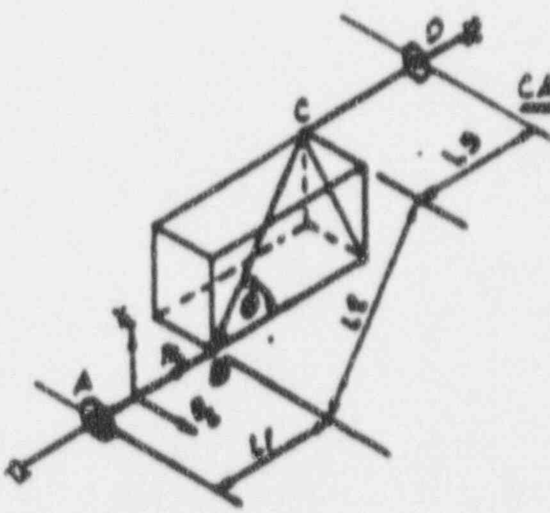
CASE 3 - CANTILEVER SPAN, AB :

$KY_L = KZ_L = 2.10$
$LY = LZ = L1$



CASE 4 - SPAN BETWEEN SUPPORTS, BC :

$KY_L = KZ_L = 1.20$
$LY = LZ = L2$

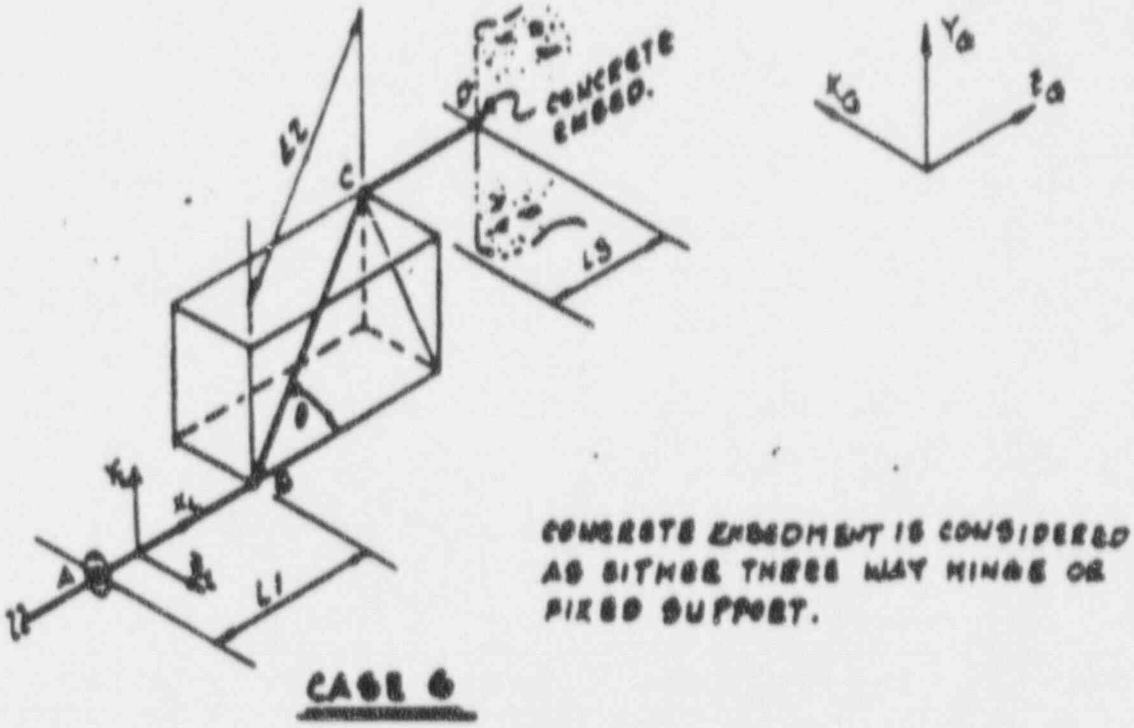


CASE 5

CASE 5 - SPAN BETWEEN SUPPORTS W/ BEND :

SEE CASE 2 ←

ATTACHMENT 8.F (CONT)



SEE CASE 2 FOR K-FACTORS AND LENGTHS.

NOTE: Attachment 8.F data taken from SAG.CP25, Appendix I, Table I.3.

ATTACHMENT 8.G

SKELETON FOR STATIC ANALYSIS OF CONDUIT SUPPORT FOR "g" VALUES ROTATED

NOTE: Attachment 8.G. skeleton taken from SAG.CP29, Attachment K.2.

```
$ PLEASE USE  'COND-RG.SKL' SKELETON FOR G-VALUES ROTATED CASES
$ INPUT FILE NO. ________.      DISK ID: _______      DATE:___________
$ USER :________      BANNER NAME :______
STRUDL 'CPSS #1' '
$ CPSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
UNITS INCHES, KIPS, DEGREES, FAHRENHEIT, LBM, SECONDS
$SHIFT COOR SYST 101 TRA  X______  Y______  Z______ .
$                     ROT  R1______ R2______ R3______
$JOINT COOR SHIFT BY 101
JOINT COORDINATES
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        .         .         .
SUPPORT JOINTS .
..............
JOINT RELEASES
_________ F - -  M - - -
_________ F -    M - -
_________ KFX ________ KFY ________ KFZ ________
          KMX ________ KMY ________ KMZ ________
_________ KFX ________ KFY ________ KFZ ________
          KMX ________ KMY ________ KMZ ________
          KMX ________ KMY ________ KMZ ________
_________ KMX ________ KMY ________ KMZ ________
_________ KMX ________ KMY ________ KMZ ________
MEMBER INCIDENCES
1
2
3
4
5
6
7
8
```

ATTACHMENT 8.G (CONT)

```
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
TYPE SPACE TRUSS
MEMBER INCIDENCES
_______
MEMBER RELEASES
_________ STA F _ _ M _ _ _ END F _ _ M _ _
          STA F _ _ M _ _ _ END F _ _ M _ _
CONSTANTS
E 29.E3 ALL ; POISSON 0.3 ALL ; DENS 0.284 ALL
G 11.2E3 ALL ; CTE 0.0000065 ALL
FYLD 36.0 ALL BUT 46.0 ____________________
CONSTANTS
DENS 1E-3
CONSTANTS
BETA
BETA
BETA
MEMBER PROPERTIES
_____________ TABLE 'STEELW' 'W_X___'
_____________ TABLE 'TUBESQR' 'T_X_X__'
_____________ TABLE 'TUBERECT' 'T_X_X_'
_____________ TABLE 'STEELC' 'C X ' TYPE 'CHANNEL'
_____________ TABLE 'STEELMC' 'MC X ' TYPE 'CHANNEL'
_____________ TABLE 'STEELL' 'L______'
_____________ TABLE 'STEELL' 'L______'
_____________ AX 100. AY 100. AZ 100. IX 1000. IY 1000. IZ 1000.
_____________ AX      AY      AZ      IX       IY       IZ
              SY      SZ
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR  1  ADD
$ INPUT WEIGHT OF CONDUITS / BOXES IN POUNDS ( LBS )
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
PRINT STRUCTURAL DATA
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION XZ
```

