0065358

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99352 • (509) 372-7950

June 1, 2005

Mr. Roy J. Schepens, Manager
Office of River Protection
United States Department of Energy
P.O. Box 450, MSIN: H6-60
Richland, Washington 99354-1670

RECEIVED
JUN 13 2005
EDMC

Mr. Edward S. Aromi
President and General Manager
CH2M Hill Hanford Group, Inc.
P.O. Box 1500, MSIN: H6-08
Richland, Washington 99354-1670

Dear Mr. Schepens and Mr. Aromi:

Re: Letter from R. Schepens, Office of River Protection, to M. Wilson, Ecology, "Final Dangerous and Mixed Waste Research and Development and Demonstration Permit for Demonstration Bulk Vitrification Facility Required Submittal – Required Design Submittal for Secondary waste and In-Container Vitrification (ICV™) Storage Area Foundation Systems 05-TPD-050," Dated May 13, 2005 65206

The Washington State Department of Ecology (Ecology) has completed review of the Demonstration Bulk Vitrification System (DBVS) engineering design and supporting information for the In-Container Vitrification (ICV™) Storage Area Foundation Systems, and the accompanying Independent Qualified Registered Professional Engineer certified report. These materials were submitted by the United States Department of Energy, Office of River Protection in accordance with its Dangerous Waste Research, Development, and Demonstration Facility Permit (RD&D) for the DBVS Permit WA 7890008967. Based on the information submitted, Ecology approves construction of the In-Container Vitrification (ICV™) Storage Area Foundation Systems.

This approval does not constitute Ecology approval of information unrelated to In-Container Vitrification (ICV™) Storage Area Foundation Systems. The secondary waste system will be provided a separate determination when Ecology has completed the final review of the system's package.

A copy of the pages to be inserted into the DBVS Facility Permit, WA 7890008967 and instructions for posting these pages to the permit, are included as Enclosure 1 to this letter. These enclosed pages hereby become official parts of the RD&D Permit for the DBVS Facility and are to be inserted into the Permit.

If you have any questions regarding this action, please call Kathy Conaway at (509) 372-7890 or Suzanne Dahl at (509) 372-7892.

Sincerely,

Michael A. Wilson
Program Manager
Nuclear Waste Program

KAC:nc
Enclosures

cc/enc: Catherine Massimino, EPA
Gil Ramin, USDOE
Jim Rasmussen, USDOE
John Guberski, CH2M
Felix Miera, CH2M
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cc: Billie Mauss, USDOE
Peter Brockman, CH2M
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Chris Kemp, CH2M
Dave Shuford, CH2M
Ro Vinson, PAC
Stuart Harris, CTUIR
Gabriel Bohnee, NPT
Russell Jim, YN
Todd Martin, HAB
Ken Niles, ODOE
Environmental Portal

Rev 1, June 1, 2005

POSTING INSTRUCTIONS FOR THE ICV BOX FOUNDATIONS SUBMITTAL

PERMIT ATTACHMENTS:

For Permit Attachment JJ, Add an Appendix 1, Contents Page

For Permit Attachment JJ, Add to Appendix 1, Section 1, Calculation 145579-C-CA-014, Rev. 0, ICV™ Box Assembly Building Foundation

For Permit Attachment JJ, Add to Appendix 1, Section 3, Drawings H-14-106790, Rev. 0 and H-14-106797, Rev. 0

Attachment JJ Container Management

Appendix 1 Container Foundations

CONTENTS

Section 1 Supporting Calculations with Drawings

Section 2 Independent Qualified Registered professional Engineer Design Assessment Reports-Reserved

Section 3 Drawings

Section 4 Engineering Change Notices-Reserved

Section 5 Specifications-Reserved

Attachment JJ Container Management

Appendix 1 Container Foundations

Contents

Section 1 Supporting Calculations with Drawings

145579-C-CA-013, Rev. 2, ICV Box Storage Slab and Access Slabs
(Foundation #16, #17, #18)
145579-C-CA-014, Rev. 0, ICV Box Assembly Building Foundation

CALCULATION COVER SHEET

amec

CALC. NO.: 145579-C-CA-013 REV: 2 DATE: 20 December 2004

CALC. TITLE: ICV™ Box Storage Slab and Access Slabs (Foundations #16, 17, 18)

PROJECT NO.: 145579 PROJECT TITLE: Final DBVS Design

Design Verification Required: ☐ Yes ☐ No

Calculation Type: ☐ Scoping ☐ Preliminary ☒ Final

Superseded by Calculation No.: _____ ☐ Voided

ORIGINAL AND REVISED CALCULATIONS/ANALYSIS APPROVAL

REV.	ORIGINATOR:	DATE:	CHECKED:	DATE:	APPROVED	DATE
0	Paul Meyer	18-Aug-04	Divana Whitley	19-Aug-04	Tony Heim	19-Aug-04
1	Paul Meyer	18 Oct 04	Divana Whitley	18 Oct 04	John Stephens	20 Oct 04
2	P. Meyer	20-Dec-04	Divana Whitley	20 Dec-04	J. Heim	20 Dec 04

AFFECTED DOCUMENTS

DOCUMENT NUMBER:	TITLE:	REV. NO.:	DISC. LEAD INITIALS
H-14-106790	Bulk Vitrification ICV™ Box Storage Area Plan / Details	0	PM
H-14-106792	Bulk Vitrification Melt Area Foundation Plans and Sections	1	PM

RECORD OF REVISION

REV. NO.	REASON FOR REVISION:
0	Initial Issue
1	Box weight increased from 85 tons to 240,000 lb. Re-verified design of storage slabs. Storage curbs calculations added.
2	Significant revision to provide additional design information. All attachments revised

ATTACHMENTS

DOCUMENT NUMBER/ID:	TITLE:	TOTAL PAGES
Attachment 1	Handwritten calculations	4
Attachment 2	Page 4 of AMEC DBVS Site Geotechnical Report	1
Attachment 3	Page 4 of PCA "Thickness Design for Concrete Pavements" including Table 1 "Effect of Untreated Subbase on k Values (pci)"	1
Attachment 4	Page 8 of PCA "Thickness Design for Concrete Pavements" Figure 7. "Design chart for tandem–axle loads for Case 1" Nomograph	1
Attachment 5	From ACI 330R-92 "Guide for Design and Construction of Concrete Parking Lots" – Page 9 – Steel in Parking Lots	1
Attachment 6	Foundation Drawings	6
Attachment 7	e-mail from Brad Hupy, Senior Geotechnical Engineer, to P. Meyer	2
Attachment 8	Storage Curbs (MathCAD Calculations)	6
Attachment 9	Foundation Information Chart Showing Performance Category	1
Attachment 10	Record of Discussion: Tom Wilson and Air Pallet Manufacturer	1
Attachment 11	Rebar Design for Foundation Pads or Slabs	1

1 INTRODUCTION

1.1 Purpose

The purpose of this calculation is to determine slab thickness and reinforcement for the ICV™[1] Box Storage Area Slab and the two Melt Area Approach Slabs.

1.2 Scope

The scope of this calculation includes determining the required concrete thickness and reinforcement. Design of the precast concrete curbs attached to the box storage slab is included.

2 BASIS

2.1 Design Inputs

Box curb layouts are provided on drawing F-145579-00-B-0022 Rev D. This drawing is included as part of Attachment 6.

2.2 Criteria

From: TFC-ENG-STD-06 Rev B-1, October 27, 2003.

The ICV™ Box Storage Area Slab and the Melt Area Approach Slabs have no performance categories, as they are not SSCs. This was provided at the March 11, 2004, biweekly design review meeting. The attached foundations chart (Attachment 9) was included in an e-mail from David Shuford CH2MHill to John Stephens AMEC confirming the Performance Categories of SSCs. Discussion with CH2M also concluded that the Box itself is an inherently "movable" object and so is designated PC-1M. Design is based on standard engineering practice to provide a hard, flat surface to allow the use of air pallets to move and store ICV™ boxes.

Frost heaving has been considered and will be negligible. This is confirmed in an e-mail from the author of the DBVS Site Geotechnical report and is included as Attachment 7.

[1] ICV™ is a trademark of AMEC Inc.

Design Loads:

Live Load: 240,000 lb. gross weight ICV™ Box supported on 21" high by 12" wide precast concrete curbs along the length of the box.

Dead Load: None. Self-weight of the slab is fully supported on a prepared compacted granular base.

Wind load: the slabs are flush with grade and not subject to wind. Wind load is considered in the design of the box support curbs.

Other loads (snow, seismic, volcanic ashfall, flood, groundwater pressure, thermal, concrete creep or lightning) have no bearing on the foundation design.

Snow load: the ground snow load on the Hanford site is 15 psf. By inspection, a 12" or 24" thick reinforced slab will not be affected by a 9" depth of snow, and this load may safely be ignored.

Seismic load: the stored boxes are inherently movable and therefore a PC-1M designation applies. Seismic loading is not required.

Volcanic Ashfall: the ashfall load on the Hanford site is 3 psf for PC-1 SSCs. By inspection, a 24" thick reinforced slab-on-grade will not be affected by such a minor load, and this load may safely be ignored.

Flood: the DBVS site is at elevation 663 feet and is not in any of the flood areas identified in HNF-SD-GN-ER-501 *Natural Phenomena Hazards, Hanford Site, Washington.* Flood loads may safely be ignored.

Groundwater Pressure: the DBVS site is at elevation 663 feet. The Geotechnical report notes that groundwater levels are approximately 300 feet below the ground surface. Groundwater pressure may safely be ignored.

Thermal: like any exterior concrete slab on grade, the foundation is subjected to normal annual and daily temperature variations. It is not constrained from expanding or contraction by the surrounding soil. The foundation shape is a simple rectangular prism, and no change in the foundation geometry occurs due to thermal stresses. Thermal stresses will be very small and may safely be ignored. Steel is provided in a quantity sufficient to resist cracking of the slab, as demonstrated in the attached calculations.

Concrete creep: the foundation will be cast in place on a firm compacted soil subgrade. Long term creep of a non-suspended slab will be negligible. Concrete creep stresses may safely be ignored.

Lightning: the entire DBVS site will have a grounding grid installed. Copies of the grounding drawings are included with Attachment 6. Elevated equipment and structures will be attached to the ground grid.

2.3 Assumptions

1. Detailed ICV™ Box data gives a length of 24.7 feet, a width of 8.2 feet. Increases in plan dimension are not anticipated. Curb spacings will remain approximately as shown on the curb layout drawings.

2. Calculated full box weight is approximately 207,000 pounds, from AMEC Drawing F-145579-35-D-0004 Rev D, 30 Sept 2004. Recent discussions have suggested that adding a top-off layer of grout is possible. This would increase the weight of the box by another 20,000 pounds or so. To ensure that future increases in weight can be sustained by the slab, and to provide for a slight margin of safety, a design weight of 240,000 pounds has been used. This weight will be confirmed once 100% design is complete and checked against the slab design. Corrective action will be taken if required.

3. Other design loads are provided by either design standards or calculation (e.g. slab dead load).

4. Radiant heat from the stored boxes will not be a significant source of heat to the top of the slab, no more than might be experienced on the hottest summer days. The space between the boxes and the slab will be 21" with openings in the supporting curbs to allow air flow.

3 REFERENCES

1. *Uniform Building Code*, 1997. International Conference of Building Officials, Whittier, California, USA.

2. *ACI Manual of Concrete Practice*, 1997. American Concrete Institute, Farmington Hills, Michigan, USA.

3. *Thickness Design for Concrete Pavements*, 1966. Portland Cement Association, Skokie Illinois, USA.

4. AMEC Drawing F-145579-35-D-0004 Rev D, 30 Sept 2004.

5. TFC-ENG-STD-06 Rev B-1, *Design Loads for Tank Farm Facilities*, Issued October 22, 2003 by CH2M Hill Hanford Group Inc. Hanford, Washington.

6. *Report of Geotechnical Engineering Services, Bulk Vitrification Process Partial DBVS Richland Washington.* April 2004. AMEC Earth and Environmental Inc., Portland, Oregon.

7. HNF-SD-GN-ER-501 Rev 1B, *Natural Phenomena Hazards, Hanford Site, Washington.* As revised by ECN 672877, May 15, 2002. Numatec Hanford Company, Richland, Washington.

8. DOE-STD-1020-2002 *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* January 2002. U.S. Department of Energy, Washington, D.C.

9. ER-5193 *Hilti HIT HY-150 Adhesive Anchor Systems*, report by ICC Evaluation Services (for use with UBC & IBC codes) Whittier, California. Reissued September 4, 2004

10. G-LI-002 Rev B, *Site Improvements Plan Equipment List* prepared by AMEC Trail Mechanical Group, Issued July 23, 2004.

4 METHODS

Sizing of concrete slab and reinforcement follow the methodology shown in ACI 330R-92 and *Thickness Design for Concrete Pavements*. The nomograph provided as Figure 6 in *Thickness Design for Concrete Pavements* is used and is included with the calculations as Attachment 4.

Hand calculations were performed using a HP 32S II handheld calculator, and are provided as Attachment 1.

Minimum steel for shrinkage and temperature reinforcement for the 24" deep slabs are checked against the UBC/ACI 318 standard as shown in Attachment 11. Distributed steel reinforcement for the 12" slab is checked against he recommendations of ACI 330R. The relevant section of ACI 330 is provided as Attachment 5.

MathCAD calculations were prepared for the curbs design following the methods of ASCE-7 for wind load and the adhesive manufacturer's approved methodology for determining the capacity of adhesive anchor strength. The manufacturer's method is confirmed by the ICBO/UBC report.

5 RESULTS AND CONCLUSIONS

Concrete slab thickness and reinforcement are adequate to safely support the design loads of an ICV™ Box supported on concrete curbs. The slab design has been included in the 3-D computer model of the ICV™ Box Storage Area. Foundation drawings are attached.

145579-C-CA-013

Attachment 1

Handwritten Calculations

DESIGN MEMORANDUM

Client: GeoMelt | Sheet 1 Of 4
Project: Final DBVS Design | Date: 2004 OCT 18
Data For: Box Storage Area Slab | Work Order: 145579
Prepared By: PM | Checked By: | File No:

amec

Note: This form must be used for project calculations and original filed in project files

Box Support Curbs in Storage Area - PC-1M?
- Glass is cooled
- No chance of spill
- Movable by definition - cannot anchor
- ∴ PC-1M

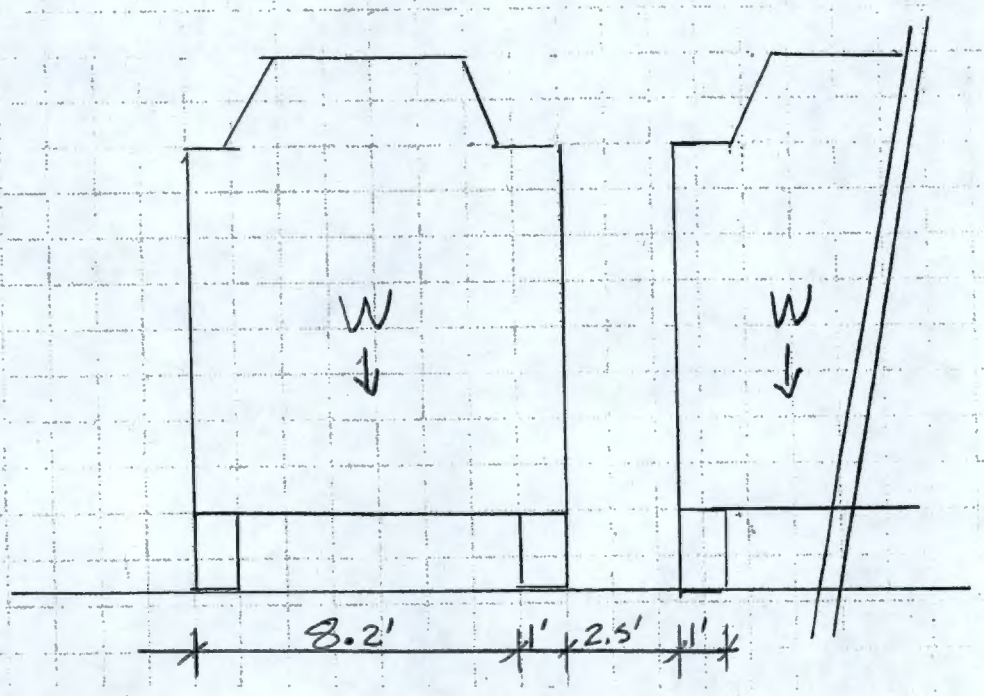
∴ Seismic loading not an issue
By inspection (100 tons) wind not an issue

Gravity is sole load to consider on slab

Box wt = 240,000 pounds max

Amec Air Pallet Data Sheet + DWG F-145579-35-D-0004 Rev D.

Boxes will be supported as below



W = 240000 LB

Attachment: 1 | Calculation: 145579-C-CA-013 | Rev: 2

Originator: [signature] | Checker: Dinna Whitta | Page 1
Date: OCT 18 2004 | Date: Oct 18/04 | of 4

DESIGN MEMORANDUM

Client: GEO MELT | Sheet 2 Of 4
Project: FINAL DBVS DESIGN | Date: 2004 OCT 18
Data For: BOX STORAGE AREA SLAB | Work Order: 145579
Prepared By: PM | Checked By: | File No:

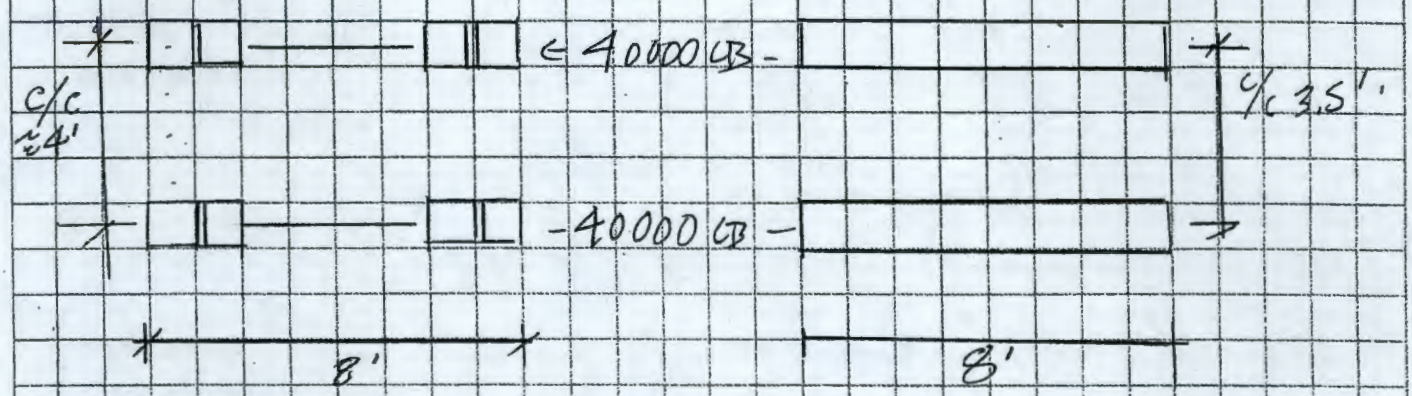
amec

Note: This form must be used for project calculations and original filed in project files

BOX IS SUPPORTED ON 6 CURBS, EACH 8' LONG X 12" WIDE.
LOAD ON EACH CURB = 1/6 240,000 LB
= 40,000 LB EACH

CLOSEST SPACING = 3.5 feet c/c OF CURBS

VERY SIMILAR (ALTHOUGH LESS STRESSFUL OVERALL) TO TANDEM AXLE LOAD FROM TRUCK.
ASSUME SAME LOADS ON EACH



CURB LOADS WILL BE LESS SEVERE ON SLAB THAN CONCENTRATED WHEEL LOADS.

∴ CHECK SLAB AGAINST 80000 LB TANDEM AXLE LOAD.. IF OK FOR WHEEL LOAD, OK FOR BOX CURBS.

Attachment: 1 | Calculation: 145579-C-CA-013 | Rev: 2

Originator: [signature] | Checker: [signature] | Page 2
Date: OCT 18, 2004 | Date: Oct 18/04 | of 4

DESIGN MEMORANDUM

Client: GeoMelt | Sheet 3 of 4
Project: Final DBVS Design | Date: 2004 Oct. 18
Data For: Box Storage Area Slab | Work Order: 145579
Prepared By: PK | Checked By: | File No:

amec

Note: This form must be used for project calculations and original filed in project files

Concrete Modulus of Rupture = $M_R = 2.3 (f_c)^{2/3}$

$= 2.3(4000 psi)^{2/3}$

$= 580$ psi

To ensure no cracking - set factor of safety = 2.0

∴ limit $M_r \leq 290$ psi

Soil Modulus of Subgrade Reaction
$k = 243$ pci for compacted native soil

Amec ETE Geotech Report (attached page)

Adding 12" layer crushing gravel will improve k to ≥ 320 pci but conservatively check w/ k = 240 pci

Using attached nomograph

Portland Cement Association

Tandem Load = 80 kips (2x40000 lb)
k = 240 pci
t = 12" - total concrete thickness

M_r determined to be 260 psi

M_R max = 290 psi ∴ OK - no cracking

Fatigue Loading: 50 boxes - no fatigue

Access Slabs: 24" thick - same "k" obviously OK.

Attachment: 1 | Calculation: 145579-C-CA-013 | Rev: 2

Originator: Paul Moyer | Checker: Diana Whitby | Page 3
Date: Oct 18 2004 | Date: Oct 18/04 | of 4

DESIGN MEMORANDUM

Client: GEO MELT | Sheet 4 Of 4

Project: FINAL DBVS DESIGN | Date: 2004 OCT 18

Data For: ICV BOX STORAGE AREA | Work Order: 145579

Prepared By: PM | Checked By: | File No:

amec

Note: This form must be used for project calculations and original filed in project files

REINFORCING STEEL PER ACI 330R
LIMITS SHRINKAGE CRACKING
AND ALLOWS FOR MAXIMUM (IE NONE)
JOINT SPACING

$$A_{reqd} = \frac{L C_f w h}{24 f_s}$$

ACI 330R
EQUATION 2-2

A = Area of steel per foot of width (in^2)
L = JOINT DISTANCE (ft) = 17.7 ft (no joints)
C_f = DRAG COEFFICIENT = 1.5 (TYPICAL - ACI)
w = CONCRETE DENSITY = 150 pcf (STD CONC.)
h = SLAB THICKNESS (inches) = 12 in
f_s = 2/3 REBAR STEEL YIELD STRENGTH = 2/3 (60000 psi) = 40,000 psi

$$A_{reqd} = \frac{(17.7')(1.5)(150\ lb/ft^3)(12'')}{24\ (40000\ psi)} = 0.497\ in^2 = 0.5\ in^2/ft$$

$A_{provided}$ = 2 x #5 BARS @ 12" c/c
#5 BAR = 0.31 in^2
∴ $A_{provided}$ = 2(0.31) = 0.6 in^2/ft

∴ OK @ STORAGE AREA SLAB

SIMILARLY - NORTH ACCESS SLAB L=47.5' h=24" A_{req} = 0.3 in^2 OK
SOUTH ACCESS SLAB L=51.5' h=24" A_{req} = 0.3 in^2 OK

∴ ALL 3 SLABS OK

Attachment: 1 | Calculation: 145579-C-CA-013 | Rev: 2

Originator: P. Moyer | Checker: Diana Whitley | Page 4
Date: OCT 18 2004 | Date: Oct 18/04 | of 4

145579-C-CA-013

Attachment 2

Page 4 of AMEC DBVS Site Geotechnical Report

from about 7 to 12 feet bgs. The sand became denser in all borings below a depth of about 12 feet with Standard Penetration Test (SPT) blow counts ranging from 10 to 22.

Estimated physical characteristics and index properties of the near-surface soil are provided in Table 1.

Table 1: Soil Properties

Characteristic	To 8 Feet bgs	Below 8 Feet bgs or in Compacted Native Sand
Dry Density (γ_d) (pounds per cubic foot [pcf])	85 to 95	105 to 115
Moisture Content (%)	10	3
Angle of Internal Friction (ϕ)	28	33
Shear Modulus (G) (T/ft^2)	500	500
Modulus of Subgrade Reaction (K_M) (T/ft^3)	87† 100pci 210†† 243pci	210
Poisson's Ratio (μ)	0.25	0.25
Active Lateral Earth Pressure (K_a)	0.36	.29
Passive Lateral Earth Pressure (K_p)	2.8	3.4
At Rest Lateral Earth Pressure (K_o)	0.53	0.46
Friction Coefficient for Footings (f)	0.34	0.34

† Native soil in loose state
†† Native soil compacted to medium dense to dense state.

Attachment: 2
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 1 of 1

3.4 Groundwater Conditions

Groundwater in the site vicinity has been extensively studied[1] and is located at more than 300 feet bgs.

3.5 Soil Corrosion Potential

We collected two soil samples on the site from boring B-1 at depths of approximately 2.5 and 5.0 feet. The samples were tested by ACS Testing of Tigard, Oregon in accordance with AASHTO T289 to determine the soil pH. The sample of brown fine sand obtained at 2.5 feet has a pH equal to 8.8. The sample of gray fine to medium sand obtained at 5.0 feet has a pH equal to 9.3. Based on the results of the pH tests,

145579-C-CA-013

<u>Attachment 3</u>

Page 4 of PCA "Thickness Design for Concrete Pavements" including Table 1 "Effect of Untreated Sub-base on k Values (pci)"

adequate allowances for fatigue due to load repetitions (see next section). Also, the brief periods when k values are low during spring thaws are more than offset by the longer periods when the subgrade is frozen and k values are much higher than assumed for design. To avoid the tedious and complex methods required to design for seasonal variations in k, normal summer or fall weather k values are used as reasonable mean values. This practice reflects the effects of k values on thickness design with reliable accuracy.

It is usually not economical to use subbases for the sole purpose of increasing k values. However, where a subbase is needed for other purposes, there will be an increase in k which should be used in the thickness design. If the subbase is an untreated granular material, the approximate increase in k may be taken from Table 1.*

The values shown in Table 1 are based on the Burmister analysis of two-layer systems.[22] Plate bearing tests made to determine k values on subgrades and subbases for full-scale test slabs show that the k values given in Table 1 are conservative and reliable.[11,12,23]

Cement-treated subbases are now widely used for heavy-duty concrete pavements. They are constructed from A-1, A-2-4, A-2-5, and A-3 granular materials. The cement content for cement-treated subbase is based on standard laboratory freeze-thaw and wet-dry tests and PCA weight-loss criteria. Other procedures that give an equivalent quality of material may be used. Design k values for cement-treated subbases meeting these criteria are given in Table 2.

*For large projects, the change in k may be determined by making a plate bearing test on top of a section of subbase constructed to the specifications for the project being designed.

Table 1. Effect of Untreated Subbase on k Values

Subgrade k value	Subbase k value 4 in.	6 in.	9 in.	12 in.
50	65	75	85	110
100	130	140	160	190
200	220	230	270	320
300	320	330	370	430

Attachment: 3
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 1 of 1

Subgr k val				n.
50				0
100	280	400	520	640
200	470	640	830	—

Fatigue

Like other construction materials, concrete is subject to the effects of fatigue. A fatigue failure occurs when a material ruptures under continued repetitions of loads that cause stress ratios of less than unity. Since the critical stresses in concrete are flexural, fatigue due to flexural stress is used for thickness design, and the stress ratios are the ratios of flexural stress to modulus of rupture. For example, if an axle load causes a flexural stress of 500 psi and the modulus of rupture is 700 psi,

$$\text{stress ratio} = \frac{500}{700} = 0.71.$$

Flexural fatigue research on concrete has shown that, as ratios decrease, the number of stress repetitions to failure increases. This research has also shown that:

1. When the stress ratio is not more than about 0.55, concrete will withstand virtually unlimited stress repetitions without loss in load-carrying capacity. Hence, concrete has a flexural fatigue endurance limit at a stress ratio of approximately 0.55.
2. Repetitions of loads with stress ratios below the endurance limit increase concrete's ability to carry loads with stress ratios above the fatigue limit; i.e., concrete's fatigue resistance is improved.
3. Rest periods also increase the flexural fatigue resistance of concrete.

For thickness design purposes, the stress ratio for the endurance limit of concrete is reduced from 0.55 to a more conservative ratio of 0.50. Allowable load repetitions for stress ratios between 0.50 and 0.85 are shown in Table 3. The values given in Table 3 are also conservative with respect to flexural fatigue research on concrete.

The design problems, which start on page 12, show how the Table 3 fatigue data are used for thickness design.† This usage is based on the Miner hypothesis[38] that fatigue resistance not consumed by repetitions of one load is available for repetitions of other loads. Theoretically, the total fatigue used should not exceed 100 percent. In practice, about 100 percent is suitable for designs based on the 90-day modulus of rupture. For designs based on the 28-day modulus of rupture, fatigue consumption can be increased to about 125 percent. This increase takes account of the strength gain after 28 days.

Load Safety Factors

In the past, load impact factors were used for thickness design. Committee 325 of the American Concrete Institute[24] has suggested a 10 percent impact factor and 20 percent has been proposed and used by other agencies.

Tests that show the response of vehicles to pavements do show impact effects on the test vehicles. However, there is now substantial evidence to show that the axle loads of a moving truck cause smaller stresses than the stresses produced when the truck is stopped. In the Maryland Road Test,[15] stresses were measured at various

†For a more detailed account of fatigue research in relation to thickness design, see *Modern Techniques for Thickness Design of Concrete Pavements*, available from PCA.

145579-C-CA-013

<u>Attachment 4</u>

Page 8 of PCA "Thickness Design for Concrete Pavements" Figure 7. "Design chart for Tandem - axle loads for Case 1" Nomograph

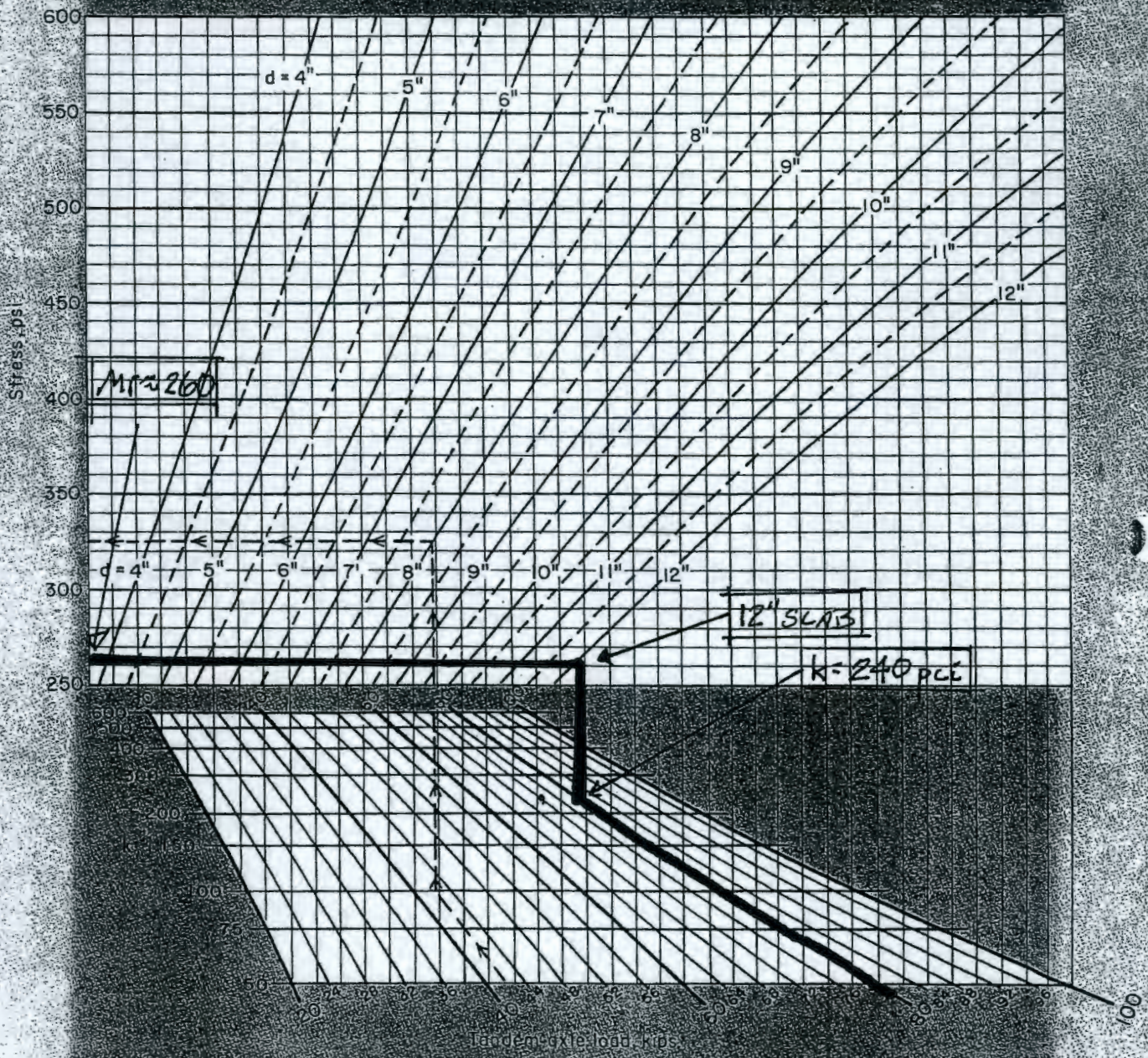


Fig. 7. Design chart for tandem axle loads for Case 1 (based on Ref. 8 Influence Chart 6)

Attachment:	4
Calc. No.:	145579-C-CA-013
Rev. No.:	2
Sheet	1 of 1

145579-C-CA-013

<u>Attachment 5</u>

From ACI 330R-92 "Guide for Design and Construction of Concrete Parking Lots" – Page 9 – Steel in Parking Lots

the pavements are difficult to construct and maintain. Their use should be kept to the absolute minimum necessary to prevent excessive stress in, or distortion of, the pavement. Internal expansion joints should be omitted, that is, the main body of the pavement should not contain expansion joints. When used in this manner, expansion joints can often contribute to premature pavement failures.

When contraction joints are spaced as previously discussed, expansion joints are not required in either the transverse or longitudinal directions. The practice of omitting expansion joints tends to hold the interior of the pavement areas in restraint, thus preventing cracks and joints from opening, and adds to the strength of the contraction joint.

2.8—Steel in parking lot pavements

2.8.1 *Distributed steel reinforcement*—When joint spacings are in excess of those that will effectively control shrinkage cracking or when uncorrectable subgrade conditions may provide nonuniform support, distributed steel reinforcement is used to control the opening of intermediate cracks. The sole function of the distributed steel reinforcement is to hold together the fracture faces if cracks should form. The quantity of steel varies depending on joint spacing, slab thickness, coefficient of subgrade resistance, and the allowable tensile stress of the steel. The area of steel required per foot of slab width is computed by the following drag formula

$$A = \frac{L\,C_f\,w\,h}{24 f_s} \qquad (2\text{-}2)^8$$

where

A = area of distributed steel reinforcement required/foot of slab, in.^{2}
L = distance between joints, ft.
C_f = coefficient of subgrade resistance to slab movement (a value of 1.5 is most commonly used in design)
w = weight of concrete (145 lb/ft^3)
h = slab thickness, in.
f_s = allowable tensile stress in distributed steel reinforcement, psi (a value of ⅔ yield strength is commonly used)

Distributed steel reinforcement is needed in pavements with transverse joints spaced more than 30 times the slab thickness. Since contraction joints must be free to open, distributed steel reinforcement is interrupted at the joints. Because increased spacing between joints will increase joint openings and reduce aggregate interlock load transfer, truck pavements with wide joint spacing may require load transfer dowels. Distributed steel reinforcement should be supported on chairs or precast concrete blocks to hold it in position, usually about 2 in. below the top of the slab.

When the pavement is jointed to form short panel lengths that will control intermediate cracking, distributed steel reinforcement is not necessary. The use of distributed steel reinforcement will not add to the load-carrying capacity of the pavement, nor compensate for poor subgrade preparation or poor construction practices.

2.8.2 *Dowels*—Experience has shown that dowels or other load transfer devices are not needed for most parking lot conditions. They may be economically justified where there are poor subgrade support conditions or heavy truck traffic.

Plain (smooth) dowels across contraction joints in pavements with long joint spacing provide load transfer while permitting the joints to move. Correct alignment and lubrication of the dowels is essential for proper joint function. They should be plastic-coated in areas where deicing salts are commonly used. The dowel size should be in correct proportion to the pavement thickness. Recommended sizes and spacings of dowel bars[9] are shown in Table 2.8.2. In thinner pavements of 7 in. and less, dowels may be impractical. It is usually more economical to keep joint spacing close, utilizing the benefit of aggregate interlock, and thicken the pavement slightly, if necessary, to reduce deflections.

Table 2.8.2—Dowel size*,9

Slab depth, in.	Dowel diameter, in.	Dowel enbedment, in.†	Total dowel length, in.‡
5	⅜	5	12
6	¾	6	14
7	⅞	6	14
8	1	6	14
9	1⅛	7	16

* All dowels spaced at 12-in. centers.
† On each side of joint.
‡ Allowance made for joint openings and for minor errors in positioning dowels.

2.8.3 *Tie bars*—Tie bars as shown in detail in Fig. C-1, Appendix C, should be used to tie only the first longitudinal joint from the pavement edge to keep the outside slab from separating from the pavement. Tie bars are not required in the interior joints of parking lots and other wide paved areas since these are confined by surrounding slabs. Tie bars should be used on center line joints of entrance drives and access roads if there are no curbs. Refer to Table 2.8.3 for tie bar dimensions.

Table 2.8.3—Tie bar dimensions

Slab depth, in.	Tiebar size, in.	Tiebar spacing: Distance to nearest free edge or to nearest joint where movement can occur			
		10 ft, in.	12 ft, in.	14 ft, in.	24 ft, in.
5	½x24	30	30	30	28
5½	½x24	30	30	30	25
6	½x24	30	30	30	23
6½	½x24	30	30	30	21
7	½x24	30	30	30	20
7½	½x24	30	30	30	18
8	½x24				
8½	½x24				
9	½x30				

Attachment: 5
Calc. No.: 145579-C-CA-013
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Sheet 1 of 1

TECHSTREET™

145579-C-CA-013

Attachment 6

Foundation Drawings

H-14-106790 Rev. 0 - Bulk Vitrification
ICV™ Box Storage Area Plan/Details

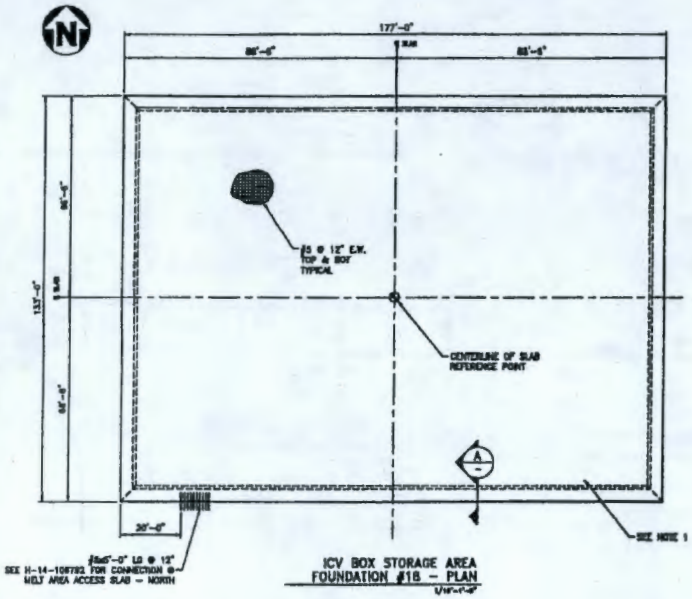
H-14-106792 Rev. 1- Bulk Vitrification Melt Area
Foundation Plans and Sections

H-14-106789 Rev. 1 - Bulk Vitrification
Civil Site Improvements Plan

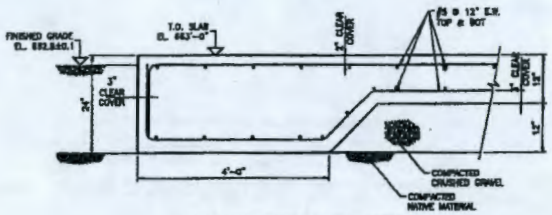
F-145579-00-B-0022 Rev. D - Bulk Vitrification
ICV Box Storage Area Curb Layout & Details

H-14-106812 Rev. 1
Bulk Vitrification Grounding Layout General Arrangement

H-14-106813 Rev. 1
Bulk Vitrification Typical Grounding Details

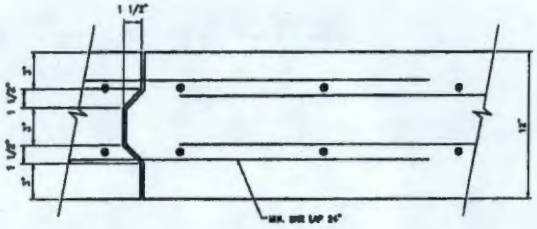


ICV BOX STORAGE AREA FOUNDATION #18 - PLAN

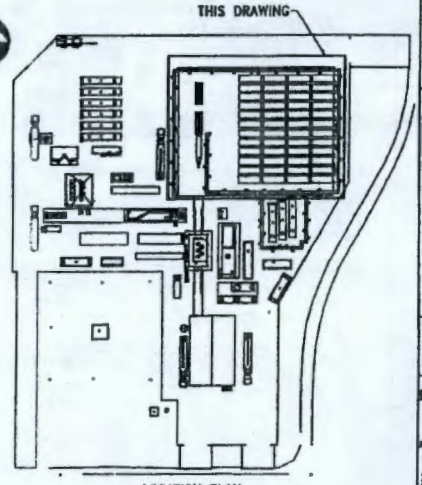


SLAB THICKENING @ PERIMETER

SECTION A



CONSTRUCTION JOINT DETAIL



LOCATION PLAN

Attachment: 6
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 1 of 6

NOTES:

FOR GENERAL NOTES, DESIGN CRITERIA, MATERIAL SPECIFICATIONS, AND FOUNDATION LOCATIONS REFER TO DRAWING H-14-106789 "BULK VITRIFICATION - CIVIL SITE IMPROVEMENTS"

1. ICV BOX STORAGE AREA SLAB SUPPORTS LOADED AIR PALLET TRAFFIC. CONCRETE SURFACE SHALL BE CLASS II "SUPERFLAT" WITH MINIMUM FLATNESS NUMBERS OF F=100 AND F=30 AS DESCRIBED IN ACI 302.1R.

THIS DRAWING PREVIOUSLY ISSUED AS AMEC DRAWING F-143643-00-C-0005.

DWG NO	TITLE	REF NUMBER	TITLE
-	-	-	-

DRAWING TRACEABILITY LIST — REFERENCES — NEXT USED ON H-14-106789

REVISIONS

amec

NAME	DATE
DRAWN	
CHECKED	
ENGINEER	
SUPERVISOR	
PROJECT ENGINEER	
PROJECT MANAGER	

145579-FINAL DBVS DESIGN

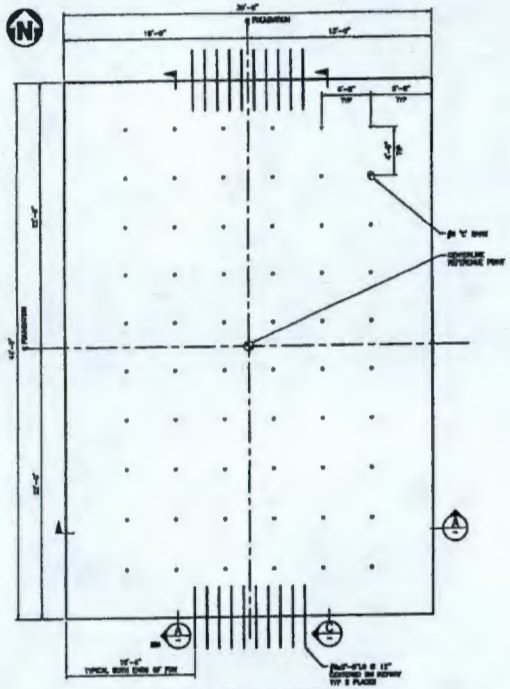
U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX STORAGE AREA
PLAN / DETAILS

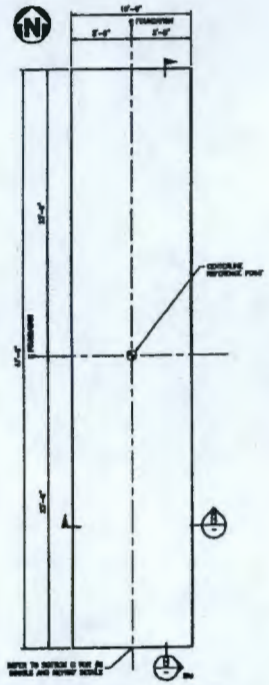
F 2410 0900 H-14-106790 0

SCALE AS SHOWN 821145 SHEET 1 OF 1

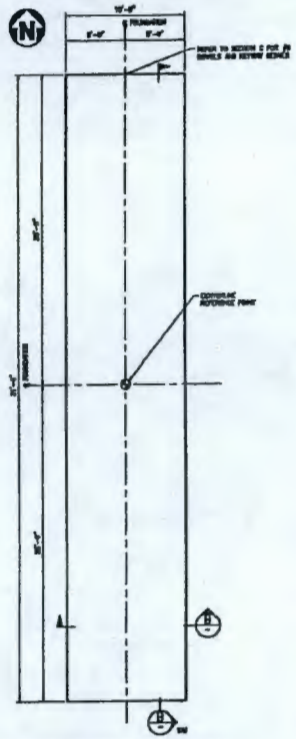
Attachment: 6
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 2 of 6



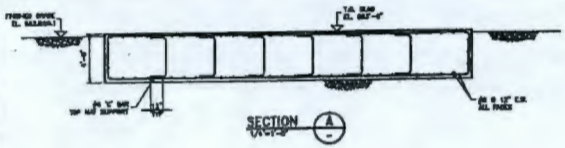
MELT AREA SUPPORT STRUCTURE FOUNDATION #1 – PLAN



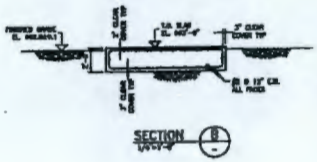
MELT AREA ACCESS SLAB – NORTH FOUNDATION #17 – PLAN



MELT AREA ACCESS SLAB – SOUTH FOUNDATION #16 – PLAN



SECTION A



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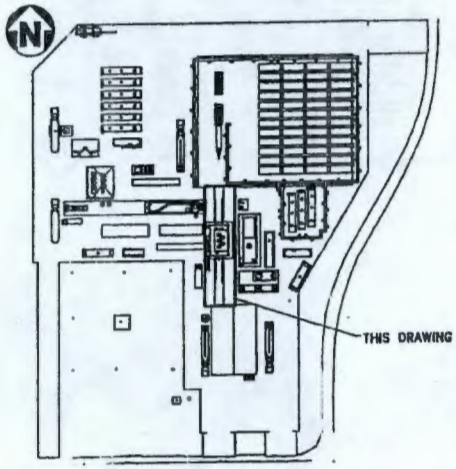
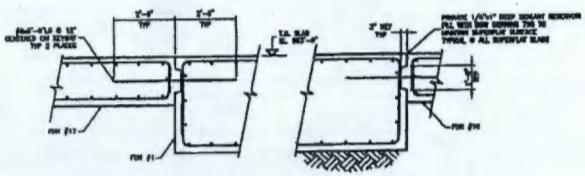


LOCATION PLAN



CONSTRUCTION JOINT DETAIL

SECTION C

NOTES:

FOR GENERAL NOTES, DESIGN CRITERIA, MATERIAL SPECIFICATIONS, AND FOUNDATION LOCATIONS REFER TO DRAWING H-14-106789 "BULK VITRIFICATION – CAL SITE IMPROVEMENTS"

1. MELT AREA AND NORTH ACCESS SLABS SUPPORT LOADED AIR PALLET TRAFFIC. CONCRETE SURFACE SHALL BE CLASS B "SUPERFLAT" WITH MINIMUM FLATNESS NUMBERS OF Fr=100 AND Fv=30 AS DESCRIBED IN ACI 302.1R.

2. SOUTH ACCESS SLAB SHALL HAVE MINIMUM FLATNESS OF Fr=30 AND Fv=15.

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	

REV	DATE	DESCRIPTION	BY	CHK	APP
1		MINOR SCHEDULE/NOTES AT CONSTRUCTION JOINTS. MODIFIED SECTIONS A & C ON PLAN.			

REVISIONS

THIS DRAWING FORMERLY ISSUED AS AMEC DRAWING F-143643-00-C-0007.

amec

NAME	DATE
DRAWN	
CHECKED	
DESIGNED	
APPROVED	
PROJECT ENGINEER	
PROJECT MANAGER	

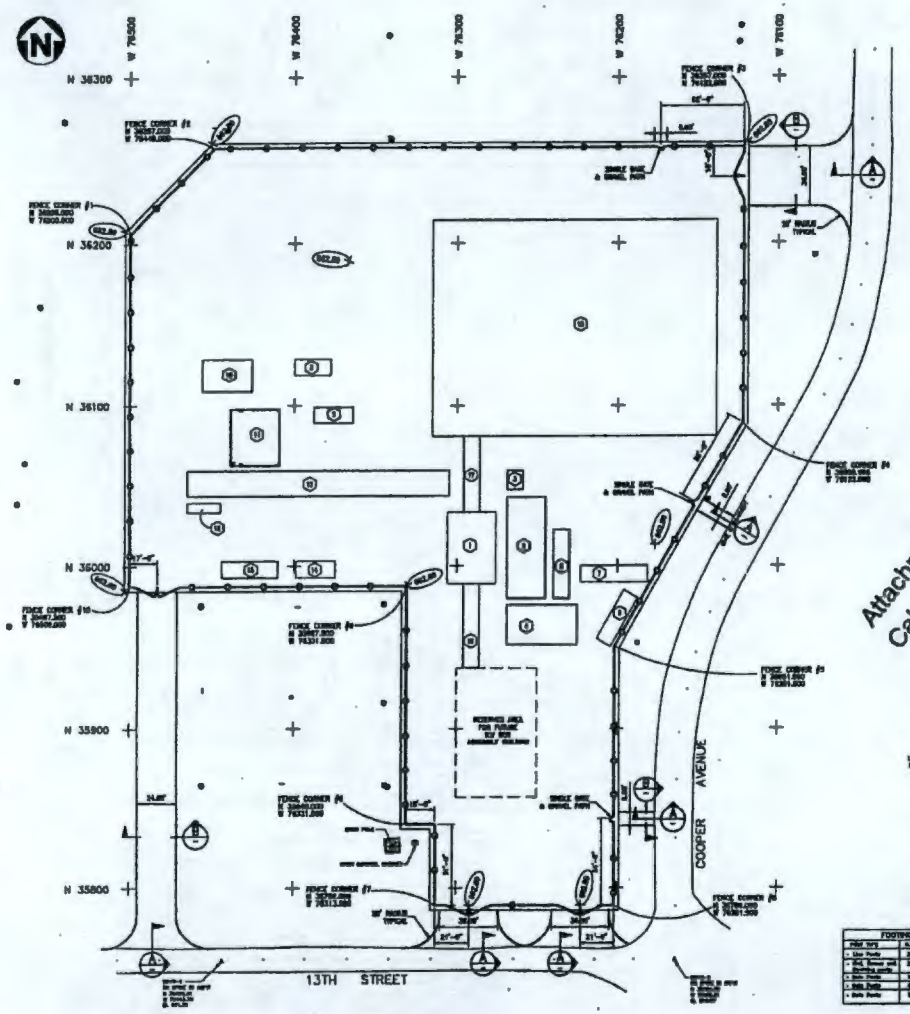
145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
MELT AREA FDN
PLANS & SECTIONS

F | 2410 | 0900 | H-14-106792 | 1

SCALE AS SHOWN | 821145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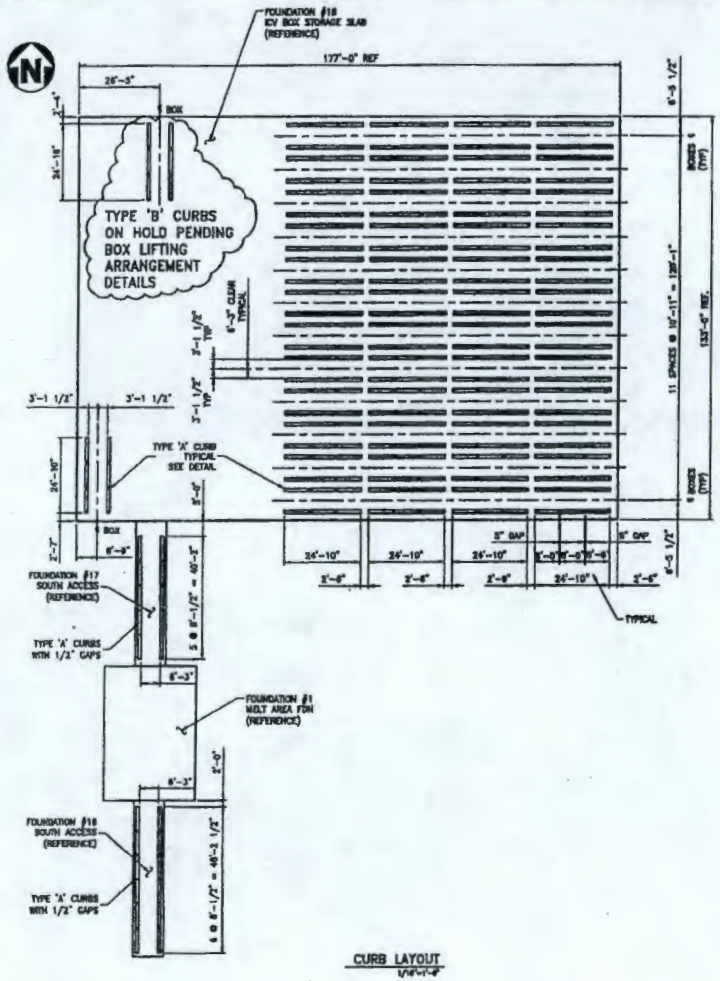
W 76500
W 76400
W 76300
W 76200
W 76100
W 76000
13TH STREET
COOPER AVENUE
FENCE CORNER #1
FENCE CORNER #2
FENCE CORNER #3
FENCE CORNER #4
FENCE CORNER #5
FENCE CORNER #6
FENCE CORNER #7
FENCE CORNER #8
FENCE CORNER #9
FENCE CORNER #10
SINGLE GATE
DOUBLE GATE
RESERVED AREA FOR FUTURE ILV BOX ASSEMBLY BUILDING
30' GATE TYPICAL
24'-0"
21'-4"
21'-4"
24'-0"
24'-0"
24'-0



CURB LAYOUT
1/16"=1'-0"

NOTES:

1. FOR DETAILS OF CONCRETE SLABS SEE DRAWINGS H-14-106790 AND H-14-106792.
2. PRECAST CONCRETE CURBS SHALL CONFORM TO CONSTRUCTION SPECIFICATION DIVISION 03480.
3. PRECAST CONCRETE SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000psi, MAXIMUM W/C RATIO OF 0.5 AND AIR CONTENT OF 5-8%.
4. TYPE 'A' CURBS SHALL HAVE A TOLERANCE OF ±0.125 INCHES FROM DIMENSIONED HEIGHT AND WIDTH OVER FULL LENGTH OF CURBS.
5. ADHESIVE INSTALLATION SHALL FOLLOW MANUFACTURER'S WRITTEN INSTRUCTIONS.
6. CURBS DESIGNED TO SUPPORT ICV BOX WITH TOTAL WEIGHT OF UP TO 240,000 LBS.

Attachment: 6
Calc. No.: 145579-C-CA-013
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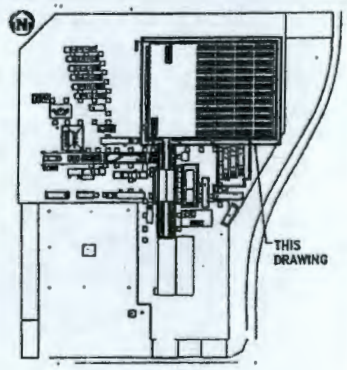
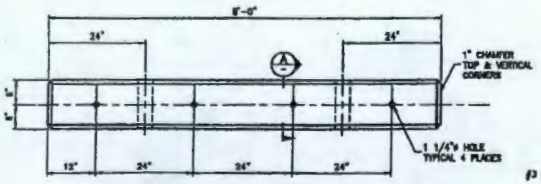
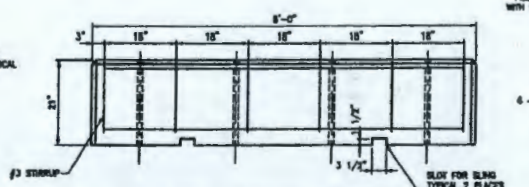


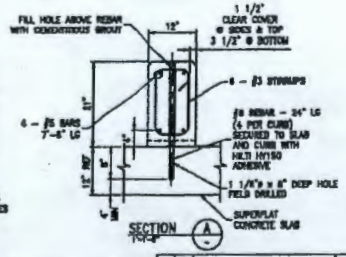
LOCATION PLAN



PLAN – TYPE 'A' CURB
PRE-CAST CONCRETE: 3ksi REQ'D 1"=1'-0"



TYPE 'A' CURB – ELEVATION
1"=1'-0"



SECTION A
1"=1'-0"

Rev.	Revision Description	Date	By	Chk'd	Appr'd	Eng Mgr
D	ISSUED FOR OWNER HOLD REVIEW	22 NOV 04	BPC		PW	TH
C	ISSUED FOR INTERNAL APPROVAL	22 NOV 04	BPC		PW	TH
B	ISSUED FOR INTERNAL REVIEW	04 NOV 04	BPC		PW	TH
A	ISSUED FOR REVIEW	18 OCT 04	BPC		PW	JCB

DOE ENGINEER ID: F-145579-00-B-0022 | REV: D

bechtel

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX STORAGE AREA
CURB LAYOUT & DETAILS

SIZE: F | SCALE: 1/16"=1' | SHEET

DWG NO	TITLE	NOT USED ON
–		

DRAWING TRACEABILITY LIST

NO' NUMBER	TITLE
–	

REFERENCES

REVISIONS

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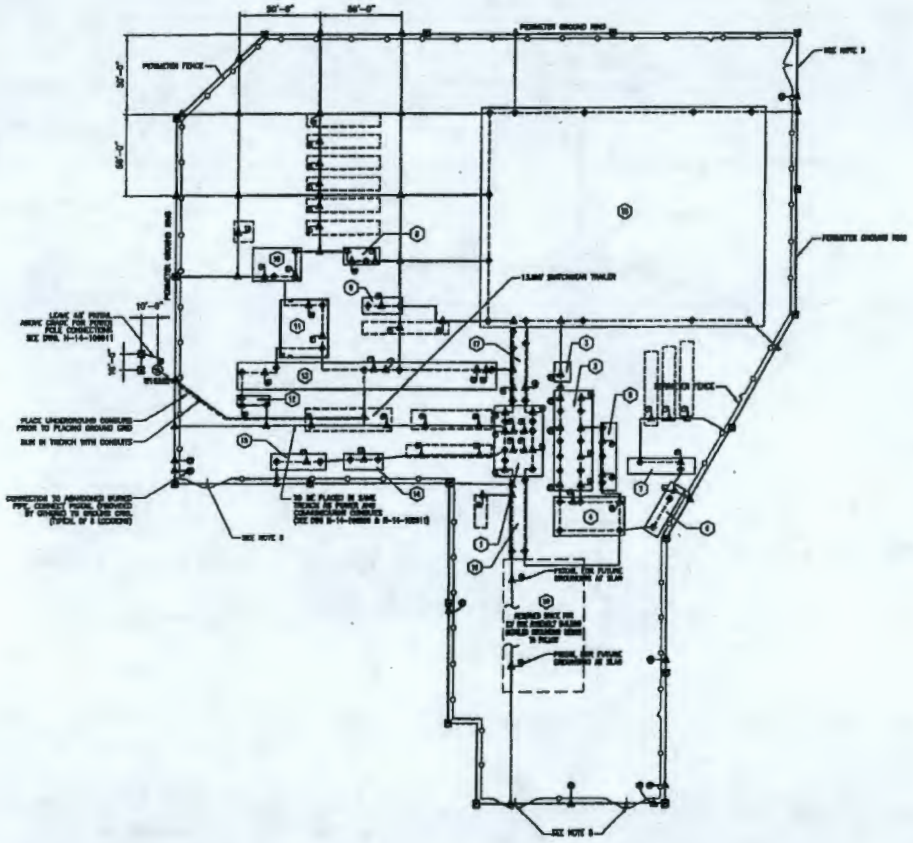
SCALE BAR



NOTES:

1. ALL GROUND CONDUCTORS TO BE #4/0 BARE MEDIUM SOFT DRAWN STRANDED COPPER.

2. ALL GROUND CONDUCTORS TO BE PROTECTED WITH AT LEAST 6" OF RUBBER HOSE OR PVC PIPE WHERE CONDUCTOR GOES INTO OR OUT OF CONCRETE OR SOIL (SEE DETAIL 5 ON DRAWING H-14-106813).

3. THE ENTIRE INSTALLATION, INCLUDING UPER ELECTRODES, SUBJECT TO INSPECTION BY A CHUM HILL APPROVED NED ELECTRICAL INSPECTOR PRIOR TO BACKFILLING OR POURING CONCRETE.

4. AFTER INSTALLATION, THE GROUND GRID MUST BE TESTED FROM ONE OF THE GROUND ROD TEST WELLS USING THE FALL OF POTENTIAL TEST (IEEE STD.81). IF TEST RESULTS ARE ABOVE 3.0 OHMS, SALT SHALL BE PLACED AROUND THE PERIMETER GRID, ESPECIALLY NEAR THE GROUND RODS, AND THEN THE SALT THOUROUGHLY SOAKED INTO THE SOIL. THEN THE GROUNDS MUST BE RETESTED TO CONFIRM IT IS BELOW 3.0 OHMS. A COPY OF ALL GROUNDING TESTS ARE TO BE GIVEN TO THE SITE ENGINEER. IF THERE ARE ANY FURTHER DIFFICULTIES, THE DESIGN OR SITE ENGINEERS SHOULD BE CONSULTED FOR FURTHER ADVICE.

5. PERIMETER GROUND RING TO BE CONTINUOUS UNDER ROADS.

6. TRANSFERRING THE GROUND POTENTIAL RISE MAY CREATE UNSAFE CONDITIONS. THEREFORE AN ELECTRICAL ENGINEER MUST REVIEW THE DESIGNS WHENEVER:
   - THE FENCE IS EXTENDED BEYOND THE SITE BOUNDARIES (ISOLATING SECTIONS SHALL BE INSTALLED)
   - THE FENCE IS CONNECTED TO ANOTHER FENCE OUTSIDE THE SITE BOUNDARIES
   - THERE IS NEW COMMUNICATIONS WIRING THAT CROSSES THE SITE BOUNDARIES, SUCH AS TELEPHONE OR WLAN (HANFORD LOCAL AREA NETWORK) (ISOLATOR SHALL BE USED)
   - ANY NEW CONDUCTIVE PIPE THAT CROSSES THE SITE BOUNDARIES WILL NEED TO HAVE A SUFFICIENTLY LONG LENGTH OF DIELECTRIC PIPE
   - ANY NEW POWER OR SIGNAL WIRING THAT CROSSES THE SITE BOUNDARIES INCLUDING WIRING FOR LIGHTING
   - THE SITE BOUNDARIES ARE BASICALLY THE PERIMETER GROUND RING.

7. PIGTAILS SHALL PROTRUDE FROM CONCRETE FOUNDATIONS APPROXIMATELY 3" FROM THE OUTER EDGE, GENERALLY IN THE POSITIONS SHOWN.

8. PREVIOUSLY AMEC DRAWING F-143043-00-E-0020.

LEGEND

- GROUND PIGTAIL. - LEAVE EXTRA 20' ABOVE FINAL GRADE (LOCATIONS ARE APPROXIMATE. EXACT LOCATIONS TO BE DETERMINED WITH SITE ENGINEER) SEE DETAIL 3 ON DRAWING H-14-106813
- CONNECTION OF #4/0 BARE COPPER GROUND CONDUCTORS TO REBAR SEE DETAIL 2 ON DRAWING H-14-106813
- CONNECTION OF #4/0 BARE COPPER GROUND CONDUCTORS SEE DETAIL 1 ON DRAWING H-14-106813
- 3/4"X20' COPPER CLAD STEEL GROUND ROD SEE DETAIL 8 ON DRAWING H-14-106813
- 3/4"X20' COPPER CLAD STEEL GROUND ROD INSTALLED IN AN ACCESSIBLE GROUND TEST WELL SEE DETAIL 7 ON DRAWING H-14-106813
- EXOTHERMIC CONNECTION, c/w 20'-#4/0 Cu PIGTAIL, TO ABANDONED BURIED PIPING. (GROUND PIGTAIL INSTALLED BY GROUND CONTRACTOR) CONNECT PIGTAIL TO MAIN GROUND GRID. (REFER TO SITE CLEANUP & GROUND FOR DETAILS OF EXISTING U/G PIPING. SEE DWG. H-14-106798).
- #4/0 BARE COPPER GROUND CONDUCTOR TO BE BURIED MINIMUM 30" BELOW FINAL GRADE
- #4/0 BARE COPPER GROUND CONDUCTOR ENCASED IN CONCRETE (UFER) TO BE WOVEN THROUGH THE BOTTOM REBAR OR TIE-WRAPPED. SEE DETAIL 4 ON DRAWING H-14-106813
- PERIMETER FENCING (NOT PART OF ELECTRICAL CONTRACT DOES NOT NEED TO BE INTERCONNECTED TO THE GROUND GRID)
- EQUIPMENT FOUNDATION NUMBER DESIGNATION SEE DRAWING H-14-106798 FOR DESCRIPTIONS.

	MAXIMUM CALCULATED	MAXIMUM PERMISSIBLE
TOUCH POTENTIAL *	818V	833V
STEP POTENTIAL *	104V	3016V

* FOR MORE DETAILS OF THE VOLTAGE CRITERIA REFER TO THE CALCULATIONS BY 145579-E-CA-003

Attachment: 6
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DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES NOT USED ON DWG ITEM	

REVISIONS

amec

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U.S. DEPARTMENT OF ENERGY
Office of River Protection

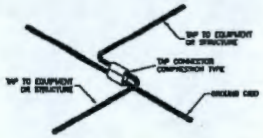
BULK VITRIFICATION GROUNDING LAYOUT GENERAL ARRANGEMENT

F 2410 7301 H-14-106812 1

SCALE 1:30 621145

GRID CROSS CONNECTION

SINGLE TAP CONNECTION

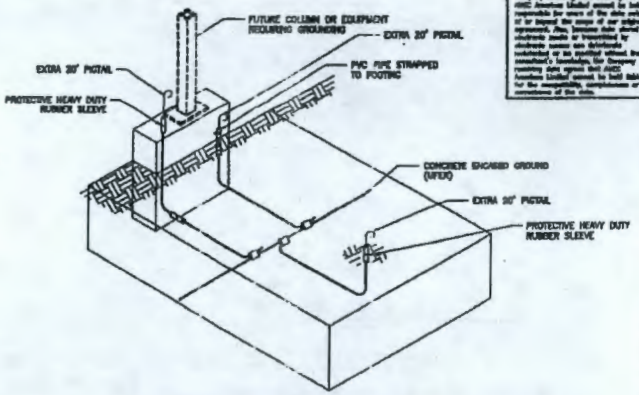


GRID TEE/DOUBLE TAP CONNECTION

DETAIL 1 N.T.S.

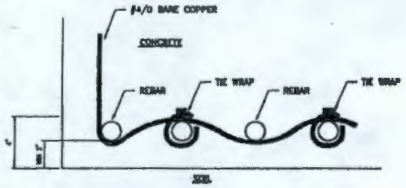
(ALL 3 METHODS ARE ACCEPTABLE)

DETAIL 2 N.T.S.



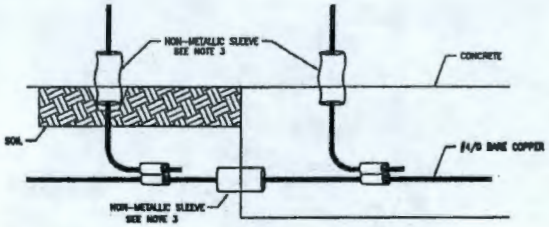
SEE NOTE 7

DETAIL 3 N.T.S.



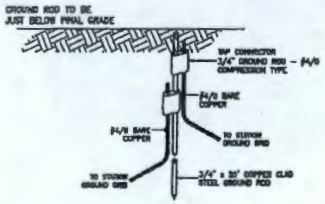
CONCRETE ENCASED ELECTRODE (UFER)
SEE NOTE 2

DETAIL 4 N.T.S.



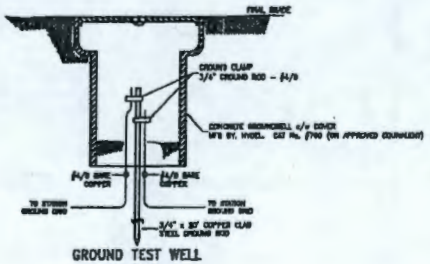
DETAIL 5 N.T.S.

Attachment: 6
Calc. No.: 145579-C-CA- 013
Rev. No.: 2
Sheet 6 of 6



GROUND ROD
(TYPICAL)

DETAIL 6 N.T.S.



GROUND TEST WELL
(TYPICAL)

DETAIL 7 N.T.S.

NOTES

1. REINFORCING STEEL AND GROUND CONDUCTOR MUST BE CLEANED TO BARE METAL AT CONTACT POINT AND BE COATED WITH PENETROX (OR SIMILAR ANTIFOULING) BEFORE CONNECTION IS MADE.

2. BARE STRANDED COPPER #4/0 CONDUCTORS TO BE WOVEN THROUGH THE REBAR AND TIE WRAPPED TO THE REBAR AT A MINIMUM EVERY 3 FEET. UFER TO BE INSTALLED WITH A MINIMUM LENGTH OF 20 FEET. UFER TO BE EMBEDDED TO REBAR AS SHOWN ON THE GROUNDING LAYOUT DRAWING AT A MINIMUM TO BE EMBEDDED NOT LESS THAN EVERY 3 OF THE DRAWING. UFER TO BE INSTALLED NEAR THE BOTTOM OF THE CONCRETE FOOTING OR SLAB. UFER TO BE A MINIMUM OF 2" FROM THE BOTTOM OF THE CONCRETE AND, WHERE POSSIBLE, TO BE NOT WITHIN 6" FROM THE BOTTOM OF THE SLAB.

3. NON-METALLIC SLEEVE TO BE SCHED. PVC OR HEAVY DUTY RUBBER WHICH FLEXIBLY IS REQUIRED. USE 4" LENGTH TYPICAL FOR ALL TRANSITIONS TO AND FROM CONCRETE AND SOIL.

4. ALL GROUND CONNECTIONS TO BE MADE WITH COPPER SOFT DRAWN STRANDED CONDUCTOR, MIN. NO. #4/0 UNLESS OTHERWISE NOTED. GROUNDING CONNECTIONS TO BE EXOTHERMIC, WITH AS FEW SPLICES AS POSSIBLE.

5. GROUNDING CONNECTIONS TO BE MADE ON TOP UNLESS OTHERWISE APPROVED.

6. ALL GROUNDING CONNECTIONS TO BE INSTALLED USING THE MANUFACTURER'S MINIMUM PROCEDURES AND REPORTED BEFORE PERFORM CONCRETE OR BACKFILLING.

7. EITHER OF THE 3 TYPES OF UNIONS IS ACCEPTABLE. EXACT LOCATIONS TO BE DETERMINED WHEN THE UNIONS. PIGTAIL TO EXTEND A MINIMUM OF 20' EXTRA LENGTH ABOVE FINAL GRADE FOR FUTURE CONNECTION (BY OTHERS) TO STRUCTURAL STEEL OR EQUIPMENT.

8. WHERE PIGTAILS PROTRUDE FROM CONCRETE FOUNDATIONS, THE PIGTAILS SHALL BE APPROXIMATELY 6" FROM THE OUTER EDGE AND VERTICALLY IN THE PREFERRED ORIENTATION OF THE U.A.

9. FOR SITE GROUNDING SEE DRAWING H-14-106813.

10. PREVIOUSLY ISSUED DRAWING H-14-[illegible]-00-S-0001.

DWG NO	TITLE	REF NUMBER	TITLE

DRAWING TRACEABILITY LIST — REFERENCES — NEXT USED ON DWG ITEM

REVISIONS

amec

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
TYPICAL GROUNDING
DETAILS

F 2410 7301 H-14-106813 1

SCALE N.T.S. 621145

145579-C-CA-013

Attachment 7

E-mail Dec 17, 2004 from Brad Hupy, P.E. (author of DBVS Geotechnical Report) to P. Meyer

Paul Meyer (Trail)

From: Brad Hupy
Sent: Friday, December 17, 2004 2:47 PM
To: Paul Meyer (Trail)
Subject: RE: Questions about the soils and report at Hanford

In order to have frost heave three things are needed; water, low temperature, and soil fine for enough for capillary potential to raise the water to the freezing front. Because Hanford is a near desert climate, there is little water near the ground surface. Within a The tabulated capillary rise for fine sand is in the range of 1 to 11 feet and for medium sand in the range of 0.3 to 1.5 feet. Hanford certainly is cold enough in the winter to freeze water.

The little water in the near surface soil does freeze but the associated heave is negligible. The sand will not support capillary rise of several hundred feet that would be required to produce (feed) a growing freezing front and cause damaging heave. In our opinion, there is little risk of frost heave in the soil at the project site.

-----Original Message-----
From: Paul Meyer (Trail)
Sent: Friday, December 17, 2004 1:47 PM
To: Brad Hupy
Subject: RE: Questions about the soils and report at Hanford

Question: is it possible to state that a soil identified as "SP" (i.e. sand with few fines) will not be subject to frost heaving? Especially if it is very deep (e.g. our site at Hanford)

-Paul

Attachment: 7
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 1 of 2

-----Original Message-----
From: Brad Hupy
Sent: Tuesday, December 07, 2004 9:09 AM
To: Paul Meyer (Trail)
Cc: Tony Heim
Subject: RE: Questions about the soils and report at Hanford

Paul,

This is really pretty simple. The frost depth cited in our report is from statewide tabulation. If Hanford has determined and published site specific frost depth measurements then they may be used in lieu of the tabulated data. Site specific data is commonly used in this is way. A very good example is seismic ground motions.

-----Original Message-----
From: Paul Meyer (Trail)
Sent: Monday, December 06, 2004 4:33 PM
To: Brad Hupy
Cc: Tony Heim
Subject: Questions about the soils and report at Hanford

We are still awaiting approval from the "Independent Qualified Registered Professional Engineer" (IQRPE) who is checking our foundation designs to ensure they will satisfy all design criteria.

He has raised the following points/questions:

Your report indicates a frost depth of 45 inches for granular soil and recommends a foundation depth of 48 inches for critical structures. This is at odds with Hanford's' own measurements (See pages 26 through 28 of the attached Hanford document) which indicate that a temperature of 32 F has never been achieved at depths of only 36 inches. This is causing some problems for us, as the IQRPE wants us to conform to the requirements of the Geotech report in addition to Hanford's own design criteria

For your information, we have three types of foundations on the site. Foundation depths below grade are 45.6, 36.6 and 21.6 inches. Actual concrete thicknesses are 48, 39 and 24 inches, with the top of concrete set at 663.00 feet, while surrounding grade is at 662.8 feet. We removed the native soil to elevation 661.000 and

brought the local grade up to 662.8 with compacted crushed rock.

The four 48" foundations consist of two chimneys, and two large steel structures. These are all "critical structures" to use the phrase from your report. Foundations are uniformly 48" thick, and are 10'x12' and 20'x30' feet for the two chimneys, and 30x44 and 24x62 for the two steel structures. Foundations are not enclosed.

The single 39" foundation is a pre-engineered building, measuring 50 feet wide by 84 feet long by foundation consist of a single 12" thick slab with a thickened (to 39") edge. The building will be heated, and have an overhead crane.

The many (~100) 24" deep foundations support single pieces of freestanding equipment or "utility poles" that are connected by pipes, cable trays and ducts. Foundations are uniformly 24" thick and vary in size from 44x24 to 6x6 feet. Most are the 6x6 ones. Minor seasonal movement of the foundations would not be a problem. Actual gravity loads are quite light, typical values are substantially under 250 psf, yes, that's 250, not 2500. Foundations are not enclosed.

All the foundations will bear on compacted native soil, which was prepared as recommended in your report. As noted, the native soil is basically a gravelly sand, with few fines. I don't believe it is frost-susceptible.

Could you please reply to the following questions, raised by our reviewers?

1) Is the frost depth of 45 inches correct? Seems deep compared to other references.

2) Is the frost depth of 45 inches still valid, given we have removed some native soil, and the surface is now covered with 1.8 feet (21.6") of compacted crushed rock? Does the crushed rock make a difference?

3) Are the depths of foundations shown above for the various types of foundations suitable for the uses described?

4) IS frost heave an issue for the foundations as described?

Thanks for your help on this. I'll be traveling to Hanford on Tuesday Dec 07, for a meeting Wednesday, Dec 08. I will have e-mail access while there. I will be traveling back to Trail Thursday, Dec 09 and back in the office Friday, Dec 10. Best way to contact me is via e-mail until Friday, phone after that.

Paul Meyer, P.Eng.
Senior Structural Engineer
AMEC Americas Limited
Energy and Mining Division
1385 Cedar Avenue
Trail BC Canada V1R 4C3
1-250-368-2407, fax 2455
paul.meyer@amec.com

Attachment: 7
Calc. No.: 145579-C-CA-013
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<< File: HNF-SD-GN-ER-501 (Rev. 1).pdf >>

145579-C-CA-013

Attachment 8

Storage Curbs
(MathCAD Calculations)

GENERAL DIMENSION

PC = Performance Class		$PC := 1\ M$	
H = Height of box	$H := 117.25in$	$H = 9.8ft$	
B = Width of box		$B := 8.2ft$	
L = Length of box		$L := 24.7ft$	
hcg = Height to center of gravity of box	$hcg := 0.5 \cdot H$	$hcg = 4.9ft$	
Wb = Weight of box		$Wb := 240000lb$	E - mail October 14th
h = Height of concrete curb		$h := 21in$	
b = Width of concrete curb		$b := 12in$	
l = Length of concrete curb		$l := 8ft$	
wc = unit weight of concrete		$wc := 150 \frac{lb}{ft^3}$	ASCE 7 Table C3-2 pg 250
Wc = Weight of concrete curb	$Wc := wc \cdot h \cdot b \cdot l$	$Wc = 2100lb$	

LOADS

Vertical Loads

Self weight

There are two concrete curbs holding each box therefore:

VL = Vertical load per curb $\quad VL := \frac{Wb}{2} \quad VL = 120000\,lb$

Snow/Rain

The snow and rain on each box is negligible compared to the self weight of the box.

Concrete Bearing Capacity

MaxBC = Maximum bearing capacity of concrete $\quad MaxBC := 4000\frac{lb}{in^2}$

When the box is sitting on the curbs there is a minimum of 9" of the 12" walls that will always be loaded by the box, therefore:

BC = Bearing on each curb $\quad BC := \frac{VL}{(b - 3in)\cdot L} \quad BC = 45\frac{lb}{in^2}$

$$if(BC \le MaxBC, \text{"Design is Good"}, \text{"Design is Bad"}) = \text{"Design is Good"}$$

FOS = Factor of Safety $\quad FOS := \frac{MaxBC}{BC} \quad FOS = 88.9$

Lateral Load

Wind

Following DOE-STD-1020-2002 and ASCE 7 standards
Method 2 6.5.13

Exposure C		TFC-ENG-STD-06 REV B-1 Table 3 page 24
Kz = Velocity Pressure Exposure Coefficient	$Kz := 0.85$	ASCE 7 page 75 Table 6-3
Kzt = Topographic Factor	$Kzt := 1$	ASCE 7 page 47 Figure 6-4 flat ground
Kd = Wind Directionality Factor	$Kd := 0.85$	ASCE 7 page 76 Table 6-4 Building type wall

V = "Three-second gust" wind velocity $V := 85\frac{mi}{hr}$ TFC-ENG-STD-06 REV B-1 Table 3 Page 24

Ia = Importance Factor $Ia(PC) := \begin{cases} 1.15 & \text{if } PC = 2 \\ 1.0 & \text{if } PC = 1 \\ \text{"prob"} & \text{otherwise} \end{cases}$ $Ia(PC) = 1$ TFC-ENG-STD-06 REV B-1 Table 3 Page 24

qz = Velocity Pressure $qz := 0.00256\left(\frac{hr}{mi \cdot ft}\right)^2 \cdot lb \cdot Kz \cdot Kzt \cdot Kd \cdot V^2 \cdot Ia(PC)$ ASCE 7 page 31 6.5.10 (6-15)

$qz = 13.4\frac{lb}{ft^2}$

G = Gust factor $G := 0.85$ ASCE 7 page 30 6.5.8.1

Cf = Force Coefficient $Cf := 1.3$ ASCE 7 page 69 Figure 6-19

Af = Area normal to the wind $Af := (H + h) \cdot L$ $Af = 284.6ft^2$

Pw = Wind pressure $Pw := qz \cdot G \cdot Cf$ $Pw = 14.8\frac{lb}{ft^2}$

Fw = Wind force $Fw := qz \cdot G \cdot Cf \cdot Af$ $Fw = 4202\,lb$

Fwf = Factored wind force $Fwf := 1.3 \cdot Fw$ $Fwf = 5462.6\,lb$

Under each 25 foot long box there will be three 8 feet curbs on each side.

$$\frac{Fwf}{6} = 910.4\,lb$$

Therefore divide the total factored wind force by 6 curbs for a per curb force of 910 lb.

Impact

Method 1 - information from AeroGo (the air pallet company)

Mxspd = Maximum speed of air pallet $Mxspd := 40\frac{ft}{min}$ $Mxspd = 0.455\frac{mi}{hr}$

Mxld = Maximum lateral load of the drive system of the air pallet $Mxld := 4000lb$ E-mail from Tom Wilson, File No: 145579 / 35.4.9.2

Aspd = Assumed speed of ICV Box $\quad Aspd := 4.55 \frac{mi}{hr}$

E = Energy of ICV Box at 0.455 mi/hr $\quad E := Wb \cdot Mxspd^2 \quad E = 106666.7 \frac{lb\,ft^2}{sec^2}$

Mbox2 = Mass of ICV Box at 4.55 mi/hr with equivalent energy $\quad Mbox2 := \frac{E}{Aspd^2} \quad Mbox2 = 2395.2\,lb$

The 240,000 lb ICV Box moving at 0.455 mi/hr produces the same energy as a 2400 lb vehicle moving at 4.55 mi/hr

Method 2 - ASCE-07

Assuming that the curbs act similar to a vehicle barrier system

Ps = Lateral Load on curb from vehicle in parking area $\quad Ps := 6000lb$ ASCE 7-02 pg 10 Section 4.4.2.c.

Which is about 3000 lb at 5 mi/hr

Check energy to see if impact force is equivalent to the drive force

E2 = Energy of vehicle at 5 mi/hr $\quad E2 := 3000 \cdot lb \cdot \left(5 \cdot \frac{mi}{hr}\right)^2 \quad E2 = 161333.3 \frac{lb\,ft^2}{sec^2}$

FOE = Factor of Energy $\quad FOE := \frac{E2}{E} \quad FOE = 1.5$

3000 lb at 5 mi/hr is 1.5 times the energy of 2400 lb at 4.54 mi/hr

Therefore it appears reasonable to use 4000 lb as the unfactored impact load on the curb from the ICV Box at 40 ft/min (0.455 mi/hr) with an impact factor of 1.5 - design values are the same

Seismic Load

With a Performance Class of 1M (temporary) seismic does not need to be evaluated. TFC-ENG-STD-06 REV B-1 Section 3.6.5.1 Page 7

OVERTURNING FORCE

Fo = Overturning force $\quad Fo := Ps \cdot h + \frac{Fwf}{6} \cdot \frac{h}{2} \quad Fo = 135559.6\,lb \cdot in$

Fr = Self resistance force $\quad Fr := Wc \cdot \frac{b}{2} \quad Fr = 12600\,lb \cdot in$

Ts = Required capacity from bars $Ts := \frac{Fo - Fr}{\frac{b}{2}}$ $Ts = 20493.3\ lb$

n = Number of bars $n := 4$

C = Capacity each bar needs to carry $C := \frac{Ts}{n}$ $C = 5123.3\ lb$

Using #8 bars

Emd = Embedment depth $Emd := 8in$ ICBO ER-5193 page 8 Table 10

Concrete thickness must be equal to or greater than 1.5 times the anchor embedment depth

Ccr = Critical Edge Distance $Ccr := 12in$ ICBO ER-5193 page 8 & 9 Table 10 & 11

Aed = Actual edge distance $Aed := 6in$

if(Ccr ≤ Aed, "Don't use Reduction Factor ", "Use Reduction Factor") = "Use Reduction Factor"

Scr = Critical Spacing $Scr := 16in$ ICBO ER-5193 page 8 & 9 Table 10 & 11

Smin = Minimum spacing $Smin := 0.25 \cdot Scr$ $Smin = 4\ in$

Asp = Actual spacing $Asp := 24in$

if(Scr ≤ Asp, "Don't Use Reduction Factor ", "Use Reduction Factor") = "Don't Use Reduction Factor "

This will be a short term loading and therefore a factor of 1.33 can be used. ICBO ER-5193 page 2 Section 2.3.2

Stl = Short term loading factor $Stl := 1.33$

Because one of the critical distances has been compromised, a reduction factor is to be used for both shear and tension.

Pal = Allowable shear load $Pal := 8375lb$ ICBO ER-5193 page 9 Table 11

At 1/3 of the critical edge distance (4") the reduction factor for shear is 0.2
At 6/6 of the critical edge distance (12") the reduction factor for shear is 1.0 ICBO ER-5193 page 4 Table 4

Using linear interpolation:

At 3/6 of the critical edge distance (6") the reduction factor for shear is 0.4 therefore

Rfs = Shear reduction factor $Rfs := 0.4$

Pr = Factored allowable shear load per bar $Pr := Pal \cdot Rfs \cdot Stl$ $Pr = 4455.5\ lb$

Ta = Allowable tension load $Ta := 11330lb$ ICBO ER-5193 page 8 Table 10

At 1/3 of the critical edge distance (4") the reduction factor for tension is 0.6
At 6/6 of the critical edge distance (12") the reduction factor for tension is 1.0
ICBO ER-5193 page 4 Table 4

Using linear interpolation:

At 3/6 of the critical edge distance (6") the reduction factor for tension is 0.7 therefore

Rft = Tension reduction factor $Rft := 0.7$

Tr = Factored allowable tension load per bar $Tr := Ta \cdot Rft \cdot Stl$ $Tr = 10548.2\ lb$

$$\frac{Ps}{n\,Pr} + \frac{Ts}{n\,Tr} = 0.82$$

ICBO ER-5193 page 1 Section 2.3.1

$$\text{if}\left(\frac{Ps}{n \cdot Pr} + \frac{Ts}{n \cdot Tr} \le 1.0, \text{"OK"}, \text{"Need more reinforcing"}\right) = \text{"OK"}$$

*AMEC E&E Geomelt Division
Bulk Vitrification Process, Partial DBVS
Report of Geotechnical Engineering Services

145579-C-CA-013

Attachment 9

Foundation Information Chart Showing Performance Category

GeoMelt Structures Systems and Components Foundations for site development				Notes from Mar 11 Meeting category	comment
	Length (ft.)	Width (ft.)	Depth (ft.)		
Items with elevated tanks or stacks. 48" deep foundation req'd					
Melt Area Support structure	44	26	4	PC-2	
(slab directly under melt is 24" thick)					
Waste Dryer structure			4	PC-2	
Off-gas Stack (75' x 2')	16	16	4	PC-2	
Baghouse Stack (40'x1')	8	8	4	PC-2 if a separate stack.	Baghouse could be on top of soil tank and therefore high enough itself. Mech to determine.
Items that are considered "permanent" and require 24" deep foundations					
Tri-Mer scrubber	36	30	2	GS (PC-1)	
Selective Catalytic Reduction Unit				PC-2	
SCR Scrubber				with SCR	
Any Pre-engineered buildings				GS (PC-1)	
Items that are considered temporary, but will be anchored to prevent movement					
60x12 Off-Gas Trailer	64	15	2	GS (PC-2)	Block wheels and provide levellers. Tie downs against wind if req'd.
32x12 elect trailers (2) (13.8 kV and Power Modul	34	14	1	GS (PC-1)	Block wheels and provide levellers. Tie downs against wind if req'd.
32x8 elect trailers (2) (both 480V)	34	10	1	GS (PC-1)	Block wheels and provide levellers. Tie downs against wind if req'd.
40x8 control trailer	42	10	1	GS (PC-1)	Block wheels and provide levellers. Tie downs against wind if req'd.
22x9 Generator set	24	11	2	GS (PC-1)	
10,000 usg Diesel fuel storage tanks (2)	34	10	2	GS (PC-1)	Containment and anchor for wind if req'd
Baghouse near 40'stack	8	8	2	GS (PC-1)	
Air Compressor package	*10*	8	2	GS (PC-1)	May not need anchoring
30x8 Liquid Waste Pump skid	32	10	1	PC-2	Anchored
30x8 Effluent pump skid	32	10	1	GS (PC-1)	Anchored
Waste dryer steam supply skid	22	10	2	GS (PC-1)	
Dryer Chilled Water System	22	10	2	GS (PC-1)	
OGTS Chiller	11	6	2	GS (PC-1)	
Ammonia evaporator skid				GS (PC-1)	
Sintered Metal filters				PC-2	
Items that are considered temporary and which may not require anchorage					
ICV hood support stand				GS (PC-1)	
All non-producton portable buildings	(office/washroom/change/lunch)			GS (PC-1)	Check wind for anchor requirements
All "Baker" tanks except fuel storage				GS (PC-1)	Check wind for anchor requirements
Waste Receipt Tanks (baker)				(PC-2)	Check wind for anchor requirements
Storage and other similar ISO containers				GS (PC-1)	
Other site development concrete or paving					
ICV Box Storage area concrete pad	to be determined		1		
Concrete paved area at box receipt	to be determined		1		
DBVS North access road		24	0.5		
DBVS West side road - (is there room for this???)		?	0.5		
Fencing to surround site - gates at truck entry			post depth varies		
Foundation Chart March 11, 2004.xls	Prepared by	paul.meyer	11/25/2004		

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Calc. No.: 145579-C-CA-013
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<u>Attachment 10</u>

Record of Discussion:
Tom Wilson and Air Pallet Manufacturer

amec

RECORD OF DISCUSSION

Date/Time:	4 October 2004 / 4.15 pm.	Project/File No:	145579 / 35.4.9.2
Between:	Tom Wilson	of:	AMEC (Trail Office)
and	John Massenburg	of:	AeroGo
Subject:	**Area 35 / ICV Box : Air Pallet Data.**		

Distribution: Frank Sweet, Glyn Jones, Paul Meyer, Billy Merry, Michael Paul, Victor Lourenco.

1. Changing the ICV Box weight from 95 tonnes to 100 tonnes will not change the size of the Air Pallet presently proposed.

2. The maximum total lateral force imposed by the air pallet is 4,000 lb (generated by 2 drive units).

Tom Wilson

Attachment: 10
Calc. No.: 145579-C-CA-013
Rev. No.: 2
Sheet 1 of 1

AMEC Americas Limited
1385 Cedar Avenue
Trail, BC V1R 4C3
Tel (250) 368-2400
Fax (250) 368-2401
www.amec.com

145579-C-CA-013

Attachment 11

Rebar Design for Foundation Pads or Slabs

Re-bar Design For Fdn Pads or Slabs Ref: ACI 318		24" FDN
Bars: Top or Bot only =1, Top & Bot =2		2
fy	psi	60000
f'c	psi	4000
ϕ		0.9
Mu	k-ft	21
b	in	12
h	in	24
d	in	20.5
A = 0.59 * fy/f'c		8.85
B = -1		-1
C = Mu /(ϕ bd^2fy)		0.0009
ϕ Ru = Mu /bd^2		50.0
ρ (1)		0.1121
ρ (2)		0.00093
ρ (temp)		0.00180
ρ min		0.0033
Selected ρ for design		0.00093
Check ρ < ρ max		OK
As req'd per ft (temp)	in2	0.26
As req'd (design)	in2	0.23
As req'd (1.33 *design)	in2	0.31
As req'd(min)	in2	0.82
Select design, 1.33design or min		0.31
As required	in2	0.31
Bar #		5
As per Bar		0.307
Bar Spacing		12
Total As per ft		0.31
		OK

Attachment: 11
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Rev. No.: 2
Sheet 1 of 1

Figure 4. Subcontractor Calculation Review Checklist.

Page 1 of 1

Subject: ICV™ Box Assembly Building Foundation

The subject document has been reviewed by the undersigned.
The checker reviewed and verified the following items as applicable.

Documents Reviewed: Calc. No. 145579-C-CA-014 Rev Ø

Analysis Performed By: AMEC

- Design Input
- Basic Assumptions
- Approach/Design Methodology
- Consistency with item or document supported by the calculation
- Conclusion/Results Interpretation
- Impact on existing requirements
- _____

Checker (printed name, signature, and date) Craig Shaw / Craig Shaw 4/19/05

Organizational Manager (printed name, signature and date) David H. Shuford / David H Shuford 4/19/05

Final acceptance into the CH2M system will require the AMEC addition of Fig 3 checklist as required per TFC-ENG-DESIGN-C-10, Rev A-7

CALCULATION COVER SHEET

amec

CALC. NO.: 145579-C-CA-014 REV: 0 DATE: 05 January 2005

CALC. TITLE: ICV™ Box Assembly Building Foundation

PROJECT NO.: 145579 PROJECT TITLE: Final DBVS Design

Design Verification Required: ☐ Yes ☐ No

Calculation Type: ☐ Scoping ☐ Preliminary ☒ Final

Superseded by Calculation No.: _____ ☐ Voided

ORIGINAL AND REVISED CALCULATIONS/ANALYSIS APPROVAL

REV.	ORIGINATOR:	DATE:	CHECKED:	DATE:	APPROVED	DATE
0	Pam Meyer	05 JAN 05	Dirana Whitley	05 Jan-05	J. Heim	05 Jan 05

AFFECTED DOCUMENTS

DOCUMENT NUMBER:	TITLE:	REV. NO.:	DISC. LEAD INITIALS
H-14-106797	ICV™ Box Assembly Building Fdn - Plan & Details	C	

RECORD OF REVISION

REV. NO.	REASON FOR REVISION:
0	Initial Issue

ATTACHMENTS

DOCUMENT NUMBER/ID:	TITLE:	TOTAL PAGES
Attachment 1	ICV™ Box Assembly Building Foundation Calculations	60
Attachment 2	ICV™ Box Assembly Building Foundation Computer Input/Output	73
Attachment 3	ICV™ Box Assembly Building Reference Drawings	7
Attachment 4	e-mail from Dave Shuford, CH2M Hill, to P. Meyer	1
Attachment 5	e-mail from Brad Hupy, Senior Geotechnical Engineer, to P. Meyer	2

1 INTRODUCTION

1.1 Purpose

The purpose of this calculation is to determine the size and reinforcing details for the ICV™ Box Assembly Building Foundation.

1.2 Scope

The scope of this calculation includes determining estimated loadings of the ICV™ Box Assembly Building, and the design of a foundation that will support it.

In order to allow early placement of the ICV™ Box Assembly Building Foundation prior to receipt of final vendor information, estimates of the loads imposed by the building frames have been calculated using conservative assumptions, based on the best information available. Foundation design will be checked against final pre-engineered metal building design details and vendor information once these become available and remedial action taken, if required, before steel or PEMB erection.

2 BASIS

2.1 Design Inputs

The required size of the ICV™ Box Assembly Building has been determined by the Mechanical General Arrangement, which is included in Attachment 3. Loads from the pre-engineered metal building (PEMB) have been calculated based on an assumed framing scheme, rather than PEMB Vendor data. The PEMB procurement process will require that the PEMB Vendor design be similar to the assumed framing scheme, i.e. pin-connected bases.

2.2 Criteria

TFC-ENG-STD-06 Rev B-1, October 27, 2003

The ICV™ Box Assembly Building is Performance Category PC-1. This was provided in an e-mail from David Shuford CH2MHill to Paul Meyer AMEC. The e-mail is included as Attachment 4.

The foundation is 39" thick at the edges. The bottom of the foundation will be approximately 36" below the top surface of the adjacent grade. Frost heaving has been considered and will be negligible. This is confirmed in an e-mail from the author of the DBVS Site Geotechnical report and is included as Attachment 5.

Design Loads:

All loads are as provided in the Design Criteria TFC-ENG-STD-06. Further explanation follows:

Dead load: Self weight of structure and permanent equipment. The dead load of walls and roof have been assumed to be between 10 and 15 psf, with the heavier loads used to check gravity and seismic loading and the lighter used to check wind loading. This is conservative.

Live Loads:

Roof live loading is controlled by snow/minimum roof load.

Mechanical allowance at roof (suspended) 50 psf.

Crane loading: 15 ton overhead crane

Seismic Loading: Zone 2B as defined in the UBC

Other Loads: Wind and snow loads, per TFC-ENG STD-06

Volcanic ashfall is included in the roof live load

Flood, groundwater pressure, thermal, concrete creep or lightning either do not apply or have no bearing on the foundation design.

Flood: the DBVS site is at elevation 663 feet and is not in any of the flood areas identified in HNF-SD-GN-ER-501 *Natural Phenomena Hazards, Hanford Site, Washington.* Flood loads may safely be ignored.

Groundwater Pressure: the DBVS site is at elevation 663 feet. The Geotechnical report notes that groundwater levels are approximately 300 feet below the ground surface. Groundwater pressure may safely be ignored.

Thermal: The ICV™ Box Assembly Building will be heated. Daily and seasonal temperature variations will be minimal. Thermal stresses will be small and may safely be ignored.

Concrete creep: the foundation will be cast in place on a firm compacted soil subgrade. Long term creep of a non-suspended slab will be negligible. Concrete creep stresses may safely be ignored.

Lightning: the entire DBVS site will have a grounding grid installed. Copies of the grounding drawings are included with attachment 10. Pigtails are provided from the grounding grid through the foundation for attachment to the supported structures, systems or components

2.3 Assumptions

1. The weather enclosure will be an 84'x50' pre-engineered metal building (PEMB) self-supporting structure. The PEMB will have an eave height of 40 feet. The building will be supported by 5 rigid frames, each of which will have pin-connected bases. Walls and roof will be insulated steel sheeting. Loads from the PEMB are calculated using the UBC methods assuming the framing system shown on the drawings included in Attachment 3. We believe these values to be conservative, particularly recognizing the very conservative method of deriving wind loads described in section 4 below. Upon receipt of Vendor drawings for the PEMB, the design loads provided by the PEMB vendor will be compared to calculated values to verify that estimates were conservative. Corrective action will be taken if necessary.

2. An allowance of 50 psf has been made at the roof elevation for "miscellaneous" pipe, duct and lighting loads. Normal industrial design practice is to allow 10 to 20 psf as an allowance. The use of the 50 psf allowance is very conservative and provides a good assurance that actual loads will not exceed the allowance.

3. A crane dead load of 30,000 lb is assumed. Catalogue data for similar cranes suggest a value of 23,000 lb. as being typical. The use of 30,000 lb. is conservative. Upon receipt of Vendor drawings for the crane, the design loads provided by the crane vendor will be compared to calculated values to verify that estimates were conservative. Corrective action will be taken if necessary.

3 REFERENCES

1. *Uniform Building Code*, 1997. International Conference of Building Officials, Whittier, California.
2. *ACI Manual of Concrete Practice*, 1997. American Concrete Institute, Farmington Hills, Michigan.
3. TFC-ENG-STD-06 Rev B-1, *Design Loads for Tank Farm Facilities,* Issued October 22, 2003 by CH2M Hill Hanford Group Inc. Hanford, Washington.
4. ASCE 7-02 *Minimum Design Loads for Buildings and Other Structures,* 2002. American Society of Civil Engineers, Reston, Virginia.
5. *Report of Geotechnical Engineering Services, Bulk Vitrification Process Partial DBVS Richland Washington.* April 2004. AMEC Earth and Environmental Inc., Portland, Oregon.
6. HNF-SD-GN-ER-501 Rev 1B, *Natural Phenomena Hazards, Hanford Site, Washington.* As revised by ECN 672877, May 15, 2002. Numatec Hanford Company, Richland, Washington.
7. DOE-STD-1020-2002 *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* January 2002. U.S. Department of Energy, Washington, D.C.
8. STAAD-Pro 2004, *Published by Research Engineers International, Yorba Linda, California.*
9. *Thickness Design for Concrete Pavements,* 1966. Portland Cement Association, Skokie Illinois, USA.
10. AMEC Drawing F-145579-35-D-0018 Rev C, 10 November 2004.

4 METHODS

The ICV™ Box Assembly Building size has been determined by the Mechanical General Arrangement, included with Attachment 3. The foundation size matches these dimensions, which correspond to "standard" pre-engineered metal building modular sizes. The weight of the structure has been conservatively estimated based on normal PEMB construction. Weights of movable equipment that might help resist seismic or wind loads (such as the ICV™ Box) have been conservatively ignored.

The Uniform Building Code (UBC) section on concrete design references ACI 318 in its opening paragraph and notes that the two standards are essentially the same. Where there are differences, the UBC either relaxes some requirements or makes simplifying assumptions that don't readily apply to the design of the two large foundations. In particular, the calculation of shear and tensile strengths for the groups of deeply embedded bolts used in this foundation can't be modelled effectively using UBC. The ACI method allows more confidence in the calculated results and is conservative, and also meets the requirements of UBC.

There is a clause in TFC-ENG STD-06 that requires wind loads comply with ASCE-7 using the values from Table 3 (i.e. 85 mph with an importance factor of 1.0 or 1.15 for PC-1 and PC-2 structures respectively). We found this requirement confusing, as elsewhere in the document, (e.g. clause 3.7.18) we are required to determine the capacity of the steel structures based solely on UBC. The mixing of one methodology/code, with variations between load factors, with another method of determining strengths seems counter to good engineering practice. Ideally, one should use either "all UBC" or "all ASCE", and in fact, the final results will normally be very similar.