ATTACHMENT 8.G (CONT)

```
PLOT PROJECTION YZ
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 40.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
$CHANGE
$INERTIA OF JOINTS LUMPED
$INERTIA OF JOINTS FACTOR  1  ADD
$                 LINEAR X 0.0   Y 0.0   Z 0.0
$ADDITION
UNITS DEGREES
$ DEAD LOAD OF CONDUIT SUPPORT IS IN  -Y  DIRECTION
LOADING 1 'UNIT "G" +X DIRECTION'
DEAD LOAD COMP GLO X 1.0 BY JOINTS
$JOINT LOADS
$                   MOM X          Y          Z
$MEMBER LOADS
$              FORCE   X CON  FRA P              L  1.0
$              FORCE   Y CON  FRA P              L  1.0
$              FORCE   Z CON  FRA P              L  1.0
$              MOM     X CON  FRA P              L  1.0
$              MOM     Y CON  FRA P              L  1.0
$              MOM     Z CON  FRA P              L  1.0
LOADING 2 'UNIT "G" -Y DIRECTION'
DEAD LOAD COMP GLO Y -1.0 BY JOINTS
$JOINT LOADS
$                   MOM X          Y          Z
$MEMBER LOADS
$              FORCE   X CON  FRA P              L  1.0
$              FORCE   Y CON  FRA P              L  1.0
$              FORCE   Z CON  FRA P              L  1.0
$              MOM     X CON  FRA P              L  1.0
$              MOM     Y CON  FRA P              L  1.0
$              MOM     Z CON  FRA P              L  1.0
LOADING 3 'UNIT "G" +Z DIRECTION'
DEAD LOAD COMP GLO Z 1.0 BY JOINTS
$JOINT LOADS
$                   MOM X          Y          Z
$MEMBER LOADS
$              FORCE   X CON  FRA P              L  1.0
$              FORCE   Y CON  FRA P              L  1.0
$              FORCE   Z CON  FRA P              L  1.0
$              MOM     X CON  FRA P              L  1.0
$              MOM     Y CON  FRA P              L  1.0
$              MOM     Z CON  FRA P              L  1.0
LOAD COMB 4   'OBE LOADING +X DIR   (MAX SEIS)' COMPONENTS -
1
LOAD COMB 5   'OBE LOADING +X DIR   (MED SEIS)' COMPONENTS -
1
LOAD COMB 6   'OBE LOADING +X DIR   (MIN SEIS)' COMPONENTS -
1
LOAD COMB 7   'OBE LOADING +Y DIR   (MAX SEIS)' COMPONENTS -
2
LOAD COMB 8   'OBE LOADING +Y DIR   (MED SEIS)' COMPONENTS -
2
LOAD COMB 9   'OBE LOADING +Y DIR   (MIN SEIS)' COMPONENTS -
```

ATTACHMENT 8.G (CONT)

```
2
LOAD COMB 10 'OBE LOADING +Z DIR   (MAX SEIS)' COMPONENTS -
3
LOAD COMB 11 'OBE LOADING +Z DIR   (MED SEIS)' COMPONENTS -
3
LOAD COMB 12 'OBE LOADING +Z DIR   (MIN SEIS)' COMPONENTS -
3
LOAD COMB 13 'SSE LOADING +X DIR   (MAX SEIS)' COMPONENTS -
1
LOAD COMB 14 'SSE LOADING +X DIR   (MED SEIS)' COMPONENTS -
1
LOAD COMB 15 'SSE LOADING +X DIR   (MIN SEIS)' COMPONENTS -
1
LOAD COMB 16 'SSE LOADING +Y DIR   (MAX SEIS)' COMPONENTS -
2
LOAD COMB 17 'SSE LOADING +Y DIR   (MED SEIS)' COMPONENTS -
2
LOAD COMB 18 'SSE LOADING +Y DIR   (MIN SEIS)' COMPONENTS -
2
LOAD COMB 19 'SSE LOADING +Z DIR   (MAX SEIS)' COMPONENTS -
3
LOAD COMB 20 'SSE LOADING +Z DIR   (MED SEIS)' COMPONENTS -
3
LOAD COMB 21 'SSE LOADING +Z DIR   (MIN SEIS)' COMPONENTS -
3
PRINT STRUCTURAL DATA
PRINT LOADING DATA
STIFFNESS ANALYSIS REDUCE BAND
LOAD COMB 22 'OBE SRSS 4 9 11' RMS -
4 9 11
LOAD COMB 23 'OBE SRSS 5 9 10' RMS -
5 9 10
LOAD COMB 24 'OBE SRSS 4 8 12' RMS -
4 8 12
LOAD COMB 25 'OBE SRSS 6 8 10' RMS -
6 8 10
LOAD COMB 26 'OBE SRSS 5 7 12' RMS -
5 7 12
LOAD COMB 27 'OBE SRSS 6 7 11' RMS -
6 7 11
LOAD COMB 28 'SSE SRSS 13 18 20' RMS -
13 18 20
LOAD COMB 29 'SSE SRSS 14 18 19' RMS -
14 18 19
LOAD COMB 30 'SSE SRSS 13 17 21' RMS -
13 17 21
LOAD COMB 31 'SSE SRSS 15 17 19' RMS -
15 17 19
LOAD COMB 32 'SSE SRSS 14 16 21' RMS -
14 16 21
LOAD COMB 33 'SSE SRSS 15 16 20' RMS -
15 16 20
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
$ FOLLOWING LOAD CASES 1000 SERIES ARE OBE & 2000 SERIES ARE SSE
LOAD COMB 1001 'DL+SRSS 4 9 11 (OBE)' COMPONENTS -
2   1.0  22   1.0
LOAD COMB 1002 'DL-SRSS 4 9 11 (OBE)' COMPONENTS -
2   1.0  22  -1.0
LOAD COMB 1003 'DL+SRSS 5 9 10 (OBE)' COMPONENTS -
2   1.0  23   1.0
LOAD COMB 1004 'DL-SRSS 5 9 10 (OBE)' COMPONENTS -
2   1.0  23  -1.0
LOAD COMB 1005 'DL+SRSS 4 8 12 (OBE)' COMPONENTS -
2   1.0  24   1.0
```