To attempt to satisfy the STD-06 requirement, but still use a consistent set of calculations, we used a 90 mph wind speed with the UBC methodology. This exceeds the "three second gust" value from table 3 of STD-06. This makes our calculations of wind load conservative, as the use of a 90 mph wind load with the UBC methodology results in design loads much higher than if we had used the ASCE-7 method throughout, or if we had used the UBC-published value for this site's wind speed (70 mph) and applied the relevant gust factors.

The ASCE-7 method will give approximately the same net pressure on a building surface using 85 mph "3-second" wind speed as the UBC method will for a 70 mph "hourly" wind. We have used 90 mph and the UBC method, and calculated pressures will be roughly 1.65 times as high as either method used "correctly." Wind pressure varies with the square of wind velocity, thus (90/70)^2 = 1.65

This is very conservative, and therefore we believe that our calculations meet and in fact exceed, the ASCE-7 standard.

Based on the derived weight of the structure, gravity, wind and seismic forces on the foundation have been calculated using the Tank Farm Facilities Design Loads and the methods prescribed in the Uniform Building Code. Loads on column bases have been derived using the STAAD-Pro computer program. This is an industry-standard program published by Research Engineers International. The steel design calculations are included with Attachment 1, and the computer input/output in Attachment 2.

Foundation allowable resisting forces have been calculated using the methods in the Uniform Building Code and ACI-318. Soil bearing pressures are compared to the allowable values from the Geotechnical Report.

Sizing of the concrete floor slab and reinforcement follow the methodology shown in ACI 330R-92 and *Thickness Design for Concrete Pavements*, as the UBC provides little guidance for slab-on-grade design in normal soils

5 RESULTS AND CONCLUSIONS

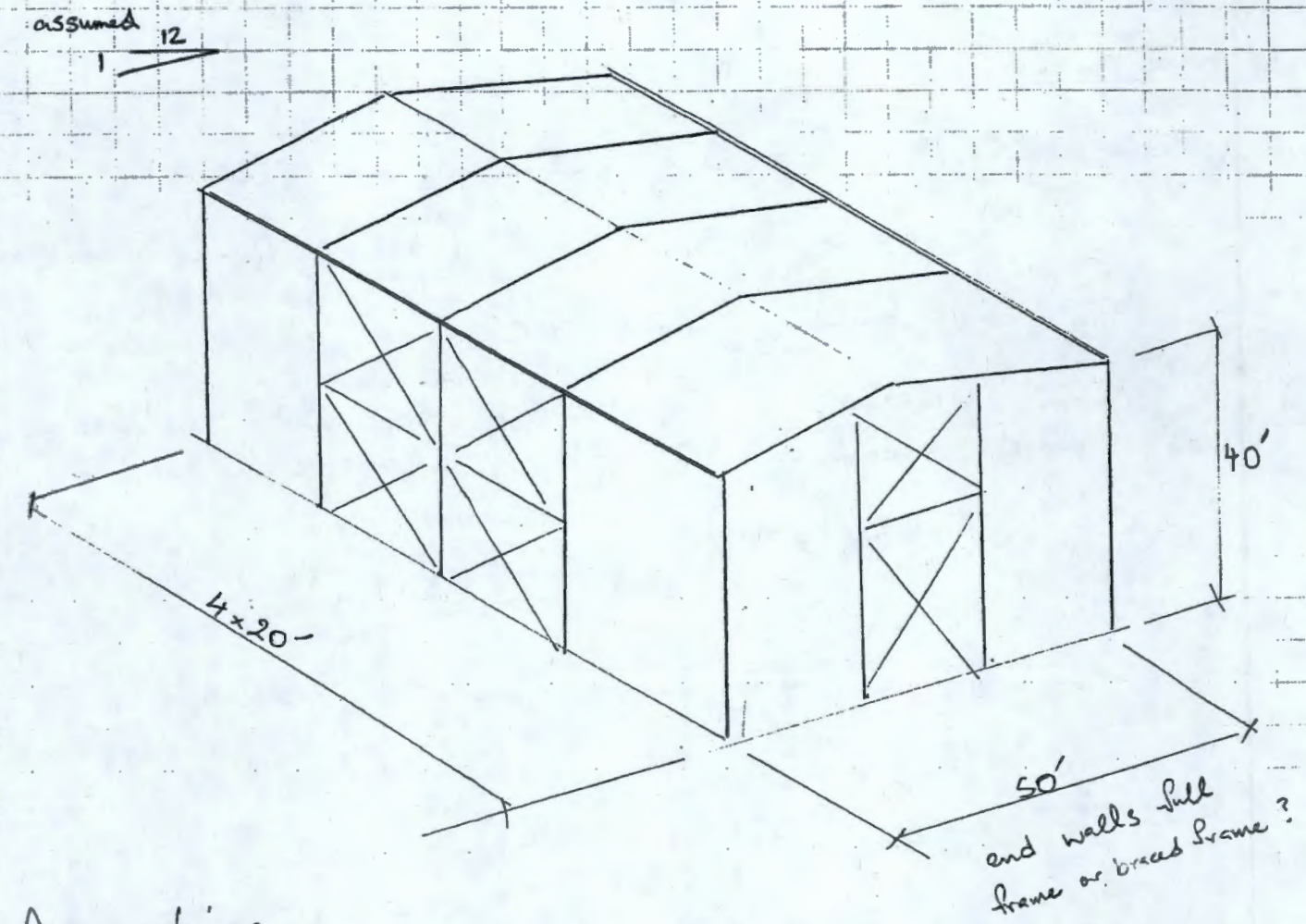
The foundation design is adequate to safely support all loads created by the assumed ICV™ Box Assembly Building. Concrete foundation size and reinforcing details have been included in the 3-D computer model of the Melt Area. A foundation drawing is attached. This drawing lists the maximum allowable loads applied at each rigid frame column base plate for reference of the PEMB Vendor. As discussed above, these allowable values are based on conservative design assumptions and should exceed the actual values. Upon receipt of Vendor drawings for the PEMB, the design loads provided by the PEMB vendor will be compared to calculated values to verify that estimates were conservative. Corrective action will be taken if necessary.

145579-C-CA-014

Attachment 1

ICV™ Box Assembly Building Foundation Calculations

Pre-Eng Building Geometry.



Assumptions

- Pinned column bases.
- 15 ton crane travelling longitudinally column brackets to inside assume 6' off c/c. (hanging from roof beams c/c 38')
- Side wall bracing, 2 bays each.

Loading:–

Per MASS bldg. same site

1) Wind load:

(UBC 1620) $P = C_e C_q q_s I_w$ — 20-1

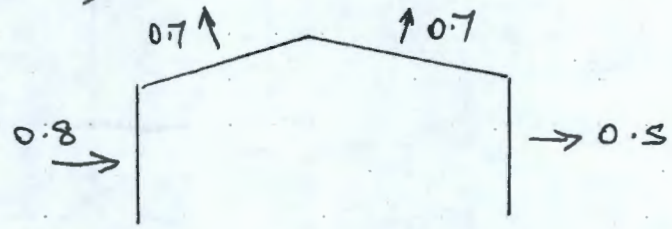
$C_e = 1.31$ (table 16-G)

Pre-Eng building height = 40'

From HNF-SD-GN-ER-501 document, the design basic wind speed is 90 mph, Exposure C used –

C_q (Table 16-H)

Method 1



$I_w = 1.15$ (Table 16-K)

$q_s = 20.8$ psf – (Table 16-F)

$P_{windward\ side} = 1.31 \times (0.8)(1.15)(20.8)$

$= 25.0$ psf.

$P_{leeward} = 1.31 \times (0.5)(1.15)(20.8)$

$= 15.67$ psf.

$P_{roof} = 21.93$ psf.

2 Snow load:

UBC 1640

$P_f = C_e I P_g$ (40-1-1)

$C_e = 1.0$
$I = 1.15$

Using ASCE 7 Ground snow $P_g = 20$ psf.

$\therefore P_f = 1.0 \times 1.15 \times 20$
$= 23$ psf.

3 Volcanic Ash

5 psf re Hanford SD-GN-GR-501

4 Floods – N/A.

5 Service suspended load

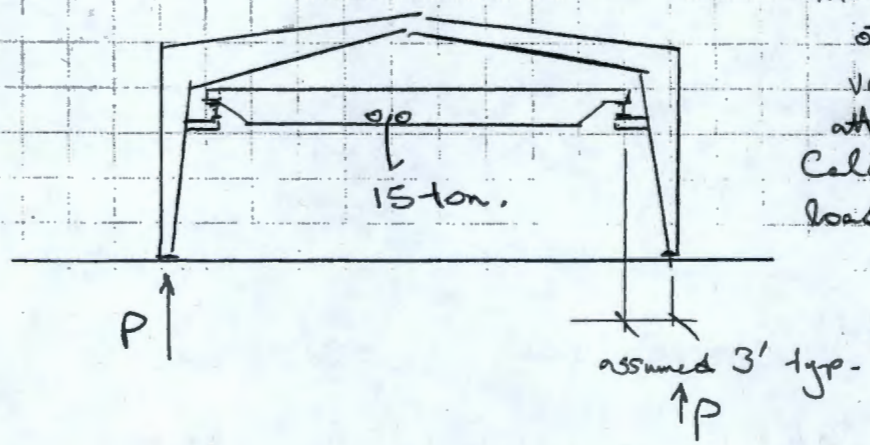
Assume 50 psf for max piping, cable tray, lighting, temporary lifting.

Assume minimum 5 psf for minimum of suspended load during uplift bldg conditions.

6 Dead loads

	Max	Min (for comb. WL)
Assume bldg roof DL =	15 psf.	10 psf.
Walls =	15 psf.	10 psf.

7. Crane load



※ Crane DL based on other similar cranes, vendor information – see attached "Kingsway". DL = 23k. Calcs use 30k as conservative load.

Assume crane beam, trucks, trolley wt ~ 30 k.
crane lift wt = 15 ton
= 30 k.
Impact load 15%
Lift wt = 30 × 1.15
= 34.5 k

wt to one column when lift to one extreme side

$$P = \frac{DL30}{2} + 34.5$$

$$= 49.5 \text{ k}, \text{ Say } 50 \text{ k.}$$

longitudinal + stop forces 10% = 3.45 k, each rail,
lateral forces 3.45 k., each rail.

KINGSWAY
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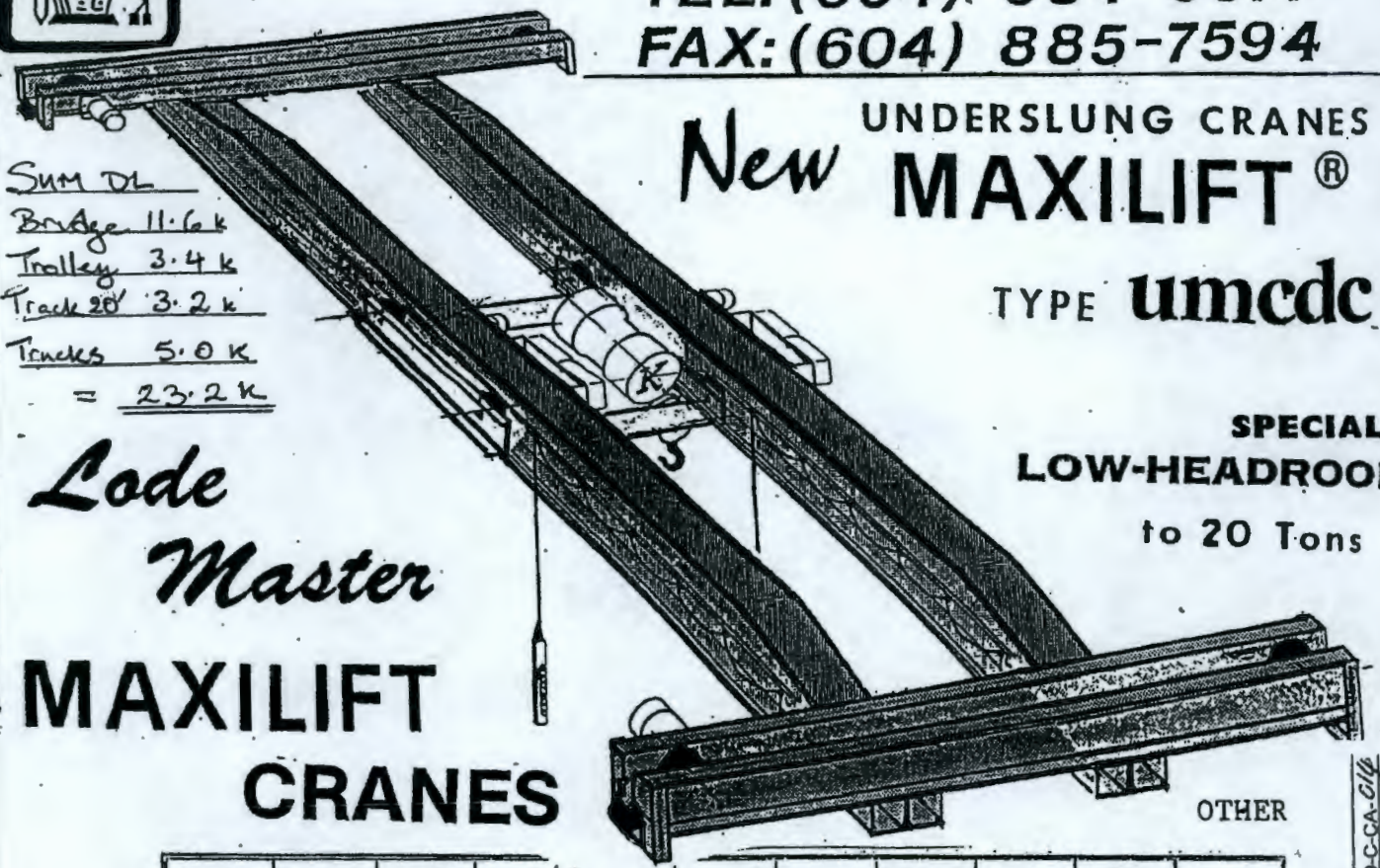
TEL: (604) 984-0377
FAX: (604) 885-7594



UNDERSLUNG CRANES

New MAXILIFT®

TYPE **umcdc**

SUM DL
Bridge 11.6 k
Trolley 3.4 k
Track 20' 3.2 k
Trucks 5.0 k
= 23.2 k

SPECIAL LOW-HEADROOM
to 20 Tons

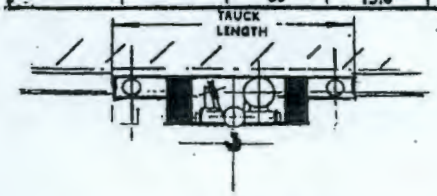
Lode Master

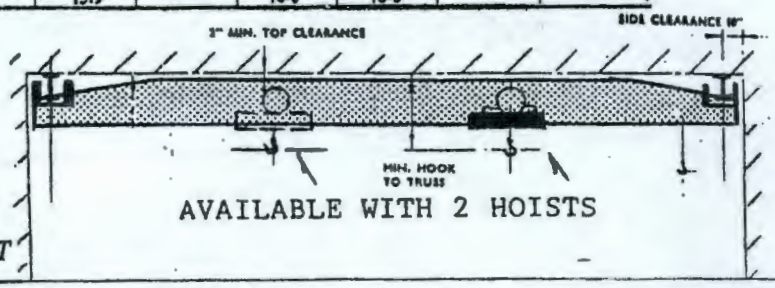
MAXILIFT CRANES

OTHER

CODE NO.	CAPACITY TONS	SPAN FEET	BRIDGE WEIGHT TONS	TROLLEY WEIGHT TONS.	WHEEL LOAD TONS	WHEEL DIAMETER INCHES	WHEEL CENTRES FEET	TRUCK LENGTH FEET/INS	MIN: HOOK TO TRUSS INCHES	HOOK APPROACH INCHES
L.T.O. 5	5	40 46 52 60	4.1 5.0 5.5 6.7	1.4	4.4 4.6 4.8 5.0	6"	8-0 9-6 10-0 12-0	10-0 11-6 12-6 14-6	34"	39"
L.T.O. 10	10	40 46 52 60 66	4.7 5.7 6.3 8.0 9.6	1.5	7.4 7.7 7.8 8.3 8.8	8"	8-0 9-6 10-0 12-0 13-0	10-0 11-6 12-6 14-6 15-6	42"	44"
L.T.O. 15	15	40 46 52 60 66 72 80	5.8 7.1 8.5 9.6 11.5 13.1 15.0	1.7	11.0 11.1 11.3 11.6 12.2 12.6 12.9	10"	8-0 9-6 10-0 12-0 13-0 14-6 16-0	10-0 11-6 12-6 14-6 15-6 17-0 18-6	51"	49"
L.T.O. 20	20	26 32 40 46 52 60 66 72 80	4.7 5.5 6.6 8.0 9.9 11.3 12.3 14.8 15.6	1.7	13.2 13.4 13.6 13.9 14.4 14.8 15.4 15.7 15.9	12"	7-0 7-0 8-0 9-6 10-0 12-0 13-0 14-6 16-0	9-0 9-0 10-0 11-6 12-6 14-6 15-6 17-0 18-6	59"	53"

NOTE: DIMENSIONS APPROX





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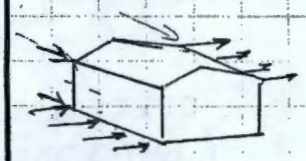
KINGSWAY ENGINEERING

8. Seismic (shear @ eave ht calculation)

Total bldg wt — roof — $84 \times 50 \times 15^{\#} = 63$ k

snsp. wt roof $= 84 \times 50 \times 50^{\#}$ (max) $= 210$ k



½ ht. wall wt. $= \frac{2}{2}(40)(50+84) \times 15^{\#} = 80$ k

Total = 353 k DL + LL
+ Crane DL 39 k (crane lift ⚓ not incl in seismic shear calc)
($30^k + 3 \times 3^k$ addn track) Σ 392 k

From previous calcs in MASS — see 145579-C-CA-011 Attachment #6, pp 5–7 of 48.

$V = 0.25W$
$= 0.25 \times 392$
$= 98$ k shear.

divided between 4 frames. (3 mid, 2 × ½ ends)

$= \frac{98}{4}$

$V_{lateral} = 24.5$ k / mid frame.

$V_{longit} = \frac{98}{2} = 49$ k / side wall.

Building column Vertical Loads.

— DL from roof — mid frames = 7.5 k/col.
end frames = 3.75 k/col.

— Susp. LL from roof — mid frames = $\frac{50 \times 20}{2} \times 50 = 25$ k/col (max)

$= \frac{50 \times 20}{2} \times 5 = 2.5$ k/col (min.)

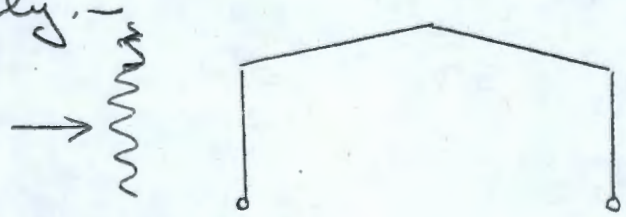
— end frames = 12.5 k/col (max)

= 1.25 k/col (min).

— Snow LL — mid frames = $\frac{50 \times 20}{2} \times 23$*
= 11.5 k/col
end frames = 5.75 k/col.

— Crane load. LL — mid or end frame = 50 k max
15 k min.

— Wind load —
(A) Laterally. —



$$OTM = \left(\underset{\text{(windward p)}}{25.0} + \underset{\text{(leeward p)}}{15.67}\right) \times 20 \times \frac{40^2}{2} \text{ k ft}$$

$$= 40.67 \times 10 \times 1600$$

$$= 650.7 \text{ k ft}$$

$$\text{Col. loads} = \pm \frac{650.7}{50 \text{ span}}$$

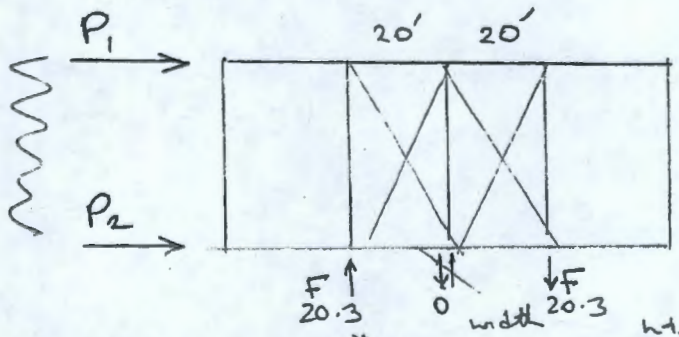
$$= \pm 13.0 \text{ k}$$

Net uplift in wd Condns —

$$P \uparrow = 21.93^{\#} \times \frac{50}{2} \times 20$$

$$= 11 \text{ k / col.}$$

(B) Longitudinally – (Assume 2 of 4 bays braced, 2 sides, tension only bracing)



/ side

$$P_2 = P_1 = 40.67^{\#} \times 50/2 \times \frac{40}{2} \text{ ht.}$$

$$= 20.33 \text{ k / side.}$$

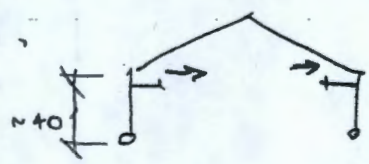
$$F = \pm \frac{40}{40} \times 20.3$$

$$F = 20.33 \times \cancel{\frac{40}{2 \times 20}}$$

$$= \pm 20.3 \text{ k}$$

Crane loads

(A) laterally.



$$M_{OT} = 3.45 \times 40$$

$$F_{col} = \pm \frac{3.45 \times 40}{50}$$

$$= \pm 2.76 \text{ k.}$$

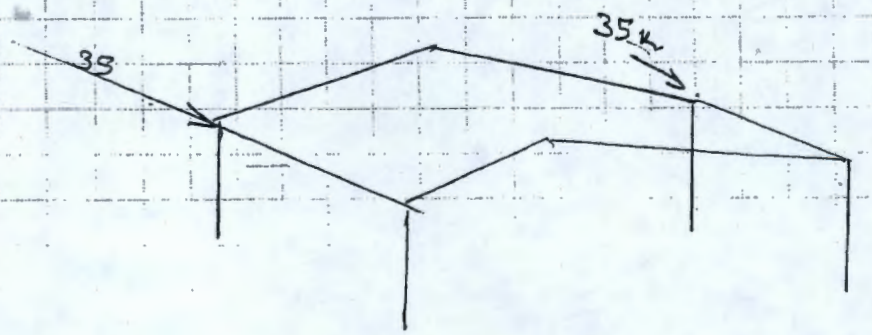
(B) Longitudinally

$$M_{OT} = 3.45 \times 40$$

$$F_{col} \text{ (braces only)} = \frac{3.45 \times 40}{40}$$

$$= \pm 3.45 \text{ k.}$$

Seismic.



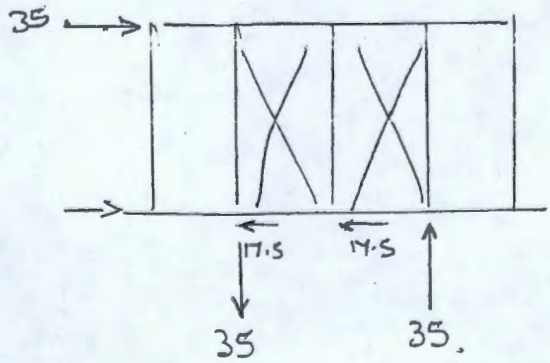
Σ DL @ Roof = 392 k whole roof.

Seismic $V = \frac{0.25}{1.4} \times 392$ Service load

= 70 k

(a) Seismic longitudinal
ie 35 k / side.

So braced column reactions

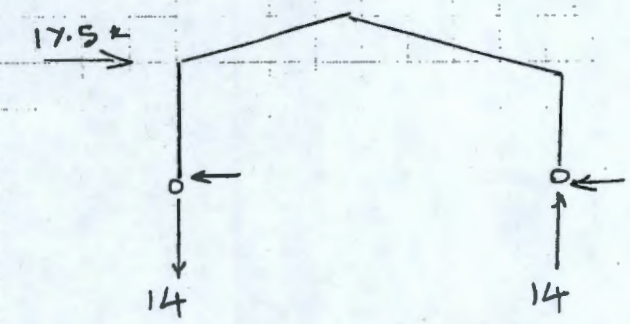


$35 \times 40/40$

(b) Seismic lateral

F / frame $\doteq \frac{70}{4}$

$= 17.5k$



$17.5 \times \frac{40}{50} = 14k$

Conclusion – Comparison between WL + E/Q in use of load combinations –

Seismic longitudinal – Max col ↓ = 35k
→ = 17.5k

Seismic – Min col ↑ = -35k
→ = 17.5k

Seismic lateral Max col ↓ = 14k

Min col ↑ = -14k

Wind. longitudinal – Max col ↓ = 20.3 − 11
= 10.3k

Min col ↑ = −20.3 − 11
= −31.3

Conclusion – Seismic governs Col +/- . over WL.

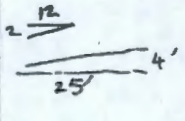
Frame review for lateral reactions to base from vertical loads

– Assume I col = I beams.

$$k = \cancel{\frac{I_2}{I_1}} \times \frac{h}{s}$$

$$= \frac{40}{25}$$

$$= 1.6$$



$$\phi = \frac{f}{h}$$

$$= \frac{4}{40}$$

$$= 0.10$$

$$m = 1 + \phi = 1.1$$

$$B = 2(k+1) + m = 2(\overset{2.6}{\cancel{1.6+1}}) + 1.1$$
$$= 6.3$$

$$C = 1 + 2m = 1 + 2.2$$
$$= 3.2$$

$$N = B + mC = 6.3 + 3.2 \times 1.1$$
$$= 9.8$$

FOLLOWING HAND CHECK OF COMPUTER RUNS – USING KLEINLOGEL FACTORS.

Roof DL. (15)

$$M_B = \frac{wL^2(3+5m)}{16N}$$

$$= \frac{(20\times15)\times50^2(\overset{8.5}{\cancel{3+5\times1.1}})}{16\times9.8}$$

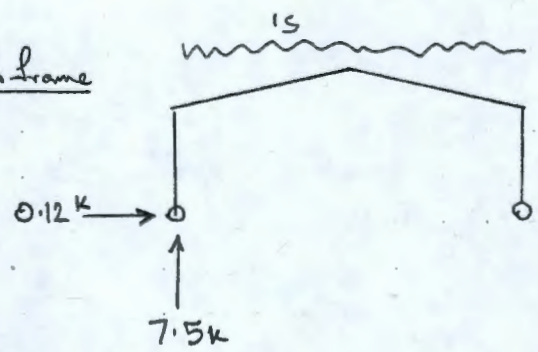
$$= 4.74 \text{ kft}$$

$$H_A = -H_E = -\frac{M_B}{h}$$

$$= \frac{4.74}{40}$$

$$= 0.12 \text{ k}$$

Mid frame



Roof Susp LL. (50)(5)

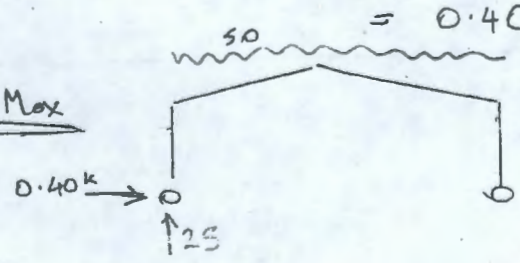
$$M_B = 4.74 \times \frac{50}{15}$$

$$= 15.8$$

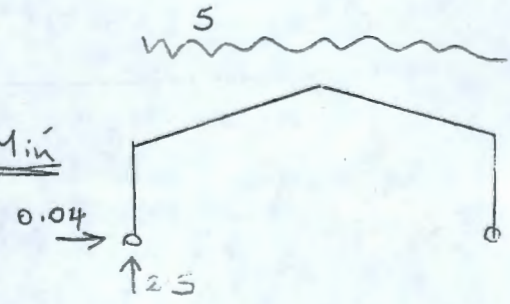
$$H_A = \frac{15.8}{40}$$

$$= 0.40k$$

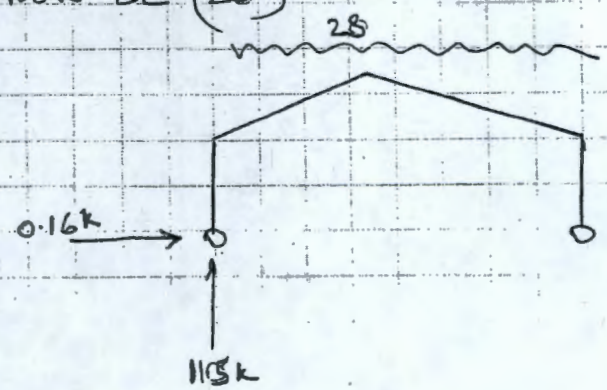
Max



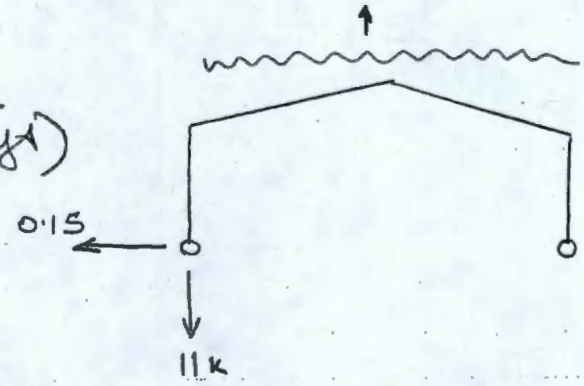
Min



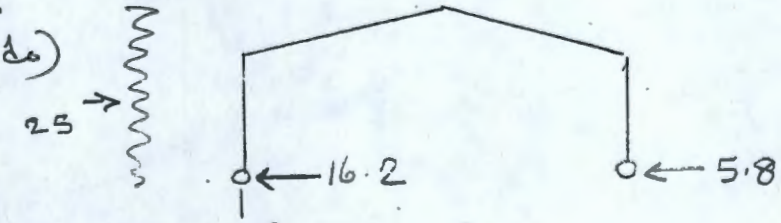
Snow LL (25)



WL (uplift)



WL (side)



$$M_D = -\frac{wh^2}{8} \cdot \frac{2(B+C)+k}{N}$$

$$= -\frac{25 \times 20 \times 44^2}{8} \times \frac{2(6.3+3.2)+1.6}{9.8}$$

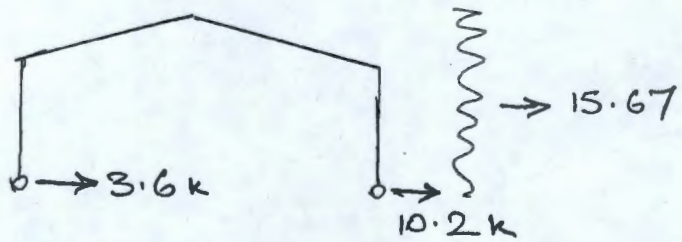
(40+4) 9.6 2.12

$$= -256.5 \text{ k ft.}$$

$$H_A = -\frac{M_D}{h}$$
$$= \frac{256.5}{44}$$
$$= 5.8\,k.$$

$$H_E = -(wh - H_A)$$
$$= -(25 \times 20 \times 44 - 5.8)$$
$$= (22 - 5.8)$$
$$= 16.2$$

Leeward wind



$$M_D = \frac{-wh^2}{8} \cdot \frac{2(B+C)+k}{N}$$
$$= \frac{-15.67 \times 20 \times 44^2}{8} (2.12)$$
$$= 160.8\ k\,ft.$$

$$H_E = \frac{M_D}{h}$$
$$= \frac{160.8}{44}$$
$$= 3.6\,k.$$

$$H_A = wh - H_E$$
$$= \underset{13.8}{\cancel{15.67 \times 20}} \times 44 - 3.6$$
$$= 10.2\,k$$

Summary of Loadings -

Run #1

Wind transverse: DL + SLL + Snow LL
DL + WL
DL (red) + 0.75 (LL + Snow + WL)

#2 Wind longitudinal. DL + SLL + Snow LL
DL (red) + WL
DL + 0.75 (LL + Snow + WL)

#3 Seismic transverse

CALCULATION SHEET

amec

CALC. NO.: 145579-C-CA-014 **REV:** 0 **ISSUE DATE:** 25 November 2004
CALC. TITLE: ICV Assembly Building Foundation
PROJECT NO.: 145579 **PROJECT TITLE:** Final DBVS Design
ATTACHMENT: 1
ATTACHMENT TITLE: Foundation ICV Assembly Building – Foundation Calculations **Page:** 18 of 60
ORGINATOR: JHuitt **CHECKER:**
DATE: Nov 28, 04 **DATE:** 25-Nov-04

Location	Bldg DL (roof + walls)	Redn 0.9DL	lateral DL	(Max.) Susp. LL	(Min.) Susp. LL	lateral Susp. (max)	lateral Susp. (min)	Snow LL	Snow LL	max/min Crane LL
1/B	10	12.6	0.06	12.5	1.25	0.2	Neg.	0.08	8	50/13
5/B	10	12.6	0.06	12.5	1.25	0.2		0.08	6	50/13
1/C	20	25.2	0.12	25	2.5	0.4		0.16	14.5	50/13
5/C	20	25.2	0.12	25	2.5	0.4		0.16	14.5	50/13
1/D	20	25.2	0.12	25	2.5	0.4		0.16	14.5	50/13
5/D	20	25.2	0.12	25	2.5	0.4		0.16	14.5	50/13
1/E										
5/E										

// JOIN

CALCULATION SHEET

amec

CALC. NO.: 145579-C-CA-014 **REV:** 0 **ISSUE DATE:** 25 November 2004
CALC. TITLE: ICV Assembly Building Foundation
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DATE: Nov 18,04 **DATE:** 25-Nov-04

	lateral WL	lateral WL	lateral WL	lat. WL	lat WL	WL	long'd. WL	long'd WL	long'd WL (incl*)	Seismic	Seismic
1.7											
1.7											
1.7	−13 (tot)	16.2	incl	+3.6	−11	+0.15	−20.3	10.1	−11		
1.7	+13 (tot)	−5.8	incl	−10.2	−11	+0.15	−20.3	10.1	−11		
1.7	−13 (tot)	16.2	incl	+3.6	−11	+0.15	0	10.1	−11		
1.7	+13 (tot)	−5.8	incl.	−10.2	−11	+0.15	0	10.1	−11		
							+20.3	0			
							+20.3	0			

// [illegible]

Loading Cases. 1/ C.

DL + SLL + Snow LL + CLL

	= ↕	↔
DL	20	0.12
Susp LL	→ 25 max	0.40
	2.5 min	
Snow	11.5	0.16
CL	50 max	1.7
	15 min	1.7
	106.5 k (max)	2.38 k.

Wind lateral: DL + WL

	= ↕	↔ (lateral)
DL	20	0.12
WL →	−13 / +13	16.8 / −5.8
	(incl)	3.6 / −10.2
direct WL ↑	−11	(incl)
	+ 22	+ 20.4
	+ 4	− 16

Wind Longit: DL + WL

	= ↕	↔ (longit)
DL	20	0.12
direct WL ↑	−11	
↕ WL (long)	+ 20.3 / −20.3	10.1
	− 11	10.2
	+ 29	

1/C continued.

DL + Susp DL/LL + 0.75 (Snow LL + Gr L + WL)

=

	20	0.12
	25/2.5	0.4
	10	0.16
	50/15 / 0	1.7 / 0
× 0.75	-13/+13	16.8/-58
	incl	3.6/-10.2
	-11	incl
	+84	

Not design case.

CALCULATION SHEET

amec

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DATE: Nov 18, 04 **DATE:** 25. Nov. 04

DL + Susp. LL + 0.75 (Snow LL + CL + E)

(DL) longit.

↕

20
25 / 2.5

45

20
25
6
51

0.75 (11.5
50 / 15 / 0
± 35

72

+ .75 × (50
35
85

Σ 117 k max

DL + SusL + E ↕

20
25 / 2.5

64
51
116

Snow 0
wave 0
± 35

= −12.5 min.

Conclusion. —

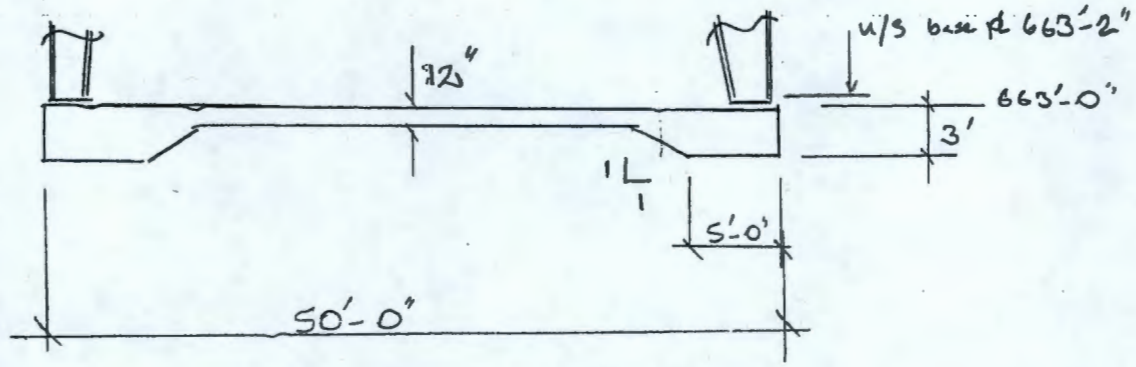
Central bay design case is +117 k down
2.4 k shear

or −12.5 k up.
+ 17.5 k shear

or 84.5 k down
15 k shear

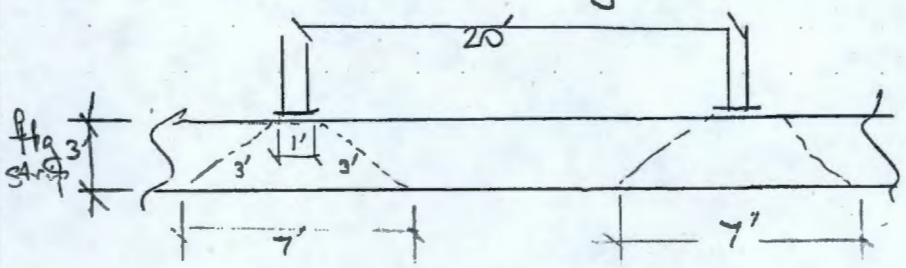
Foundation Design – Concrete

Consider the side strips as continuous spread footings attached to central bldg slab. Slab loads carried by only slabs not column ftgs.



Soil Bearing in Down-Loads from Bldg

Allowable max soil brg 3 ksf — Refs.



Influence length of column loads on soil @ base of ftg strip.

Since max load = 113.5 k/col.

min area req'd = $\frac{113.5}{3}$

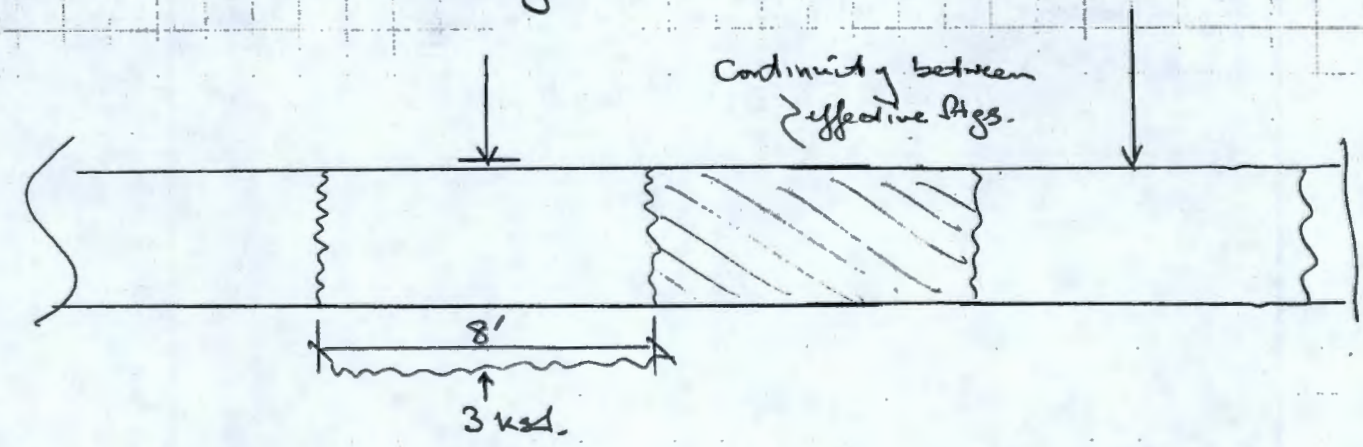
= 37.8 ft²

since strip, @ 5' wide, length (min) = $\frac{37.8}{5}$
5' wide

= 7.57' lg. to achieve soil brg @ 3 ksf

This conforms closely with 45° lines in 3'-3" thickness of 7', so we can assume that the column portions of the strip ftg act as isolated spread ftgs.

— Assume isolated ftg



Conc. bending (longit) $= \dfrac{wl^2}{2}$

$= \dfrac{3 \times 3.5^2}{2}$

$= 18.4$ kft/ft width, (add ✱)

$\Sigma = 23.6$ kft/ft

Concrete section $d = 36 - 3 - \frac{1}{2}$

$= 32.5"$

As req'd ≐ 43 □"/ft.

is minimum steel OK @ 0.0018 = 0.78 □"/ft. (tab)

— See over for calcs of rebar areas req'd. —

* lateral bending based on $5'/2 = 2.5'$ lever arm

So use same rebar as longitudinal but lower stress.

Shear loads @ base pt level. — longitudinal forces from bracing loads act as a couple in the slab.

Adding ~ $17.5^k \times \frac{3'}{2} \times \frac{1}{5}$ k ft / ft width strip

$= 5.25$ k ft / ft.

If strip ftg acts as continuous strip, ie soil stresses lower than 3 ksf bnd effective area from span = 20' rather than ~ 8'

then bearing = $\frac{113.5}{5 \times 20}$

= 1.13 ksf.

So ftn bending = $\frac{wl^2}{10}$ — (continuous)

$= \frac{1.13 \times 20^2}{10}$

= 45.2 kft / ft.

$d = 39'' - 3 - \frac{3}{4} - \frac{1}{2}$
$= 34.75''$ ∴ A_s req'd ~ 0.72 in²/ft.

bottom steel now revised to #8 @ 8"
= 1.18 in²/ft

so OK

BE7848 Douglas Landsem
Employment Security Bldg.

Re-bar Design For Fdn Pads or Slabs Ref: ACI 318		39" Deep Bottom
Bars: Top or Bot only =1, Top & Bot =2		2
fy	psi	60000
f'c	psi	3500
ϕ		0.9
Mu	k-ft	70
b	in	12
h	in	39
d	in	32.5
A = 0.59 * fy/f'c		10.11429
B = -1		-1
C = Mu /(ϕ bd^2fy)		0.0012
ϕ Ru = Mu /bd^2		66.3
ρ (1)		0.0976
ρ (2)		0.00124
ρ (temp)		0.00180
ρ min		0.0033
Selected ρ for design		0.00124
Check ρ < ρ max		OK
As req'd per ft (temp)	in2	0.42
As req'd (design)	in2	0.48
As req'd (1.33 *design)	in2	0.64
As req'd(min)	in2	1.30
Select design, 1.33design or min		0.64
As required	in2	0.64
Bar #		6
As per Bar		0.442
Bar Spacing		8
Total As per ft		0.66
		OK

BE7848

Douglas Landsem
Employment Security Bldg.

Re-bar Design For Fdn Pads or Slabs Ref: ACI 318		39" Deep Top
Bars: Top or Bot only =1, Top & Bot =2		2
fy	psi	60000
f'c	psi	3500
ϕ		0.9
Mu	k-ft	47
b	in	12
h	in	39
d	in	32.5
A = 0.59 * fy/f'c		10.11429
B = -1		-1
C = Mu /(ϕ bd^2fy)		0.0008
ϕ Ru = Mu /bd^2		44.5
ρ (1)		0.0980
ρ (2)		0.00083
ρ (temp)		0.00180
ρ min		0.0033
Selected ρ for design		0.00083
Check ρ < ρ max		OK
As req'd per ft (temp)	in2	**0.42**
As req'd (design)	in2	0.32
As req'd (1.33 *design)	in2	0.43
As req'd(min)	in2	1.30
Select design, 1.33design or min		**0.43**
As required	in2	**0.43**
Bar #		6
As per Bar		**0.442**
Bar Spacing		12
Total As per ft		**0.44**
		OK

Resistance to column uplift and conc. strip bending.

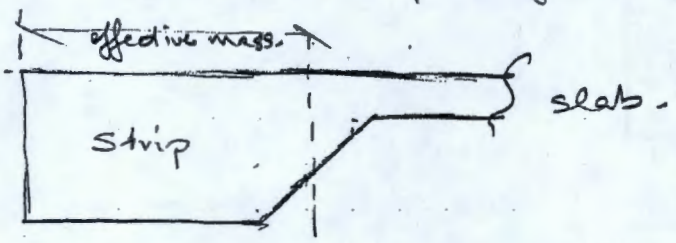
— Uplift, from computer runs ~

run 4C.19 = −7.2
21 = −17.65 k ←

Uplift resistance needed for SF of 2

= 2 × 17.65 k
= 35.3 k wt.

wt of 1 ft strip (ignoring slab attached)

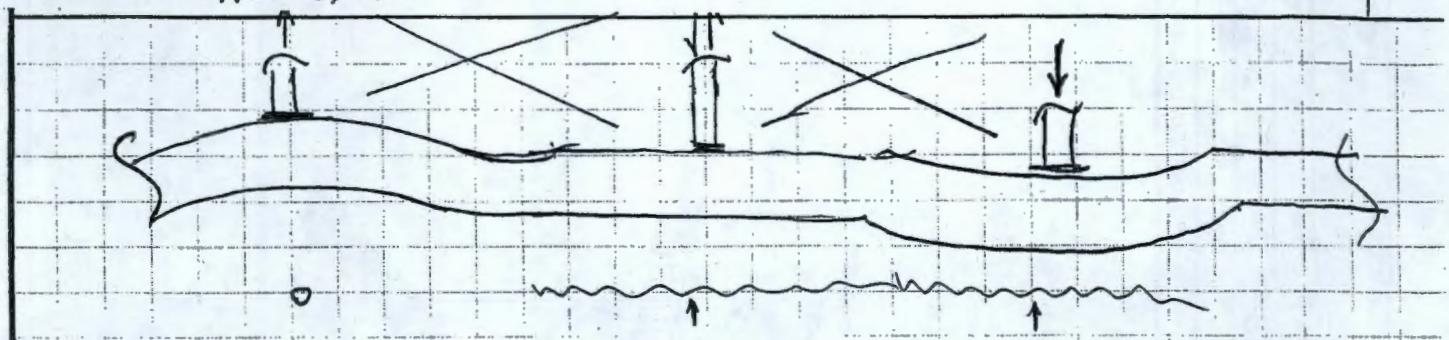


wt / ft = 6 × 3.25 × 0.150
= 2.925 k/ft.

for resistance of 35.3 k

need length of $\frac{35.3}{2.925}$
= 15′

spacing of cols 20′ So we do have uplift resistance + SF. However this means that almost the whole of the strip is trying to lift. So we should assume that soil bearing is zero and the strip is suspended @ column & bending 10′ each side!