ATTACHMENT 8.G (CONT)

```
LOAD COMB 1006 'DL-SRSS 4 8 12 (OBE)' COMPONENTS -
2    1.0  24  -1.0
LOAD COMB 1007 'DL+SRSS 6 8 10 (OBE)' COMPONENTS -
2    1.0  25   1.0
LOAD COMB 1008 'DL-SRSS 6 8 10 (OBE)' COMPONENTS -
2    1.0  25  -1.0
LOAD COMB 1009 'DL+SRSS 5 7 12 (OBE)' COMPONENTS -
2    1.0  26   1.0
LOAD COMB 1010 'DL-SRSS 5 7 12 (OBE)' COMPONENTS -
2    1.0  26  -1.0
LOAD COMB 1011 'DL+SRSS 6 7 11 (OBE)' COMPONENTS -
2    1.0  27   1.0
LOAD COMB 1012 'DL-SRSS 6 7 11 (OBE)' COMPONENTS -
2    1.0  27  -1.0
LOAD COMB 2001 'DL+SRSS 13 18 20 (SSE)' COMPONENTS -
2    1.0  28   1.0
LOAD COMB 2002 'DL-SRSS 13 18 20 (SSE)' COMPONENTS -
2    1.0  28  -1.0
LOAD COMB 2003 'DL+SRSS 14 18 19 (SSE)' COMPONENTS -
2    1.0  29   1.0
LOAD COMB 2004 'DL-SRSS 14 18 19 (SSE)' COMPONENTS -
2    1.0  29  -1.0
LOAD COMB 2005 'DL+SRSS 13 17 21 (SSE)' COMPONENTS -
2    1.0  30   1.0
LOAD COMB 2006 'DL-SRSS 13 17 21 (SSE)' COMPONENTS -
2    1.0  30  -1.0
LOAD COMB 2007 'DL+SRSS 15 17 19 (SSE)' COMPONENTS -
2    1.0  31   1.0
LOAD COMB 2008 'DL-SRSS 15 17 19 (SSE)' COMPONENTS -
2    1.0  31  -1.0
LOAD COMB 2009 'DL+SRSS 14 16 21 (SSE)' COMPONENTS -
2    1.0  32   1.0
LOAD COMB 2010 'DL-SRSS 14 16 21 (SSE)' COMPONENTS -
2    1.0  32  -1.0
LOAD COMB 2011 'DL+SRSS 15 16 20 (SSE)' COMPONENTS -
2    1.0  33   1.0
LOAD COMB 2012 'DL-SRSS 15 16 20 (SSE)' COMPONENTS -
2    1.0  33  -1.0
PRINT LOADING DATA
LOADS LIST -
22 TO 33
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
GENERATE RESULTS
LOAD LIST -
1001 TO 1012   2001 TO 2012
COMBINED ALL
LOAD LIST ALL
OUTPUT DECIMAL 3
OUTPUT BY JOINTS ; OUTPUT BY MEMBERS
LIST REACTIONS
LOAD LIST 1001 1002
LIST REACTION
LOAD LIST 1003 1004
LIST REACTION
LOAD LIST 1005 1006
LIST REACTION
LOAD LIST 1007 1008
LIST REACTION
LOAD LIST 1009 1010
LIST REACTION
LOAD LIST 1011 1012
LIST REACTION
LOAD LIST 1001 TO 1012
LIST REACTION
```

ATTACHMENT 8.C (CONT)

```
LOAD LIST 2001 2002
LIST REACTION
LOAD LIST 2003 2004
LIST REACTION
LOAD LIST 2005 2006
LIST REACTION
LOAD LIST 2007 2008
LIST REACTION
LOAD LIST 2009 2010
LIST REACTION
LOAD LIST 2011 2012
LIST REACTION
LOAD LIST 2001 TO 2012
LIST REACTION
LOAD LIST 1001 TO 1012 2001 TO 2012
SECTION FR NS 2  0.0 1.0
GROUP '&LM' DEFINITION
MEMBERS ALL BUT ______________
END OF GROUP DEFINITION
LIST SECTION STRESS MEMBERS '&LM'
$ DL COMB OBE (FOR CHECK WELD)
LOAD LIST -
1001 TO 1012
LIST FORCES ENVELOPE MEMBERS ______________
$ DL COMB SSE (FOR CHECK WELD)
LOAD LIST -
2001 TO 2012
LIST FORCES ENVELOPE MEMBERS ______________
PARAMETERS
'CODE' 'AISC' ALL ; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL ; 'CB' 1.0 ALL
'ASF' 1.6 LOADINGS 2001 TO 2012
'FSHMAX'  0.5 ALL
'FACMAX'  0.9 ALL
'FATMAX'  0.9 ALL
'FBMAX'   0.9 ALL
PARAMETERS
'LY' ______  MEM __________
'LY' ______  MEM __________
'LY' ______  MEM __________
'LZ' ______  MEM __________
'LZ' ______  MEM __________
'LZ' ______  MEM __________
'CMY' ______  MEM __________
'CMY' ______  MEM __________
'CMZ' ______  MEM __________
'CMZ' ______  MEM __________
'KY' ______  MEM __________
'KY' ______  MEM __________
'KY' ______  MEM __________
'KZ' ______  MEM __________
'KZ' ______  MEM __________
'KZ' ______  MEM __________
'UNLCF' ______  MEM __________
'UNLCF' ______  MEM __________
'UNLCF' ______  MEM __________
LOAD LIST -
1001 TO 1012  2001 TO 2012
CHECK CODE ALL BUT ______________
GENERATE TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGES
```

ATTACHMENT 8.H

SKELETON FOR STATIC ANALYSIS ON CONDUIT SUPPORT FOR "ς" VALUES NOT ROTATED

NOTE: Attachment 8.H. skeleton taken from SAG.CP29, Attachment K3.

```
$ PLEASE USE 'COND-UR.SKL' AS THE SKELETON FOR G-VALUES NOT ROTATED CASES
$ INPUT FILE NO. ________.___   DISK ID: _______      DATE:____________
$ USER :_________________       BANNER NAME :______
STRUDL 'CPSS #1' '           '
$ CPSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
UNITS INCHES, KIPS, DEGREES, FAHRENHEIT, LBM, SECONDS
$SHIFT COOR SYST 101 TRA  X______  Y_______  Z_______
$                    ROT  R1______ R2______  R3______
$JOINT COOR SHIFT BY 101
JOINT COORDINATES
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         .          .          .
SUPPORT JOINTS -
---------------
JOINT RELEASES
__________  F  - -  M - - -
__________  F  - -  M - - -
__________  KFX ________ KFY ________ KFZ ________
            KMX ________ KMY ________ KMZ ________
____ _____  KFX ________ KFY ________ KFZ ________
            KMX ________ KMY ________ KMZ ________
            KMX ________ KMY ________ KMZ ________
__________  KMX ________ KMY ________ KMZ ________
__________  KMX ________ KMY ________ KMZ ________
MEMBER INCIDENCES
1
2
3
4
5
6
7
8
```

ATTACHMENT 8.H (CONT)

```
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
TYPE SPACE TRUSS
MEMBER INCIDENCES
______

MEMBER RELEASES
________ STA F _ _ M _ _ _ END F _ _ M _ _
________ STA F _ _ M _ _ _ END F _ _ M _ _
CONSTANTS
E 29.E3 ALL ; POISSON 0.3 ALL ; DENS 0.284 ALL
G 11.2E3 ALL ; CTE 0.0000065 ALL
FYLD 36.0 ALL BUT 46.C ____________________
CONSTANTS
DENS 1E-3
CONSTANTS
BETA
BETA
BETA
MEMBER PROPERTIES
____________ TABLE 'STEELW'   'W__X___'
____________ TABLE 'TUBESQR'  'T__X__X__'
____________ TABLE 'TUBERECT' 'T__X__X__'
____________ TABLE 'STEELC'   'C X   ' TYPE 'CHANNEL'
____________ TABLE 'STEELMC'  'MC X   ' TYPE 'CHANNEL'
____________ TABLE 'STEELL' 'L______'
____________ TABLE 'STEELL' 'L______'
____________ AX 100. AY 100. AZ 100. IX 1000. IY 1000. IZ 1000.
____________ AX      AY      AZ      IX       IY       IZ
____________ SY      SZ
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR  1  ADD
$ INPUT WEIGHT OF CONDUITS / BOXES IN POUNDS ( LBS )
____________ LINEAR X ____ Y ____ Z ____
____________ LINEAR X ____ Y ____ Z ____
____________ LINEAR X ____ Y ____ Z ____
____________ LINEAR X ____ Y ____ Z ____
____________ LINEAR X ____ Y ____ Z ____
PRINT STRUCTURAL DATA
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION XZ
```

ATTACHMENT 8.H (CONT)

```
PLOT PROJECTION YZ
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 40.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
*CHANGE
$INERTIA OF JOINTS LUMPED
$INERTIA OF JOINTS FACTOR  1  ADD
$              LINEAR X 0.0   Y 0.0   Z 0.0
$ADDITION
UNITS DEGREES
$ DEAD LOAD OF CONDUIT SUPPORT IS IN  -Y DIRECTION
LOADING 1 'UNIT "G" +X DIRECTION'
DEAD LOAD COMP GLO X 1.0 BY JOINTS
$JOINT LOADS
$                    MOM X           Y          Z
$MEMBER LOADS
$              FORCE   X CON FRA P               L  1.0
$              FORCE   Y CON FRA P               L  1.0
$              FORCE   Z CON FRA P               L  1.0
$              MOM     X CON FRA P               L  1.0
$              MOM     Y CON FRA P               L  1.0
$              MOM     Z CON FRA P               L  1.0
LOADING 2 'UNIT "G" -Y DIRECTION'
DEAD LOAD COMP GLO Y -1.0 BY JOINTS
$JOINT LOADS
$                    MOM X           Y          Z
$MEMBER LOADS
$              FORCE   X CON FRA P               L  1.0
$              FORCE   Y CON FRA P               L  1.0
$              FORCE   Z CON FRA P               L  1.0
$              MOM     X CON FRA P               L  1.0
$              MOM     Y CON FRA P               L  1.0
$              MOM     Z CON FRA P               L  1.0
LOADING 3 'UNIT "G" +Z DIRECTION'
DEAD LOAD COMP GLO Z 1.0 BY JOINTS
$JOINT LOADS
$                    MOM X           Y          Z
$MEMBER LOADS
$              FORCE   X CON FRA P               L  1.0
$              FORCE   Y CON FRA P               L  1.0
$              FORCE   Z CON FRA P               L  1.0
$              MOM     X CON FRA P               L  1.0
$              MOM     Y CON FRA P               L  1.0
$              MOM     Z CON FRA P               L  1.0
LOAD COMB 4   'OBE LOADING +X DIR' COMPONENTS -
1
LOAD COMB 5   'OBE LOADING +Y DIR' COMPONENTS -
2
LOAD COMB 6   'OBE LOADING +Z DIR' COMPONENTS -
3
LOAD COMB 7   'SSE LOADING +X DIR' COMPONENTS -
1
LOAD COMB 8   'SSE LOADING +Y DIR' COMPONENTS -
2
LOAD COMB 9   'SSE LOADING +Z DIR' COMPONENTS -
```

ATTACHMENT 8.H (CONT)

```
3
PRINT LOADING DATA
STIFFNESS ANALYSIS REDUCE BAND
LOAD COMB 10 'OBE SRSS 4 5 6' RMS -
4 5 6
LOAD COMB 11 'SSE SRSS 7 8 9' RMS -
7 8 9
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
$ FOLLOWING LOAD CASES 1000 SERIES ARE OBE & 2000 SERIES ARE SSE
LOAD COMB 1001 'DL+SRSS 4 5 6 (OBE)' COMPONENTS -
2  1.0  10   1.0
LOAD COMB 1002 'DL-SRSS 4 5 6 (OBE)' COMPONENTS -
2   1.0  10  -1.0
LOAD COMB 2001 'DL+SRSS 7 8 9 (SSE)' COMPONENTS -
2   1.0  11   1.0
LOAD COMB 2002 'DL-SRSS 7 8 9 (SSE)' COMPONENTS -
2   1.0  11  -1.0
LOADS LIST -
10 TO 11
PRINT LOADING DATA
GENERATE RESULTS
LOAD LIST -
1001 TO 1002  2001 TO 2002
COMBINED ALL
LOAD LIST ALL
OUTPUT DECIMAL 3
OUTPUT BY JOINTS ; OUTPUT BY MEMBERS
LIST DISPLACEMENTS, REACTIONS, FORCES
SECTION FR NS 2  0.0 1.0
GROUP '&LM' DEFINITION
MEMBERS ALL BUT ____________________
END OF GROUP DEFINITION
LIST SECTION STRESS MEMBERS '&LM'
$ DL COMB OBE (FOR CHECK WELD)
LOAD LIST -
1001 TO 1002
LIST FORCES ENVELOPE MEMBERS ______________
$ DL COMB SSE (FOR CHECK WELD)
LOAD LIST -
2001 TO 2002
LIST FORCES ENVELOPE MEMBERS ______________
PARAMETERS
'CODE' 'AISC' ALL ; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL ; 'CB' 1.0 ALL
'ASF' 1.6 LOADINGS 2001 TO 2002
'FSHMAX'  0.5 ALL
'FACMAX'  0.9 ALL
'FATMAX'  0.9 ALL
'FBMAX'   0.9 ALL
PARAMETERS
'LY' ______  MEM __________
'LY' ______  MEM __________
'LY' ______  MEM __________
'LZ' ______  MEM __________
'LZ' ______  MEM __________
'LZ' ______  MEM __________
'CMY' _____  MEM __________
'CMY' _____  MEM __________
'CMZ' _____  MEM __________
'CMZ' _____  MEM __________
'KY' ______  MEM __________
'KY' ______  MEM __________
'KY' ______  MEM __________
'KZ' ______  MEM __________
```

ATTACHMENT 8.H (CONT)

```
'KZ' ______ MEM __________
'KZ' ______ MEM __________
'UNLCF' ________ MEM __________
'UNLCF' ________ MEM __________
'UNLCF' ________ MEM __________
LOAD LIST -
1001 TO 1002  2001 TO 2002
CHECK CODE ALL BUT ____________________.
GENERATE TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGES
```

ATTACHMENT 8.I

QUALIFICATION OF CA-5a SUPPORTS

Support capacities for Ca-5a are clamp capacities. As an alternative, CA-5a support can also be qualified by one of the following methods:

(1) Qualify the support using force level approach. See example A.

(2) Qualify the support using stress level approach. See example B.

NOTE: Attachment 8.I data taken from SAG.CP25 Attachment BB.