Strip bending ~ (self wt) $2.925 \times \frac{10^2}{2}$

= 146 kft / 6' wide
= 24.4 kft / ft wide

∴ Top steel needs to be ~ 0.39 in²

Actually #6 @ 12" = 0.44 in² so OK

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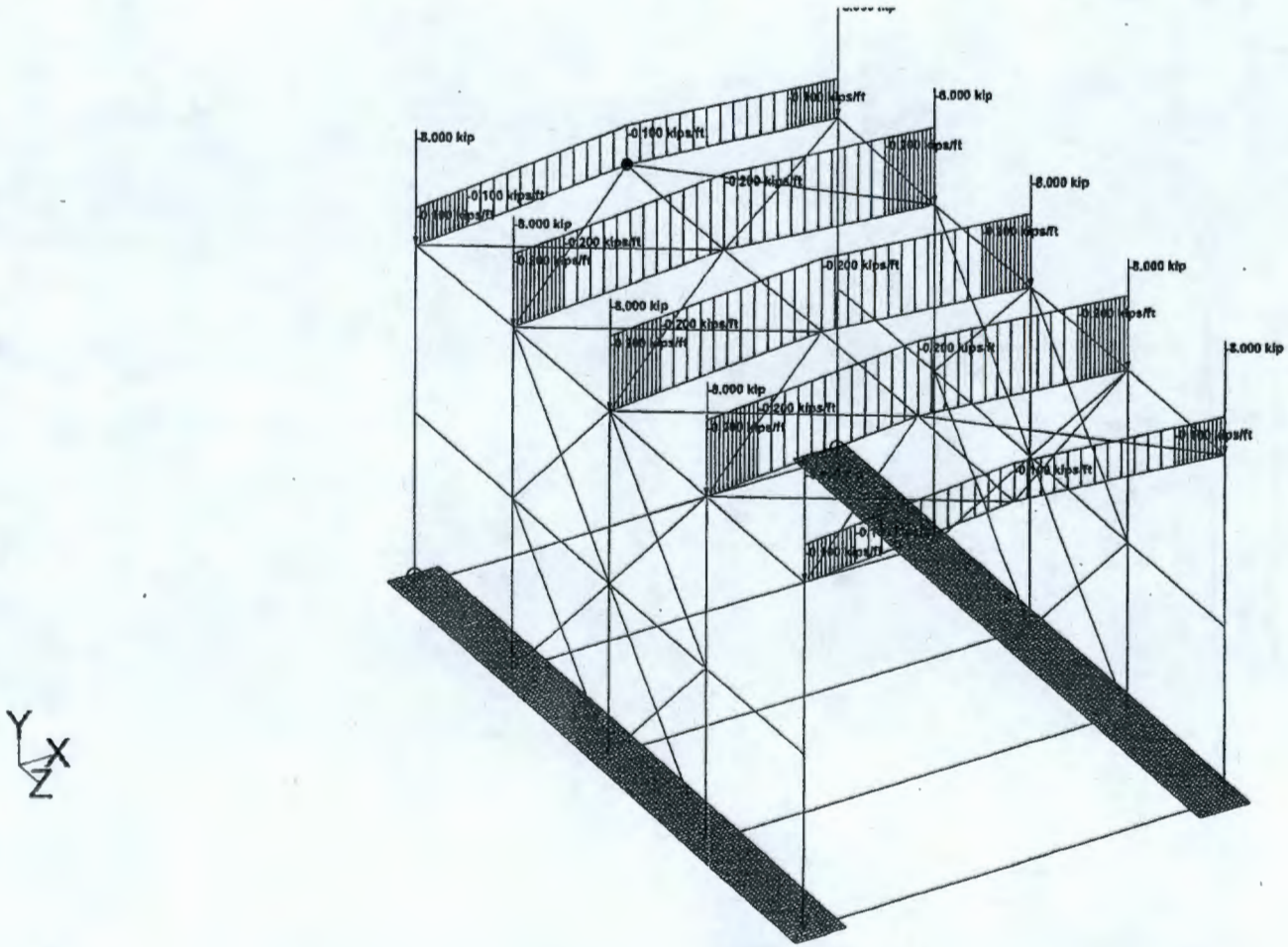
Job Title	Calc. No.: 145579-C-CA-014	Part		
	Rev. No.: 0	Ref		
	Sheet: 32 of 60	By	Date 12-Nov-04	Chd
Client		File HANFORDFOUNDATION	Date/Time 23-Nov-2004 17:40	



Load 1

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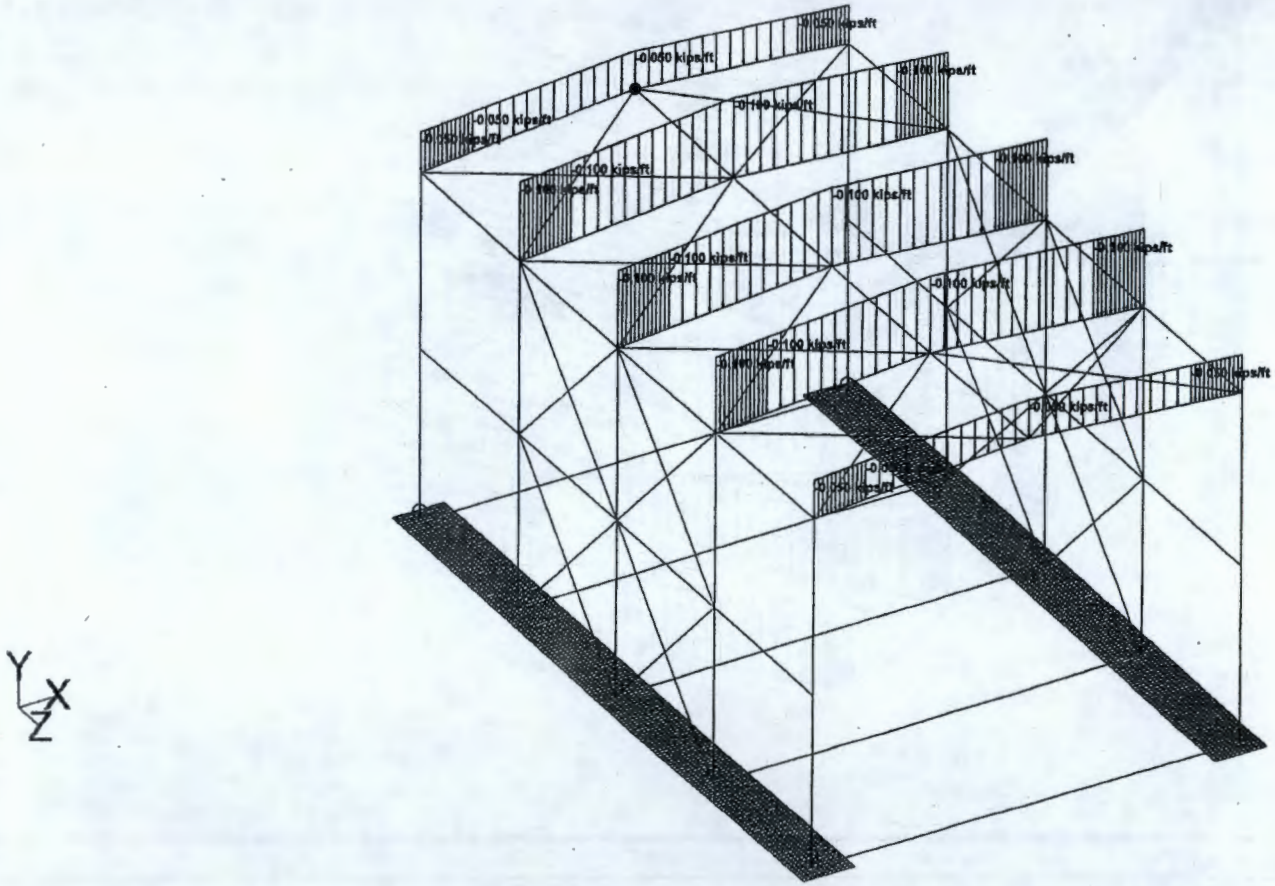
Job Title	Calc. No.: 145579-C-CA-014	Part		
	Rev. No.: 0	Ref		
	Sheet: 33 of 60	By	Date 12-Nov-04	Chd
Client		File HANFORDFOUNDATION	Date/Time 23-Nov-2004 17:40	



Load 3

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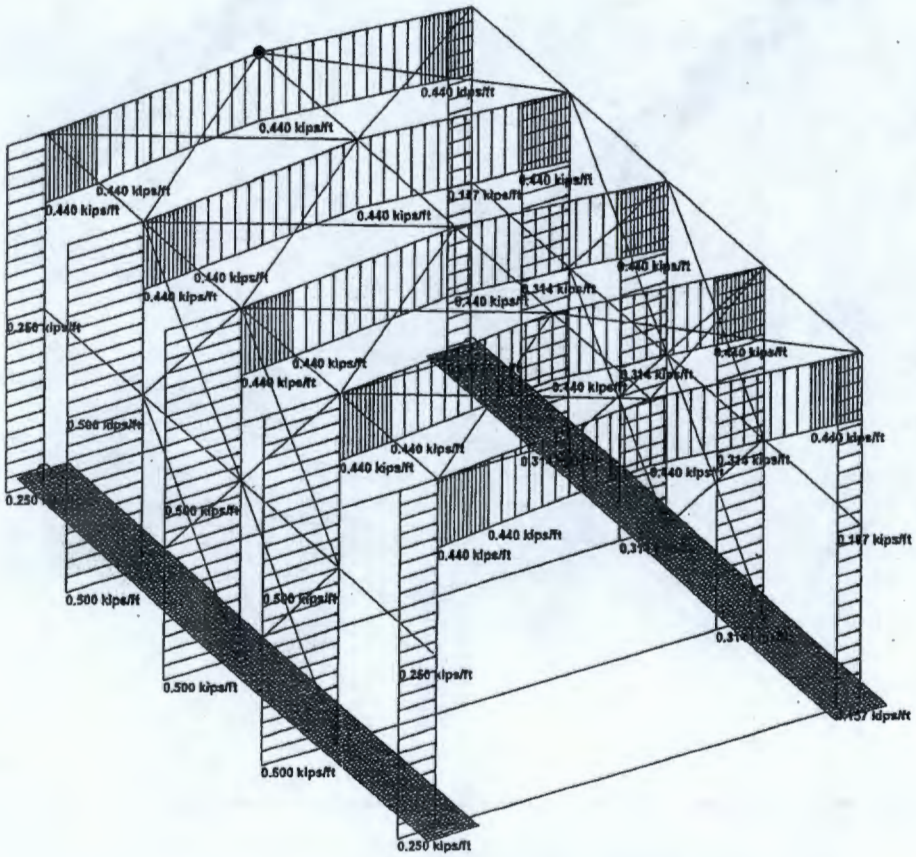
	Calc. No.: 145579-C-CA-014	Part		
Job Title	Rev. No.: 0	Ref		
	Sheet: 34 of 60	By	Date 12-Nov-04	Chd
Client		File HANFORDFOUNDATION	Date/Time 23-Nov-2004 17:40	



Load 5

Verification of overall stability.

1) Safety in overturning

— Assume min. roof DL reduced to 10 psf
wall DL " " 10 psf
snsp. DL " " 5 psf.

$$M_{\text{rightening (bldg loads)}} = 84 \times 0.01 \times \frac{50^2}{2} + 84 \times 0.01 \times 40 \times 50 + 84 \times 0.005 \times \frac{50^2}{2}$$

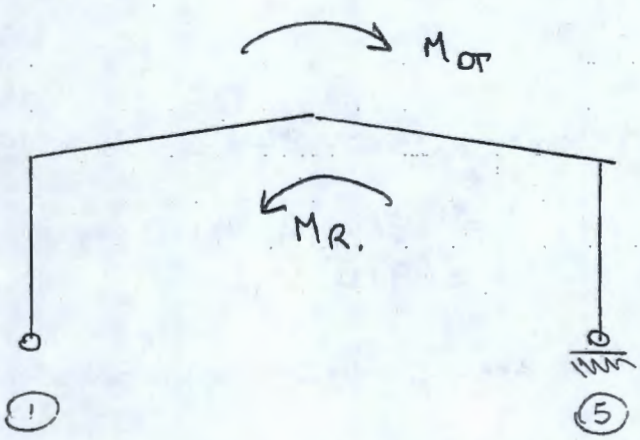
$$= 1050 + 1680 + 525$$

$$= 3255 \text{ kft.}$$

$$M_{\text{rightening}_2 \text{ (ldn)}} = \underset{\text{(average)}}{w} \times t \times \underset{\text{unit wt} \times \text{length}}{} \times l$$

$$= 6 \times 3.25 \times 0.15 \times 84 \, (50-2)$$

$$= 11794 \text{ kft.}$$



Moments around pt 5

$$\Sigma M_R = 3255 + 11794$$
$$= 15049 \text{ kft.}$$

(ignoring wt of end walls)

$$M_{\text{overturning}} = 3\left(\left(\underset{\text{side WL}}{0.314} + 0.5\right)\frac{40^2}{2}\right) + 2\left(0.25 + 0.15\right)\left(\frac{40^2}{2}\right)$$
$$+ 5\left(0.44 \times \frac{50^2}{2}\right)$$

$= 4355$ k ft

Safety factor $\frac{M_R}{M_{OT}}$

$= \frac{15049}{4355}$

$= 3.46 > 1.5$ min req'd.

2) Sliding

$V = (\cancel{0.5 + 0.314}^{.814}) \times 40 \times 3 + (\cancel{0.25 + 0.15}^{.40}) \times 40 \times 2$

$= 97.7 + 32$

$= 129.7$ k.

Resistance: — wt conc ~ $3.0 \times 84 \times 2$ (ft) $+ 0.15 (50-12)(84-12)$ (slab)

$= 504 + 410$

$= 914$ k.

Friction factor — assume 0.25 (conservative - could be ~ 0.40)

$F_R = \mu N$

$= 0.25 \times 914$

$= 228.5$ k

$SF = \frac{F_R}{V}$

$= \frac{228}{129}$

$= 1.76 > 1.5$ OK

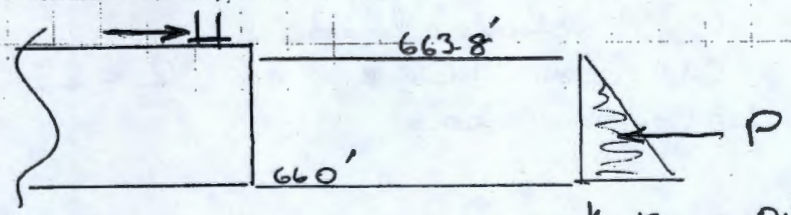
Lateral shears.

Maxima.

± 16.8 k Z dir. (longit)
+ 16.05 k X dir
− 19.6 k X dir } (lateral)

Trial

Assume resisted by soil pressure outside ftg rather than slab attachment.



$k_a p = 0.33 \times 2.8 \times 0.11$
$= 0.1$ ksf.

$\therefore P = 0.1 \times \frac{2.8}{2}$ /ft
$= 0.14$ k/ft.

for ftg 7' lg.

resistance $= 7 \times 0.14$
$= 1.0$ k. NG

Even if passive pressure considered, resistance ~ 3 k.

NG

vs. 20 k.

Conclusion — Must tie slab to edge ftg — This also removes the overturning pressure from lateral shears.

tension area req'd $= \frac{19.6}{20}$
$= 1$ in² /col.

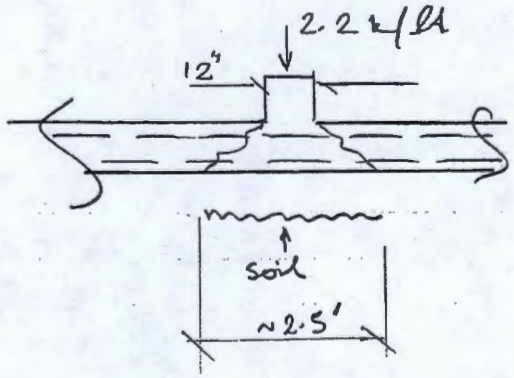
∴ 2 - #8 bars conservative. (actual supplied = 3-#8)

Slab Concrete.

Slab is assessed to be 12" thick. Preliminary calculations indicate t.e b reinforcing.

Loadings — Storage racks.
H20 vehicle loads.
ICV box 110 k on 2 x 25' pedl strips.
Lay-down areas

Strip ftgs — load 110k between 50' of pedl.
ie $\frac{110}{50} = 2.2$ k/ft.



lateral moment in slab ~ $2.2 \times \frac{0.75^2}{2}$
$= 0.6$ k ft / ft run.

As reqd ~ 0.04 in² bottom. OK.

Shear capacity ~ 6 k / ft run OK

Min steel in slab = 0.0018 x 12 x 12 NBC 1907.12.2.1
= 0.26 in²/ft
ie 0.13 in² t.e b.

Using #5 @ 12" ew top & bot = 0.31 in² ew.

so A_s = 0.62 in²/ft > 0.26 min.

& 0.04 bottom req'd

H 20 loads: 32 k / axle
24 k / axle tandem.

PCA. or Fig 6 method – 32 k axle, d = 9" for f'c = 300

– 24 k tandem. ~ 9"

So 12" slab is OK for H 20 loading.

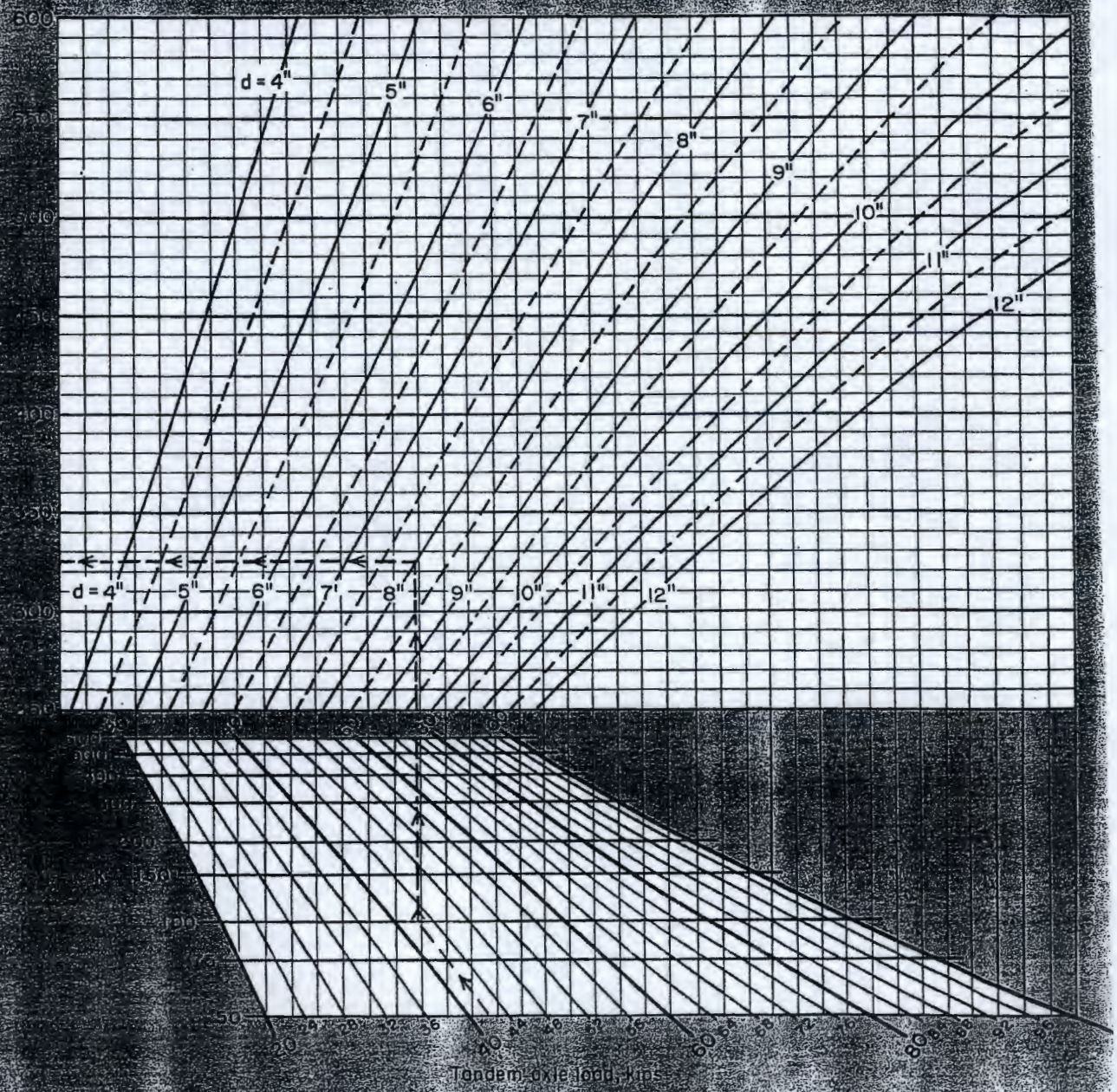


Fig. 7. Design chart for tandem-axle loads for Case I (based on Ref. 8, Influence Chart 6).

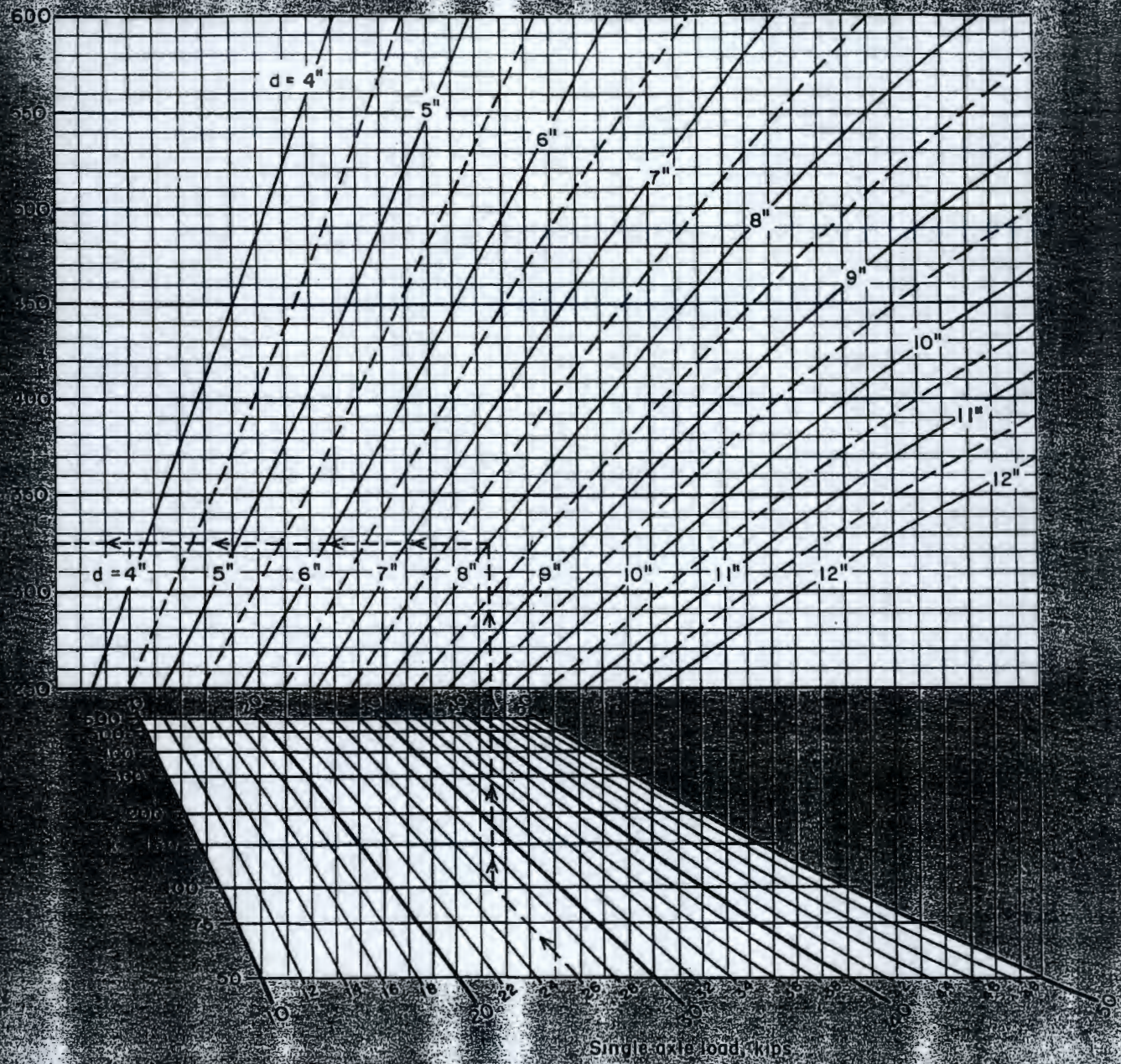


Fig. 6. Design chart for single-axle loads for Case 1 (based on Ref. 8, Influence Chart 6).

Storage and laydown areas are undefined for loading but the 12" slab will be OK with a conservative load limit defined on it of 500 psf.

Joints:—

Put construct / shrinkage joints at ~ 20' c/c.

Slab design.

Loadings — ICV box — wheel load placement
— strip load as placed.

— Storage loads — Area

— Storage loads — racks — post loads

— Lift trucks — wheel

— Trucks — wheel.

1) Lift trucks.

Assume max is 20 k capacity on dual front tires, pneu.
or, 10 k capacity on single front tires.

From P7 fig 2 tables. Slab thickness ~ 9.5"
" ~ 9.5"

So assumed 12" OK

2) Trucks. — single axle 24 k
dual axle 40 k

Conc. flex. stress $MR = 7.5\sqrt{f'c}$
$= 474$ psi.

$WS = \frac{474}{2}$
$= 238$ psi.

Slab stress/1000lb axle $= \frac{238}{24} = 10$ psi.

In fig 4, P8,

assume $k = 100$ pci — soil

slab thickness req'd = 8"

3) Storage Loads – Area.

Area loading from table 4, P13 ~ 1200 psf.

— This easily OK for area storage

4) Storage loads – rack posts.
$k = 100$ pci.

SF ~ 4
If pt loads = 5k & spacing 6' x 6'

$$\text{slab stress} = \frac{474}{4 \times 5}$$
$$= 23.7 \text{ psi} \quad / 1000 \text{ lb}$$

Area ~ 15 in²

Fig 7b on P10,
slab thickness ~ 9.7" req'd.

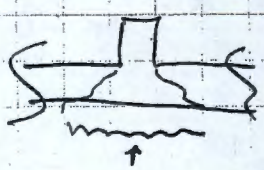
Alternatively at 12" slab & 6' x 6' post grid,
Allowable stress in slab = 16 psi. / 1000.
∴ Post load = 7400 lb. max.

5) ICV box – strip loads

– 110 k / 50' pedls

= 2.2 k/ft.

spread over 12" + 2 × 12"
= 36"



∴ soil bng press = 0.7 k/ft² equivalent to area loading since strip load is isolated maximum.

Rebar - P16, Fig. 15.
12" slab.
As ~ 0.10 in²/ft.
#5 @ 12" = 0.31 in²/ft. OK

Joint spacing
P14, Table 8. 12" slab, probable spacing ~ 30' +.

Wind pressure acting on the structure W and on the moving load WL.
Earthquake forces EQ.
Earth E, water and ice pressure ICE, stream flow SF, and uplift B acting on the substructure.
Forces resulting from elastic deformations, including rib shortening R.
Forces resulting from thermal deformations T, including shrinkage S.

Highway Bridge Loads. *Vehicular live load* of highway bridges is expressed in terms of design lanes and lane loadings. The number of design lanes depends on the width of the roadway.

Each lane load is represented either by a standard truck with trailer (Fig. 17-3) or, alternatively as a 10-ft-wide uniform load in combination with a concentrated load (Fig. 17-4). As indicated

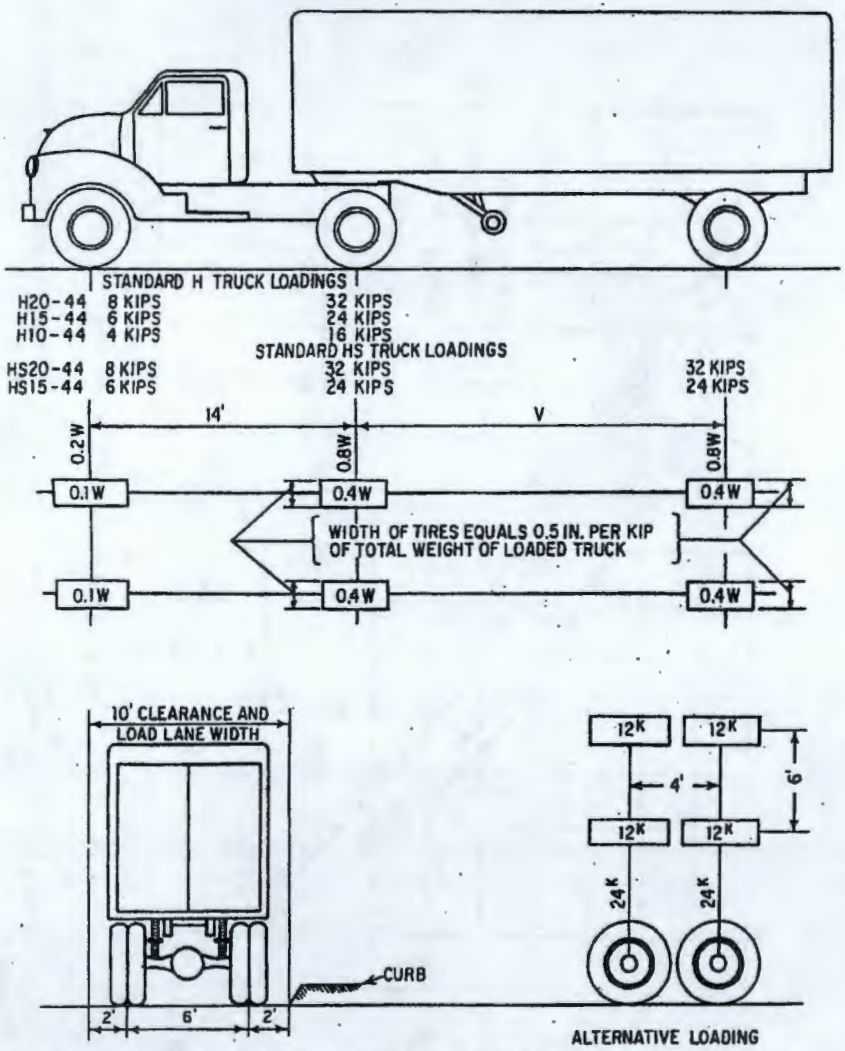


Fig. 17-3. Standard truck loading. For H trucks, W = total weight of truck and load, and for HS trucks, W = combined weight on the first two axles, which is the same weight as for H trucks. V indicates a variable spacing from 14 to 30 ft that should be selected to produce maximum stress.

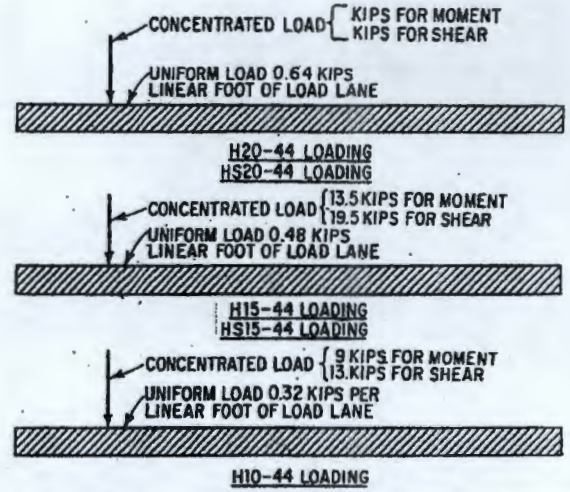


Fig. 17-4. H and HS lane loadings for simply supported spans. For maximum negative moment in continuous spans, an additional concentrated load of equal weight should be placed in one other span for maximum effect. For maximum positive moment, only one concentrated load should be used per lane, but combined with as many spans loaded uniformly as required for maximum effect.

in Fig. 17-3, there are five classes of loading: H20, H15, and H10, which represent a truck with two loaded axles, and HS20 and HS15, which represent a truck and trailer with three loaded axles. These loading designations are followed by a 44, which indicates that the loading standard was adopted in 1944.

In proportioning any member, all lane loads should be assumed to occupy, within their respective lanes, the positions that produce maximum stress in that member. Table 17-1 gives maximum moments, shears, and reactions for one loaded lane. Effects resulting from the simultaneous loading of more than two lanes may be reduced by a loading factor, which is 0.90 for three lanes and 0.75 for four lanes.

In design of steel grid and timber floors for H20 or HS20 loading, one axle load of 24 kips or two axle loads of 16 kips each, spaced 4 ft apart, may be used, whichever produces the greater stress, instead of the 32-kip axle shown in Fig. 17-3. For slab design, the center line of the wheel should be assumed to be 1 ft from the face of the curb.

Sidewalks and their immediate supports should be designed for a uniform live load of 85 psf. The effect of sidewalk live loading on main bridge members should be computed from

$$P = \left(30 + \frac{3{,}000}{l}\right)\frac{55 - b}{50} \leq 60 \text{ psf} \qquad (17\text{-}1)$$

where P = sidewalk live load, psf
l = loaded length of sidewalk, ft
b = sidewalk width, ft

Curbs should resist a force of 500 lb per lin ft acting 10 in. above the floor. For design loads for *railings*, see Fig. 17-5.

Impact is expressed as a fraction of live-load stress and is determined by the formula:

$$I = \frac{50}{125 + l} \quad (30\% \text{ maximum}) \qquad (17\text{-}2)$$

where l = span, ft; or for truck loads on cantilevers, length from moment center to farthermost axle; or for shear due to truck load, length of loaded portion of span. For negative moments in continuous spans, use the average of two adjacent loaded spans. For cantilever shear, use I = 30%. Impact is not figured for abutments, retaining walls, piers, piles (except for steel and concrete piles above ground rigidly framed into the superstructure), foundation pressures and footings, and sidewalk loads.

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The combination of a low k value with a low working stress in Fig. 2 results in a more conservative slab thickness than usual. More reliable and more economical designs can be obtained by the complete design method given in *Slab Thickness Design for Industrial Concrete Floors on Grade*. Use of this publication is illustrated in the following design-procedure examples.

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Table 4. Lift Truck Characteristics (Composites Averaged from Manufacturers' Data)

Rated capacity,* lb	Load on drive axle,** kips	Range of wheel spacings, in. (c to c)		
		Single wheels, s†	Dual wheels	
			s_d†	s†
2,000	6.4	26 to 30	—	—
4,000	10.4	31 to 35	—	—
6,000	14.6	32 to 38	—	—
10,000	22.2	37 to 43	10 to 12††	41 to 53††
15,000	32.5	37 to 45	10 to 12	47 to 60
20,000	42.0	40 to 50	12 to 14	54 to 65
30,000	63.3	—	14	57
45,000	100.6	—	18	73
60,000	132.0	—	21	70

Other data:
Load Contact Pressure
solid or cushion tires—180 to 250 psi
pneumatic tires—80 to 100 psi (inflation pressure)
Load Contact Area (per tire)
solid or cushion tires—3 or 4 times tire width
pneumatic tires—wheel load divided by contact pressure
Approximately 90% of total weight (truck + load) on drive axle at rated capacity.
Maximum axle load for many lift trucks is slightly greater than twice the rated capacity.

*Load center 24 in. from fork face, mast vertical.
**Varies by about 10%, depending on manufacturer
†See insert drawings on Figs 2 and 4
††Values shown are for pneumatic tires; limited data for 10,000-lb-capacity trucks with solid or cushion tires show shorter spacings; for example, 8.5x29 in.

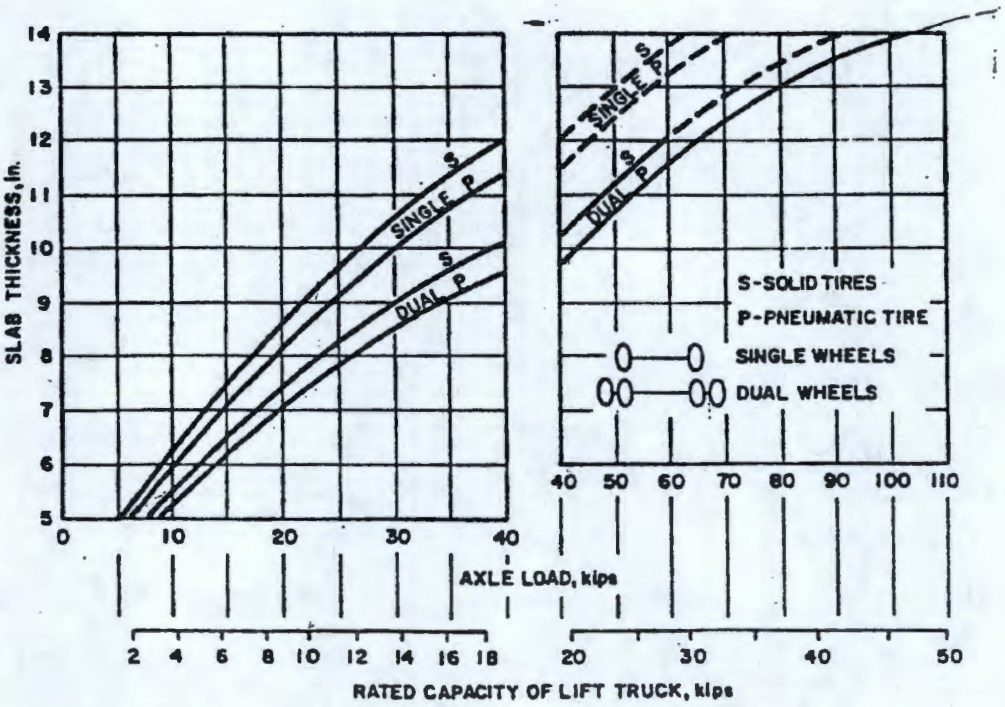

Fig. 2. Estimated slab thicknesses for lift trucks (based on average truck data shown in Table 4 and conservative design assumptions of k = 50 pci; concrete working stress = 250 psi).

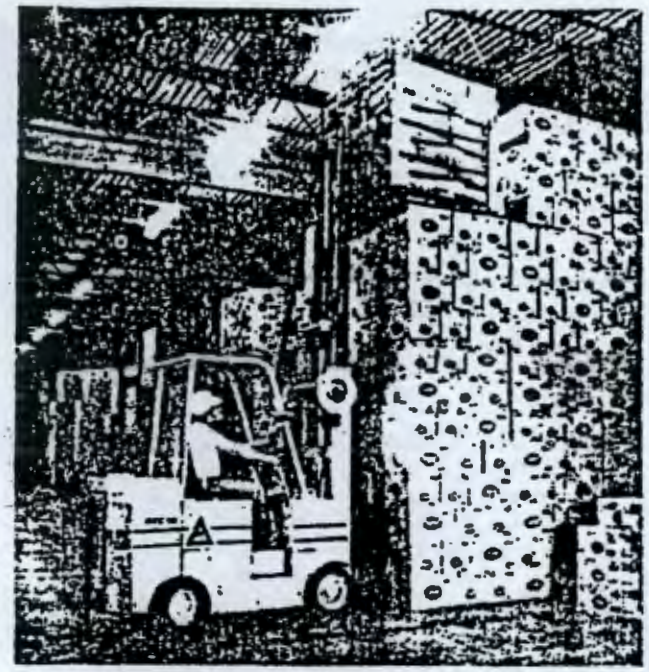

Fig. 3. Traffic and load data are needed for design of industrial concrete floors on ground.

Design Procedure

Vehicle Loads

Design for industrial lift-truck loads requires knowledge of several specifics:

- Maximum axle loads
- Number of load repetitions
- Wheel contact area
- Spacing between wheels on heaviest axles
- Subgrade strength
- Flexural strength of concrete *

Traffic and load data for past and future operating conditions for lift trucks can be gathered from plant maintenance departments, planning and operations departments, and truck manufacturers' data. With this information, the safety factor can be selected and used to determine an allowable working stress with which to enter the design charts.

The safety factor (flexural strength divided by working stress) reflects the expected frequency of loadings of the heaviest vehicles. Safety factors in the range of 1.7 to 2.0 are suggested for industrial and commercial floors. The high number should be used where the heavy load traffic is frequent and channelized. Where traffic is light and not channelized, low safety factors of 1.4 to 1.7 can be used.

The design chart for industrial trucks with single-wheel axles, Fig. 4, was taken from *Slab Thickness Design for*

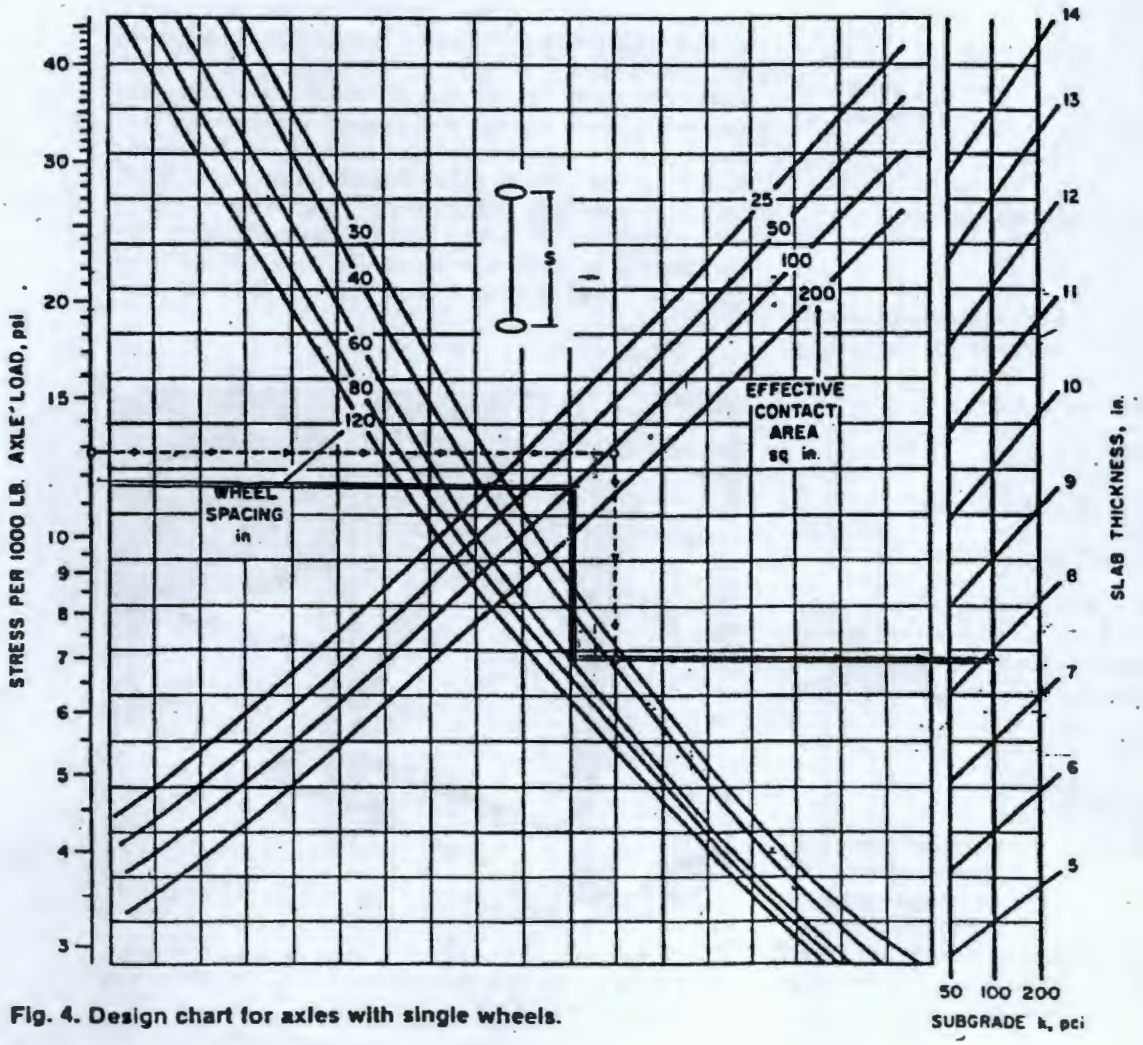

Fig. 4. Design chart for axles with single wheels.

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Industrial Concrete Floors on Grade. The chart is entered with a calculated number for allowable working stress per 1000 lb of axle load. This number is obtained by dividing the modulus of rupture of the concrete by the safety factor and then dividing the result by the axle load in kips. The calculation makes it possible for one chart to cover a wide range of load magnitudes.

For axles equipped with dual wheels, *Slab Thickness Design for Industrial Concrete Floors on Grade* includes a chart for converting a dual-wheel axle load to an equivalent single-wheel axle load. Then Fig. 4 can be used to determine the required thickness of the slab.

The effective contact area used in the charts is the corrected area of tire in contact with the slab. If tire data are not available, the contact area can be estimated for pneumatic tires by dividing wheel load by inflation pressure. For solid or cushion tires, it can be approximated by multiplying tire width by three or four. Tire data can also be obtained from the tire manufacturers.

Thickness Design Example—Single-wheel axle loads

Data for Lift Truck

Axle load	25 kips (axle with single wheels)
Wheel spacing	37 in.
Number of wheels	2
Tire inflation pressure	110 psi
Tire contact area	$= \frac{\text{wheel load}}{\text{inflation pressure}}$
	$= \frac{25{,}000/2}{110} = 114$ sq in. (large enough, correction not required)

Subgrade and Concrete Data

Subgrade modulus, k	100 pci
Concrete flexural strength, MR	640 psi

Design Steps

1. Safety factor, SF:
   For frequent operations of forklift trucks in channelized aisle traffic, select a safety factor permitting unlimited stress repetitions—2.0.
2. Concrete working stress, WS:
   $$WS = \frac{MR}{SF} = \frac{640}{2.0} = 320 \text{ psi}$$
3. Slab stress per 1000 lb of axle load:
   $$\frac{WS}{\text{axle load, kips}} = \frac{320}{25} = 12.8 \text{ psi/1000 lb}$$
4. Enter Fig. 4 at left with stress of 12.8 psi; move right to contact area of 114 sq in.; down to wheel spacing of 37 in.; then right to read a slab thickness of 7.9 in. on the line for subgrade k of 100 pci. Use 8-in.-thick slab.

High-Rack-Storage Leg Loads

Advancements in mechanized, computerized material-handling equipment generated the high-rack configuration now used for product storage in warehouses. In these buildings, permanent racks of fixed dimensions may rise to heights up to 60 ft. When loads on the legs (or posts) exceed the wheel loads of vehicles operating in the warehouse, leg loads will control the thickness design.

For leg loads, the design objective is to keep flexural stresses in the slab within safe limits. When flexural requirements are satisfied by adequate slab thickness, pressures on the soil will not be excessive; and when a correct-size base plate is used, concrete bearing and punching shear stresses will remain within acceptable limits.

The design factors for high-rack-leg loads are similar to those used for vehicle loads except that a higher safety factor is selected. The specific design factors are

Maximum expected load on leg (post)
Effective (corrected) load contact area
Spacing between legs (posts)
Subgrade strength
Flexural strength of the concrete

Fig. 6, taken from *Slab Thickness Design for Industrial Concrete Floors on Grade*, is used to determine the slab thickness requirements for rack configurations and loads. The x- and y-leg spacings used in Fig. 6 are the smallest dimension in the rack configuration (except the spacing between legs on opposite sides of a joint).

The procedure is similar to that for wheel loads. In the grid to left of chart, locate the point corresponding to stress per 1000-lb-leg (post) load and effective contact area. Move right to the y-post spacing (length or long axis dimension of the racks); then move up (or down) to the x-spacing and right to read the slab thickness.

For loads on high racks, use high safety factors because of the height of the racks. High-rack loads require conservative safety considerations because the racks sometimes support the roof structure and because the effects of differences in movement at the base of the rack are magnified at the top. In addition, if the rack layout and the slab joint layout are not coordinated, it is possible that some rack legs could be located near a joint. Unless the slab edges are intentionally thickened, this would result in higher floor slab stresses than those shown in Fig. 6, which are based on loads at the slab interior. Safety factors should be chosen to account for the possibility of rack loads applied close to slab edges or corners.

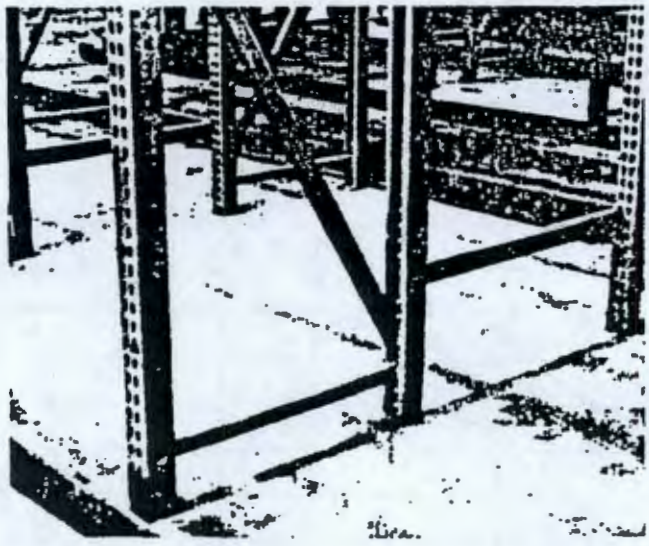

Fig. 5. Loaded legs supporting high-rack storage must have base plates of adequate size to prevent bearing or shear failure in the slab.

Table 5. Allowable Distributed Loads, Unjointed Aisle (Uniform Load, Fixed Layout)

Slab thickness, in.	Working stress, psi	Critical aisle width, ft**	Allowable load, psf†					
			At critical aisle width	At other aisle widths				
				6-ft aisle	8-ft aisle	10-ft aisle	12-ft aisle	14-ft aisle
Subgrade k = 50 pci*								
5	300	5.6	610	615	670	815	1,050	1,215
	350	5.6	710	715	785	950	1,225	1,420
	400	5.6	815	820	895	1,085	1,400	1,620
6	300	6.4	670	675	695	780	945	1,175
	350	6.4	785	785	810	910	1,100	1,370
	400	6.4	895	895	925	1,040	1,260	1,570
8	300	8.0	770	800	770	800	880	1,010
	350	8.0	900	935	900	935	1,025	1,180
	400	8.0	1,025	1,070	1,025	1,065	1,175	1,350
10	300	9.4	845	930	855	850	885	960
	350	9.4	985	1,085	1,000	990	1,035	1,120
	400	9.4	1,130	1,240	1,145	1,135	1,185	1,285
12	300	10.8	915	1,065	955	915	925	965
	350	10.8	1,065	1,240	1,115	1,070	1,080	1,125
	400	10.8	1,220	1,420	1,270	1,220	1,230	1,290
14	300	12.1	980	1,225	1,070	1,000	980	995
	350	12.1	1,145	1,430	1,245	1,170	1,145	1,160
	400	12.1	1,310	1,630	1,425	1,335	1,310	1,330

*k of subgrade: disregard increase in k due to subbase.
**Critical aisle width equals 2.209 times radius of relative stiffness. Critical aisle width has maximum negative bending moment (tension in top slab at aisle centerline due to loads on each side of aisle). For other aisle widths, bending moments are not maximum.
Assumed load width = 300 in.; allowable load varies only slightly for other load widths. Allowable stress = one-half flexural strength.
†There is an explanation in *Slab Thickness Design for Industrial Concrete Floors on Grade*, from which this table is reproduced, for what appear to be anomalous allowable loads.

Table 6. Allowable Distributed Loads, Unjointed Aisle (Nonuniform Loading, Variable Layout)

Slab thickness, in.	Subgrade k* pci	Allowable load, psf**			
		Concrete flexural strength, psi			
		550	600	650	700
5	50	535	585	635	685
	100	760	830	900	965
	200	1,075	1,175	1,270	1,370
6	50	585	640	695	750
	100	830	905	980	1,055
	200	1,175	1,280	1,390	1,495
8	50	680	740	800	865
	100	960	1,045	1,135	1,220
	200	1,355	1,480	1,603	1,725
10	50	760	830	895	965
	100	1,070	1,170	1,265	1,365
	200	1,515	1,655	1,790	1,930
12	50	830	905	980	1,055
	100	1,175	1,280	1,390	1,495
	200	1,660	1,810	1,965	2,115
14	50	895	980	1,060	1,140
	100	1,270	1,385	1,500	1,615
	200	1,795	1,960	2,120	2,285

Reproduced from *Slab Thickness for Industrial Concrete Floors on Grade* Portland Cement Association publication IS195D

*k of subgrade disregard increase in k due to subbase
**For allowable stress equal to one-half flexural strength
Based on aisle and load widths giving maximum stress

Allowable loads based on this consideration can be found in Tables 5 and 6 for fixed and variable storage layouts. Note that the k value of the subgrade, rather than the k value on top of the subbase (if there is one), is used in these tables.

Storage Layout

The magnitudes of flexural stresses and deflections due to distributed loads vary with slab thickness and subgrade strength. They also vary with aisle width, dimensions of the loaded area, and the existence of joints or cracks in the aisleway. In Table 5 for fixed layout, the critical aisle width and its allowable distributed load are identified and the loads for other aisle widths are given. Table 5 is used when the storage layout is preplanned.

The allowable loads shown in Table 6 for variable layout represent the most critical conditions and are suggested for practical design use where the aisle and storage layout is unknown at planning time. There are no restrictions on where the load is placed or on the uniformity of loading for the allowable loads in Table 6. When there are joints in the aisleways or if cracks should occur, the limit of load will depend on the tolerable settlement of the slab.

For wheel and rack loads, increased slab thickness effectively reduces the unit pressure transmitted to the subgrade soil. Under uniform distributed loads, however, soil pressure is not reduced by slab thickness, but is equal to the uniform load on the slab plus the slab weight plus the weight of any fill material. Therefore, when the loads

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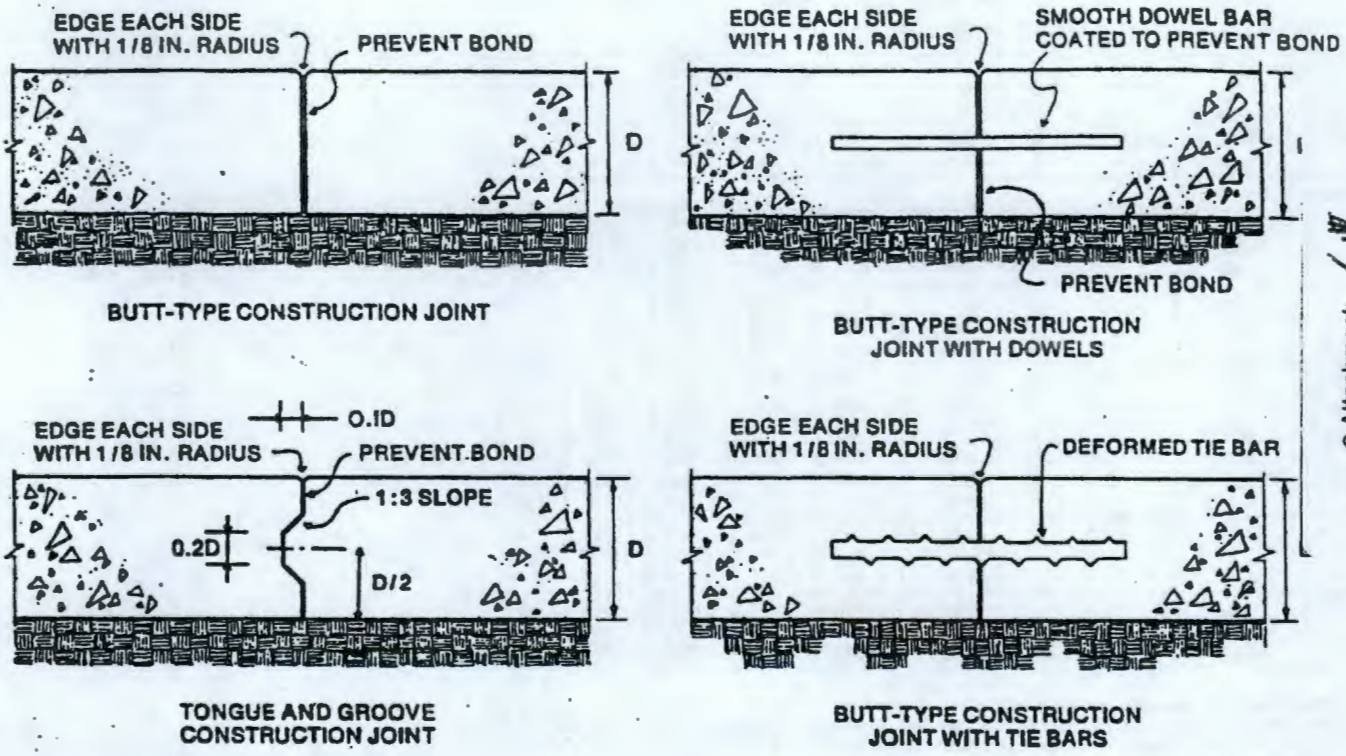

Fig. 13. Varieties of construction joints.