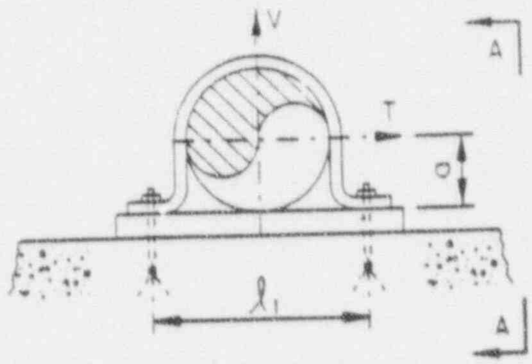
ATTACHMENT 8.I (CONT)

EXAMPLE A: Qualification of CA-5a Support by Force Level Approach

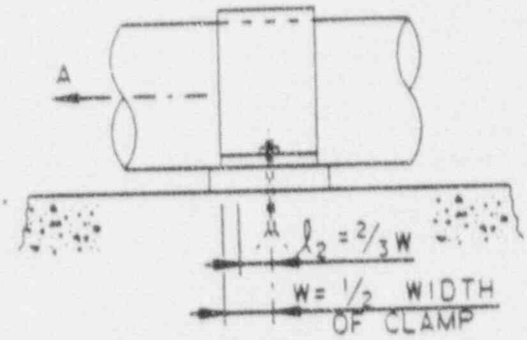
(a) Support No. ________________

Support Type: Ca-5a - Attached to wall (Cond Vert.)

JT. No. ________ Computer Run No. __________ Date __________



PLAN



SECTION A-A

CONDUIT SIZE ____________ HILTI BOLT SIZE ____________

L_T (lbs)	L_L (lbs)	SEISMIC CONDITION	q_h	q_v	FORCES AT CONDUIT CENTER					
					D.L. + O.B.E.			D.L. + S.S.E.		
					V_O (lbs) $[q_{h_O} \times L_T]$	T_O (lbs) $[q_{h_O} \times L_T]$	A_O (lbs) $[q_{v_O} + 1] \times L_L$	V_S (lbs) $[q_{h_S} \times L_T]$	T_S (lbs) $[q_{h_S} \times L_T]$	A_S (lbs) $[q_{v_S} + 1] \times L_L$
		O.B.E.								
		S.S.E.								

LOAD COMB.	a (in.)	l_1 (in.)	l_2 (in.)	PULL OUT/BOLT $\left[\frac{V}{2} + \frac{T \cdot a}{l_1} + \frac{A \cdot a}{2 l_2}\right]$ = P (lbs)	SHEAR/BOLT $\left[\left(\frac{T}{2}\right)^2 + \left(\frac{A}{2}\right)^2\right]^{1/2}$ = S (lbs)	ALLOWABLES		INTERACTION $P/P_A + S/S_A$	INTERACTION ≤1.0 *	
						PULL OUT P_A (lbs)	SHEAR S_A (lbs)		YES	NO
D.L. + O.B.E.										
D.L. + S.S.E.										

* YES - SUPPORT IS O.K.
NO - SEE EXAMPLE B (THIS ATTACHMENT)

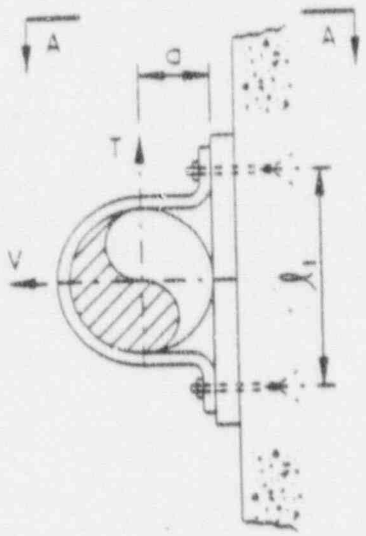
ATTACHMENT 8.I (CONT)

EXAMPLE A: Qualification of CA-5a Support by Force Level Approach

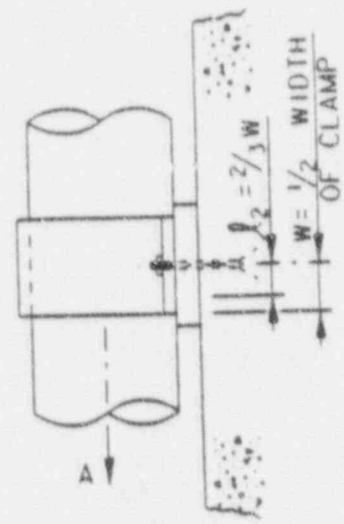
(b) Support No. ______________

Support Type: Ca-5a - Attached to wall (Cond Horz.)

JT. No. ________ Computer Run No. ________ Date ____________



ELEVATION



SECTION A-A

CONDUIT SIZE ____________ HILTI BOLT SIZE ____________

L_T (lbs)	L_L (lbs)	SEISMIC CONDITION	g_h	g_v	FORCES AT CONDUIT CENTER: D.L. + O.B.E. V_O (lbs) $[g_{h_O} \times L_T]$	D.L. + O.B.E. T_O (lbs) $[(g_{h_O}+1) \times L_T]$	D.L. + O.B.E. A_O (lbs) $[g_{v_O} \times L_L]$	D.L. + S.S.E. V_S (lbs) $[g_{h_S} \times L_T]$	D.L. + S.S.E. T_S (lbs) $[(g_{h_S}+1) \times L_T]$	D.L. + S.S.E. A_S (lbs) $[g_{v_S} \times L_L]$
		O.B.E.								
		S.S.E.								

LOAD COMB.	a (in.)	ℓ_1 (in.)	ℓ_2 (in.)	PULL OUT/BOLT $\left[\frac{V}{2} + \frac{T \cdot a}{\ell_1} + \frac{A \cdot a}{2\ell_2}\right]$ = P (lbs)	SHEAR/BOLT $\left[\left(\frac{T}{2}\right)^2 + \left(\frac{A}{2}\right)^2\right]^{1/2}$ = S (lbs)	ALLOWABLES: PULL OUT P_A (lbs)	ALLOWABLES: SHEAR S_A (lbs)	INTER-ACTION $P/P_A + S/S_A$	INTER-ACTION ≤ 1.0 * YES	INTER-ACTION ≤ 1.0 * NO
D.L. + O.B.E.										
D.L. + S.S.E.										

* YES - SUPPORT IS O.K.
NO - SEE EXAMPLE B (THIS ATTACHMENT)

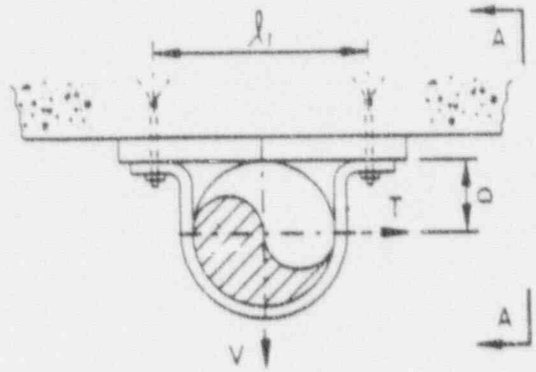
ATTACHMENT 8.I (CONT)