Table 7. Dowel Size and Spacing

Slab depth, in.	Diameter, in.	Total length, in.	Spacing, in. c to c
5	⅝	12	12
6	¾	14	12
7	⅞	14	12
8	1	14	12
9	1⅛	16	12
10	1¼	16	12
Tiebar Size and Spacing			
5	#4	30	30
6	#4	30	30
7	#4	30	30
8	#4	30	30
9	#5	30	30
10	#5	30	30

Table 8. Suggested Spacing of Control Joints

Slab thickness, in.	Less than ¾-in. aggregate: spacing, ft	Larger than ¾-in. aggregate: spacing, ft	Slump less than 4 in.: spacing, ft
5	10*	13	15
6	12	15	18
7	14	18	21
8	16	20	24
9	18	23	27
10	20	25	30

*Given spacings also apply to the distance from control joints to parallel isolation joints or to parallel construction joints. Refer to text for other factors that may call for different spacing.

Construction Joints

Construction joints form the edges of each day's work or are inserted where construction operations are suspended for 30 minutes or more. A true construction joint (also called a cold joint) permits neither horizontal or vertical movement. Because true construction joints are difficult to make, they are usually made to function as and usually align with the control joints or isolation joints.

A butt-type joint is satisfactory for thin floors, as shown in Fig. 13. For thicker, more heavily loaded floors, a tongue and groove joint is used or dowels are added to the butt joint. When work is interrupted for 30 minutes or more and the joint is inserted, a butt joint with tiebars should be used (Fig. 13). Tiebars will prevent an opening of the joint at this location that could cause a crack to develop in the adjacent panel. Tiebar sizes and spacings are shown in Table 7.

Filling Joints

The movement at control joints in a floor is generally very small. For many industrial and commercial uses, these joints can be left unfilled; but where there are wet conditions, hygienic and dust-control requirements, or considerable traffic by small, hard-wheeled vehicles such as fork lifts, joint filling is necessary.

In many places, a resilient material is satisfactory, but to provide support to the edges and prevent spalling at the joints, a good quality rigid or semirigid filler with a Shore "A" hardness number of approximately 80 should be used.

Extruded lead strips embedded in the control joints give support to the edges and thereby reduce spalling.

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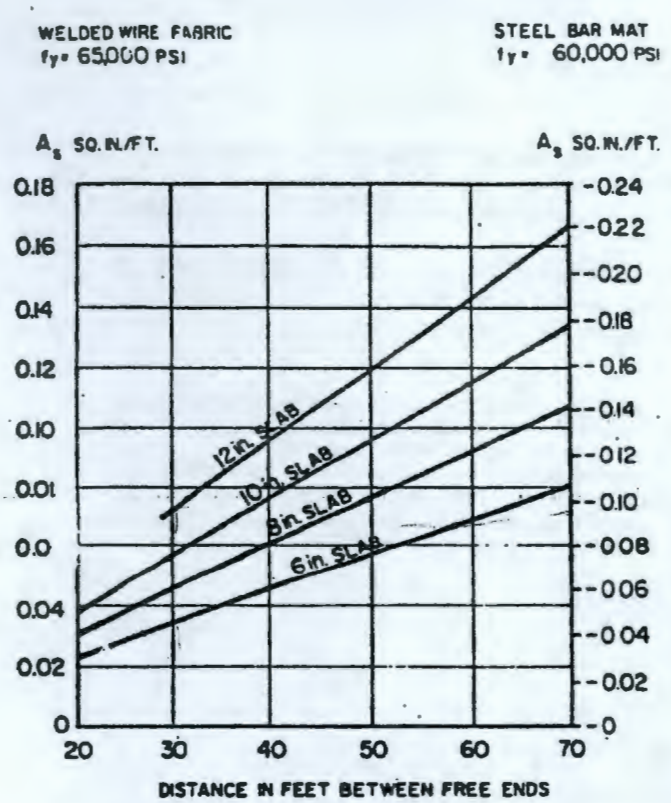

Fig. 15. Selection chart for distributed steel.

UNJOINTED FLOORS

An unjointed floor can be constructed when joints are unacceptable in floor use. Three methods are suggested:

1. A prestressed floor can be built with prestressing steel strands pulled taut to put a small compressive stress in the concrete. This will counteract the development of tensile stresses and provide a crack-free surface. Large areas, 10,000 sq ft and larger, can be constructed in this manner without any control joints.
2. Concrete made with expansive cement can be used to offset the amount of drying shrinkage to be anticipated after curing. Control joints are not needed when construction joints are used at intervals of 40 to 120 ft. Large areas, to 10,000 sq ft, can be cast in this manner.
3. Large areas can be cast without control joints when distributed steel about one-half of 1% times the cross-sectional area is placed in the slab to resist shrinkage. Areas as large as a tennis court can be built without control joints.

CONSTRUCTION

Workmanship

All parties—owner, designer, contractor—must agree prior to bidding on the level of quality or class of workmanship that will be necessary for the floor job they want. A good concrete floor on ground is the result of sensible planning, careful design and detailing, complete specifications, proper inspection, good workmanship, and the good intentions of each person sharing responsibility for the end result.

Subgrades

Good construction begins with a well-prepared subgrade. Many floor problems can be traced to poor subgrade preparation. A poorly compacted and prepared subgrade ranks high as a cause of settlement cracking and failure to carry the applied loads.

The subgrade should be uniform, firm, and free from all sod, grass, humus, and other rich organic matter as these materials will not compact to give good support to

Fig. 16. Subgrade must be moist when concrete is placed.

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Because flexure controls, the design factors are similar to those used for vehicle loads except that the use of a higher safety factor may be appropriate. The specific design factors are:

maximum post load
load contact area
spacing between posts
subgrade-subbase strength
flexural strength of concrete

Figs. 7a, 7b, and 7c are used to determine the slab thickness requirements for k values of 50, 100, and 200 pci. The charts* were developed to estimate slab stresses for the two equivalent post configurations and load conditions shown in Fig. 8, representing continuous racks. In Figs. 7a, 7b, and 7c, the post spacing, y, is in the longitudinal direction of a continuous rack and x is the transverse spacing.

When using the design charts, the load contact area should be corrected to effective contact area as determined from Fig. 5.

For special post load configurations that deviate substantially from those indicated in Fig. 8, slab stresses may be determined by computer program[10]** or by influence charts.[18]

It should be noted that the design procedure is based on load stresses only; it is not necessary to consider shrinkage stresses (see first footnote on page 4).

*For a structurally reinforced slab, bending moments computed from the flexural stress determined from Figs. 7a, 7b, and 7c may be used to compute the required tensile reinforcement.

**The computer program may be used with appropriate modifications in the shape of the contact area. For the range of contact areas involved, a circular or elliptical area may be used without significant error to approximate a square or rectangular area.

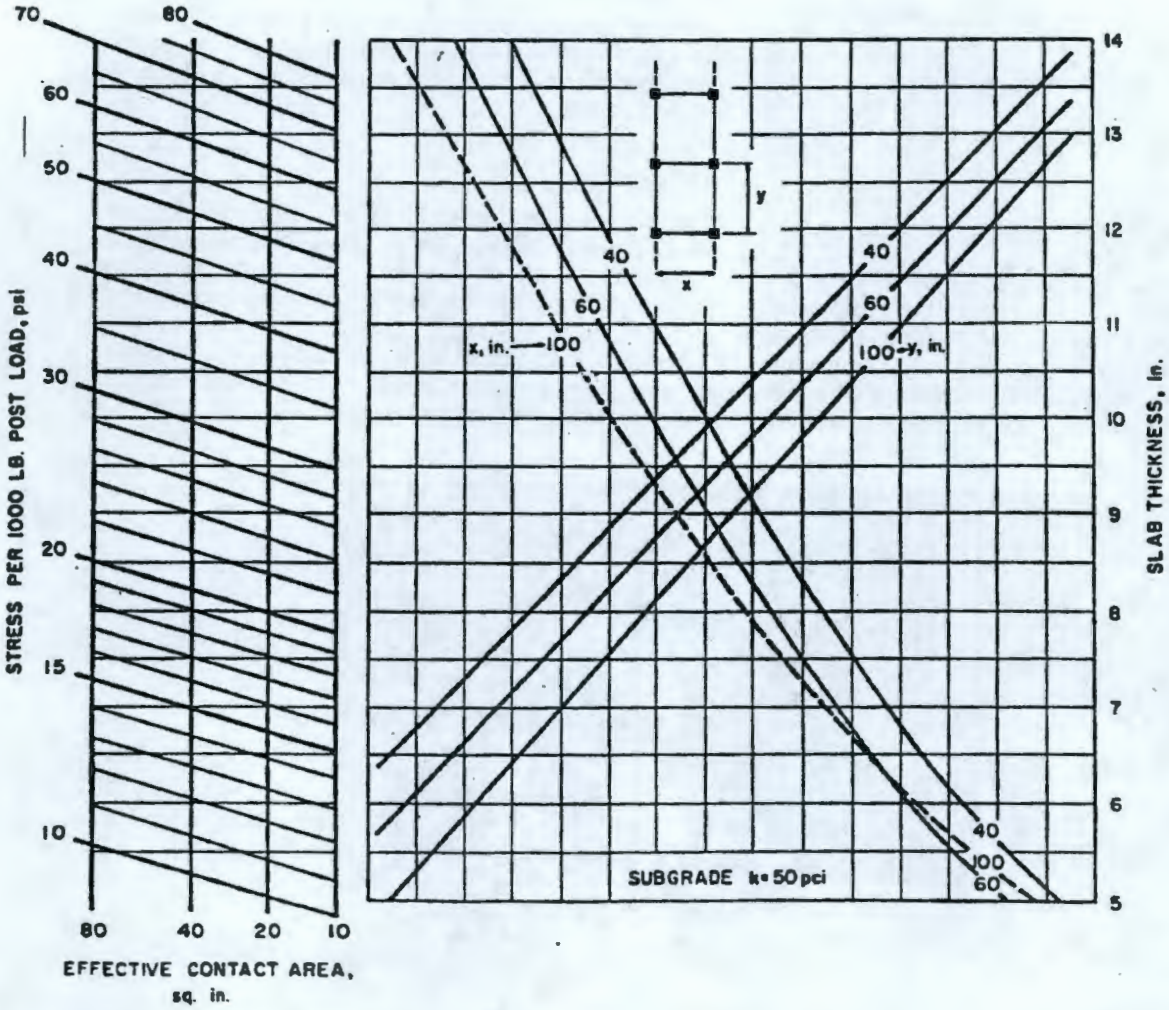

Fig. 7a. Design chart for post loads, subgrade k = 50 pci.

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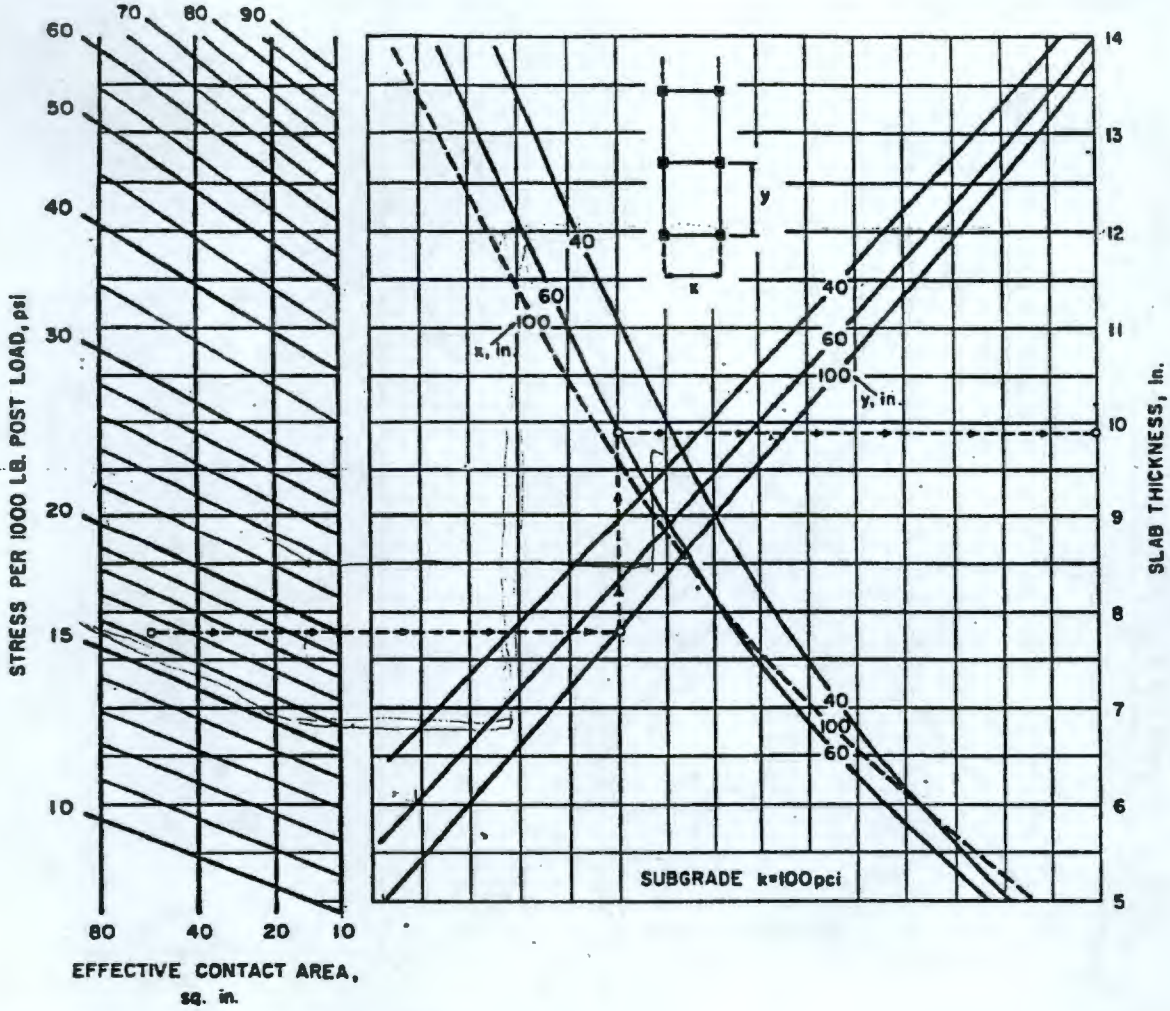

Fig. 7b. Design chart for post loads, subgrade k = 100 pci.

Safety Factors for Post Loads

The specific safety factors to be selected for concentrated static loads are not given here but are left to the judgment of the design engineer. There are two reasons for this:

(1) The range of possible safety factors may be quite wide; the factor may be relatively low—2 or less—under a noncritical loading condition, or quite high—approximately 5—in a situation where consequences of slab failure are quite serious.

(2) Performance experience and experimental data for concentrated static loads are not available.

Some of the factors to be considered in the selection of the safety factor are discussed below.

Static loads on posts have effects different from loads on vehicles in that (1) moving wheel loads produce lower slab stresses than static loads of the same magnitude, and (2) creep effects reduce stress under static load. Information on how these effects may be quantified in design problems is not available.

There may be several reasons to use higher safety factors for loads on high racks than those used for low racks or for vehicle loads or distributed loads. The rack posts are sometimes designed to partially support the roof structure, and effects of differences in deflection between rack posts are magnified with high racks. In addition, if the rack layout and the slab joint layout are not coordinated, it is possible that some rack posts could be located at or near a joint or corner. Unless the slab edges are thickened, this would result in higher stresses* than those shown in Figs. 7a, 7b,

*Edge load stresses are higher than corner load stresses, which are in turn higher than interior load stresses. However, edge and corner stresses are diminished somewhat in the usual situation where load transfer at the joints is provided by dowels, keyways, or aggregate interlock under saw cuts. An analysis using a conservative 25% load transfer and the multiple post configurations indicated in Fig. 8 shows that edge stresses exceed interior stresses by 13% to 50%. Reference 17 gives experimental data on edge and corner stresses and equations for computing these.

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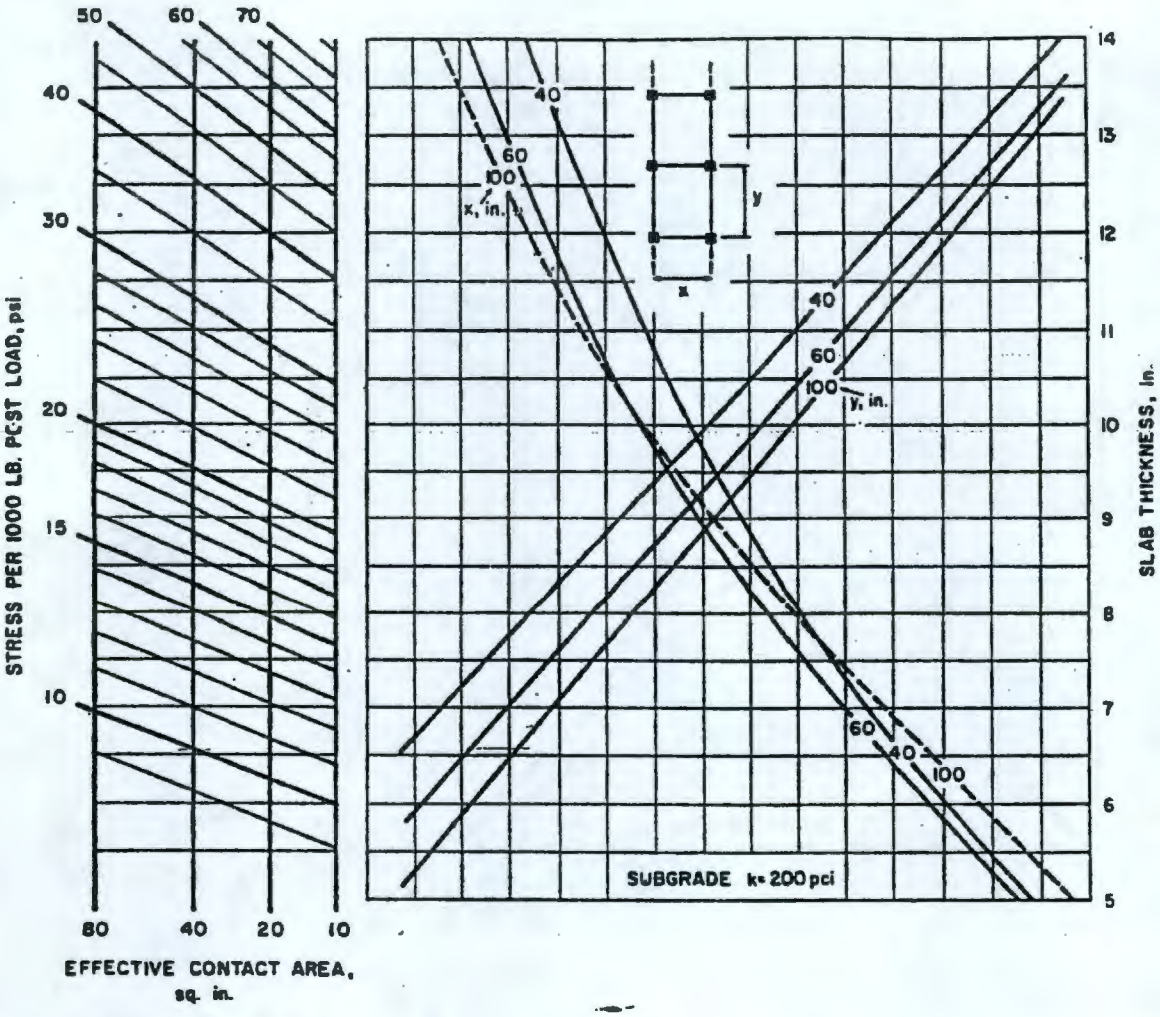

Fig. 7c. Design chart for post loads, subgrade $k = 200$ pci.

and 7c, which are based on loads at the slab interior. Safety factors should be chosen to account for this possibility of higher stresses due to slab edge or corner loads.

Since there is a lack of published data on performance experience with rack loads on slabs on grade, safety factors cannot be suggested with as much confidence as for vehicle loads. Therefore, it is important to consider carefully the characteristics of this type of loading and the desired performance requirements.

A safety factor of 4.8 can be computed based on building code requirements[16] if the post is considered as a critical structural element—a column—in the building and the slab is considered as an unreinforced spread footing.

This value of 4.8 is considered the upper limit of the safety factor range because the post load situation is usually not as critical as that for columns on footings. The latter are spaced farther apart and each supports a greater proportion of the total structural load. The fundamental difference between the two types of loading lies in the difference in the magnitudes of pressure on the underlying soil. Soil pressures under a footing may be near the limit of allowable soil bearing; if a failure should occur in the footing, the allowable soil pressure would be exceeded and there would be a possibility of intolerable soil penetration, settlement, or complete collapse. On the other hand, soil pressures under a slab of adequate thickness supporting a post load are much lower than those for a footing. This is because the slab distributes the load over a large area of subgrade. Even if a joint or crack, or intersection of these, should occur at a post, deflections and soil pressures will be increased by magnitudes of two or three* but are still not excessive.

After the designer has considered the degree of criticalness of his loading conditions and selected an appropriate safety factor, Fig. 7a, b, or c is used to establish a slab design thickness based on flexure. Shear stress and concrete

*Reference 17 shows experimental data comparing deflections due to loads at slab corners, edges, and interiors from which corresponding soil pressures can be computed.

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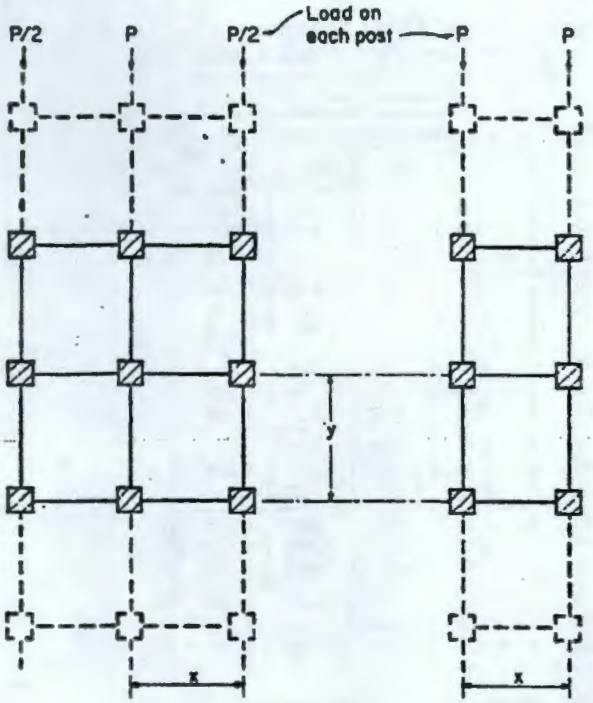

Fig. 8. Post configurations and loads for which Figs. 7a, 7b, and 7c apply.

bearing stress should also be computed to determine if these values are within safe limits. The following example problem illustrates the procedure for determining slab stresses due to post loads.

Design Example—Post Loads

Data for Post Configuration and Load

Post spacings	98 in. longitudinal (y), 66 in. transverse (x)
Post loads	13 kips, each post
Load contact area	8-in.-sq. plate (64 sq.in.)

Subgrade and Concrete Data

Subgrade modulus, k	100 pci
Concrete flexural strength, MR	640 psi at 28 days

Design Steps

1. Safety factor, SF:
   Assume that a factor of 3.0 has been selected.
2. Concrete working stress, WS:

$$WS = \frac{MR}{SF} = \frac{640}{3.0} = 213 \text{ psi}$$

3. Slab stress per 1,000 lb. of post load

$$= \frac{WS}{\text{post load, kips}} = \frac{213}{13} = 16.4 \text{ psi}$$

4. For a subgrade k-value of 100 pci, use Fig. 7b. In the grid at the left of the figure, locate the point corresponding to 16.4 psi stress and 64-sq.in. contact area; then move right to y-post spacing of 98 in.; up to x-post spacing of 66 in.; then right to slab thickness of 9.8 in. (use 10-in.-thick slab).
5. Use Fig. 5 to determine if the effective contact area is significantly larger than the actual contact area. For a 10-in. slab and contact area of 64 sq.in., the effective contact area is 70 sq.in.; this correction does not significantly change the required slab thickness.
6. The following check of concrete bearing and shear stresses indicates that they are within allowable limits (see footnote on page 7, right column).

allowable bearing stress
for interior load $= 4.2MR = 2{,}690$ psi
for edge or corner load $= 2.1MR = 1{,}345$ psi

$$\text{computed bearing stress} = \frac{\text{post load}}{\text{load area}} = \frac{13{,}000}{64}$$

$$= 203 \text{ psi}$$

$$\text{allowable shear stress} = 0.27MR = 173 \text{ psi}$$

$$\text{computed shear stress} = \frac{\text{post load}}{\text{shear area}}$$

computed shear stress for interior load

$$= \frac{\text{post load}}{\text{slab depth [(load periphery) + 4 (slab depth)]}}$$

$$= \frac{13{,}000}{10\,[32 + 40]} = 18 \text{ psi}$$

computed shear stress for edge load

$$= \frac{\text{post load}}{\text{slab depth [0.75 (load periphery) + 2 (slab depth)]}}$$

$$= \frac{13{,}000}{10\,[24 + 20]} = 30 \text{ psi}$$

computed shear stress for corner load

$$= \frac{\text{post load}}{\text{slab depth [0.5 (load periphery) + (slab depth)]}}$$

$$= \frac{13{,}000}{10\,[16 + 10]} = 50 \text{ psi}$$

For very heavy post loads, the required thickness of plain concrete slabs may be great enough that alternate designs should be considered, such as:

- integral or separate footings under each post or line of posts (post locations would have to be permanently fixed);
- structurally reinforced slabs with steel designed to take the tensile stresses;
- use of a cement-treated subbase under the concrete slab.

DISTRIBUTED LOADS

Distributed loads are defined as loads covering a large area

due to material placed directly on the floor in storage bays. For most plant and warehouse buildings, concentrated loads are the controlling factor in floor design since distributed loads usually do not produce flexural stresses of the same magnitude. However, after an adequate slab thickness has been selected to support the heaviest vehicle and post loads, the effects of distributed loads should also be examined.

As discussed on pages 3 and 4, the design objectives for distributed loads are (1) to prevent cracks in the aisleways due to excessive negative moment (tension in top of slab), and (2) to avoid objectionable settlement of the slab.

Cracking in an unjointed aisle due to distributed loads can be controlled by selecting an adequate slab thickness. Slab settlement, however, cannot be prevented by making the slab thicker. Usually the magnitude of distributed loads placed on floors with properly prepared and compacted subgrades is not sufficient to cause excessive settlement. However, for very heavy distributed loads on compressible subgrades, the possibility of soil consolidation should be examined by soil foundation engineering techniques.

Allowable Loads to Prevent Cracking in Unjointed Aisleway

In an unjointed aisleway between distributed load areas, the maximum negative bending moment in the slab may be up to twice as great as the moment in the slab beneath the loaded area. As a result, one design objective is to limit these stresses in the aisleway so that a crack will not occur.

Allowable loads based on this design objective are shown in Tables 4 and 5.* The use of these tables is discussed in the following sections: Table 4 is used if the aisle and storage layout may be changed during the service life of the floor. If the layout is permanently fixed, Table 5 is used.

It should be noted that the *k*-value of the subgrade, rather than the *k* on top of the subbase (if there is one), is used in Tables 4 and 5. This is appropriate for distributed loads covering large areas, while the use of the *k*-value on the top of the subbase is appropriate for concentrated loads.

Variable Storage Layout

The magnitudes of flexural stresses and deflections due to distributed loads vary with slab thickness and subgrade strength. They also depend on aisle width, width of loaded area, and whether or not a joint or crack exists in the aisleway. These additional variables are not always constant or predictable during the service life of a floor. Therefore, the allowable loads shown in Table 4, representing the most critical conditions, are suggested for practical design use where the aisle and storage layout is not predictable or permanent.

Since the allowable loads in Table 4 are based on the most critical conditions, there are no restrictions on the load layout configuration or the uniformity of loading. Loads up to these magnitudes may be placed nonuniformly in any configuration and changed during the service life of the floor. (Heavier loads may be allowed, as shown in Table 5, under restricted conditions of load configuration.)

The allowable loads in Table 4 are based on a safety factor of 2.0 (allowable working stress equal to one-half of the concrete's flexural strength). This is conservative. For other safety factors that the designer may wish to use, the allowable working stress is first computed by dividing the 28-day flexural strength, *MR*, by the safety factor; then the allowable load may be computed as:

$$W = 0.123 f_t \sqrt{hk}$$

where W = allowable load, psf
f_t = allowable working stress, psi
h = slab thickness, in.
k = subgrade modulus, pci

Fixed Storage Layout

As discussed in the previous section, slab stresses under distributed loads vary with aisle width, load width, and joint

Table 4. Allowable Distributed Loads, Unjointed Aisle (Nonuniform Loading, Variable Layout)

Slab thickness, in.	Subgrade k,[1] pci	Allowable load, psf[2] — Concrete flexural strength, psi: 550	600	650	700
5	50	535	585	635	685
	100	760	830	900	965
	200	1,075	1,175	1,270	1,370
6	50	585	640	695	750
	100	830	905	980	1,055
	200	1,175	1,280	1,390	1,495
8	50	680	740	800	865
	100	960	1,045	1,135	1,220
	200	1,355	1,480	1,603	1,725
10	50	760	830	895	965
	100	1,070	1,170	1,265	1,365
	200	1,515	1,655	1,790	1,930
12	50	830	905	980	1,055
	100	1,175	1,280	1,390	1,495
	200	1,660	1,810	1,965	2,115
14	50	895	980	1,060	1,140
	100	1,270	1,385	1,500	1,615
	200	1,795	1,960	2,120	2,285

[1] *k* of subgrade; disregard increase in *k* due to subbase.
[2] For allowable stress equal to ½ flexural strength.
Based on aisle and load widths giving maximum stress.

*In the preparation of these tables, flexural stresses were computed based on Hetényi.[21] A similar approach was used by Rice[20] for distributed loads. Although the basic equations are the same, the allowable loads shown in Tables 4 and 5 differ from those of Rice because he made a large allowance for slab shrinkage stresses. In addition, he considered zero uplift of joints in the aisleway as one of the design criteria. As explained in the first footnote on page 4, shrinkage stresses may be disregarded in the design procedure. Also, it can be shown that loads up to the magnitudes shown in Tables 3 and 4 produce only very small joint uplifts that would be completely tolerable for most requirements. Concerning slab stresses due to wheel loads at uplifted joints, experimental data[17] show that these are less than the stresses in slabs that are not uplifted at the joint.

Table 5. Allowable Distributed Loads, Unjointed Aisle (Uniform Load, Fixed Layout)

Slab thickness, in.	Working stress, psi	Critical aisle width, ft.(2)	Allowable load, psf: At critical aisle width	At other aisle widths: 6-ft. aisle	8-ft. aisle	10-ft. aisle	12-ft. aisle	14-ft. aisle
Subgrade k = 50 pci(1)								
5	300	5.6	610	615	670	815	1,050	1,215
	350	5.6	710	715	785	950	1,225	1,420
	400	5.6	815	820	895	1,085	1,400	1,620
6	300	6.4	670	675	695	780	945	1,175
	350	6.4	785	785	810	910	1,100	1,370
	400	6.4	895	895	925	1,040	1,260	1,570
8	300	8.0	770	800	770	800	880	1,010
	350	8.0	900	935	900	935	1,025	1,180
	400	8.0	1,025	1,070	1,025	1,065	1,175	1,350
10	300	9.4	845	930	855	850	885	960
	350	9.4	985	1,085	1,000	990	1,035	1,120
	400	9.4	1,130	1,240	1,145	1,135	1,185	1,285
12	300	10.8	915	1,065	955	915	925	965
	350	10.8	1,065	1,240	1,115	1,070	1,080	1,125
	400	10.8	1,220	1,420	1,270	1,220	1,230	1,290
14	300	12.1	980	1,225	1,070	1,000	980	995
	350	12.1	1,145	1,430	1,245	1,170	1,145	1,160
	400	12.1	1,310	1,630	1,425	1,335	1,310	1,330
Subgrade k = 100 pci(1)								
5	300	4.7	865	900	1,090	1,470	1,745	1,810
	350	4.7	1,010	1,050	1,270	1,715	2,035	2,115
	400	4.7	1,155	1,200	1,455	1,955	2,325	2,415
6	300	5.4	950	955	1,065	1,320	1,700	1,925
	350	5.4	1,105	1,115	1,245	1,540	1,985	2,245
	400	5.4	1,265	1,275	1,420	1,760	2,270	2,565
8	300	6.7	1,095	1,105	1,120	1,240	1,465	1,815
	350	6.7	1,280	1,285	1,305	1,445	1,705	2,120
	400	6.7	1,460	1,470	1,495	1,650	1,950	2,420
10	300	7.9	1,215	1,265	1,215	1,270	1,395	1,610
	350	7.9	1,420	1,475	1,420	1,480	1,630	1,880
	400	7.9	1,625	1,645	1,625	1,690	1,860	2,150
12	300	9.1	1,320	1,425	1,325	1,330	1,400	1,535
	350	9.1	1,540	1,665	1,545	1,550	1,635	1,795
	400	9.1	1,755	1,900	1,770	1,770	1,865	2,050
14	300	10.2	1,405	1,590	1,445	1,405	1,435	1,525
	350	10.2	1,640	1,855	1,685	1,640	1,675	1,775
	400	10.2	1,875	2,120	1,925	1,875	1,915	2,030
Subgrade k = 200 pci(1)								
5	300	4.0	1,225	1,400	1,930	2,450	2,565	2,520
	350	4.0	1,425	1,630	2,255	2,860	2,990	2,940
	400	4.0	1,630	1,865	2,575	3,270	3,420	3,360
6	300	4.5	1,340	1,415	1,755	2,395	2,740	2,810
	350	4.5	1,565	1,650	2,050	2,800	3,200	3,275
	400	4.5	1,785	1,890	2,345	3,190	3,655	3,745
8	300	5.6	1,550	1,550	1,695	2,045	2,635	3,070
	350	5.6	1,810	1,810	1,980	2,385	3,075	3,580
	400	5.6	2,065	2,070	2,615	2,730	3,515	4,095
10	300	6.6	1,730	1,745	1,775	1,965	2,330	2,895
	350	6.6	2,020	2,035	2,070	2,290	2,715	3,300
	400	6.6	2,310	2,325	2,365	2,620	3,105	3,860
12	300	7.6	1,890	1,945	1,895	1,995	2,230	2,610
	350	7.6	2,205	2,270	2,210	2,330	2,600	3,045
	400	7.6	2,520	2,595	2,525	2,660	2,972	3,480
14	300	8.6	2,025	2,150	2,030	2,065	2,210	2,480
	350	8.6	2,360	2,510	2,365	2,405	2,580	2,890
	400	8.6	2,700	2,870	2,705	2,750	2,950	3,305

[1] k of subgrade; disregard increase in k due to subbase.

[2] Critical aisle width equals 2.209 times radius of relative stiffness.

Assumed load width = 300 in.; allowable load varies only slightly for other load widths. Allowable stress = one-half flexural strength.

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location. In a storage area where this layout is known and will remain fixed throughout the service life of the floor, the heavier distributed loads shown in Table 5* may be allowed. These loads are based on limiting the negative moment in an unjointed aisleway so that an aisle crack does not occur.

Allowable Loads to Prevent Slab Settlement

In the previous discussion, the allowable loads were based on preventing a crack in an unjointed aisleway between loaded storage areas. If these cracks can be tolerated or if there are joints in the aisleways, there need be no such restriction on the load magnitude. In this case, the limit of load depends on the tolerable settlement of the slab.

Slab settlement is caused by excessive pressures on the soil below. For concentrated loads, a greater slab thickness reduces the pressure on the soil. However, for distributed loads, slab thickness has virtually no effect on soil pressure—the soil pressure is equal to the distributed load plus the weight of the slab. Therefore, use of a thick slab does not reduce settlement under distributed loads.

An estimate of the minimum settlement that may occur can be made by computing[21] the elastic deflection using the subgrade modulus k. Computing the deflection profile for the entire slab width provides an estimate of the potential slab uplift away from the load as well as downward deflection of the part of the slab that is under the load. These computed elastic deflections may be a fair estimate only if the soil is relatively incompressible.

For slabs on compressible subgrades, settlement under distributed loads may be considerably greater than the computed elastic deflection. If the distributed loads are heavy, the settlement should be estimated by methods used in soils engineering for spread or raft foundations. As described in most texts on soils engineering, data from test footings of different sizes are helpful in estimating the amount of settlement on compressive soils.

The tolerable settlement may be considerably less than that allowed for foundations, depending on the operational requirements of the floor. For example, if a joint or crack exists in the aisle or within certain distances of the edge of the distributed load, the differential settlement between the loaded and unloaded sides of the joint or crack may cause a bump that is objectionable to vehicle traffic.

UNUSUAL LOADS

Special load configurations—unusual wheel or post configurations, tracked vehicles, vehicles with closely spaced axles or with more than 4 wheels per axle, very large wheel contact areas, strip loads—that differ substantially from those indicated in the previous discussions may be analyzed by one of the following methods:

1. For concentrated loads (wheel or post loads), slab stresses, deflections, and soil pressures may be determined with influence charts[18] or a computer program.[10] The influence charts may also be used for strip loads if the length of the load contact area is not great.**
2. When one or both of the dimensions of a load contact area is large† (distributed loads in a storage bay or a strip load), the situation can be considered as a one-dimensional problem and the method of Hetényi[21] may be used.

In either case, the controlling design considerations will be similar to those indicated in Fig. 2 based on the size of the load contact areas. (For strip loads, the controlling design considerations cannot be expressed in terms of contact area; it may be necessary to analyze several of the design considerations indicated in Fig. 2.)

A wide range of design situations can be analyzed with a computer program for foundations mats.[19]

Vibrating loads, such as those caused by heavy generators or compressors, may require a special foundation design and this is beyond the scope of this discussion.

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*What may at first appear to be anomalies in the values shown in Table 5 are explained by the following considerations. For a given slab thickness and subgrade strength there is a critical aisle width for which the slab stress in the aisleway is maximum. As shown in Table 5, the allowable load for the critical aisle width is less than for any other aisle width. The critical aisle width exists when the maximum bending moment in the aisle due to a load on one side of the aisle coincides with the point of maximum moment due to the load on the other side of the aisle. This doubles the negative bending moment (tension in top of slab) at aisle centerline. For aisle widths other than the critical aisle width, the bending moments due to loads on each side of the aisle are not maximum; the load on one side of the aisle may counteract stress caused by a load on the other side.

**Influence charts cover a dimension of either 4ℓ or 6ℓ (see next footnote), depending on the particular chart used.

†The analysis of Hetényi as used for slab design applies to loads of finite width and infinite length; however, the error is not significant if the length exceeds 6ℓ where ℓ is defined by:

$$\ell = \sqrt[4]{\frac{Eh^3}{12(1-\mu^2)k}}$$

where ℓ = radius of relative stiffness, in.
E = concrete modulus of elasticity, psi
h = slab thickness, in.
μ = Poisson's ratio
k = modulus of subgrade reaction, pci

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Attachment 2

ICV™ Box Assembly Building Foundation Computer Input/Output

CALCULATION SHEET

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CALC. NO.: 145579-C-CA-014 **REV:** 0 **ISSUE DATE:** 25 November 2004
CALC. TITLE: ICV Assembly Building Foundation
PROJECT NO.: 145579 **PROJECT TITLE:** Final DBVS Design
ATTACHMENT: 2
ATTACHMENT TITLE: Foundation ICV Assembly Building – Computer Input/Output **Page:** 1 of 73
ORGINATOR: **CHECKER:**
DATE: **DATE:** Nov 25, 04

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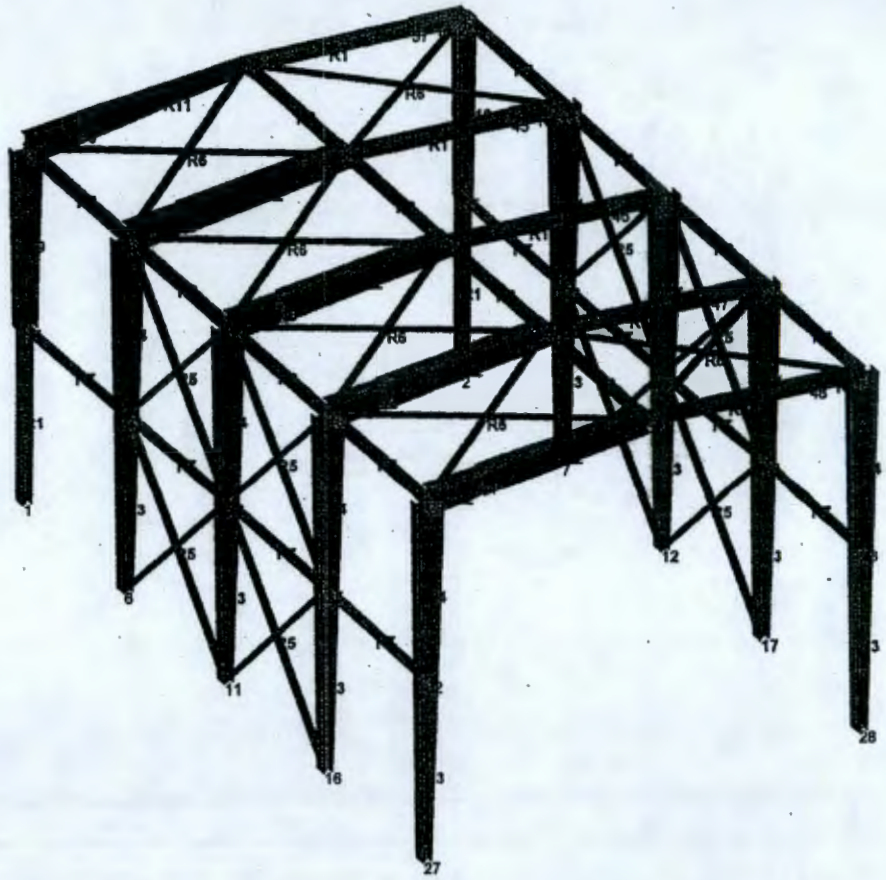

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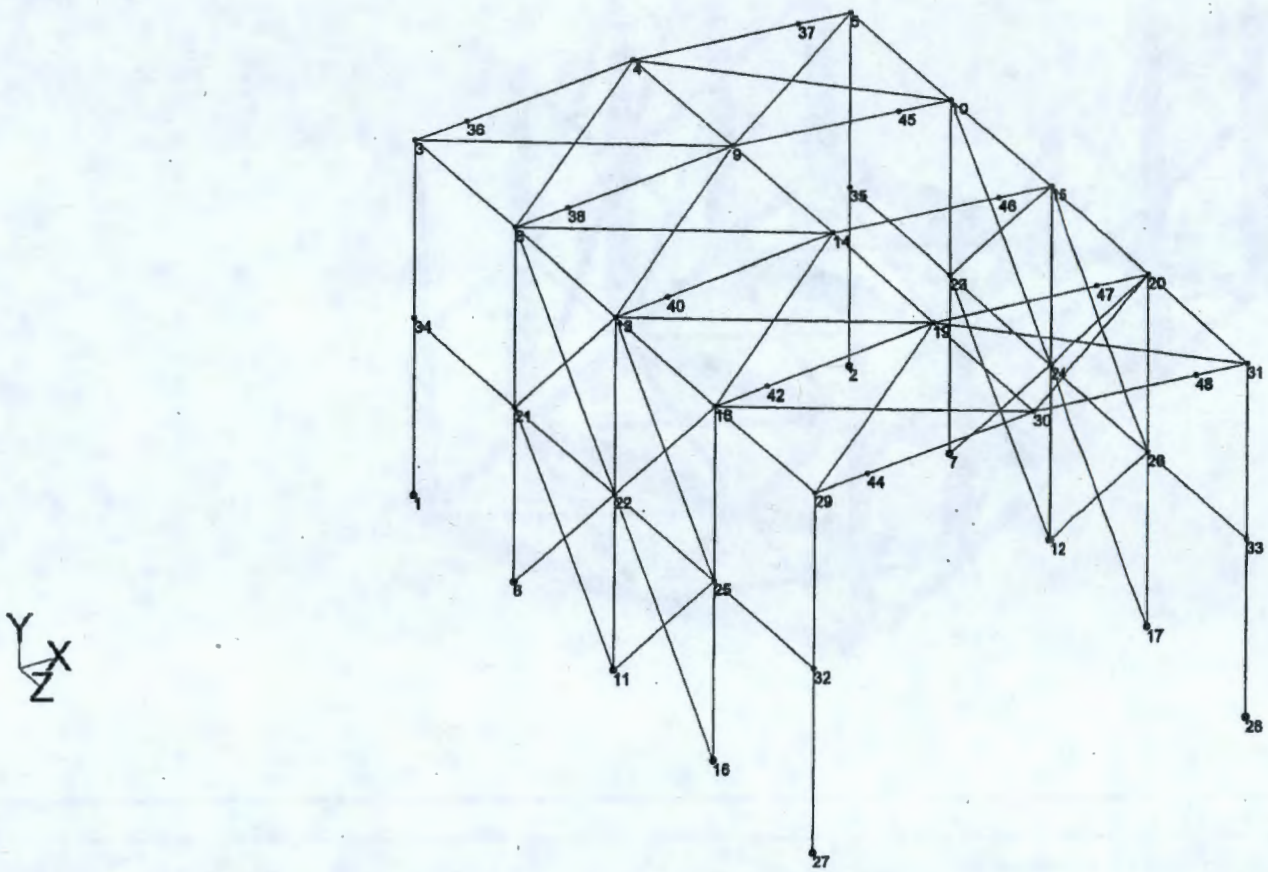

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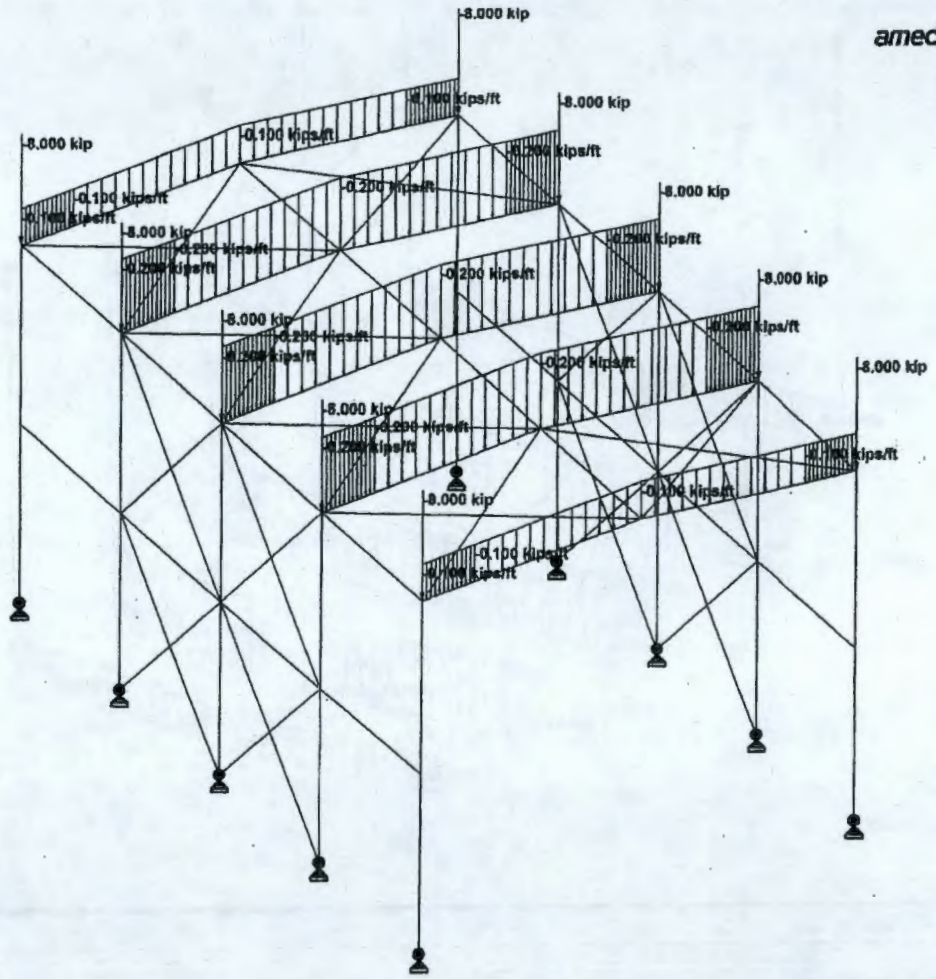

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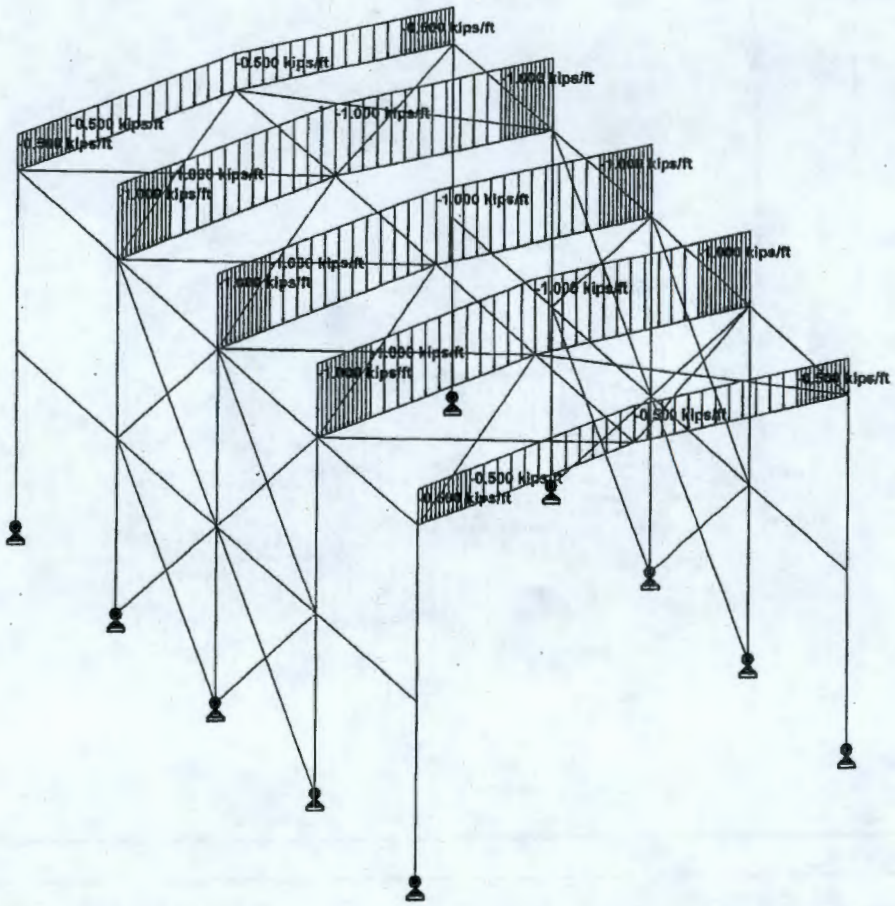

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SUSP. MAX LOAD

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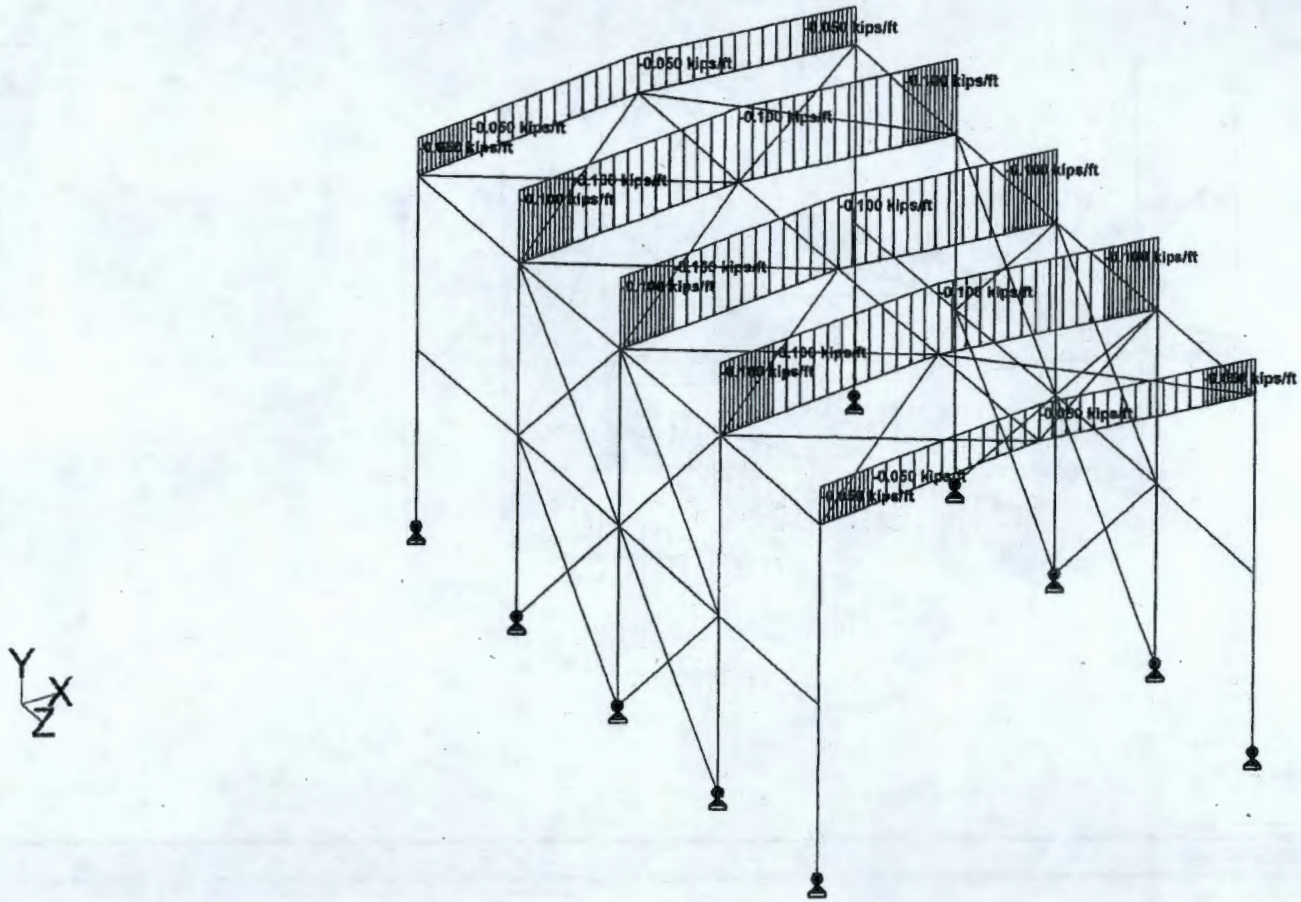

Load 3

SUSPENDED
MIN LOAD

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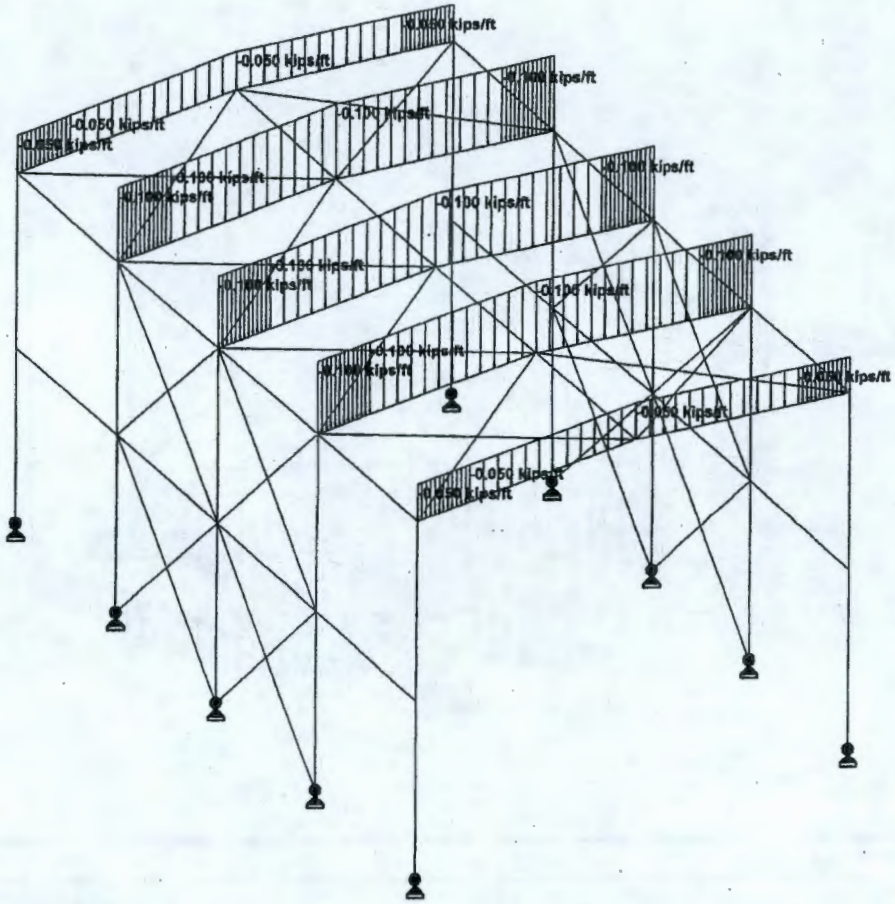

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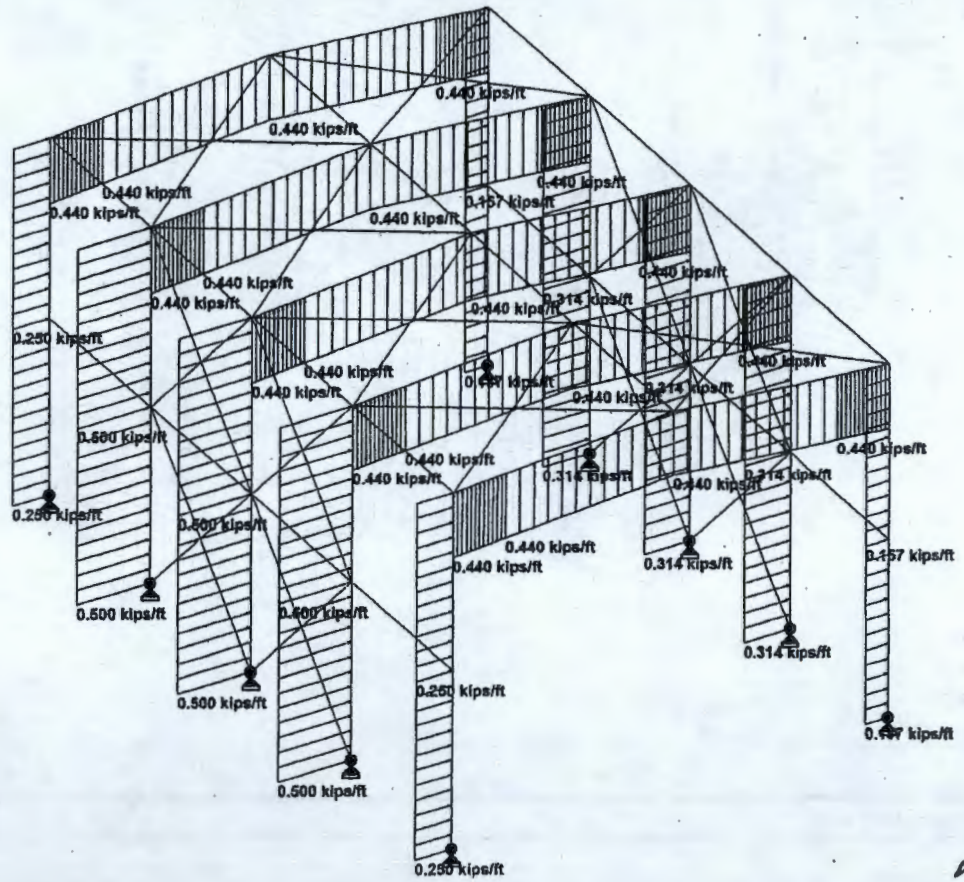

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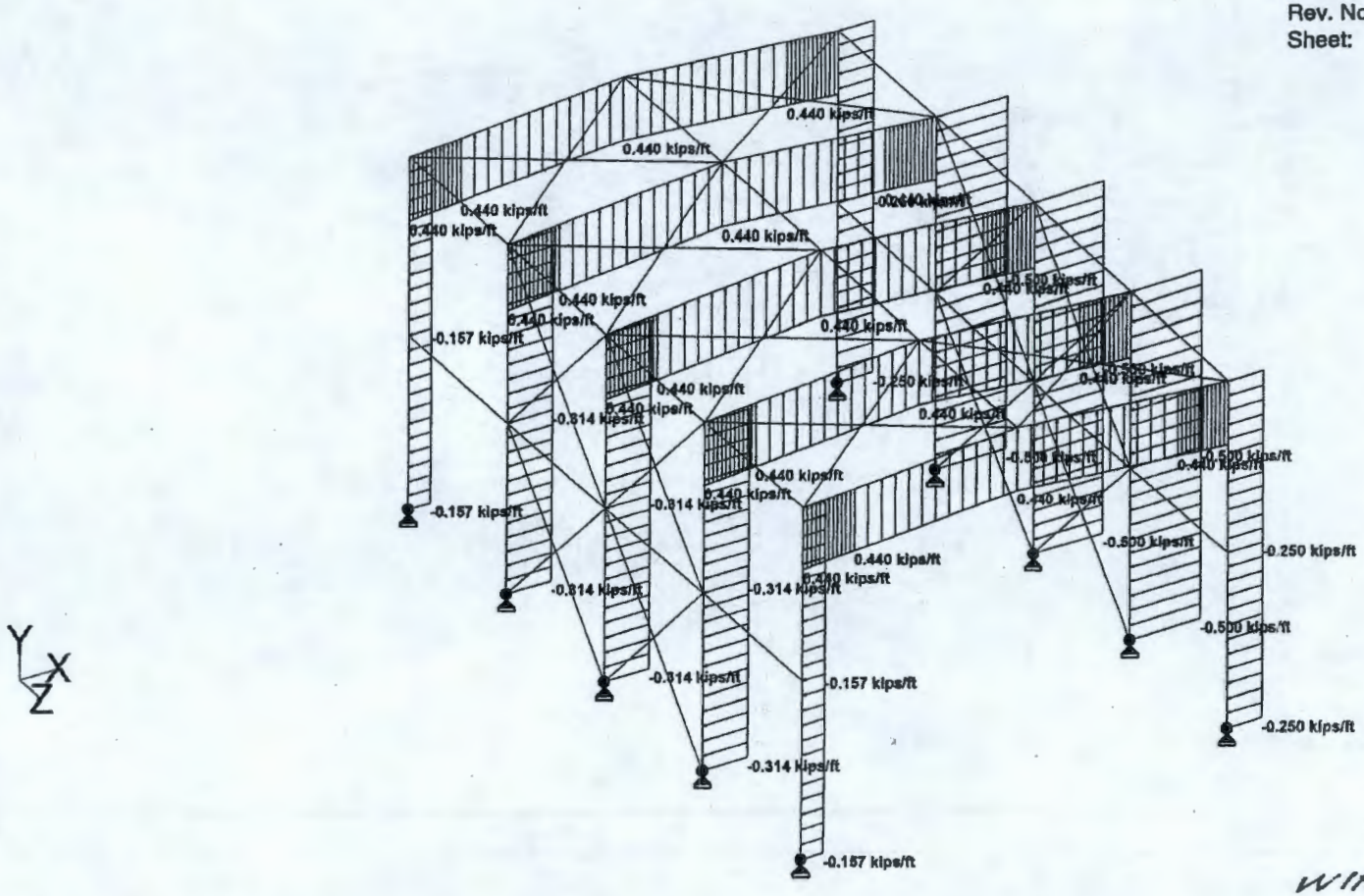

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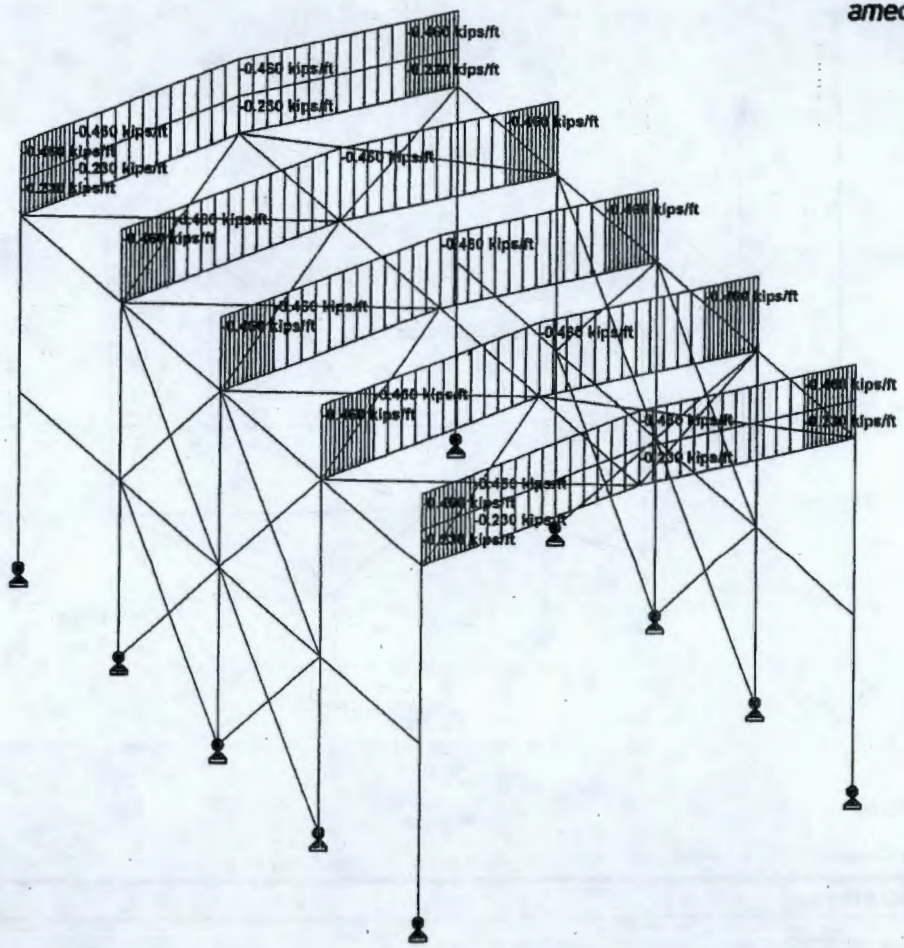

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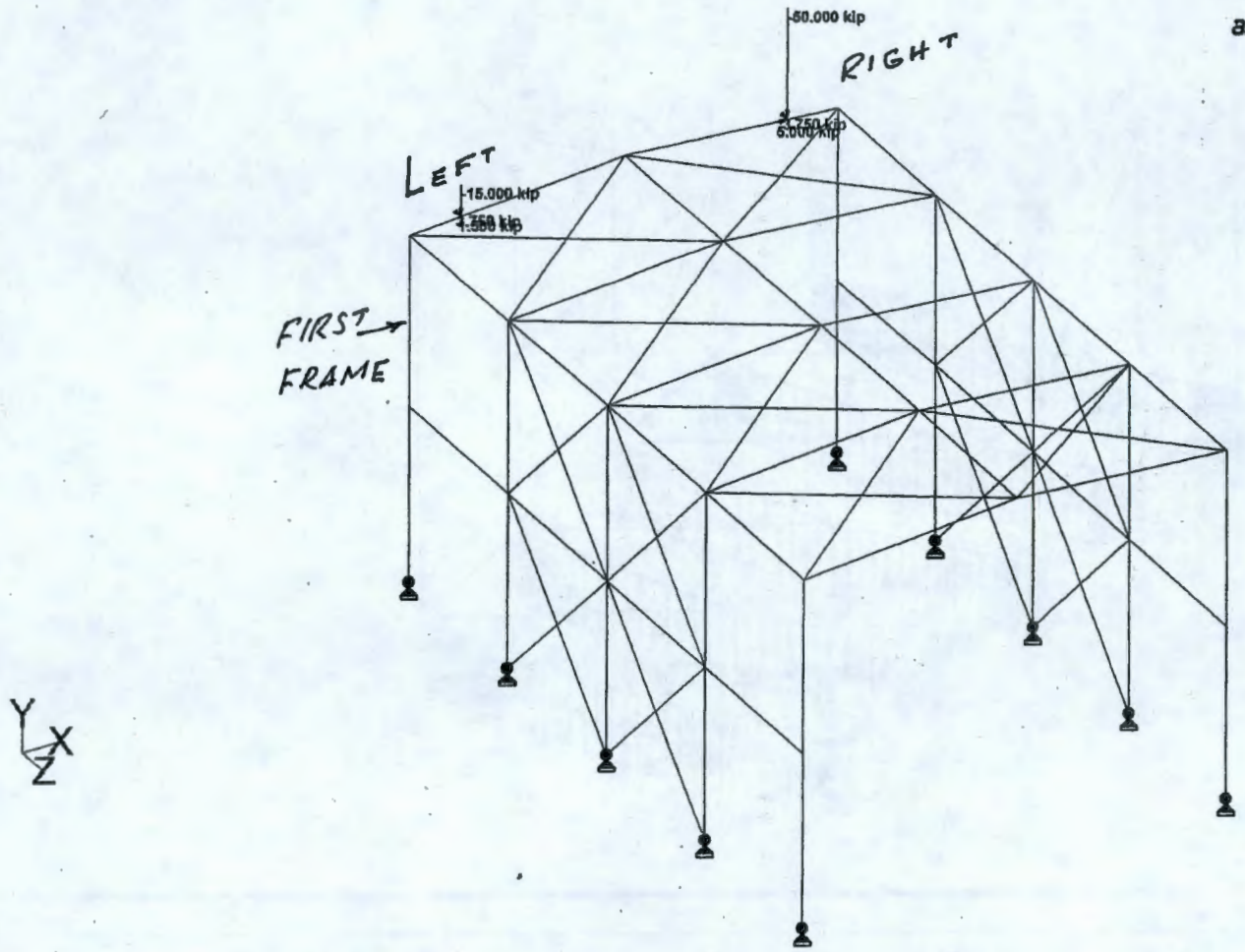

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CRANE 1ST FRAME
RIGHT COLUMN

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Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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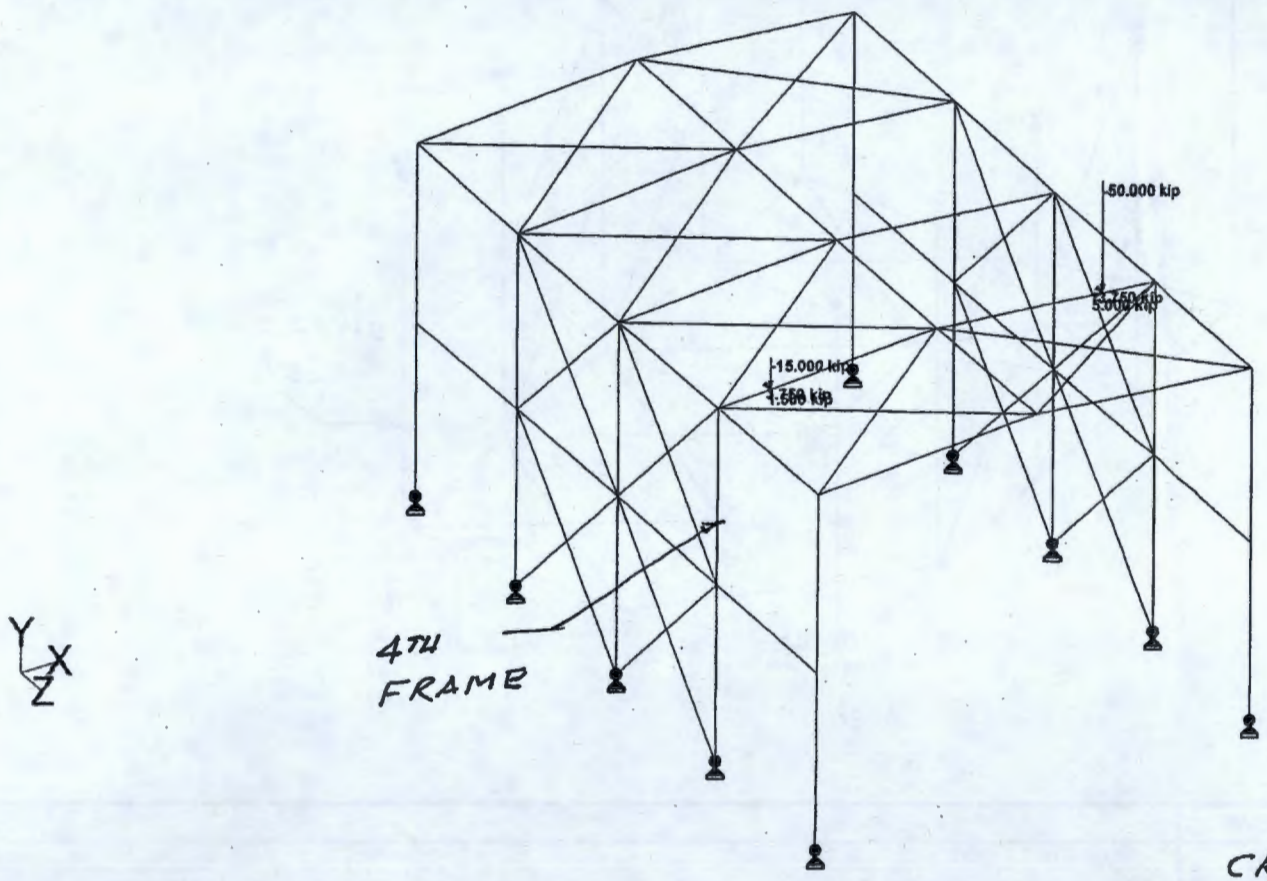

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CRANE @ 4TH FRAME
RIGHT COLUMN

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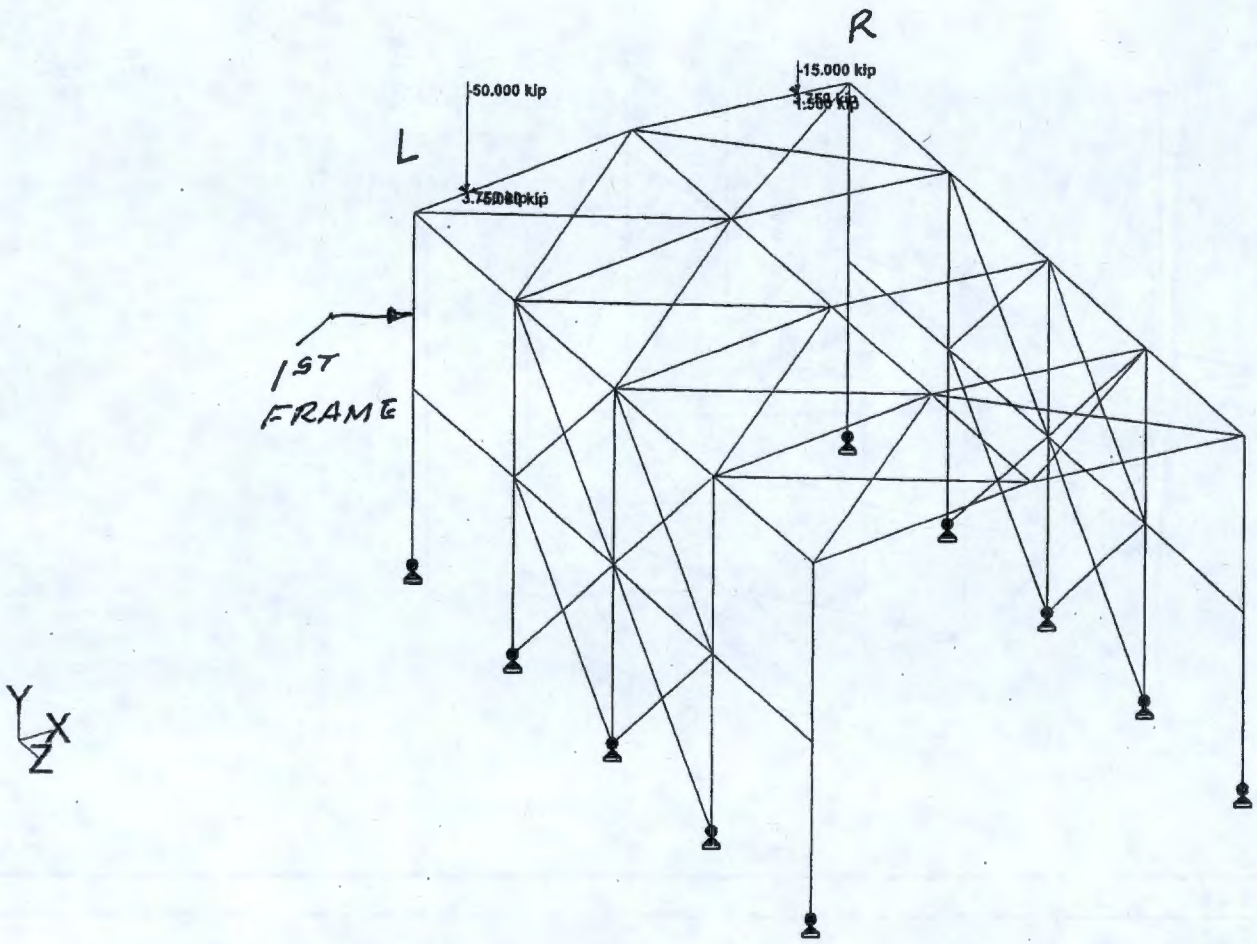

Load 10

CRANE @ 1ST FRAME
LEFT COLUMN

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
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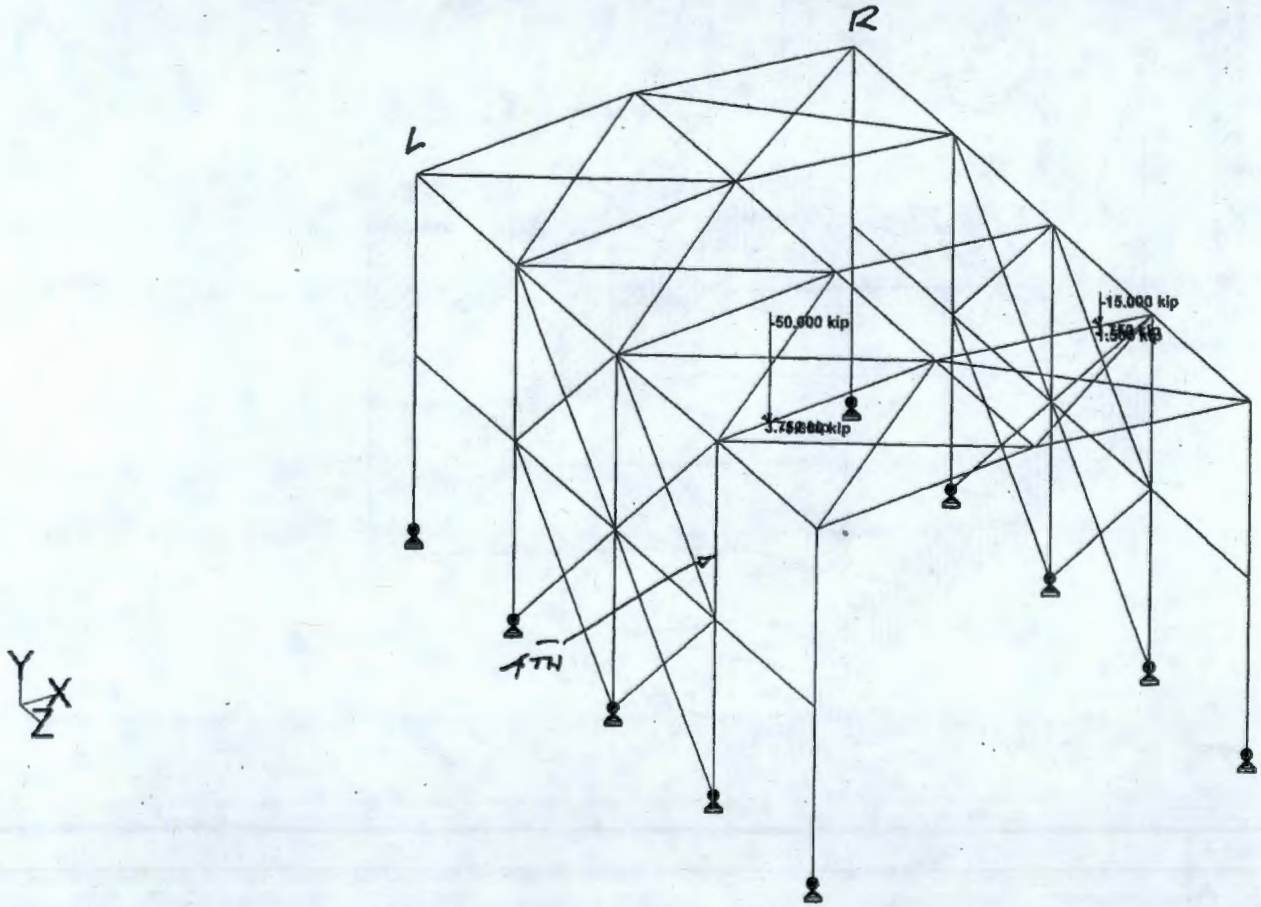

Load 11

CRANE @ 4T FRAME
LEFT COL

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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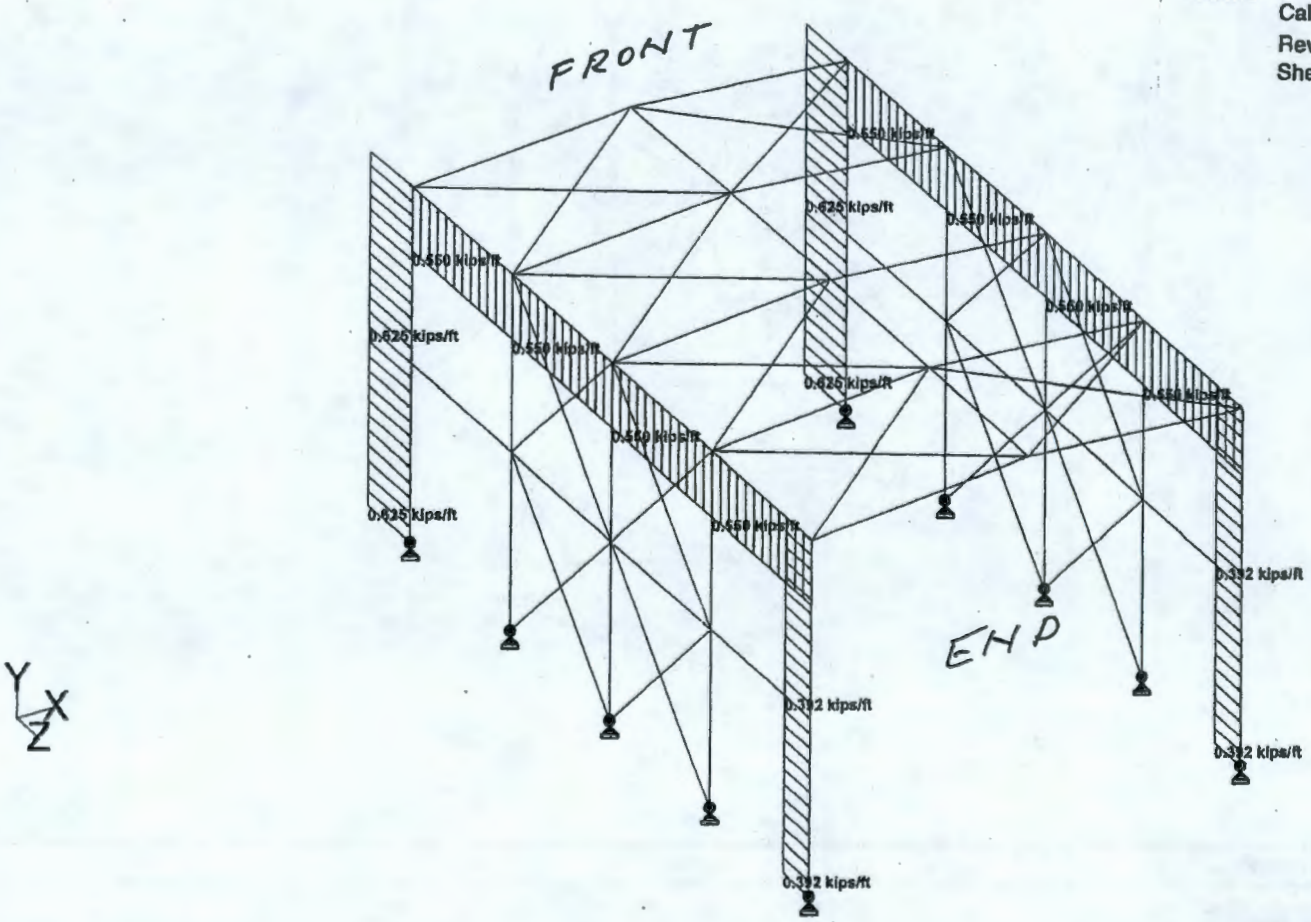

Load 12

WIND
FRONT TO END

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title: BASIC LOADING CASES	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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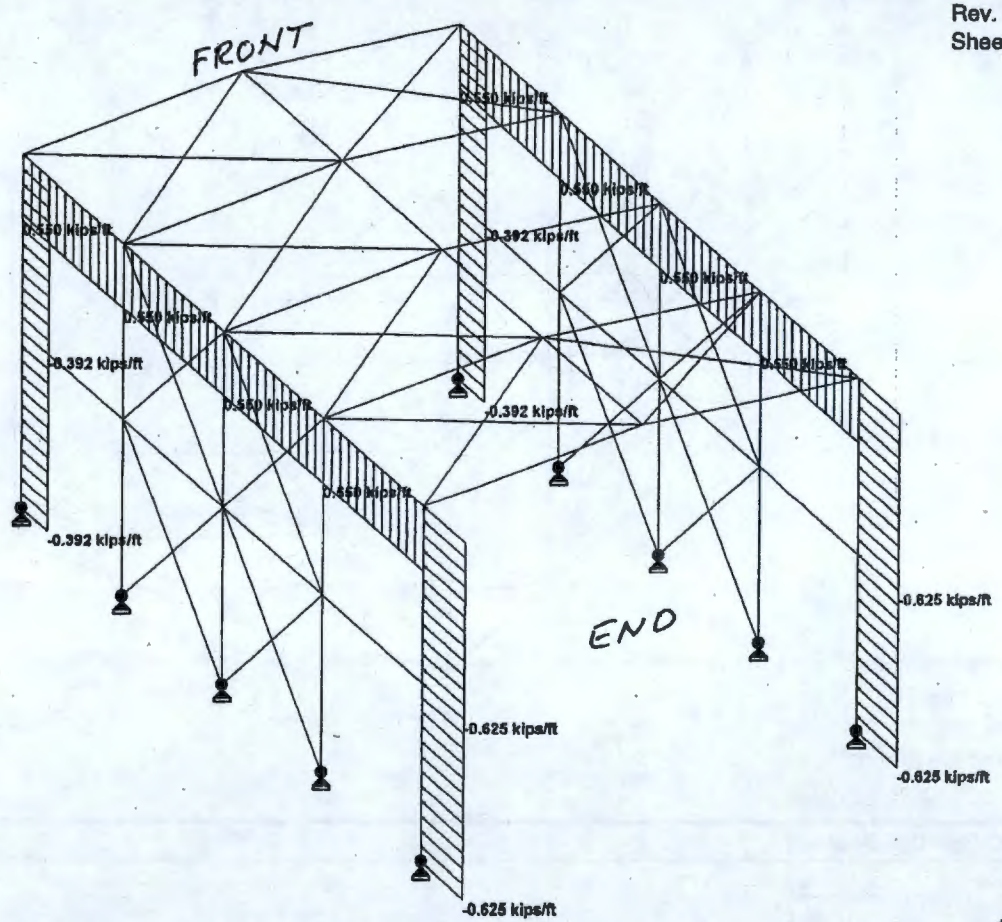

Load 13

WIND
END TO FRONT

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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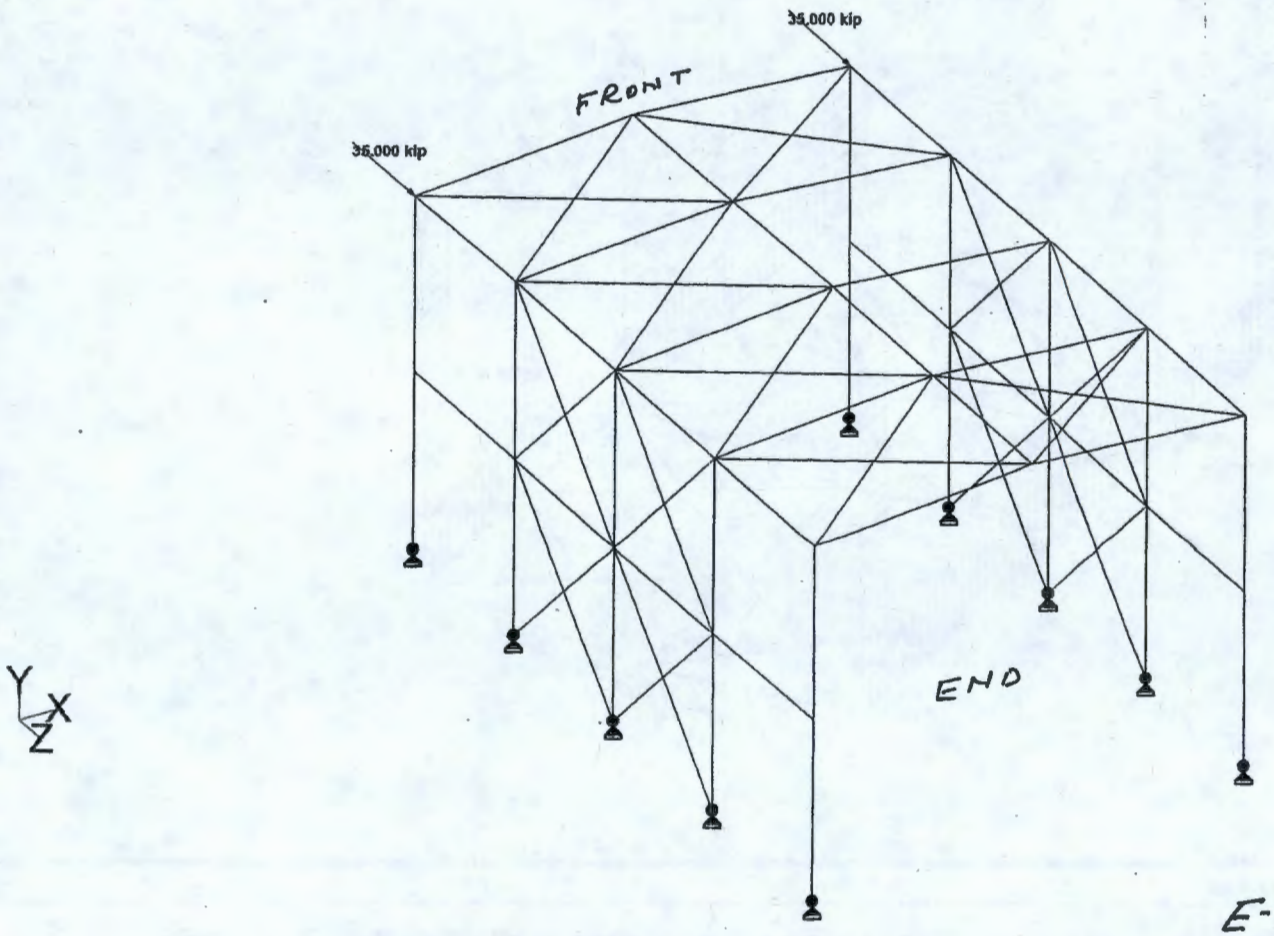

Load 14

E-Q FRONT TO END
HEAVY
MAX DL, MAX SL

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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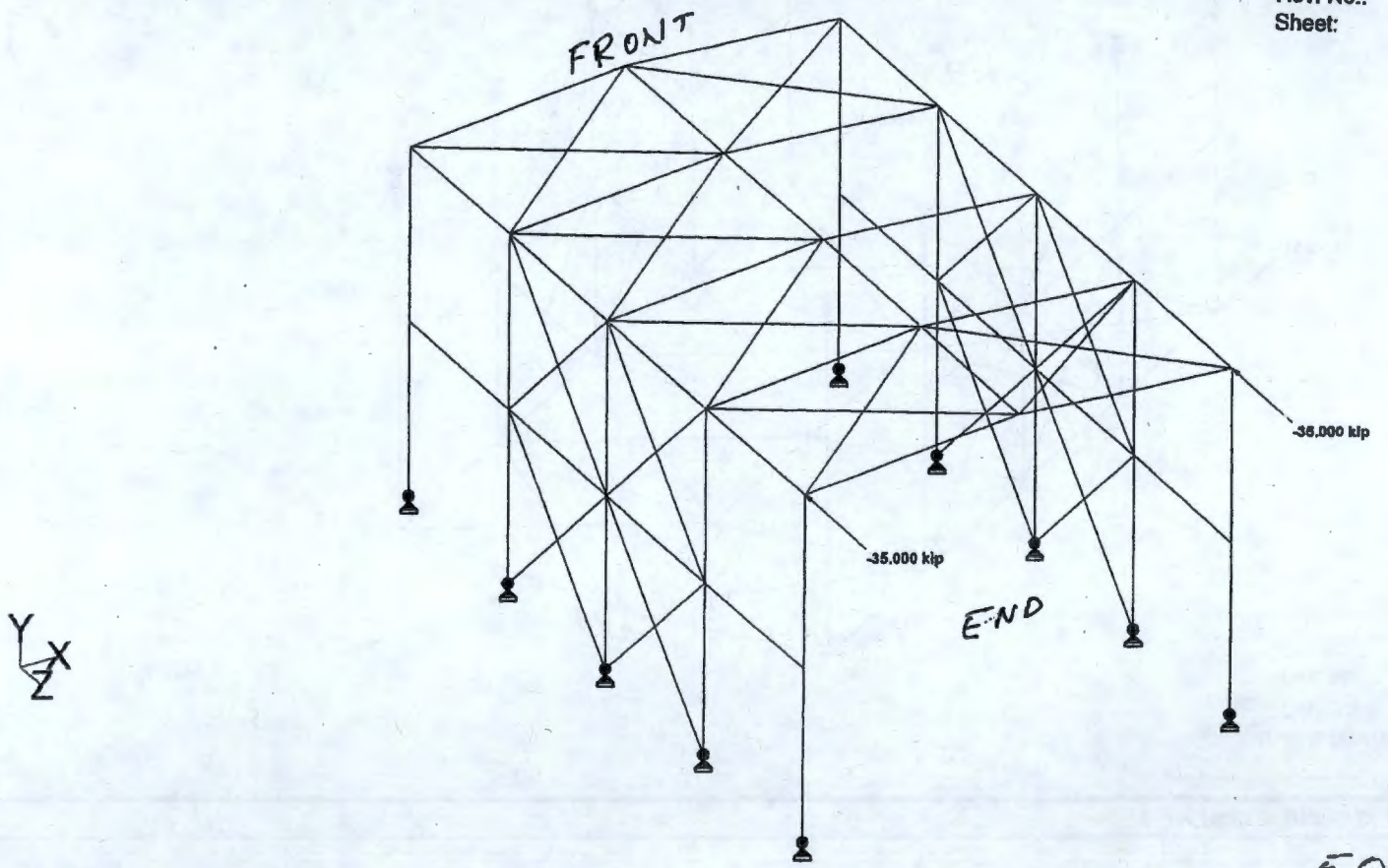

Load 15

EQ END TO FRONT
HEAVY
MAX OL MAX SL

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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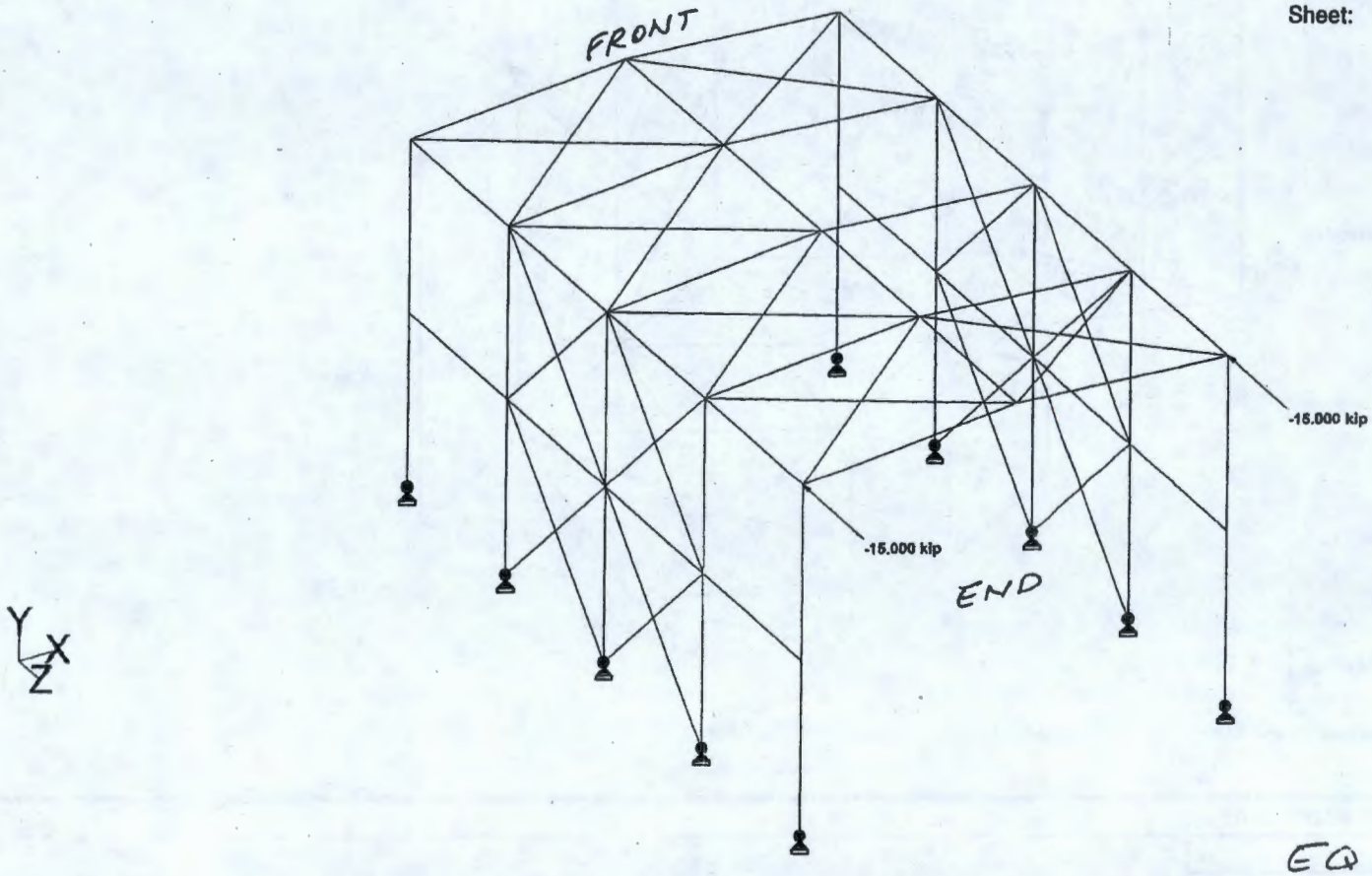

Load 17

EQ END TO FRONT
LIGHT
MIN DL, MIN SL

Software licensed to AMEC	Job No	Sheet No 1	Rev
	Part		
Job Title	Ref		
	By	Date 12-Nov-04	Chd
Client	File HANFORD10PSFDL.std	Date/Time 19-Nov-2004 09:25	

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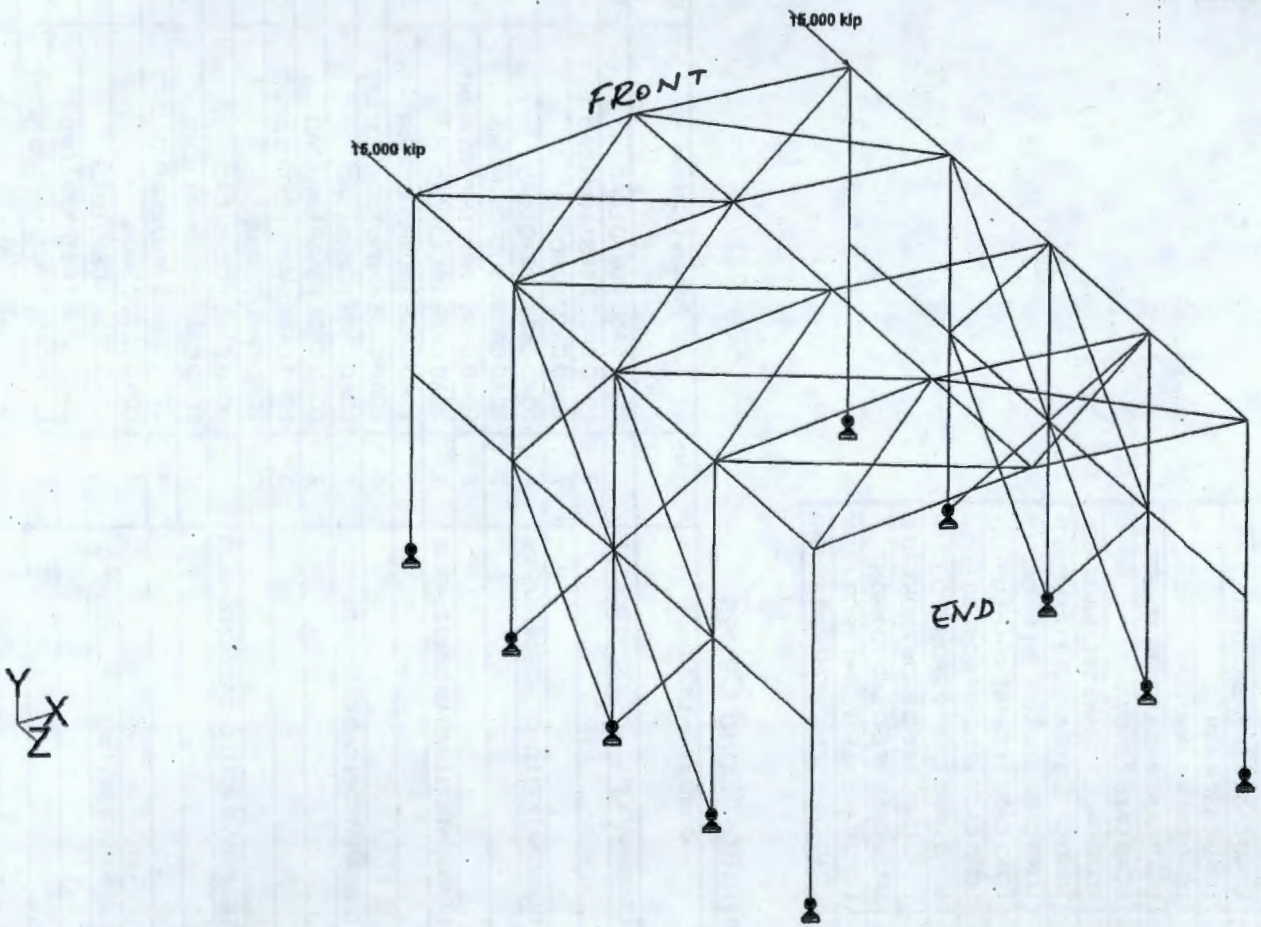

Load 16

EQ FRONT TO END
LIGHT
MIN DL, MIN SL

Basic Load Cases

Number	Name
1	LOAD CASE 1 DEAD LOAD
2	LOAD CASE 2 SUSP MAX LOAD
3	LOAD CASE 3 SUSPENDED MIN
4	LOAD CASE 4 ASH
5	LOAD CASE 5 WIND LEFT TO RIGHT
6	LOAD CASE 6 WIND RIGHT TO LEFT
7	LOAD CASE 7 SNOW
8	LOAD CASE 8 CRANE 1ST FRAME RIGH
9	LOAD CASE 9 CRANE 4TH FRAME RIGH
10	LOAD CASE 10 CRANE 1ST FRAME LEF
11	LOAD CASE 11 CRANE 4TH FRAME LEF
12	LOAD CASE 12 WIND FRONT TO END
13	LOAD CASE 13 WIND FROM END TO FR
14	LOAD CASE 14 E-Q FROM FRONT TO E
15	LOAD CASE 15 E-Q END TO FRONT
16	LOAD CASE 16 E-Q LIGHT FROM FRON
17	LOAD CASE 17 E-Q LIGHT END TO FRO

Combination Load Cases

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
18	COMBINATION LOAD CASE 18 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		7	LOAD CASE 7 SNOW	1.00
19	COMBINATION LOAD CASE 19 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	1.00
20	COMBINATION LOAD CASE 20 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	1.00
21	COMBINATION LOAD CASE 21 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	0.75
		7	LOAD CASE 7 SNOW	0.75
22	COMBINATION LOAD CASE 22 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	0.75
		7	LOAD CASE 7 SNOW	0.75
23	COMBINATION LOAD CASE 23 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	0.50
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
24	COMBINATION LOAD CASE 24 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00

Combination Load Cases Cont...