EXAMPLE A: Qualification of CA-5a Support by Force Level Approach

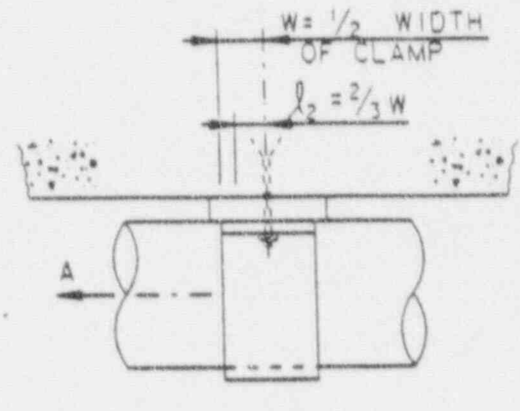
(c) Support No.______________

Support Type: Ca-5a - Attached to ceiling

JT. No. _______ Computer Run No. ________ Date __________



ELEVATION



SECTION A-A

CONDUIT SIZE ____________ HILTI BOLT SIZE ____________

L_T (lbs)	L_L (lbs)	SEISMIC CONDITION	g_h	g_v	FORCES AT CONDUIT CENTER: D.L. + O.B.E. V_O (lbs) $[g_{v_O}+1] \times L_T$	T_O (lbs) $[g_{h_O} \times L_T]$	A_O (lbs) $[g_{h_O} \times L_L]$	D.L. + S.S.E. V_S (lbs) $[g_{v_S}+1] \times L_T$	T_S (lbs) $[g_{h_S} \times L_T]$	A_S (lbs) $[g_{h_S} \times L_L]$
		O.B.E.								
		S.S.E.								

LOAD COMB.	a (in.)	ℓ_1 (in.)	ℓ_2 (in.)	PULL OUT/BOLT $\left[\frac{V}{2} + \frac{T \cdot a}{\ell_1} + \frac{A \cdot a}{2 \ell_2}\right]$ = P (lbs)	SHEAR/BOLT $\left[\left(\frac{T}{2}\right)^2 + \left(\frac{A}{2}\right)^2\right]^{1/2}$ = S (lbs)	ALLOWABLES: PULL OUT P_A (lbs)	ALLOWABLES: SHEAR S_A (lbs)	INTER-ACTION $P/P_A + S/S_A$	INTER-ACTION ≤ 1.0 * YES	NO
D.L. + O.B.E.										
D.L. + S.S.E.										

* YES - SUPPORT IS O.K.
NO - SEE EXAMPLE B (THIS ATTACHMENT)

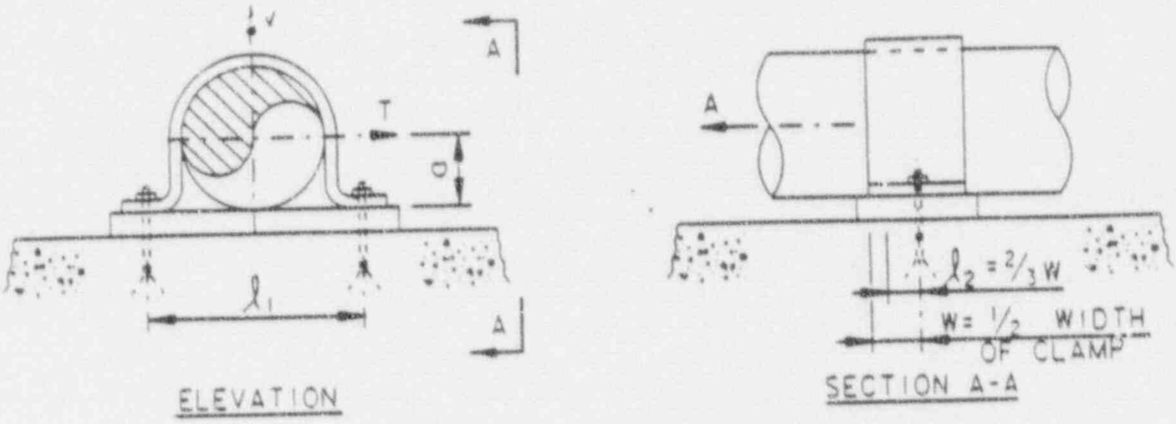
ATTACHMENT 8.I (CONT)

EXAMPLE A: Qualification of CA-5a Support by Force Level Approach

(d) Support No. ______________

Support Type: Ca-5a - Attached to floor

JT. No. ________ Computer Run No. ________ Date ________



CONDUIT SIZE ______________ HILTI BOLT SIZE ______________

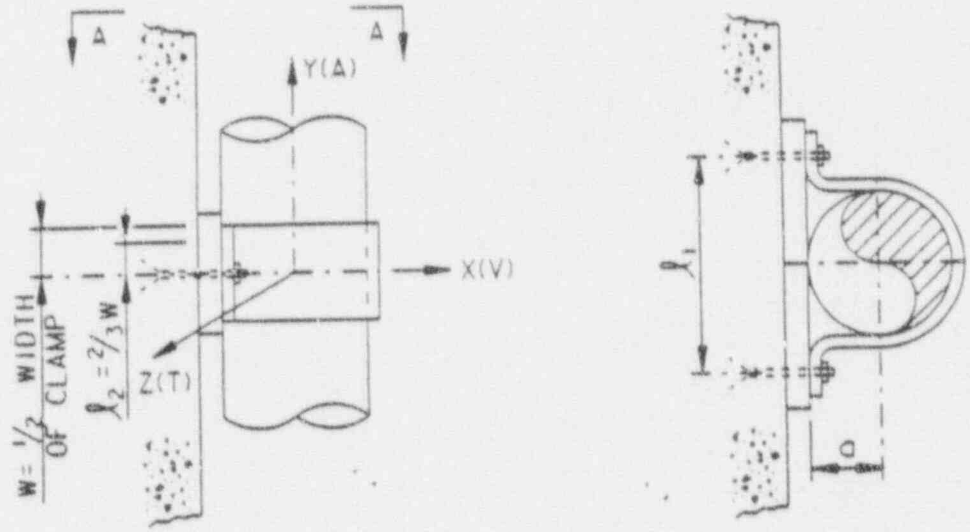
L_T (lbs)	L_L (lbs)	SEISMIC CONDITION	g_h	g_v	FORCES AT CONDUIT CENTER: D.L. + O.B.E. V_o (lbs) $[g_{v_o}-1] \times L_T$	D.L. + O.B.E. T_o (lbs) $[g_{h_o} \times L_T]$	D.L. + O.B.E. A_o (lbs) $[g_{h_o} \times L_L]$	D.L. + S.S.E. V_s (lbs) $[g_{v_s}-1] \times L_T$	D.L. + S.S.E. T_s (lbs) $[g_{h_s} \times L_T]$	D.L. + S.S.E. A_s (lbs) $[g_{h_s} \times L_L]$
		O.B.E.								
		S.S.E.								

LOAD COMB.	a (in.)	l_1 (in.)	l_2 (in.)	PULL OUT/BOLT $\left[\frac{V}{2} + \frac{T \cdot a}{l_1} + \frac{A \cdot a}{2 l_2}\right]$ = P (lbs)	SHEAR/BOLT $\left[\left(\frac{T}{2}\right)^2 + \left(\frac{A}{2}\right)^2\right]^{1/2}$ = S (lbs)	ALLOWABLES: PULL OUT P_A (lbs)	ALLOWABLES: SHEAR S_A (lbs)	INTERACTION $P/P_A + S/S_A$	INTERACTION ≤1.0 *: YES	INTERACTION ≤1.0 *: NO
D.L. + O.B.E.										
D.L. + S.S.E.										

* YES - SUPPORT IS O.K.
NO - SEE EXAMPLE B (THIS ATTACHMENT)

ATTACHMENT 8.I (CONT)

EXAMPLE B: Qualification of CA-5a support by Stress Level Approach.



ELEVATION   SECTION A-A

a = 1.75"
ℓ_1 = 5.125"
ℓ_2 = 0.54"
P_A = 608
S_A = 1021

SEISMIC G VALUES (O.B.E.)*:
g_x = 2.36
g_y = 2.77
g_z = 2.16 (USE 2.36)

* IN THIS EXAMPLE, G = 1.5 × PEAK
WHEN DESIGN G ARE USED, ROTATION OF G VALUES IS REQUIRED.

FROM COMPUTER RUN, LOAD CASES 1, 2 AND 3:

F_x = 88# F_y = 67# F_z = 96#

(A) PULL OUT/BOLT

(a) FROM O.B.E.

(i) DUE TO F_x (V)

$$\frac{V}{2} = \frac{(88 \times 2.36)}{2} = 104\#$$

(ii) DUE TO F_y (A)

$$\frac{Aa}{2\ell_2} = \frac{(67 \times 2.77)(1.75)}{(2)(0.54)} = 301\#$$

(iii) DUE TO F_z (T)

$$\frac{Ta}{\ell_1} = \frac{(96 \times 2.36)(1.75)}{5.125} = 78\#$$

ATTACHMENT 8.I (CONT)

EXAMPLE B: Qualification of CA-5a support by Stress Level Approach.

SRSS OF PULL OUT/BOLT DUE TO O.B.E. LOADS

$$P_{SRSS} = \sqrt{(104)^2 + (301)^2 + (78)^2} = 328^{\#}$$

(b) FROM D.L. (A)

$$\frac{A \times a}{2 \times \ell_2} = \frac{(67)(1.75)}{(2)(0.54)} = 109^{\#}$$

$\therefore$ TOTAL PULL OUT/BOLT $= P_{DL} + P_{SRSS}$

$= 109 + 328$

$= 437^{\#}$

(B) SHEAR/BOLT

(a) FROM O.B.E.

(i) DUE TO F_y (A)

$$\frac{A}{2} = \frac{(67)(2.77)}{2} = 93^{\#}$$

(ii) DUE TO F_z (T)

$$\frac{T}{2} = \frac{(96)(2.36)}{2} = 114^{\#}$$

(b) FROM D.L. (A)

$$\frac{A}{2} = \frac{67}{2} = 34^{\#}$$

$$\therefore \text{SHEAR/BOLT} = \sqrt{\left(\frac{T}{2}\right)^2 + \left(\frac{A}{2}\right)^2}$$

$$= \sqrt{(114)^2 + (93 + 34)^2}$$

$$= 171^{\#}$$

$$\text{INTERACTION RATIO} = \frac{P}{P_A} + \frac{S}{S_A} = \frac{437}{608} + \frac{171}{1021} = 0.89$$

ATTACHMENT 8.J
GUIDELINES FOR PREPARATION OF CONDUIT ISOMETRICS, MODIFIED AND IN SUPPORT DRAWINGS

The following are guidelines on how to prepare conduit isometrics (ISO), modified, and IN support drawings:

I. Information on the isometric shall be as listed below:

1. Initial "issue number" shall be "CP-01".

2. Initial issue shall generally read: Issued for Construction.

3. Conduit Support Location.

4. a. For Unit 2 conduits that are located in the Unit 2 areas (Reactor, Containment, and Safeguards building), the conduit drawing number shall be as follows:

S2-0910	-	12345	-	SK.01
Designates Unit 2		Unique conduit number. This part of conduit ID comes after the alphabetical letter designating the circuit train		Sketch number

b. For Unit 2 conduits that are located in the common areas (Electrical, Fuel, Auxiliary and Service Water Intake buildings), the conduit drawing shall be as follows:

S-0910	-	12345	-	SK.01
Designates Unit 2 recommended		Unique conduit number. This part of conduit ID comes after the alphabetical letter designating the circuit train		Sketch number

Exceptions to this numbering scheme may be made by consulting the lead.

5. Routing of conduit and location of supports and electrical fittings.

Dimensions shall be shown from conduit termination point to center line of support attachment to center line of bend to edge of electrical fitting* to center line of support as applicable.

* Electrical fittings to be located are those affecting support loading as defined in the S-0910 or, S2-0910 LS- series drawings.

Each support attached to the containment liner shall have an elevation and azimuth shown on the isometric.

6. The actual angle for any bend with an angle less than 15 degrees is not required to be shown on the drawing. A bend which is less than 15 degrees will have the change of direction shown on the ISO and the angle will be labeled as less than 15 degrees. It is not required to dimension to the center line of the bend in this case. Span length from support to support must be measured along the center line of conduit.

7. The primary conduit number and diameter shall be included in all sketches. Also, secondary conduit number will be included.

ATTACHMENT 8.J (CONT'D)

8. Unique support number, support type, decision points, modified typical and individually engineered "IN" support callouts.

9. "Seismic Category" of the conduit.

10. Junction boxes shall be shown with solid lines and support type callout on only one ISO. This ISO shall also show all of the conduit exiting the junction box. On other ISOs where the same junction box appears, the junction box will be shown with dashed lines.

11. When more than one conduit is attached to a typical support, the isometric containing the same unique identifier as the support shall note all of the conduits that share the support using the conduit size and unique identifier (i.e., isometric SH. 05252-SK01 with support -03 list all conduits shared with that support).

    When more than one conduit is attached to a modified typical support or an "IN" support, the additional conduit may be shown on the applicable support drawing in lieu of noting them on the isometric.

12. For P2558 clamps, no conduit diameter will be listed (i.e., P2558-30 the -30 will not be listed).

13. Approximate column line location and elevation along with actual room number listed on the isometric.

14. Horizontal, vertical and rolling offsets in degrees.

15. Dimensions to fittings (excluding couplings, including size and type) and configurations to be included on isometric.

16. All support "L" and "a" dimensions.

17. Identify any and all fittings in bent overhangs past the last support.

II. When a typical support requires modification, minor changes to a typical support may be called out on the isometric. In lieu of this, a modified support drawing shall be prepared. The following will be shown on the modified typical (as applicable):

1. Show actual attributes of decision points.

2. Show dimensions required to locate Hilti or Richmond attachment bolts with respect to the base member.

    a. Show HKB diameter and required minimum embedment if other than listed in Drawing S-0910 or S2-0910 General Notes. All required minimum embedments will be shown for HSKB.

3. All non-standard shim plate and filler plate sizes.

4. Stud sizes, clamp types, clamp sizes and torque values.

5. Orientation of view.

ATTACHMENT 8.J (CONT'D)

6. Location of support.

   a. Room number, approximate elevation and approximate location.

   b. "L" and "a" max. dimensions if applicable or dimension(s) from support mounting surface to centerline of conduit(s).

7. Notes

   From the typical support drawing that is modified, delete general notes which do not apply. Also, add notes as applicable, i.e.,:

   1. This support is a modification of Sh. ________________.

   2. All dimensions are ± ______________________ U.O.N.

8. Title Block

   a. Change typical support type to unique conduit identifier and support number (i.e., CSM-2a-II to C23G12345-10).