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	0.50
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
25	COMBINATION LOAD CASE 25 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	0.50
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
26	COMBINATION LOAD CASE 26 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	0.50
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
27	COMBINATION LOAD CASE 27 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	0.50
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
28	COMBINATION LOAD CASE 28 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	0.50
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
29	COMBINATION LOAD CASE 29 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	0.50
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
30	COMBINATION LOAD CASE 30 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	0.50
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
31	COMBINATION LOAD CASE 31 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		12	LOAD CASE 12 WIND FRONT TO END	0.50
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
32	COMBINATION LOAD CASE 32 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		12	LOAD CASE 12 WIND FRONT TO END	0.50
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
33	COMBINATION LOAD CASE 33 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00

Combination Load Cases Cont...

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
		12	LOAD CASE 12 WIND FRONT TO END	0.50
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
34	COMBINATION LOAD CASE 34 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		12	LOAD CASE 12 WIND FRONT TO END	0.50
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
35	COMBINATION LOAD CASE 35 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		13	LOAD CASE 13 WIND FROM END TO FR	0.50
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
36	COMBINATION LOAD CASE 36 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		13	LOAD CASE 13 WIND FROM END TO FR	0.50
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
37	COMBINATION LOAD CASE 37 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		13	LOAD CASE 13 WIND FROM END TO FR	0.50
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
38	COMBINATION LOAD CASE 38 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		13	LOAD CASE 13 WIND FROM END TO FR	0.50
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
39	COMBINATION LOAD CASE 39 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		14	LOAD CASE 14 E-Q FROM FRONT TO E	0.75
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
40	COMBINATION LOAD CASE 40 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		14	LOAD CASE 14 E-Q FROM FRONT TO E	0.75
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
41	COMBINATION LOAD CASE 41 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		14	LOAD CASE 14 E-Q FROM FRONT TO E	0.75
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
42	COMBINATION LOAD CASE 42 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		14	LOAD CASE 14 E-Q FROM FRONT TO E	0.75

Combination Load Cases Cont...

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
43	COMBINATION LOAD CASE 43 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		15	LOAD CASE 15 E-Q END TO FRONT	0.75
		7	LOAD CASE 7 SNOW	0.75
		8	LOAD CASE 8 CRANE 1ST FRAME RIGH	0.75
44	COMBINATION LOAD CASE 44 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		15	LOAD CASE 15 E-Q END TO FRONT	0.75
		7	LOAD CASE 7 SNOW	0.75
		9	LOAD CASE 9 CRANE 4TH FRAME RIGH	0.75
45	COMBINATION LOAD CASE 45 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		15	LOAD CASE 15 E-Q END TO FRONT	0.75
		7	LOAD CASE 7 SNOW	0.75
		10	LOAD CASE 10 CRANE 1ST FRAME LEF	0.75
46	COMBINATION LOAD CASE 46 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		2	LOAD CASE 2 SUSP MAX LOAD	1.00
		15	LOAD CASE 15 E-Q END TO FRONT	0.75
		7	LOAD CASE 7 SNOW	0.75
		11	LOAD CASE 11 CRANE 4TH FRAME LEF	0.75
47	COMBINATION LOAD CASE 47 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		16	LOAD CASE 16 E-Q LIGHT FROM FRON	1.00
48	COMBINATION LOAD CASE 48 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		17	LOAD CASE 17 E-Q LIGHT END TO FRO	1.00

Column Load combinations giving maximum vertical downforces

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Job No	Sheet No	Rev
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Part

Ref

By Date 12-Nov-04 Chd

Job Title: VERTICAL Y-DIR. (DOWN)

Client

File HANFORD.std Date/Time 18-Nov-2004 13:36

PLEASE NOTE: L/C (LOAD COMBINATION) 1 TO 17 ARE BASIC LOAD CASES. L/C 18 TO 48 ARE THE COMBINATION LOADING CASES

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	40	-12.078	113.493	-13.546	0.000	0.000	0.000
16	42	10.958	111.979	-13.160	0.000	0.000	0.000
17	42	-9.882	94.410	-13.353	0.000	0.000	0.000
17	32	-12.112	93.532	-9.530	0.000	0.000	0.000
16	40	9.520	93.176	-12.962	0.000	0.000	0.000
16	34	10.996	91.925	-9.147	0.000	0.000	0.000
17	24	-16.618	90.367	-6.501	0.000	0.000	0.000
16	30	17.562	89.328	-6.186	0.000	0.000	0.000
17	39	-8.693	85.887	-13.924	0.000	0.000	0.000
16	41	8.497	82.286	-12.723	0.000	0.000	0.000
6	43	8.279	81.751	12.339	0.000	0.000	0.000
17	41	-8.364	81.234	-12.701	0.000	0.000	0.000
6	45	8.969	78.552	11.284	0.000	0.000	0.000
16	39	7.786	77.308	-11.502	0.000	0.000	0.000
7	45	-9.112	77.308	11.128	0.000	0.000	0.000
6	46	8.612	76.684	11.401	0.000	0.000	0.000
17	28	-3.702	76.104	-4.622	0.000	0.000	0.000
6	44	7.908	75.969	10.979	0.000	0.000	0.000
1	45	10.106	75.515	0.035	0.000	0.000	0.000
7	44	-9.104	74.956	10.952	0.000	0.000	0.000
1	41	10.090	74.880	0.071	0.000	0.000	0.000
16	26	0.635	74.674	-4.357	0.000	0.000	0.000
7	43	-9.616	74.504	10.075	0.000	0.000	0.000
7	46	-8.764	74.474	10.532	0.000	0.000	0.000
17	34	-9.915	74.449	-9.337	0.000	0.000	0.000
1	29	13.477	73.453	0.022	0.000	0.000	0.000
16	32	9.558	73.122	-8.950	0.000	0.000	0.000
1	33	10.036	72.866	-2.396	0.000	0.000	0.000
2	43	-9.087	72.788	0.035	0.000	0.000	0.000
1	37	10.039	72.463	1.624	0.000	0.000	0.000
17	36	-12.114	72.390	-1.602	0.000	0.000	0.000
2	39	-9.093	72.191	0.071	0.000	0.000	0.000
17	26	-14.421	71.284	-6.308	0.000	0.000	0.000
2	23	-11.552	70.912	0.024	0.000	0.000	0.000
16	38	10.997	70.764	-1.216	0.000	0.000	0.000
16	28	16.124	70.525	-5.989	0.000	0.000	0.000
2	31	-9.054	70.205	-2.397	0.000	0.000	0.000
2	35	-9.053	69.797	1.623	0.000	0.000	0.000
17	31	-8.727	65.926	-9.908	0.000	0.000	0.000
1	25	3.475	65.550	0.025	0.000	0.000	0.000
11	46	8.887	63.871	12.223	0.000	0.000	0.000
11	42	8.886	63.870	-11.180	0.000	0.000	0.000
12	40	-8.996	63.640	-11.814	0.000	0.000	0.000
12	44	-8.995	63.638	11.525	0.000	0.000	0.000
2	27	-3.879	63.514	0.022	0.000	0.000	0.000
17	23	-13.233	62.761	-6.879	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	44	-12.092	62.310	1.040	0.000	0.000	0.000
16	33	8.535	62.232	-8.711	0.000	0.000	0.000
11	30	15.469	61.731	-0.374	0.000	0.000	0.000
6	35	8.313	61.677	8.324	0.000	0.000	0.000
12	24	-13.532	61.479	-0.905	0.000	0.000	0.000
17	33	-8.397	61.273	-8.685	0.000	0.000	0.000
16	46	10.946	60.626	1.456	0.000	0.000	0.000
16	29	15.101	59.634	-5.750	0.000	0.000	0.000
6	18	9.042	59.503	4.927	0.000	0.000	0.000
11	44	8.210	58.904	10.774	0.000	0.000	0.000
11	40	8.209	58.902	-12.630	0.000	0.000	0.000
12	42	-8.594	58.701	-13.264	0.000	0.000	0.000
12	46	-8.594	58.700	10.075	0.000	0.000	0.000
11	18	8.836	58.626	0.419	0.000	0.000	0.000
12	39	-8.740	58.573	-14.905	0.000	0.000	0.000
12	43	-8.740	58.571	8.434	0.000	0.000	0.000
11	45	8.423	58.546	10.446	0.000	0.000	0.000
11	41	8.422	58.545	-12.958	0.000	0.000	0.000
6	37	9.003	58.479	7.269	0.000	0.000	0.000
17	18	-8.993	58.118	-4.860	0.000	0.000	0.000
17	25	-12.903	58.108	-5.656	0.000	0.000	0.000
12	18	-9.055	58.066	-0.477	0.000	0.000	0.000
7	18	-9.656	57.552	4.361	0.000	0.000	0.000
12	41	-8.374	57.507	-13.038	0.000	0.000	0.000
12	45	-8.374	57.506	10.301	0.000	0.000	0.000
11	43	7.722	57.504	12.308	0.000	0.000	0.000
11	39	7.721	57.502	-11.096	0.000	0.000	0.000
16	22	18.196	57.427	-4.927	0.000	0.000	0.000
7	37	-9.146	57.352	7.115	0.000	0.000	0.000
17	21	-15.161	57.288	-5.242	0.000	0.000	0.000
16	31	7.824	57.254	-7.489	0.000	0.000	0.000
16	18	8.899	57.110	-4.374	0.000	0.000	0.000
17	30	-1.506	57.020	-4.429	0.000	0.000	0.000
11	38	8.919	56.871	8.912	0.000	0.000	0.000
11	34	8.919	56.871	-7.872	0.000	0.000	0.000
11	28	14.793	56.763	-1.824	0.000	0.000	0.000
8	38	8.646	56.611	7.386	0.000	0.000	0.000
12	26	-13.130	56.541	-2.355	0.000	0.000	0.000
12	32	-9.013	56.499	-8.531	0.000	0.000	0.000
12	36	-9.013	56.499	8.246	0.000	0.000	0.000
12	23	-13.276	56.412	-3.996	0.000	0.000	0.000
11	29	15.006	56.406	-2.152	0.000	0.000	0.000
6	36	7.942	55.896	6.964	0.000	0.000	0.000
16	24	-0.804	55.871	-4.159	0.000	0.000	0.000
11	27	14.304	55.364	-0.290	0.000	0.000	0.000
12	25	-12.910	55.347	-2.129	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	27	14.900	55.051	4.256	0.000	0.000	0.000
7	36	-9.139	55.001	6.938	0.000	0.000	0.000
11	22	18.189	54.938	-0.967	0.000	0.000	0.000
16	27	14.390	54.656	-4.528	0.000	0.000	0.000
7	35	-9.650	54.548	6.062	0.000	0.000	0.000
7	38	-8.799	54.519	6.519	0.000	0.000	0.000
12	21	-15.292	54.481	-1.570	0.000	0.000	0.000
6	22	18.347	53.496	3.759	0.000	0.000	0.000
17	38	-9.918	53.307	-1.410	0.000	0.000	0.000
1	43	8.639	53.081	0.033	0.000	0.000	0.000
1	39	8.622	52.446	0.069	0.000	0.000	0.000
7	21	-15.994	52.176	3.391	0.000	0.000	0.000
16	36	9.559	51.961	-1.019	0.000	0.000	0.000
11	36	8.243	51.904	7.463	0.000	0.000	0.000
11	32	8.243	51.903	-9.322	0.000	0.000	0.000
6	29	15.590	51.852	3.201	0.000	0.000	0.000
12	34	-8.612	51.560	-9.981	0.000	0.000	0.000
12	38	-8.612	51.560	6.796	0.000	0.000	0.000
11	37	8.456	51.546	7.134	0.000	0.000	0.000
11	33	8.456	51.546	-9.650	0.000	0.000	0.000
11	26	-1.340	51.445	1.286	0.000	0.000	0.000
12	31	-8.758	51.432	-11.621	0.000	0.000	0.000
12	35	-8.758	51.432	5.155	0.000	0.000	0.000
7	25	-13.800	51.096	3.147	0.000	0.000	0.000
1	27	12.009	51.019	0.020	0.000	0.000	0.000
12	28	-0.634	50.664	0.767	0.000	0.000	0.000
2	45	-7.329	50.581	0.030	0.000	0.000	0.000
11	35	7.755	50.504	8.996	0.000	0.000	0.000
11	31	7.755	50.504	-7.788	0.000	0.000	0.000
1	31	8.569	50.432	-2.398	0.000	0.000	0.000
12	33	-8.392	50.367	-9.754	0.000	0.000	0.000
12	37	-8.392	50.366	7.022	0.000	0.000	0.000
1	35	8.572	50.029	1.622	0.000	0.000	0.000
2	41	-7.336	49.984	0.066	0.000	0.000	0.000
6	30	15.233	49.984	3.318	0.000	0.000	0.000
6	28	14.530	49.269	2.896	0.000	0.000	0.000
7	24	-13.792	48.744	2.971	0.000	0.000	0.000
2	25	-9.795	48.705	0.019	0.000	0.000	0.000
17	27	-0.317	48.497	-5.000	0.000	0.000	0.000
7	23	-14.304	48.292	2.094	0.000	0.000	0.000
7	26	-13.453	48.262	2.551	0.000	0.000	0.000
2	33	-7.297	47.997	-2.402	0.000	0.000	0.000
6	23	-2.144	47.656	4.466	0.000	0.000	0.000
2	37	-7.296	47.589	1.618	0.000	0.000	0.000
11	24	-2.016	46.477	-0.164	0.000	0.000	0.000
1	10	4.292	46.443	0.017	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	25	-1.803	46.119	-0.492	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
12	30	-0.232	45.726	-0.684	0.000	0.000	0.000
12	27	-0.378	45.598	-2.324	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000
11	23	-2.504	45.077	1.370	0.000	0.000	0.000
16	25	-1.827	44.981	-3.920	0.000	0.000	0.000
17	35	-8.730	44.784	-1.981	0.000	0.000	0.000
12	29	-0.012	44.532	-0.457	0.000	0.000	0.000
1	18	7.655	44.523	0.017	0.000	0.000	0.000
6	25	-1.453	44.458	3.412	0.000	0.000	0.000
28	18	-7.141	44.228	-0.010	0.000	0.000	0.000
27	18	6.867	44.162	-0.016	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000
17	29	0.012	43.844	-3.777	0.000	0.000	0.000
7	29	-0.419	43.250	3.302	0.000	0.000	0.000
17	46	-9.896	43.226	1.233	0.000	0.000	0.000
1	23	2.008	43.116	0.023	0.000	0.000	0.000
6	26	-1.811	42.590	3.529	0.000	0.000	0.000
6	21	-7.219	42.405	4.075	0.000	0.000	0.000
2	18	-6.453	41.946	0.013	0.000	0.000	0.000
28	24	-9.936	41.911	0.011	0.000	0.000	0.000
6	24	-2.514	41.874	3.107	0.000	0.000	0.000
28	40	-6.867	41.855	-0.001	0.000	0.000	0.000
16	44	9.508	41.823	1.653	0.000	0.000	0.000
27	30	11.811	41.614	0.006	0.000	0.000	0.000
27	42	6.601	41.592	-0.007	0.000	0.000	0.000
2	29	-2.122	41.306	0.017	0.000	0.000	0.000
28	44	-6.875	41.262	-0.038	0.000	0.000	0.000
16	37	8.536	41.071	-0.779	0.000	0.000	0.000
28	26	-9.583	41.006	0.006	0.000	0.000	0.000
28	23	-9.731	40.995	-0.011	0.000	0.000	0.000
1	46	7.095	40.970	0.024	0.000	0.000	0.000
27	46	6.580	40.953	-0.043	0.000	0.000	0.000
28	42	-6.514	40.949	-0.007	0.000	0.000	0.000
28	39	-6.662	40.938	-0.024	0.000	0.000	0.000
7	28	-0.412	40.898	3.125	0.000	0.000	0.000
28	21	-11.050	40.693	-0.002	0.000	0.000	0.000
27	22	14.028	40.647	-0.007	0.000	0.000	0.000
27	28	11.118	40.571	-0.001	0.000	0.000	0.000
27	40	5.907	40.550	-0.014	0.000	0.000	0.000
6	31	8.313	40.516	0.392	0.000	0.000	0.000
1	44	6.686	40.456	0.020	0.000	0.000	0.000
7	27	-0.923	40.446	2.249	0.000	0.000	0.000
7	30	-0.072	40.416	2.706	0.000	0.000	0.000
7	22	4.077	40.407	3.623	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
28	46	-6.522	40.357	-0.043	0.000	0.000	0.000
28	43	-6.669	40.346	-0.060	0.000	0.000	0.000
1	42	7.078	40.335	0.060	0.000	0.000	0.000
27	29	11.377	40.219	-0.017	0.000	0.000	0.000
27	41	6.166	40.198	-0.030	0.000	0.000	0.000
17	37	-8.400	40.131	-0.758	0.000	0.000	0.000
28	25	-9.373	40.075	-0.011	0.000	0.000	0.000
28	41	-6.304	40.018	-0.024	0.000	0.000	0.000
16	23	-2.537	40.003	-2.699	0.000	0.000	0.000
27	44	5.886	39.910	-0.050	0.000	0.000	0.000
1	40	6.669	39.822	0.056	0.000	0.000	0.000
27	45	6.146	39.558	-0.066	0.000	0.000	0.000
11	21	-7.024	39.508	1.523	0.000	0.000	0.000
27	27	10.761	39.432	-0.016	0.000	0.000	0.000
28	45	-6.311	39.425	-0.060	0.000	0.000	0.000
27	39	5.551	39.411	-0.028	0.000	0.000	0.000
28	36	-6.834	39.267	2.430	0.000	0.000	0.000
27	38	6.531	38.940	2.425	0.000	0.000	0.000
1	30	10.465	38.908	0.011	0.000	0.000	0.000
28	32	-6.833	38.859	-1.590	0.000	0.000	0.000
27	43	5.530	38.771	-0.064	0.000	0.000	0.000
2	44	-6.007	38.746	0.020	0.000	0.000	0.000
6	48	2.729	38.708	6.301	0.000	0.000	0.000
27	34	6.534	38.538	-1.596	0.000	0.000	0.000
1	28	10.056	38.395	0.007	0.000	0.000	0.000
28	38	-6.481	38.362	2.425	0.000	0.000	0.000
28	35	-6.629	38.351	2.408	0.000	0.000	0.000
1	34	7.025	38.321	-2.408	0.000	0.000	0.000
12	22	4.055	38.239	0.937	0.000	0.000	0.000
2	40	-6.013	38.149	0.056	0.000	0.000	0.000
16	47	2.704	38.136	-6.164	0.000	0.000	0.000
2	46	-5.718	38.113	0.018	0.000	0.000	0.000
28	34	-6.480	37.953	-1.595	0.000	0.000	0.000
28	31	-6.628	37.942	-1.612	0.000	0.000	0.000
1	38	7.027	37.918	1.613	0.000	0.000	0.000
27	36	5.837	37.898	2.418	0.000	0.000	0.000
1	32	6.616	37.807	-2.412	0.000	0.000	0.000
1	22	11.978	37.802	0.007	0.000	0.000	0.000
27	37	6.096	37.546	2.402	0.000	0.000	0.000
2	42	-5.725	37.516	0.054	0.000	0.000	0.000
17	47	-2.683	37.506	-6.208	0.000	0.000	0.000
27	32	5.840	37.495	-1.603	0.000	0.000	0.000
28	37	-6.271	37.431	2.408	0.000	0.000	0.000
7	48	-2.871	37.411	6.085	0.000	0.000	0.000
1	36	6.618	37.404	1.609	0.000	0.000	0.000
6	33	9.003	37.318	-0.662	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
27	33	6.099	37.143	-1.619	0.000	0.000	0.000
28	33	-6.270	37.022	-1.612	0.000	0.000	0.000
2	24	-8.472	36.870	0.009	0.000	0.000	0.000
27	35	5.481	36.759	2.403	0.000	0.000	0.000
27	31	5.484	36.356	-1.617	0.000	0.000	0.000
2	26	-8.184	36.237	0.006	0.000	0.000	0.000
7	33	-9.149	36.211	-0.813	0.000	0.000	0.000
2	32	-5.974	36.163	-2.412	0.000	0.000	0.000
16	35	7.825	36.093	0.442	0.000	0.000	0.000
17	22	4.213	35.892	-2.424	0.000	0.000	0.000
2	36	-5.974	35.755	1.608	0.000	0.000	0.000
2	21	-9.523	35.677	0.007	0.000	0.000	0.000
2	34	-5.686	35.529	-2.414	0.000	0.000	0.000
6	34	8.646	35.449	-0.546	0.000	0.000	0.000
16	21	-7.196	35.447	-2.183	0.000	0.000	0.000
2	38	-5.685	35.121	1.606	0.000	0.000	0.000
6	32	7.943	34.734	-0.967	0.000	0.000	0.000
17	43	-8.708	34.703	0.662	0.000	0.000	0.000
7	32	-9.142	33.860	-0.989	0.000	0.000	0.000
7	31	-9.653	33.407	-1.866	0.000	0.000	0.000
7	34	-8.802	33.378	-1.409	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
1	26	0.463	31.005	0.014	0.000	0.000	0.000
16	45	8.485	30.933	1.893	0.000	0.000	0.000
1	24	0.054	30.491	0.010	0.000	0.000	0.000
6	39	8.265	30.395	-2.277	0.000	0.000	0.000
28	28	-0.828	30.138	0.008	0.000	0.000	0.000
17	45	-8.378	30.051	1.885	0.000	0.000	0.000
27	26	-1.672	29.756	0.003	0.000	0.000	0.000
2	28	-0.800	29.472	0.007	0.000	0.000	0.000
28	30	-0.475	29.233	0.003	0.000	0.000	0.000
28	27	-0.622	29.222	-0.014	0.000	0.000	0.000
2	30	-0.511	28.838	0.005	0.000	0.000	0.000
27	24	-2.365	28.713	-0.003	0.000	0.000	0.000
27	25	-2.106	28.361	-0.020	0.000	0.000	0.000
28	29	-0.265	28.301	-0.014	0.000	0.000	0.000
16	20	15.856	28.110	-2.915	0.000	0.000	0.000
27	23	-2.722	27.574	-0.018	0.000	0.000	0.000
6	41	8.955	27.196	-3.332	0.000	0.000	0.000
17	19	-11.711	26.383	-2.818	0.000	0.000	0.000
7	41	-9.128	26.127	-3.458	0.000	0.000	0.000
16	43	7.775	25.955	3.114	0.000	0.000	0.000
1	21	-3.025	25.946	0.012	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	48	2.716	25.795	6.792	0.000	0.000	0.000
11	47	2.716	25.794	-6.582	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
6	42	8.598	25.328	-3.215	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
12	47	-2.709	24.794	-6.788	0.000	0.000	0.000
12	48	-2.709	24.793	6.548	0.000	0.000	0.000
6	40	7.895	24.613	-3.637	0.000	0.000	0.000
2	22	1.986	24.580	0.005	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
11	20	15.833	23.998	-1.684	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
7	40	-9.120	23.775	-3.634	0.000	0.000	0.000
7	39	-9.632	23.323	-4.510	0.000	0.000	0.000
7	42	-8.780	23.293	-4.053	0.000	0.000	0.000
12	19	-11.754	23.167	-1.644	0.000	0.000	0.000
28	22	2.613	23.033	-0.006	0.000	0.000	0.000
27	21	-6.197	22.860	-0.011	0.000	0.000	0.000
11	1	2.267	22.414	0.089	0.000	0.000	0.000
6	1	2.305	22.052	1.822	0.000	0.000	0.000
16	1	2.286	21.570	-1.706	0.000	0.000	0.000
12	1	-2.255	21.319	-0.102	0.000	0.000	0.000
17	1	-2.266	20.948	-1.729	0.000	0.000	0.000
7	1	-2.425	20.869	1.625	0.000	0.000	0.000
6	20	15.922	20.612	0.836	0.000	0.000	0.000
7	19	-12.196	20.104	0.820	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
1	7	3.355	17.049	0.013	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
27	20	12.260	16.505	0.002	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
28	19	-8.045	16.280	0.005	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000
27	47	1.738	15.856	-0.010	0.000	0.000	0.000
28	47	-1.858	15.649	-0.007	0.000	0.000	0.000
1	48	1.923	15.631	0.010	0.000	0.000	0.000
27	48	1.726	15.491	-0.031	0.000	0.000	0.000
28	48	-1.862	15.310	-0.028	0.000	0.000	0.000
1	47	1.913	15.269	0.031	0.000	0.000	0.000
2	48	-1.659	14.628	0.008	0.000	0.000	0.000
27	1	1.462	14.301	-0.006	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
2	47	-1.663	14.287	0.029	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
28	1	-1.581	14.094	-0.002	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
1	1	1.614	14.048	0.006	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
2	1	-1.407	13.140	0.003	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
1	20	8.764	12.111	-0.003	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000
2	19	-6.639	11.388	-0.001	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
6	47	2.722	9.362	-2.051	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
16	48	2.698	8.791	2.188	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
17	48	-2.691	8.259	2.127	0.000	0.000	0.000
7	47	-2.881	8.165	-2.249	0.000	0.000	0.000
6	19	-18.165	5.823	1.258	0.000	0.000	0.000
7	20	14.566	4.412	1.129	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
11	19	-17.785	3.425	1.636	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
16	3	0.441	2.455	-0.179	0.000	0.000	0.000
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
12	20	14.041	1.538	1.699	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000
27	3	0.236	1.312	0.000	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
16	19	-17.999	-1.196	0.745	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
17	20	14.120	-2.144	0.940	0.000	0.000	0.000
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
2	20	8.707	-3.409	-0.004	0.000	0.000	0.000
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
1	19	-11.240	-3.697	0.003	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
27	19	-14.706	-7.211	-0.002	0.000	0.000	0.000
28	20	10.172	-7.267	-0.001	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000

Column Load combinations giving maximum vertical Up-forces

Basic Load Cases

Number	Name
1	LOAD CASE 1 DEAD LOAD
2	LOAD CASE 2 SUSP MAX LOAD
3	LOAD CASE 3 SUSPENDED MIN
4	LOAD CASE 4 ASH
5	LOAD CASE 5 WIND LEFT TO RIGHT
6	LOAD CASE 6 WIND RIGHT TO LEFT
7	LOAD CASE 7 SNOW
8	LOAD CASE 8 CRANE 1ST FRAME RIGH
9	LOAD CASE 9 CRANE 4TH FRAME RIGH
10	LOAD CASE 10 CRANE 1ST FRAME LEF
11	LOAD CASE 11 CRANE 4TH FRAME LEF
12	LOAD CASE 12 WIND FRONT TO END
13	LOAD CASE 13 WIND FROM END TO FR
14	LOAD CASE 14 E-Q FROM FRONT TO E
15	LOAD CASE 15 E-Q END TO FRONT
16	LOAD CASE 16 E-Q LIGHT FROM FRON
17	LOAD CASE 17 E-Q LIGHT END TO FRO

Combination Load Cases

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
18	COMBINATION LOAD CASE 18 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		5	LOAD CASE 5 WIND LEFT TO RIGHT	1.00
19	COMBINATION LOAD CASE 19 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		6	LOAD CASE 6 WIND RIGHT TO LEFT	1.00
20	COMBINATION LOAD CASE 20 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		12	LOAD CASE 12 WIND FRONT TO END	1.00
21	COMBINATION LOAD CASE 21 DL+SUSI	1	LOAD CASE 1 DEAD LOAD	1.00
		3	LOAD CASE 3 SUSPENDED MIN	1.00
		13	LOAD CASE 13 WIND FROM END TO FR	1.00

Job Title: VERICAL UPLIFT

Client

SEE PAGE 5 FOR MAX. UPLIFT
PLEASE CONSIDER L/C 18 TO 21; L/C 1-17 ARE BASIC LOAD CASES

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	10	4.292	46.443	0.017	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
6	21	1.331	24.910	8.183	0.000	0.000	0.000
17	20	-1.310	24.801	-8.180	0.000	0.000	0.000
7	21	-1.398	24.770	8.128	0.000	0.000	0.000
16	20	1.323	24.668	-8.125	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
16	19	14.455	19.473	-2.203	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
17	18	-10.322	18.472	-2.122	0.000	0.000	0.000
1	7	3.355	17.049	0.013	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000
12	18	-10.428	14.612	-1.577	0.000	0.000	0.000
11	19	14.505	14.334	-1.743	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
6	1	0.889	13.096	1.033	0.000	0.000	0.000
17	1	-0.876	13.037	-1.032	0.000	0.000	0.000
7	1	-0.935	13.021	0.998	0.000	0.000	0.000
16	1	0.884	12.932	-0.994	0.000	0.000	0.000
28	18	-6.978	12.873	0.006	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
27	19	11.269	12.817	0.005	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
12	1	-0.929	12.765	-0.035	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	1	0.939	12.750	0.030	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
7	18	-10.706	12.256	0.193	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000
6	19	14.506	11.656	0.048	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
28	1	-0.513	10.687	-0.002	0.000	0.000	0.000
1	1	0.536	10.673	0.002	0.000	0.000	0.000
27	1	0.471	10.613	-0.002	0.000	0.000	0.000
2	1	-0.465	10.554	0.002	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
2	18	-5.697	8.803	-0.002	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000
1	19	7.686	8.736	-0.006	0.000	0.000	0.000
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
28	21	-0.774	7.585	4.844	0.000	0.000	0.000
1	20	0.805	7.562	-4.843	0.000	0.000	0.000
27	21	0.708	7.470	4.843	0.000	0.000	0.000
2	20	-0.701	7.388	-4.843	0.000	0.000	0.000
28	20	-0.772	6.767	-3.197	0.000	0.000	0.000
1	21	0.810	6.756	3.197	0.000	0.000	0.000
27	20	0.714	6.665	-3.197	0.000	0.000	0.000
2	21	-0.700	6.572	3.197	0.000	0.000	0.000
12	20	-1.391	4.652	-16.828	0.000	0.000	0.000
12	21	-1.391	4.652	16.725	0.000	0.000	0.000
11	21	1.405	4.614	16.829	0.000	0.000	0.000
11	20	1.405	4.614	-16.739	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
16	3	0.441	2.455	-0.179	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000
27	3	0.236	1.312	0.000	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
6	18	-19.581	-3.133	0.469	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
7	19	16.055	-3.436	0.502	0.000	0.000	0.000
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
2	19	9.649	-5.994	-0.005	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
11	18	-19.112	-6.239	1.576	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
12	19	15.368	-7.017	1.766	0.000	0.000	0.000
1	18	-12.318	-7.071	-0.000	0.000	0.000	0.000
16	18	-19.401	-9.834	1.456	0.000	0.000	0.000
17	19	15.509	-10.055	1.636	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000
28	19	11.239	-10.674	-0.000	0.000	0.000	0.000
27	18	-15.697	-10.899	0.001	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
6	20	1.332	-17.413	-7.679	0.000	0.000	0.000
17	21	-1.315	-17.482	7.675	0.000	0.000	0.000
7	20	-1.404	-17.512	-7.727	0.000	0.000	0.000
16	21	1.324	-17.654	7.738	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000

← UPLIFT MAX

Column Load combinations giving maximum Shear forces longitudinally

Job Title: SHEAR IN Z-DIR LONGITUDINAL

Client

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	21	1.405	4.614	16.829	0.000	0.000	0.000
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
12	21	-1.391	4.652	16.725	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
6	21	1.331	24.910	8.183	0.000	0.000	0.000
7	21	-1.398	24.770	8.128	0.000	0.000	0.000
16	21	1.324	-17.654	7.738	0.000	0.000	0.000
17	21	-1.315	-17.482	7.675	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
28	21	-0.774	7.585	4.844	0.000	0.000	0.000
27	21	0.708	7.470	4.843	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
1	21	0.810	6.756	3.197	0.000	0.000	0.000
2	21	-0.700	6.572	3.197	0.000	0.000	0.000
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
12	19	15.368	-7.017	1.766	0.000	0.000	0.000
17	19	15.509	-10.055	1.636	0.000	0.000	0.000
11	18	-19.112	-6.239	1.576	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
16	18	-19.401	-9.834	1.456	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
6	1	0.889	13.096	1.033	0.000	0.000	0.000
7	1	-0.935	13.021	0.998	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000

← MAX. SHEAR IN Z-DIR

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
7	19	16.055	-3.436	0.502	0.000	0.000	0.000
6	18	-19.581	-3.133	0.469	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000
7	18	-10.706	12.256	0.193	0.000	0.000	0.000
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
6	19	14.506	11.656	0.048	0.000	0.000	0.000
11	1	0.939	12.750	0.030	0.000	0.000	0.000
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
1	10	4.292	46.443	0.017	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
1	7	3.355	17.049	0.013	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
28	18	-6.978	12.873	0.006	0.000	0.000	0.000
27	19	11.269	12.817	0.005	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
1	1	0.536	10.673	0.002	0.000	0.000	0.000
2	1	-0.465	10.554	0.002	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
27	18	-15.697	-10.899	0.001	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
27	3	0.236	1.312	0.000	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000
28	19	11.239	-10.674	-0.000	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
1	18	-12.318	-7.071	-0.000	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
2	18	-5.697	8.803	-0.002	0.000	0.000	0.000
28	1	-0.513	10.687	-0.002	0.000	0.000	0.000
27	1	0.471	10.613	-0.002	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
2	19	9.649	-5.994	-0.005	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
1	19	7.686	8.736	-0.006	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000
12	1	-0.929	12.765	-0.035	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
16	3	0.441	2.455	-0.179	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
16	1	0.884	12.932	-0.994	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
17	1	-0.876	13.037	-1.032	0.000	0.000	0.000
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
12	18	-10.428	14.612	-1.577	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
11	19	14.505	14.334	-1.743	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
17	18	-10.322	18.472	-2.122	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
16	19	14.455	19.473	-2.203	0.000	0.000	0.000
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
28	20	-0.772	6.767	-3.197	0.000	0.000	0.000
27	20	0.714	6.665	-3.197	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
1	20	0.805	7.562	-4.843	0.000	0.000	0.000
2	20	-0.701	7.388	-4.843	0.000	0.000	0.000
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
6	20	1.332	-17.413	-7.679	0.000	0.000	0.000
7	20	-1.404	-17.512	-7.727	0.000	0.000	0.000
16	20	1.323	24.668	-8.125	0.000	0.000	0.000
17	20	-1.310	24.801	-8.180	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
11	20	1.405	4.614	-16.739	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000
12	20	-1.391	4.652	-16.828	0.000	0.000	0.000

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
6	43	8.279	81.751	12.339	0.000	0.000	0.000
11	43	7.722	57.504	12.308	0.000	0.000	0.000
11	46	8.887	63.871	12.223	0.000	0.000	0.000
12	44	-8.995	63.638	11.525	0.000	0.000	0.000
6	46	8.612	76.684	11.401	0.000	0.000	0.000
6	45	8.969	78.552	11.284	0.000	0.000	0.000
7	45	-9.112	77.308	11.128	0.000	0.000	0.000
6	44	7.908	75.969	10.979	0.000	0.000	0.000
7	44	-9.104	74.956	10.952	0.000	0.000	0.000
11	44	8.210	58.904	10.774	0.000	0.000	0.000
7	46	-8.764	74.474	10.532	0.000	0.000	0.000
11	45	8.423	58.546	10.446	0.000	0.000	0.000
12	45	-8.374	57.506	10.301	0.000	0.000	0.000
7	43	-9.616	74.504	10.075	0.000	0.000	0.000
12	46	-8.594	58.700	10.075	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
11	35	7.755	50.504	8.996	0.000	0.000	0.000
11	38	8.919	56.871	8.912	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
12	43	-8.740	58.571	8.434	0.000	0.000	0.000
6	35	8.313	61.677	8.324	0.000	0.000	0.000
12	36	-9.013	56.499	8.246	0.000	0.000	0.000
11	36	8.243	51.904	7.463	0.000	0.000	0.000
6	38	8.646	56.611	7.386	0.000	0.000	0.000
6	37	9.003	58.479	7.269	0.000	0.000	0.000
11	37	8.456	51.546	7.134	0.000	0.000	0.000
7	37	-9.146	57.352	7.115	0.000	0.000	0.000
12	37	-8.392	50.366	7.022	0.000	0.000	0.000
6	36	7.942	55.896	6.964	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
7	36	-9.139	55.001	6.938	0.000	0.000	0.000
12	38	-8.612	51.560	6.796	0.000	0.000	0.000
11	48	2.716	25.795	6.792	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
12	48	-2.709	24.793	6.548	0.000	0.000	0.000
7	38	-8.799	54.519	6.519	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	48	2.729	38.708	6.301	0.000	0.000	0.000
7	48	-2.871	37.411	6.085	0.000	0.000	0.000
7	35	-9.650	54.548	6.062	0.000	0.000	0.000
12	35	-8.758	51.432	5.155	0.000	0.000	0.000
6	18	9.042	59.503	4.927	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
6	23	-2.144	47.656	4.466	0.000	0.000	0.000
7	18	-9.656	57.552	4.361	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
6	27	14.900	55.051	4.256	0.000	0.000	0.000
6	21	-7.219	42.405	4.075	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
6	22	18.347	53.496	3.759	0.000	0.000	0.000
7	22	4.077	40.407	3.623	0.000	0.000	0.000
6	26	-1.811	42.590	3.529	0.000	0.000	0.000
6	25	-1.453	44.458	3.412	0.000	0.000	0.000
7	21	-15.994	52.176	3.391	0.000	0.000	0.000
6	30	15.233	49.984	3.318	0.000	0.000	0.000
7	29	-0.419	43.250	3.302	0.000	0.000	0.000
6	29	15.590	51.852	3.201	0.000	0.000	0.000
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
7	25	-13.800	51.096	3.147	0.000	0.000	0.000
7	28	-0.412	40.898	3.125	0.000	0.000	0.000
16	43	7.775	25.955	3.114	0.000	0.000	0.000
6	24	-2.514	41.874	3.107	0.000	0.000	0.000
7	24	-13.792	48.744	2.971	0.000	0.000	0.000
6	28	14.530	49.269	2.896	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
7	30	-0.072	40.416	2.706	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
7	26	-13.453	48.262	2.551	0.000	0.000	0.000
28	36	-6.834	39.267	2.430	0.000	0.000	0.000
28	38	-6.481	38.362	2.425	0.000	0.000	0.000
27	38	6.531	38.940	2.425	0.000	0.000	0.000
27	36	5.837	37.898	2.418	0.000	0.000	0.000
28	35	-6.629	38.351	2.408	0.000	0.000	0.000
28	37	-6.271	37.431	2.408	0.000	0.000	0.000
27	35	5.481	36.759	2.403	0.000	0.000	0.000
27	37	6.096	37.546	2.402	0.000	0.000	0.000
7	27	-0.923	40.446	2.249	0.000	0.000	0.000
16	48	2.698	8.791	2.188	0.000	0.000	0.000
17	48	-2.691	8.259	2.127	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
7	23	-14.304	48.292	2.094	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
16	45	8.485	30.933	1.893	0.000	0.000	0.000
17	45	-8.378	30.051	1.885	0.000	0.000	0.000
6	1	2.305	22.052	1.822	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
12	20	14.041	1.538	1.699	0.000	0.000	0.000
16	44	9.508	41.823	1.653	0.000	0.000	0.000
11	19	-17.785	3.425	1.636	0.000	0.000	0.000
7	1	-2.425	20.869	1.625	0.000	0.000	0.000
1	37	10.039	72.463	1.624	0.000	0.000	0.000
2	35	-9.053	69.797	1.623	0.000	0.000	0.000
1	35	8.572	50.029	1.622	0.000	0.000	0.000
2	37	-7.296	47.589	1.618	0.000	0.000	0.000
1	38	7.027	37.918	1.613	0.000	0.000	0.000
1	36	6.618	37.404	1.609	0.000	0.000	0.000
2	36	-5.974	35.755	1.608	0.000	0.000	0.000
2	38	-5.685	35.121	1.606	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
11	21	-7.024	39.508	1.523	0.000	0.000	0.000
16	46	10.946	60.626	1.456	0.000	0.000	0.000
11	23	-2.504	45.077	1.370	0.000	0.000	0.000
11	26	-1.340	51.445	1.286	0.000	0.000	0.000
6	19	-18.165	5.823	1.258	0.000	0.000	0.000
17	46	-9.896	43.226	1.233	0.000	0.000	0.000
7	20	14.566	4.412	1.129	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
17	44	-12.092	62.310	1.040	0.000	0.000	0.000
17	20	14.120	-2.144	0.940	0.000	0.000	0.000
12	22	4.055	38.239	0.937	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000
6	20	15.922	20.612	0.836	0.000	0.000	0.000
7	19	-12.196	20.104	0.820	0.000	0.000	0.000
12	28	-0.634	50.664	0.767	0.000	0.000	0.000
16	19	-17.999	-1.196	0.745	0.000	0.000	0.000
17	43	-8.708	34.703	0.662	0.000	0.000	0.000
16	35	7.825	36.093	0.442	0.000	0.000	0.000
11	18	8.836	58.626	0.419	0.000	0.000	0.000
6	31	8.313	40.516	0.392	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
11	1	2.267	22.414	0.089	0.000	0.000	0.000
2	39	-9.093	72.191	0.071	0.000	0.000	0.000
1	41	10.090	74.880	0.071	0.000	0.000	0.000
1	39	8.622	52.446	0.069	0.000	0.000	0.000
2	41	-7.336	49.984	0.066	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
1	42	7.078	40.335	0.060	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
2	40	-6.013	38.149	0.056	0.000	0.000	0.000
1	40	6.669	39.822	0.056	0.000	0.000	0.000
2	42	-5.725	37.516	0.054	0.000	0.000	0.000
1	45	10.106	75.515	0.035	0.000	0.000	0.000
2	43	-9.087	72.788	0.035	0.000	0.000	0.000
1	43	8.639	53.081	0.033	0.000	0.000	0.000
1	47	1.913	15.269	0.031	0.000	0.000	0.000
2	45	-7.329	50.581	0.030	0.000	0.000	0.000
2	47	-1.663	14.287	0.029	0.000	0.000	0.000
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000
1	25	3.475	65.550	0.025	0.000	0.000	0.000
2	23	-11.552	70.912	0.024	0.000	0.000	0.000
1	46	7.095	40.970	0.024	0.000	0.000	0.000
1	23	2.008	43.116	0.023	0.000	0.000	0.000
2	27	-3.879	63.514	0.022	0.000	0.000	0.000
1	29	13.477	73.453	0.022	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
1	27	12.009	51.019	0.020	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
1	44	6.686	40.456	0.020	0.000	0.000	0.000
2	44	-6.007	38.746	0.020	0.000	0.000	0.000
2	25	-9.795	48.705	0.019	0.000	0.000	0.000
2	46	-5.718	38.113	0.018	0.000	0.000	0.000
2	29	-2.122	41.306	0.017	0.000	0.000	0.000
1	10	4.292	46.443	0.017	0.000	0.000	0.000
1	18	7.655	44.523	0.017	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
1	26	0.463	31.005	0.014	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	7	3.355	17.049	0.013	0.000	0.000	0.000
2	18	-6.453	41.946	0.013	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
1	21	-3.025	25.946	0.012	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
28	24	-9.936	41.911	0.011	0.000	0.000	0.000
1	30	10.465	38.908	0.011	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
1	48	1.923	15.631	0.010	0.000	0.000	0.000
1	24	0.054	30.491	0.010	0.000	0.000	0.000
2	24	-8.472	36.870	0.009	0.000	0.000	0.000
28	28	-0.828	30.138	0.008	0.000	0.000	0.000
2	48	-1.659	14.628	0.008	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
1	22	11.978	37.802	0.007	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
2	28	-0.800	29.472	0.007	0.000	0.000	0.000
1	28	10.056	38.395	0.007	0.000	0.000	0.000
2	21	-9.523	35.677	0.007	0.000	0.000	0.000
2	26	-8.184	36.237	0.006	0.000	0.000	0.000
28	26	-9.583	41.006	0.006	0.000	0.000	0.000
1	1	1.614	14.048	0.006	0.000	0.000	0.000
27	30	11.811	41.614	0.006	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
28	19	-8.045	16.280	0.005	0.000	0.000	0.000
2	30	-0.511	28.838	0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
2	22	1.986	24.580	0.005	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
27	26	-1.672	29.756	0.003	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
2	1	-1.407	13.140	0.003	0.000	0.000	0.000
28	30	-0.475	29.233	0.003	0.000	0.000	0.000
1	19	-11.240	-3.697	0.003	0.000	0.000	0.000
27	20	12.260	16.505	0.002	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
27	3	0.236	1.312	0.000	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
28	20	10.172	-7.267	-0.001	0.000	0.000	0.000
2	19	-6.639	11.388	-0.001	0.000	0.000	0.000
28	40	-6.867	41.855	-0.001	0.000	0.000	0.000
27	28	11.118	40.571	-0.001	0.000	0.000	0.000
28	21	-11.050	40.693	-0.002	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
27	19	-14.706	-7.211	-0.002	0.000	0.000	0.000
28	1	-1.581	14.094	-0.002	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
1	20	8.764	12.111	-0.003	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
27	24	-2.365	28.713	-0.003	0.000	0.000	0.000
2	20	8.707	-3.409	-0.004	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
27	1	1.462	14.301	-0.006	0.000	0.000	0.000
28	22	2.613	23.033	-0.006	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
27	42	6.601	41.592	-0.007	0.000	0.000	0.000
28	42	-6.514	40.949	-0.007	0.000	0.000	0.000
28	47	-1.858	15.649	-0.007	0.000	0.000	0.000
27	22	14.028	40.647	-0.007	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
28	18	-7.141	44.228	-0.010	0.000	0.000	0.000
27	47	1.738	15.856	-0.010	0.000	0.000	0.000
27	21	-6.197	22.860	-0.011	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
28	23	-9.731	40.995	-0.011	0.000	0.000	0.000
28	25	-9.373	40.075	-0.011	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
27	40	5.907	40.550	-0.014	0.000	0.000	0.000
28	27	-0.622	29.222	-0.014	0.000	0.000	0.000
28	29	-0.265	28.301	-0.014	0.000	0.000	0.000
27	27	10.761	39.432	-0.016	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
27	18	6.867	44.162	-0.016	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
27	29	11.377	40.219	-0.017	0.000	0.000	0.000
27	23	-2.722	27.574	-0.018	0.000	0.000	0.000
27	25	-2.106	28.361	-0.020	0.000	0.000	0.000
28	39	-6.662	40.938	-0.024	0.000	0.000	0.000
28	41	-6.304	40.018	-0.024	0.000	0.000	0.000
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000
27	39	5.551	39.411	-0.028	0.000	0.000	0.000
28	48	-1.862	15.310	-0.028	0.000	0.000	0.000
27	41	6.166	40.198	-0.030	0.000	0.000	0.000
27	48	1.726	15.491	-0.031	0.000	0.000	0.000
28	44	-6.875	41.262	-0.038	0.000	0.000	0.000
27	46	6.580	40.953	-0.043	0.000	0.000	0.000
28	46	-6.522	40.357	-0.043	0.000	0.000	0.000
27	44	5.886	39.910	-0.050	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
28	43	-6.669	40.346	-0.060	0.000	0.000	0.000
28	45	-6.311	39.425	-0.060	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
27	43	5.530	38.771	-0.064	0.000	0.000	0.000
27	45	6.146	39.558	-0.066	0.000	0.000	0.000
12	1	-2.255	21.319	-0.102	0.000	0.000	0.000
11	24	-2.016	46.477	-0.164	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
16	3	0.441	2.455	-0.179	0.000	0.000	0.000
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
11	27	14.304	55.364	-0.290	0.000	0.000	0.000
11	30	15.469	61.731	-0.374	0.000	0.000	0.000
12	29	-0.012	44.532	-0.457	0.000	0.000	0.000
12	18	-9.055	58.066	-0.477	0.000	0.000	0.000
11	25	-1.803	46.119	-0.492	0.000	0.000	0.000
6	34	8.646	35.449	-0.546	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
6	33	9.003	37.318	-0.662	0.000	0.000	0.000
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
12	30	-0.232	45.726	-0.684	0.000	0.000	0.000
17	37	-8.400	40.131	-0.758	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000
16	37	8.536	41.071	-0.779	0.000	0.000	0.000
7	33	-9.149	36.211	-0.813	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000
12	24	-13.532	61.479	-0.905	0.000	0.000	0.000
11	22	18.189	54.938	-0.967	0.000	0.000	0.000
6	32	7.943	34.734	-0.967	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
7	32	-9.142	33.860	-0.989	0.000	0.000	0.000
16	36	9.559	51.961	-1.019	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
16	38	10.997	70.764	-1.216	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
7	34	-8.802	33.378	-1.409	0.000	0.000	0.000
17	38	-9.918	53.307	-1.410	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
12	21	-15.292	54.461	-1.570	0.000	0.000	0.000
28	32	-6.833	38.859	-1.590	0.000	0.000	0.000
28	34	-6.480	37.953	-1.595	0.000	0.000	0.000
27	34	6.534	38.538	-1.596	0.000	0.000	0.000
17	36	-12.114	72.390	-1.602	0.000	0.000	0.000
27	32	5.840	37.495	-1.603	0.000	0.000	0.000
28	31	-6.628	37.942	-1.612	0.000	0.000	0.000
28	33	-6.270	37.022	-1.612	0.000	0.000	0.000
27	31	5.484	36.356	-1.617	0.000	0.000	0.000
27	33	6.099	37.143	-1.619	0.000	0.000	0.000
12	19	-11.754	23.167	-1.644	0.000	0.000	0.000
11	20	15.833	23.998	-1.684	0.000	0.000	0.000
16	1	2.286	21.570	-1.706	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
17	1	-2.266	20.948	-1.729	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
11	28	14.793	56.763	-1.824	0.000	0.000	0.000
7	31	-9.653	33.407	-1.866	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	35	-8.730	44.784	-1.981	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000
6	47	2.722	9.362	-2.051	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
12	25	-12.910	55.347	-2.129	0.000	0.000	0.000
11	29	15.006	56.406	-2.152	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
16	21	-7.196	35.447	-2.183	0.000	0.000	0.000
7	47	-2.881	8.165	-2.249	0.000	0.000	0.000
6	39	8.265	30.395	-2.277	0.000	0.000	0.000
12	27	-0.378	45.598	-2.324	0.000	0.000	0.000
12	26	-13.130	56.541	-2.355	0.000	0.000	0.000
1	33	10.036	72.866	-2.396	0.000	0.000	0.000
2	31	-9.054	70.205	-2.397	0.000	0.000	0.000
1	31	8.569	50.432	-2.398	0.000	0.000	0.000
2	33	-7.297	47.997	-2.402	0.000	0.000	0.000
1	34	7.025	38.321	-2.408	0.000	0.000	0.000
1	32	6.616	37.807	-2.412	0.000	0.000	0.000
2	32	-5.974	36.163	-2.412	0.000	0.000	0.000
2	34	-5.686	35.529	-2.414	0.000	0.000	0.000
17	22	4.213	35.892	-2.424	0.000	0.000	0.000
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
16	23	-2.537	40.003	-2.699	0.000	0.000	0.000
17	19	-11.711	26.383	-2.818	0.000	0.000	0.000
16	20	15.856	28.110	-2.915	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
6	42	8.598	25.328	-3.215	0.000	0.000	0.000
6	41	8.955	27.196	-3.332	0.000	0.000	0.000
7	41	-9.128	26.127	-3.458	0.000	0.000	0.000
7	40	-9.120	23.775	-3.634	0.000	0.000	0.000
6	40	7.895	24.613	-3.637	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
17	29	0.012	43.844	-3.777	0.000	0.000	0.000
16	25	-1.827	44.981	-3.920	0.000	0.000	0.000
12	23	-13.276	56.412	-3.996	0.000	0.000	0.000
7	42	-8.780	23.293	-4.053	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000
16	24	-0.804	55.871	-4.159	0.000	0.000	0.000
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
16	26	0.635	74.674	-4.357	0.000	0.000	0.000
16	18	8.899	57.110	-4.374	0.000	0.000	0.000
17	30	-1.506	57.020	-4.429	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
7	39	-9.632	23.323	-4.510	0.000	0.000	0.000
16	27	14.390	54.656	-4.528	0.000	0.000	0.000
17	28	-3.702	76.104	-4.622	0.000	0.000	0.000
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
17	18	-8.993	58.118	-4.860	0.000	0.000	0.000
16	22	18.196	57.427	-4.927	0.000	0.000	0.000
17	27	-0.317	48.497	-5.000	0.000	0.000	0.000
17	21	-15.161	57.288	-5.242	0.000	0.000	0.000
17	25	-12.903	58.108	-5.656	0.000	0.000	0.000
16	29	15.101	59.634	-5.750	0.000	0.000	0.000
16	28	16.124	70.525	-5.989	0.000	0.000	0.000
16	47	2.704	38.136	-6.164	0.000	0.000	0.000
16	30	17.562	89.328	-6.186	0.000	0.000	0.000
17	47	-2.683	37.506	-6.208	0.000	0.000	0.000
17	26	-14.421	71.284	-6.308	0.000	0.000	0.000
17	24	-16.618	90.367	-6.501	0.000	0.000	0.000
11	47	2.716	25.794	-6.582	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
12	47	-2.709	24.794	-6.788	0.000	0.000	0.000
17	23	-13.233	62.761	-6.879	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
16	31	7.824	57.254	-7.489	0.000	0.000	0.000
11	31	7.755	50.504	-7.788	0.000	0.000	0.000
11	34	8.919	56.871	-7.872	0.000	0.000	0.000
12	32	-9.013	56.499	-8.531	0.000	0.000	0.000
17	33	-8.397	61.273	-8.685	0.000	0.000	0.000
16	33	8.535	62.232	-8.711	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
16	32	9.558	73.122	-8.950	0.000	0.000	0.000
16	34	10.996	91.925	-9.147	0.000	0.000	0.000
11	32	8.243	51.903	-9.322	0.000	0.000	0.000
17	34	-9.915	74.449	-9.337	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
17	32	-12.112	93.532	-9.530	0.000	0.000	0.000
11	33	8.456	51.546	-9.650	0.000	0.000	0.000
12	33	-8.392	50.367	-9.754	0.000	0.000	0.000
17	31	-8.727	65.926	-9.908	0.000	0.000	0.000
12	34	-8.612	51.560	-9.981	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
11	39	7.721	57.502	-11.096	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
11	42	8.886	63.870	-11.180	0.000	0.000	0.000
16	39	7.786	77.308	-11.502	0.000	0.000	0.000
12	31	-8.758	51.432	-11.621	0.000	0.000	0.000
12	40	-8.996	63.640	-11.814	0.000	0.000	0.000
11	40	8.209	58.902	-12.630	0.000	0.000	0.000
17	41	-8.364	81.234	-12.701	0.000	0.000	0.000
16	41	8.497	82.286	-12.723	0.000	0.000	0.000
11	41	8.422	58.545	-12.958	0.000	0.000	0.000
16	40	9.520	93.176	-12.962	0.000	0.000	0.000
12	41	-8.374	57.507	-13.038	0.000	0.000	0.000
16	42	10.958	111.979	-13.160	0.000	0.000	0.000
12	42	-8.594	58.701	-13.264	0.000	0.000	0.000
17	42	-9.882	94.410	-13.353	0.000	0.000	0.000
17	40	-12.078	113.493	-13.546	0.000	0.000	0.000
17	39	-8.693	85.887	-13.924	0.000	0.000	0.000
12	39	-8.740	58.573	-14.905	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000