9. All conduit run diameters and identifier (i.e., 4" ∅ C23G12345) for conduit supports. For junction box support list primary conduit as a minimum.

10. Any changes in structural member sizes.

11. When a conduit support is attached to another discipline's support, shown the other discipline's support in phantom, list the phantomed support's number and label it as (Ref.).

III. When an "IN" support is required, an "IN" support drawing shall be prepared:

   A. As a minimum, the following shall be required on the "IN" Support drawing: (as applicable)

      1. All conduit diameters and unique numbers. All conduit numbers that are not the main conduit number as shown as (Ref.).

      2. Support mounting surface.

         a. Identify if wall, floor, ceiling, etc., or to another discipline's support.

         b. When a conduit support is attached to another discipline's support, show the other discipline's support in phantom, list the phantomed support's number and label it as (Ref.).

ATTACHMENT 8.J (CONT'D)

3. Support Anchorage

Anchor Bolts

a. Type

1. Thru bolts
2. Richmond Screw Anchors
3. Expansion Anchors (Hilti Kwik or Super Kwik Bolts)

   a. HKB diameter and required minimum embedment if other than listed in Drawing S-0910 or S2-0910 General Notes. All required minimum embedments will be shown for HSKB.

b. Material (A-325, A-490, etc.) for bolts other than expansion anchors.

Anchor Spacing

a. Spacing between expansion anchor bolts on separate adjacent fixtures if in violation of Specification CPES-S-2001.

b. Spacing between expansion anchor bolts and embedded plates if in violation of Specification CPES-S-2001 requirements.

c. Spacing between expansion anchor bolts and the edge of concrete (including wall and floor penetrations) if in violation of Specification CPES-S-2001 requirements.

d. Spacing between expansion anchor bolts and the heel of the angles used for water tight doors and/or block openings if in violation of Specification CPES-S-2001 requirements.

e. Show dimensions required to locate Hilti or Richmond attachment bolts with respect to the base member.

4. Location of embedded plate if not in accordance with S-0910 or S2-0910 General Notes.

NOTE: Orientation of views will be clearly defined. Section views will be used as required.

ATTACHMENT 8.K

GUIDELINES FOR PREPARATION OF CONDUIT DRAWINGS

The following are guidelines on how to prepare a conduit drawing (matrix):

1. As a minimum, the conduit drawing matrix shall contain:

    - o Conduit (Primary and secondary) identification number and size
    - o Junction box identification number and size
    - o Origin and destination of conduit
    - o Conduit maximum spans and types
    - o Condulet fittings
    - o Support numbers and types
    - o Reference location

2. For Unit 2 conduits that are located in the Unit 2 areas (Reactor, Containment, and Safeguards building), the conduit drawing number shall be as follows:

    S2-0910 SH.-12345 -SK.01

    designates Unit 2 (2)

    Sketch number (01)

    Unique conduit number (12345). This part of conduit ID comes after the alphabetical letter designating the circuit train.

    Exceptions to this numbering scheme may be made by consulting the lead.

3. For Unit 2 conduits that are located in the common areas (Electrical, Fuel, Auxiliary and Service Water Intake buildings), the conduit drawing shall be as follows:

    S-0910-2X SH. 12345 - SK.01

    designates Unit 2 recommended (2X)

    Sketch number (01)

    Unique conduit number (12345). This part of conduit ID comes after the alphabetical letter designating the circuit train

    Exceptions to this numbering scheme may be made by consulting the lead.

ATTACHMENT 8.K (CONT'D)

4. Supports shall be numbered as follows:

C23G12345 - 01

01 — Sequence number

C23G12345 — Primary conduit number

The sequence number shall be a unique identifier (i.e., not repeated on the same conduit run).

Support number for secondary supports shall be shown as XX S, where XX is the support's sequence number on the primary conduit.

5. A detailed sketch of modified supports shall be provided on separate sketches of the conduit drawing. When a sketch of a modified support is prepared, the following shall be shown in general:

   1. All conduit diameters and unique numbers.
   2. Support mounting surface.
   3. Support structural members and dimensions.
   4. Welds sizes.
   5. Anchor bolts size, type and embedment length (if not per the generic drawings).
   6. Structural bolts size and material.
   7. Anchor bolt spacing when in violation with the requirements of Specification CPES-S-2001.
   8. Conduit clamp type (if not per the generic drawings).
   9. Orientation of support with respect to (N-S), (E-W) or vertical directions.
   10. All non-standard shim plate and filler plate sizes.
   11. Any other non-standard components and miscellaneous data.

6. In general, support types shall be obtained from the PESD series of S2-0910 drawings. Support types from the S-0910 or S2-0910 drawings may be used as applicable.

7. On a case by case basis, the engineer shall review the results of the calculation and study the possibility of allowing a tolerance of +6" over the maximum span shown on the drawing matrix. If it is determined that this tolerance is feasible, the following note shall be added to the drawing notes:

   "INSTALLATION TOLERANCE OF +6" IS ALLOWED FOR CONSTRUCTION IF SPAN EXCEEDS MAXIMUM SPAN."

ATTACHMENT 8.K (CONT'D)

8. TU Electric's INDMS Database shall be reviewed to verify the conduit origination and termination points, conduit identification and size.

ATTACHMENT 8.L

CALCULATION REVIEW CHECKLIST

Calculation Number: ______ **Rev.:** ______

Question	YES	NO	NA
1. Are all generic supports design validated per latest design criteria?			
2. Are all modified or IN supports qualified per latest design criteria?			
3. Are conduit spans validated per latest S2-0910 span requirements or per latest design criteria?			
4. Are conduit isometrics with a threaded fitting at a bent overhang adequately supported?			
5. Is conduit yield stress (Fy) used smaller than or equal to 25 KSI?			
6. Is conduit modulus of elasticity (E) used equal to $29x10^3$ KSI?			
7. Is the correct coefficient of thermal expansion used?			
8. Are clamps with reduced capacities evaluated per latest clamp capacity requirments?			
9. Are tube steel to tube steel connections evaluated per latest design criteria?			

Comments: ______

					ABB	JOB NO CALC NO	PAGE OF
REV	BY	DATE	CHECKED	DATE	ABB IMPELL CORPORATION		

ATTACHMENT 8.L (CONT'D)

Calculation Review Checklist

Calculation Number ______________ Rev. ____

Question	YES	NO	NA
10. Is base metal shear checked for weld allowable determination?			
11. Are support stiffness' considered when conduit support is attached to a cable tray hanger (CTH) or HVAC support?			
12. Is the effect of two (2) inch topping considered in support design validation?			
13. Are junction boxes qualified per latest criteria?			
14. Is the dead load of the junction box accounted for?			
15. Is the correct weld pattern for junction box support checked?			
16. Are open items resolved?			
17. Does the double bend span adjacent to overhang, with CSM-2a-II type support as first support, meet the reduced span allowable?			
18. Does calculation conform to the latest design criteria?			

Comments: ____

					ABB ABB IMPELL CORPORATION	JOB NO CALC NO
REV	BY	DATE	CHECKED	DATE		