Column Load combinations giving maximum Shear forces laterally

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	22	18.347	53.496	3.759	0.000	0.000	0.000
16	22	18.196	57.427	-4.927	0.000	0.000	0.000
11	22	18.189	54.938	-0.967	0.000	0.000	0.000
16	30	17.562	89.328	-6.186	0.000	0.000	0.000
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
16	28	16.124	70.525	-5.989	0.000	0.000	0.000
6	20	15.922	20.612	0.836	0.000	0.000	0.000
16	20	15.856	28.110	-2.915	0.000	0.000	0.000
11	20	15.833	23.998	-1.684	0.000	0.000	0.000
6	29	15.590	51.852	3.201	0.000	0.000	0.000
11	30	15.469	61.731	-0.374	0.000	0.000	0.000
6	30	15.233	49.984	3.318	0.000	0.000	0.000
16	29	15.101	59.634	-5.750	0.000	0.000	0.000
11	29	15.006	56.406	-2.152	0.000	0.000	0.000
6	27	14.900	55.051	4.256	0.000	0.000	0.000
11	28	14.793	56.763	-1.824	0.000	0.000	0.000
7	20	14.566	4.412	1.129	0.000	0.000	0.000
6	28	14.530	49.269	2.896	0.000	0.000	0.000
16	27	14.390	54.656	-4.528	0.000	0.000	0.000
11	27	14.304	55.364	-0.290	0.000	0.000	0.000
17	20	14.120	-2.144	0.940	0.000	0.000	0.000
12	20	14.041	1.538	1.699	0.000	0.000	0.000
27	22	14.028	40.647	-0.007	0.000	0.000	0.000
1	29	13.477	73.453	0.022	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
27	20	12.260	16.505	0.002	0.000	0.000	0.000
1	27	12.009	51.019	0.020	0.000	0.000	0.000
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
1	22	11.978	37.802	0.007	0.000	0.000	0.000
27	30	11.811	41.614	0.006	0.000	0.000	0.000
27	29	11.377	40.219	-0.017	0.000	0.000	0.000
27	28	11.118	40.571	-0.001	0.000	0.000	0.000
16	38	10.997	70.764	-1.216	0.000	0.000	0.000
16	34	10.996	91.925	-9.147	0.000	0.000	0.000
16	42	10.958	111.979	-13.160	0.000	0.000	0.000
16	46	10.946	60.626	1.456	0.000	0.000	0.000
27	27	10.761	39.432	-0.016	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
1	30	10.465	38.908	0.011	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
28	20	10.172	-7.267	-0.001	0.000	0.000	0.000
1	45	10.106	75.515	0.035	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	41	10.090	74.880	0.071	0.000	0.000	0.000
1	28	10.056	38.395	0.007	0.000	0.000	0.000
1	37	10.039	72.463	1.624	0.000	0.000	0.000
1	33	10.036	72.866	-2.396	0.000	0.000	0.000
16	36	9.559	51.961	-1.019	0.000	0.000	0.000
16	32	9.558	73.122	-8.950	0.000	0.000	0.000
16	40	9.520	93.176	-12.962	0.000	0.000	0.000
16	44	9.508	41.823	1.653	0.000	0.000	0.000
6	18	9.042	59.503	4.927	0.000	0.000	0.000
6	33	9.003	37.318	-0.662	0.000	0.000	0.000
6	37	9.003	58.479	7.269	0.000	0.000	0.000
6	45	8.969	78.552	11.284	0.000	0.000	0.000
6	41	8.955	27.196	-3.332	0.000	0.000	0.000
11	38	8.919	56.871	8.912	0.000	0.000	0.000
11	34	8.919	56.871	-7.872	0.000	0.000	0.000
16	18	8.899	57.110	-4.374	0.000	0.000	0.000
11	46	8.887	63.871	12.223	0.000	0.000	0.000
11	42	8.886	63.870	-11.180	0.000	0.000	0.000
11	18	8.836	58.626	0.419	0.000	0.000	0.000
1	20	8.764	12.111	-0.003	0.000	0.000	0.000
2	20	8.707	-3.409	-0.004	0.000	0.000	0.000
6	34	8.646	35.449	-0.546	0.000	0.000	0.000
6	38	8.646	56.611	7.386	0.000	0.000	0.000
1	43	8.639	53.081	0.033	0.000	0.000	0.000
1	39	8.622	52.446	0.069	0.000	0.000	0.000
6	46	8.612	76.684	11.401	0.000	0.000	0.000
6	42	8.598	25.328	-3.215	0.000	0.000	0.000
1	35	8.572	50.029	1.622	0.000	0.000	0.000
1	31	8.569	50.432	-2.398	0.000	0.000	0.000
16	37	8.536	41.071	-0.779	0.000	0.000	0.000
16	33	8.535	62.232	-8.711	0.000	0.000	0.000
16	41	8.497	82.286	-12.723	0.000	0.000	0.000
16	45	8.485	30.933	1.893	0.000	0.000	0.000
11	37	8.456	51.546	7.134	0.000	0.000	0.000
11	33	8.456	51.546	-9.650	0.000	0.000	0.000
11	45	8.423	58.546	10.446	0.000	0.000	0.000
11	41	8.422	58.545	-12.958	0.000	0.000	0.000
6	31	8.313	40.516	0.392	0.000	0.000	0.000
6	35	8.313	61.677	8.324	0.000	0.000	0.000
6	43	8.279	81.751	12.339	0.000	0.000	0.000
6	39	8.265	30.395	-2.277	0.000	0.000	0.000
11	36	8.243	51.904	7.463	0.000	0.000	0.000
11	32	8.243	51.903	-9.322	0.000	0.000	0.000
11	44	8.210	58.904	10.774	0.000	0.000	0.000
11	40	8.209	58.902	-12.630	0.000	0.000	0.000
6	32	7.943	34.734	-0.967	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	36	7.942	55.896	6.964	0.000	0.000	0.000
6	44	7.908	75.989	10.979	0.000	0.000	0.000
6	40	7.895	24.613	-3.637	0.000	0.000	0.000
16	35	7.825	36.093	0.442	0.000	0.000	0.000
16	31	7.824	57.254	-7.489	0.000	0.000	0.000
16	39	7.786	77.308	-11.502	0.000	0.000	0.000
16	43	7.775	25.955	3.114	0.000	0.000	0.000
11	35	7.755	50.504	8.996	0.000	0.000	0.000
11	31	7.755	50.504	-7.788	0.000	0.000	0.000
11	43	7.722	57.504	12.308	0.000	0.000	0.000
11	39	7.721	57.502	-11.096	0.000	0.000	0.000
1	18	7.655	44.523	0.017	0.000	0.000	0.000
1	46	7.095	40.970	0.024	0.000	0.000	0.000
1	42	7.078	40.335	0.060	0.000	0.000	0.000
1	38	7.027	37.918	1.613	0.000	0.000	0.000
1	34	7.025	38.321	-2.408	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
27	18	6.867	44.162	-0.016	0.000	0.000	0.000
1	44	6.686	40.456	0.020	0.000	0.000	0.000
1	40	6.669	39.822	0.056	0.000	0.000	0.000
1	36	6.618	37.404	1.609	0.000	0.000	0.000
1	32	6.616	37.807	-2.412	0.000	0.000	0.000
27	42	6.601	41.592	-0.007	0.000	0.000	0.000
27	46	6.580	40.953	-0.043	0.000	0.000	0.000
27	34	6.534	38.538	-1.596	0.000	0.000	0.000
27	38	6.531	38.940	2.425	0.000	0.000	0.000
27	41	6.166	40.198	-0.030	0.000	0.000	0.000
27	45	6.146	39.558	-0.066	0.000	0.000	0.000
27	33	6.099	37.143	-1.619	0.000	0.000	0.000
27	37	6.096	37.546	2.402	0.000	0.000	0.000
27	40	5.907	40.550	-0.014	0.000	0.000	0.000
27	44	5.886	39.910	-0.050	0.000	0.000	0.000
27	32	5.840	37.495	-1.603	0.000	0.000	0.000
27	36	5.837	37.898	2.418	0.000	0.000	0.000
27	39	5.551	39.411	-0.028	0.000	0.000	0.000
27	43	5.530	38.771	-0.064	0.000	0.000	0.000
27	31	5.484	36.356	-1.617	0.000	0.000	0.000
27	35	5.481	36.759	2.403	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
1	10	4.292	46.443	0.017	0.000	0.000	0.000
17	22	4.213	35.892	-2.424	0.000	0.000	0.000
7	22	4.077	40.407	3.623	0.000	0.000	0.000
12	22	4.055	38.239	0.937	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	25	3.475	65.550	0.025	0.000	0.000	0.000
1	7	3.355	17.049	0.013	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
6	48	2.729	38.708	6.301	0.000	0.000	0.000
6	47	2.722	9.362	-2.051	0.000	0.000	0.000
11	48	2.716	25.795	6.792	0.000	0.000	0.000
11	47	2.716	25.794	-6.582	0.000	0.000	0.000
16	47	2.704	38.136	-6.164	0.000	0.000	0.000
16	48	2.698	8.791	2.188	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
28	22	2.613	23.033	-0.006	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
6	1	2.305	22.052	1.822	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
16	1	2.286	21.570	-1.706	0.000	0.000	0.000
11	1	2.267	22.414	0.089	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
1	23	2.008	43.116	0.023	0.000	0.000	0.000
2	22	1.986	24.580	0.005	0.000	0.000	0.000
1	48	1.923	15.631	0.010	0.000	0.000	0.000
1	47	1.913	15.269	0.031	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
27	47	1.738	15.856	-0.010	0.000	0.000	0.000
27	48	1.726	15.491	-0.031	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
1	1	1.614	14.048	0.006	0.000	0.000	0.000
27	1	1.462	14.301	-0.006	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
16	26	0.635	74.674	-4.357	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
1	26	0.463	31.005	0.014	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
16	3	0.441	2.455	-0.179	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
27	3	0.236	1.312	0.000	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
1	24	0.054	30.491	0.010	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
17	29	0.012	43.844	-3.777	0.000	0.000	0.000
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
12	29	-0.012	44.532	-0.457	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000
7	30	-0.072	40.416	2.706	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000
12	30	-0.232	45.726	-0.684	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
28	29	-0.265	28.301	-0.014	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
17	27	-0.317	48.497	-5.000	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
12	27	-0.378	45.598	-2.324	0.000	0.000	0.000
7	28	-0.412	40.898	3.125	0.000	0.000	0.000
7	29	-0.419	43.250	3.302	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
28	30	-0.475	29.233	0.003	0.000	0.000	0.000
2	30	-0.511	28.838	0.005	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
28	27	-0.622	29.222	-0.014	0.000	0.000	0.000
12	28	-0.634	50.664	0.767	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
2	28	-0.800	29.472	0.007	0.000	0.000	0.000
16	24	-0.804	55.871	-4.159	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
28	28	-0.828	30.138	0.008	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
7	27	-0.923	40.446	2.249	0.000	0.000	0.000
11	26	-1.340	51.445	1.286	0.000	0.000	0.000
2	1	-1.407	13.140	0.003	0.000	0.000	0.000
6	25	-1.453	44.458	3.412	0.000	0.000	0.000
17	30	-1.506	57.020	-4.429	0.000	0.000	0.000
28	1	-1.581	14.094	-0.002	0.000	0.000	0.000
2	48	-1.659	14.628	0.008	0.000	0.000	0.000
2	47	-1.663	14.287	0.029	0.000	0.000	0.000
27	26	-1.672	29.756	0.003	0.000	0.000	0.000
11	25	-1.803	46.119	-0.492	0.000	0.000	0.000
6	26	-1.811	42.590	3.529	0.000	0.000	0.000
16	25	-1.827	44.981	-3.920	0.000	0.000	0.000
28	47	-1.858	15.649	-0.007	0.000	0.000	0.000
28	48	-1.862	15.310	-0.028	0.000	0.000	0.000
11	24	-2.016	46.477	-0.164	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
27	25	-2.106	28.361	-0.020	0.000	0.000	0.000
2	29	-2.122	41.306	0.017	0.000	0.000	0.000
6	23	-2.144	47.656	4.466	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
12	1	-2.255	21.319	-0.102	0.000	0.000	0.000
17	1	-2.266	20.948	-1.729	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
27	24	-2.365	28.713	-0.003	0.000	0.000	0.000
7	1	-2.425	20.869	1.625	0.000	0.000	0.000
11	23	-2.504	45.077	1.370	0.000	0.000	0.000
6	24	-2.514	41.874	3.107	0.000	0.000	0.000
16	23	-2.537	40.003	-2.699	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
17	47	-2.683	37.506	-6.208	0.000	0.000	0.000
17	48	-2.691	8.259	2.127	0.000	0.000	0.000
12	48	-2.709	24.793	6.548	0.000	0.000	0.000
12	47	-2.709	24.794	-6.788	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000
27	23	-2.722	27.574	-0.018	0.000	0.000	0.000
7	48	-2.871	37.411	6.085	0.000	0.000	0.000
7	47	-2.881	8.165	-2.249	0.000	0.000	0.000
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
1	21	-3.025	25.946	0.012	0.000	0.000	0.000
17	28	-3.702	76.104	-4.622	0.000	0.000	0.000
2	27	-3.879	63.514	0.022	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
2	38	-5.685	35.121	1.606	0.000	0.000	0.000
2	34	-5.686	35.529	-2.414	0.000	0.000	0.000
2	46	-5.718	38.113	0.018	0.000	0.000	0.000
2	42	-5.725	37.516	0.054	0.000	0.000	0.000
2	36	-5.974	35.755	1.608	0.000	0.000	0.000
2	32	-5.974	36.163	-2.412	0.000	0.000	0.000
2	44	-6.007	38.746	0.020	0.000	0.000	0.000
2	40	-6.013	38.149	0.056	0.000	0.000	0.000
27	21	-6.197	22.860	-0.011	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
28	33	-6.270	37.022	-1.612	0.000	0.000	0.000
28	37	-6.271	37.431	2.408	0.000	0.000	0.000
28	41	-6.304	40.018	-0.024	0.000	0.000	0.000
28	45	-6.311	39.425	-0.060	0.000	0.000	0.000
2	18	-6.453	41.946	0.013	0.000	0.000	0.000
28	34	-6.480	37.953	-1.595	0.000	0.000	0.000
28	38	-6.481	38.362	2.425	0.000	0.000	0.000
28	42	-6.514	40.949	-0.007	0.000	0.000	0.000
28	46	-6.522	40.357	-0.043	0.000	0.000	0.000
28	31	-6.628	37.942	-1.612	0.000	0.000	0.000
28	35	-6.629	38.351	2.408	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
2	19	-6.639	11.388	-0.001	0.000	0.000	0.000
28	39	-6.662	40.938	-0.024	0.000	0.000	0.000
28	43	-6.669	40.346	-0.060	0.000	0.000	0.000
28	32	-6.833	38.859	-1.590	0.000	0.000	0.000
28	36	-6.834	39.267	2.430	0.000	0.000	0.000
28	40	-6.867	41.855	-0.001	0.000	0.000	0.000
28	44	-6.875	41.262	-0.038	0.000	0.000	0.000
11	21	-7.024	39.508	1.523	0.000	0.000	0.000
28	18	-7.141	44.228	-0.010	0.000	0.000	0.000
16	21	-7.196	35.447	-2.183	0.000	0.000	0.000
6	21	-7.219	42.405	4.075	0.000	0.000	0.000
2	37	-7.296	47.589	1.618	0.000	0.000	0.000
2	33	-7.297	47.997	-2.402	0.000	0.000	0.000
2	45	-7.329	50.581	0.030	0.000	0.000	0.000
2	41	-7.336	49.984	0.066	0.000	0.000	0.000
28	19	-8.045	16.280	0.005	0.000	0.000	0.000
2	26	-8.184	36.237	0.006	0.000	0.000	0.000
17	41	-8.364	81.234	-12.701	0.000	0.000	0.000
12	45	-8.374	57.506	10.301	0.000	0.000	0.000
12	41	-8.374	57.507	-13.038	0.000	0.000	0.000
17	45	-8.378	30.051	1.885	0.000	0.000	0.000
12	37	-8.392	50.366	7.022	0.000	0.000	0.000
12	33	-8.392	50.367	-9.754	0.000	0.000	0.000
17	33	-8.397	61.273	-8.685	0.000	0.000	0.000
17	37	-8.400	40.131	-0.758	0.000	0.000	0.000
2	24	-8.472	36.870	0.009	0.000	0.000	0.000
12	46	-8.594	58.700	10.075	0.000	0.000	0.000
12	42	-8.594	58.701	-13.264	0.000	0.000	0.000
12	38	-8.612	51.560	6.796	0.000	0.000	0.000
12	34	-8.612	51.560	-9.981	0.000	0.000	0.000
17	39	-8.693	85.887	-13.924	0.000	0.000	0.000
17	43	-8.708	34.703	0.662	0.000	0.000	0.000
17	31	-8.727	65.926	-9.908	0.000	0.000	0.000
17	35	-8.730	44.784	-1.981	0.000	0.000	0.000
12	43	-8.740	58.571	8.434	0.000	0.000	0.000
12	39	-8.740	58.573	-14.905	0.000	0.000	0.000
12	35	-8.758	51.432	5.155	0.000	0.000	0.000
12	31	-8.758	51.432	-11.621	0.000	0.000	0.000
7	46	-8.764	74.474	10.532	0.000	0.000	0.000
7	42	-8.780	23.293	-4.053	0.000	0.000	0.000
7	38	-8.799	54.519	6.519	0.000	0.000	0.000
7	34	-8.802	33.378	-1.409	0.000	0.000	0.000
17	18	-8.993	58.118	-4.860	0.000	0.000	0.000
12	44	-8.995	63.638	11.525	0.000	0.000	0.000
12	40	-8.996	63.640	-11.814	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
12	36	-9.013	56.499	8.246	0.000	0.000	0.000
12	32	-9.013	56.499	-8.531	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
2	35	-9.053	69.797	1.623	0.000	0.000	0.000
2	31	-9.054	70.205	-2.397	0.000	0.000	0.000
12	18	-9.055	58.066	-0.477	0.000	0.000	0.000
2	43	-9.087	72.788	0.035	0.000	0.000	0.000
2	39	-9.093	72.191	0.071	0.000	0.000	0.000
7	44	-9.104	74.956	10.952	0.000	0.000	0.000
7	45	-9.112	77.308	11.128	0.000	0.000	0.000
7	40	-9.120	23.775	-3.634	0.000	0.000	0.000
7	41	-9.128	26.127	-3.458	0.000	0.000	0.000
7	36	-9.139	55.001	6.938	0.000	0.000	0.000
7	32	-9.142	33.860	-0.989	0.000	0.000	0.000
7	37	-9.146	57.352	7.115	0.000	0.000	0.000
7	33	-9.149	36.211	-0.813	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
28	25	-9.373	40.075	-0.011	0.000	0.000	0.000
2	21	-9.523	35.677	0.007	0.000	0.000	0.000
28	26	-9.583	41.006	0.006	0.000	0.000	0.000
7	43	-9.616	74.504	10.075	0.000	0.000	0.000
7	39	-9.632	23.323	-4.510	0.000	0.000	0.000
7	35	-9.650	54.548	6.062	0.000	0.000	0.000
7	31	-9.653	33.407	-1.866	0.000	0.000	0.000
7	18	-9.656	57.552	4.361	0.000	0.000	0.000
28	23	-9.731	40.995	-0.011	0.000	0.000	0.000
2	25	-9.795	48.705	0.019	0.000	0.000	0.000
17	42	-9.882	94.410	-13.353	0.000	0.000	0.000
17	46	-9.896	43.226	1.233	0.000	0.000	0.000
17	34	-9.915	74.449	-9.337	0.000	0.000	0.000
17	38	-9.918	53.307	-1.410	0.000	0.000	0.000
28	24	-9.936	41.911	0.011	0.000	0.000	0.000
28	21	-11.050	40.693	-0.002	0.000	0.000	0.000
1	19	-11.240	-3.697	0.003	0.000	0.000	0.000
2	23	-11.552	70.912	0.024	0.000	0.000	0.000
17	19	-11.711	26.383	-2.818	0.000	0.000	0.000
12	19	-11.754	23.167	-1.644	0.000	0.000	0.000
17	40	-12.078	113.493	-13.546	0.000	0.000	0.000
17	44	-12.092	62.310	1.040	0.000	0.000	0.000
17	32	-12.112	93.532	-9.530	0.000	0.000	0.000
17	36	-12.114	72.390	-1.602	0.000	0.000	0.000
7	19	-12.196	20.104	0.820	0.000	0.000	0.000
17	25	-12.903	58.108	-5.656	0.000	0.000	0.000
12	25	-12.910	55.347	-2.129	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
12	26	-13.130	56.541	-2.355	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
17	23	-13.233	62.761	-6.879	0.000	0.000	0.000
12	23	-13.276	56.412	-3.996	0.000	0.000	0.000
7	26	-13.453	48.262	2.551	0.000	0.000	0.000
12	24	-13.532	61.479	-0.905	0.000	0.000	0.000
7	24	-13.792	48.744	2.971	0.000	0.000	0.000
7	25	-13.800	51.096	3.147	0.000	0.000	0.000
7	23	-14.304	48.292	2.094	0.000	0.000	0.000
17	26	-14.421	71.284	-6.308	0.000	0.000	0.000
27	19	-14.706	-7.211	-0.002	0.000	0.000	0.000
17	21	-15.161	57.288	-5.242	0.000	0.000	0.000
12	21	-15.292	54.461	-1.570	0.000	0.000	0.000
7	21	-15.994	52.176	3.391	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
17	24	-16.618	90.367	-6.501	0.000	0.000	0.000
11	19	-17.785	3.425	1.636	0.000	0.000	0.000
16	19	-17.999	-1.196	0.745	0.000	0.000	0.000
6	19	-18.165	5.823	1.258	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000

Job Title: SHEAR IN X-DIR LATERAL

Client

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
7	6	17.458	-18.952	-0.677	0.000	0.000	0.000
17	6	16.823	-25.599	2.867	0.000	0.000	0.000
12	6	16.761	-22.179	1.818	0.000	0.000	0.000
7	19	16.055	-3.436	0.502	0.000	0.000	0.000
17	19	15.509	-10.055	1.636	0.000	0.000	0.000
12	19	15.368	-7.017	1.766	0.000	0.000	0.000
6	19	14.506	11.656	0.048	0.000	0.000	0.000
11	19	14.505	14.334	-1.743	0.000	0.000	0.000
16	19	14.455	19.473	-2.203	0.000	0.000	0.000
6	6	13.173	-3.974	-1.184	0.000	0.000	0.000
16	6	13.130	4.085	-1.029	0.000	0.000	0.000
11	6	13.097	-0.803	-1.788	0.000	0.000	0.000
28	6	12.009	-22.709	0.001	0.000	0.000	0.000
27	19	11.269	12.817	0.005	0.000	0.000	0.000
28	19	11.239	-10.674	-0.000	0.000	0.000	0.000
27	6	10.562	0.892	0.007	0.000	0.000	0.000
2	6	10.347	-17.832	-0.007	0.000	0.000	0.000
2	19	9.649	-5.994	-0.005	0.000	0.000	0.000
1	19	7.686	8.736	-0.006	0.000	0.000	0.000
1	6	6.882	-3.279	-0.008	0.000	0.000	0.000
11	2	4.690	23.869	0.149	0.000	0.000	0.000
6	2	4.439	25.348	1.987	0.000	0.000	0.000
16	2	4.413	24.551	-1.793	0.000	0.000	0.000
1	10	4.292	46.443	0.017	0.000	0.000	0.000
16	11	3.532	43.896	-2.022	0.000	0.000	0.000
1	7	3.355	17.049	0.013	0.000	0.000	0.000
27	7	3.040	16.737	-0.013	0.000	0.000	0.000
1	2	2.687	13.427	-0.002	0.000	0.000	0.000
27	2	2.365	13.124	0.002	0.000	0.000	0.000
1	8	2.336	16.531	0.014	0.000	0.000	0.000
6	7	2.298	12.103	1.118	0.000	0.000	0.000
16	7	2.200	10.989	-0.874	0.000	0.000	0.000
11	7	1.879	12.342	0.181	0.000	0.000	0.000
16	9	1.614	18.825	-1.759	0.000	0.000	0.000
11	21	1.405	4.614	16.829	0.000	0.000	0.000
11	20	1.405	4.614	-16.739	0.000	0.000	0.000
6	20	1.332	-17.413	-7.679	0.000	0.000	0.000
6	21	1.331	24.910	8.183	0.000	0.000	0.000
16	21	1.324	-17.654	7.738	0.000	0.000	0.000
16	20	1.323	24.668	-8.125	0.000	0.000	0.000
11	1	0.939	12.750	0.030	0.000	0.000	0.000
6	1	0.889	13.096	1.033	0.000	0.000	0.000
16	1	0.884	12.932	-0.994	0.000	0.000	0.000
1	21	0.810	6.756	3.197	0.000	0.000	0.000
1	20	0.805	7.562	-4.843	0.000	0.000	0.000
11	11	0.739	8.790	0.195	0.000	0.000	0.000

← POSITIVE X-DIR
SEE ALSO PAGES
FOR MAX SHEAR

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
6	10	0.716	-3.517	-1.139	0.000	0.000	0.000
27	20	0.714	6.665	-3.197	0.000	0.000	0.000
27	21	0.708	7.470	4.843	0.000	0.000	0.000
27	11	0.565	1.587	0.020	0.000	0.000	0.000
1	1	0.536	10.673	0.002	0.000	0.000	0.000
27	1	0.471	10.613	-0.002	0.000	0.000	0.000
11	3	0.469	2.387	0.015	0.000	0.000	0.000
11	4	0.469	2.387	0.015	0.000	0.000	0.000
6	3	0.444	2.535	0.199	0.000	0.000	0.000
6	4	0.444	2.535	0.199	0.000	0.000	0.000
16	3	0.441	2.455	-0.179	0.000	0.000	0.000
16	4	0.441	2.455	-0.179	0.000	0.000	0.000
7	11	0.287	-6.305	-1.448	0.000	0.000	0.000
1	11	0.277	0.383	0.002	0.000	0.000	0.000
1	4	0.269	1.343	-0.000	0.000	0.000	0.000
1	3	0.269	1.343	-0.000	0.000	0.000	0.000
16	10	0.250	4.305	-1.440	0.000	0.000	0.000
6	11	0.239	-6.008	-0.983	0.000	0.000	0.000
27	4	0.236	1.312	0.000	0.000	0.000	0.000
27	3	0.236	1.312	0.000	0.000	0.000	0.000
28	10	0.167	-0.546	-0.010	0.000	0.000	0.000
12	10	0.164	0.998	-1.254	0.000	0.000	0.000
11	10	0.121	1.689	-2.176	0.000	0.000	0.000
2	11	0.120	-0.266	-0.002	0.000	0.000	0.000
27	14	0.094	0.566	-0.011	0.000	0.000	0.000
1	15	0.094	0.563	0.011	0.000	0.000	0.000
1	14	0.072	-0.284	0.059	0.000	0.000	0.000
27	15	0.066	-0.287	-0.059	0.000	0.000	0.000
7	15	0.049	32.776	9.984	0.000	0.000	0.000
17	14	0.047	32.786	-9.987	0.000	0.000	0.000
27	16	0.040	0.242	-0.005	0.000	0.000	0.000
1	17	0.040	0.241	0.005	0.000	0.000	0.000
1	16	0.031	-0.122	0.025	0.000	0.000	0.000
17	15	0.028	-35.458	9.460	0.000	0.000	0.000
27	17	0.028	-0.123	-0.025	0.000	0.000	0.000
7	14	0.027	-35.465	-9.463	0.000	0.000	0.000
12	15	0.025	2.512	15.557	0.000	0.000	0.000
12	14	0.025	2.514	-15.562	0.000	0.000	0.000
7	17	0.021	14.047	4.279	0.000	0.000	0.000
17	16	0.020	14.051	-4.280	0.000	0.000	0.000
17	17	0.012	-15.196	4.054	0.000	0.000	0.000
7	16	0.012	-15.199	-4.056	0.000	0.000	0.000
12	17	0.011	1.077	6.667	0.000	0.000	0.000
12	16	0.011	1.077	-6.669	0.000	0.000	0.000
17	10	0.007	2.070	-0.848	0.000	0.000	0.000
27	12	0.006	-5.260	-3.195	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
1	13	0.006	-5.260	3.195	0.000	0.000	0.000
7	13	0.004	9.253	6.949	0.000	0.000	0.000
17	12	0.004	9.258	-6.949	0.000	0.000	0.000
12	13	0.002	-10.511	16.777	0.000	0.000	0.000
12	12	0.002	-10.510	-16.776	0.000	0.000	0.000
1	12	0.001	-4.454	-4.845	0.000	0.000	0.000
27	13	0.000	-4.455	4.845	0.000	0.000	0.000
16	13	-0.001	-33.041	8.911	0.000	0.000	0.000
6	12	-0.001	-33.043	-8.911	0.000	0.000	0.000
17	13	-0.002	-33.026	8.906	0.000	0.000	0.000
28	12	-0.002	-5.268	-3.195	0.000	0.000	0.000
7	12	-0.002	-33.029	-8.906	0.000	0.000	0.000
2	13	-0.002	-5.266	3.195	0.000	0.000	0.000
6	13	-0.002	9.280	6.951	0.000	0.000	0.000
16	12	-0.002	9.280	-6.951	0.000	0.000	0.000
11	13	-0.003	-10.523	16.785	0.000	0.000	0.000
11	12	-0.003	-10.523	-16.784	0.000	0.000	0.000
2	12	-0.003	-4.450	-4.845	0.000	0.000	0.000
28	13	-0.004	-4.451	4.845	0.000	0.000	0.000
27	10	-0.014	-0.273	-0.011	0.000	0.000	0.000
11	17	-0.019	0.994	6.688	0.000	0.000	0.000
2	17	-0.020	0.205	0.005	0.000	0.000	0.000
11	16	-0.020	0.993	-6.686	0.000	0.000	0.000
28	16	-0.020	0.207	-0.005	0.000	0.000	0.000
6	17	-0.020	14.122	4.280	0.000	0.000	0.000
16	16	-0.023	14.111	-4.279	0.000	0.000	0.000
2	16	-0.023	-0.136	0.026	0.000	0.000	0.000
28	17	-0.024	-0.132	-0.026	0.000	0.000	0.000
6	16	-0.028	-15.225	-4.071	0.000	0.000	0.000
16	17	-0.029	-15.234	4.073	0.000	0.000	0.000
11	15	-0.045	2.318	15.604	0.000	0.000	0.000
2	15	-0.046	0.478	0.012	0.000	0.000	0.000
11	14	-0.046	2.316	-15.600	0.000	0.000	0.000
28	14	-0.046	0.482	-0.012	0.000	0.000	0.000
6	15	-0.047	32.951	9.988	0.000	0.000	0.000
16	14	-0.053	32.926	-9.984	0.000	0.000	0.000
2	14	-0.054	-0.318	0.061	0.000	0.000	0.000
28	15	-0.056	-0.308	-0.061	0.000	0.000	0.000
6	14	-0.065	-35.524	-9.500	0.000	0.000	0.000
16	15	-0.068	-35.545	9.503	0.000	0.000	0.000
28	11	-0.113	0.697	0.013	0.000	0.000	0.000
12	11	-0.129	2.590	-1.556	0.000	0.000	0.000
11	9	-0.163	2.166	-1.738	0.000	0.000	0.000
7	9	-0.166	-5.662	-0.889	0.000	0.000	0.000
7	10	-0.176	-2.527	-0.654	0.000	0.000	0.000
6	8	-0.205	0.748	0.267	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
2	3	-0.233	1.284	-0.000	0.000	0.000	0.000
2	4	-0.233	1.284	-0.000	0.000	0.000	0.000
28	3	-0.257	1.348	0.000	0.000	0.000	0.000
28	4	-0.257	1.348	0.000	0.000	0.000	0.000
2	9	-0.265	0.578	0.001	0.000	0.000	0.000
1	9	-0.268	-0.302	-0.003	0.000	0.000	0.000
28	8	-0.310	0.682	-0.010	0.000	0.000	0.000
12	8	-0.324	2.419	-3.743	0.000	0.000	0.000
27	9	-0.360	0.197	0.011	0.000	0.000	0.000
17	8	-0.432	8.274	-2.479	0.000	0.000	0.000
17	3	-0.438	2.507	-0.199	0.000	0.000	0.000
17	4	-0.438	2.507	-0.199	0.000	0.000	0.000
12	4	-0.464	2.397	-0.017	0.000	0.000	0.000
12	3	-0.464	2.397	-0.017	0.000	0.000	0.000
2	1	-0.465	10.554	0.002	0.000	0.000	0.000
7	4	-0.467	2.496	0.181	0.000	0.000	0.000
7	3	-0.467	2.496	0.181	0.000	0.000	0.000
28	1	-0.513	10.687	-0.002	0.000	0.000	0.000
28	9	-0.584	1.904	0.020	0.000	0.000	0.000
12	9	-0.665	9.174	0.378	0.000	0.000	0.000
16	8	-0.697	-2.332	0.189	0.000	0.000	0.000
6	9	-0.699	-6.962	-1.546	0.000	0.000	0.000
2	21	-0.700	6.572	3.197	0.000	0.000	0.000
2	20	-0.701	7.388	-4.843	0.000	0.000	0.000
28	20	-0.772	6.767	-3.197	0.000	0.000	0.000
28	21	-0.774	7.585	4.844	0.000	0.000	0.000
11	8	-0.814	0.300	0.307	0.000	0.000	0.000
27	8	-0.835	-1.322	-0.009	0.000	0.000	0.000
7	8	-0.848	-6.265	-2.057	0.000	0.000	0.000
17	1	-0.876	13.037	-1.032	0.000	0.000	0.000
12	1	-0.929	12.765	-0.035	0.000	0.000	0.000
7	1	-0.935	13.021	0.998	0.000	0.000	0.000
17	20	-1.310	24.801	-8.180	0.000	0.000	0.000
17	21	-1.315	-17.482	7.675	0.000	0.000	0.000
12	21	-1.391	4.652	16.725	0.000	0.000	0.000
12	20	-1.391	4.652	-16.828	0.000	0.000	0.000
7	21	-1.398	24.770	8.128	0.000	0.000	0.000
7	20	-1.404	-17.512	-7.727	0.000	0.000	0.000
17	11	-2.017	19.637	-1.718	0.000	0.000	0.000
2	10	-2.028	16.358	0.014	0.000	0.000	0.000
12	7	-2.157	12.772	-0.204	0.000	0.000	0.000
2	2	-2.331	12.836	-0.003	0.000	0.000	0.000
17	7	-2.352	12.103	-1.144	0.000	0.000	0.000
7	7	-2.560	11.725	0.922	0.000	0.000	0.000
28	2	-2.573	13.484	0.004	0.000	0.000	0.000
2	7	-2.716	15.971	0.013	0.000	0.000	0.000

Cont...

Node	L/C	Force-X (kip)	Force-Y (kip)	Force-Z (kip)	Moment-X (kNm)	Moment-Y (kNm)	Moment-Z (kNm)
28	7	-2.988	16.650	-0.011	0.000	0.000	0.000
2	8	-4.371	45.968	0.021	0.000	0.000	0.000
17	2	-4.375	25.066	-1.988	0.000	0.000	0.000
12	2	-4.643	23.975	-0.171	0.000	0.000	0.000
7	2	-4.671	24.959	1.814	0.000	0.000	0.000
17	9	-4.945	45.082	-1.975	0.000	0.000	0.000
2	5	-4.999	-3.035	-0.004	0.000	0.000	0.000
2	18	-5.697	8.803	-0.002	0.000	0.000	0.000
28	5	-6.207	0.837	0.007	0.000	0.000	0.000
28	18	-6.978	12.873	0.006	0.000	0.000	0.000
17	5	-9.008	2.928	-0.891	0.000	0.000	0.000
12	5	-9.035	-0.550	-1.525	0.000	0.000	0.000
7	5	-9.303	-3.260	-0.986	0.000	0.000	0.000
17	18	-10.322	18.472	-2.122	0.000	0.000	0.000
12	18	-10.428	14.612	-1.577	0.000	0.000	0.000
7	18	-10.706	12.256	0.193	0.000	0.000	0.000
1	18	-12.318	-7.071	-0.000	0.000	0.000	0.000
1	5	-13.122	-19.087	-0.003	0.000	0.000	0.000
27	18	-15.697	-10.899	0.001	0.000	0.000	0.000
27	5	-16.404	-22.825	0.003	0.000	0.000	0.000
11	18	-19.112	-6.239	1.576	0.000	0.000	0.000
16	18	-19.401	-9.834	1.456	0.000	0.000	0.000
6	18	-19.581	-3.133	0.469	0.000	0.000	0.000
11	5	-20.520	-21.376	1.532	0.000	0.000	0.000
16	5	-20.726	-25.221	2.630	0.000	0.000	0.000
6	5	-20.914	-18.763	-0.763	0.000	0.000	0.000

← NEGATIVE X-DIR

145579-C-CA-014

Attachment 3

ICV™ Box Assembly Building Reference Drawings

H-14-106797 Rev. C
Bulk Vitrification ICV™ Box Assembly Building
Fdn-Plans & Sections

H-14-106789 Rev. 1
Bulk Vitrification Civil Site Improvements Plan

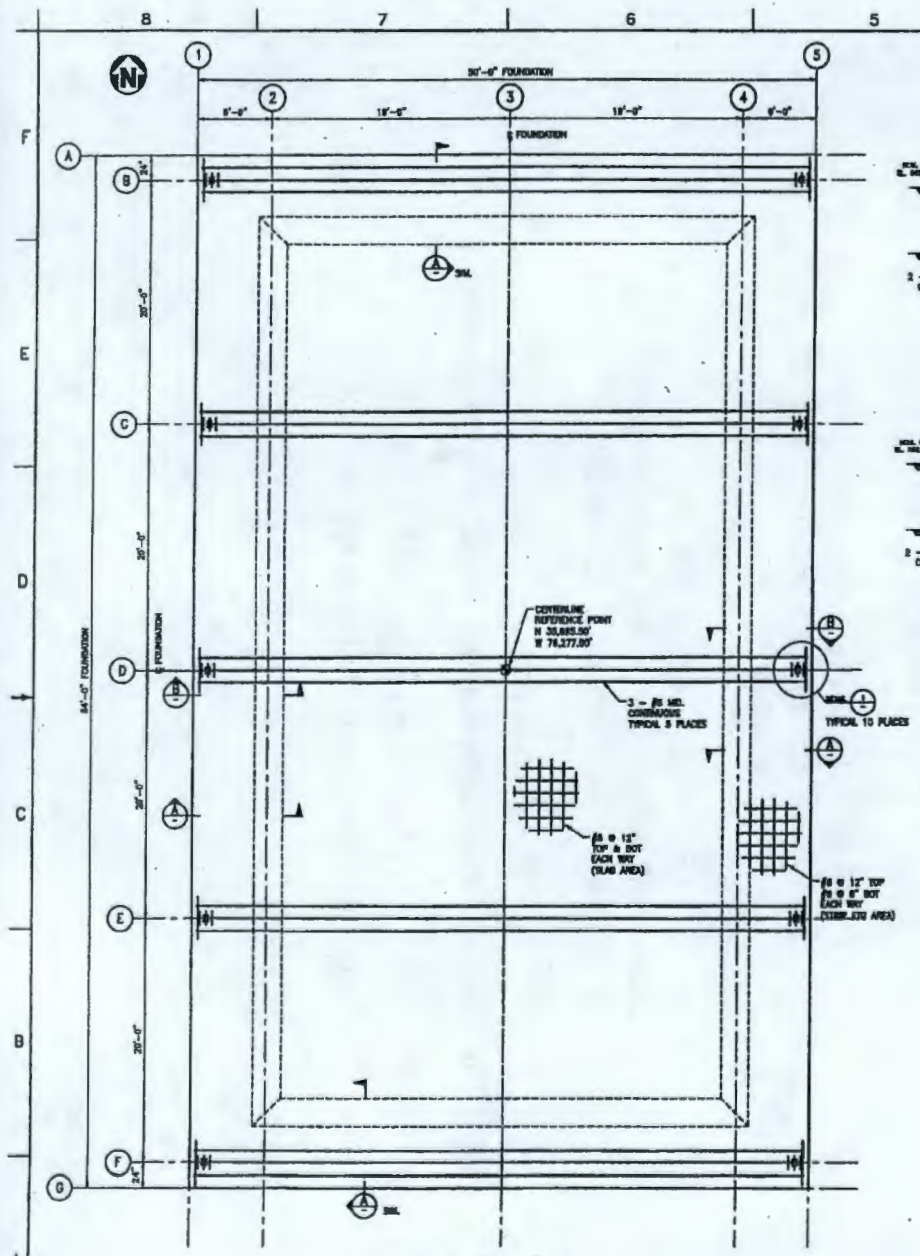
F-145579-00-B-0015 Rev. C
Bulk Vitrification ICV™ Box Assembly Building
Plan & Section

F-145579-00-B-0016 Rev. C
Bulk Vitrification ICV™ Box Assembly Building
Elevations

F-145579-35-D-0018 Rev. C
Bulk Vitrification ICV™ Box Assembly
Enclosure G.A. Plans and Elevations

H-14-106812 Rev. 1
Bulk Vitrification Grounding Layout General Arrangement

H-14-106813 Rev. 1
Bulk Vitrification Typical Grounding Details



ASSEMBLY BUILDING
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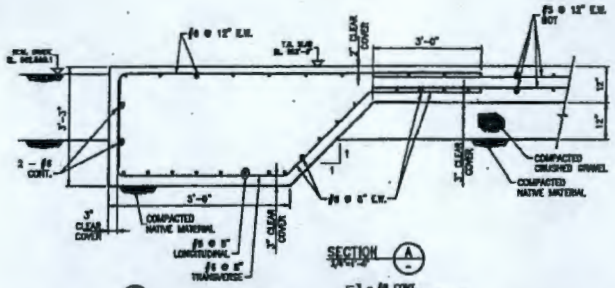
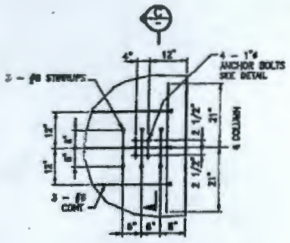
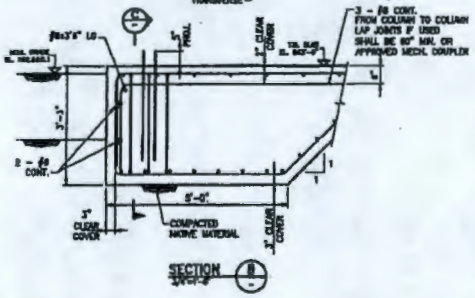


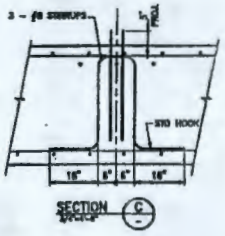
SECTION A



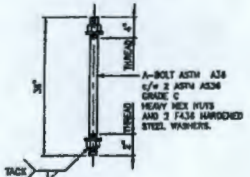
DETAIL 1



SECTION B



SECTION C



1"ø ANCHOR
40 REQ'D

Attachment: 3
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 1 of 7

NOTES:

FOR GENERAL NOTES, DESIGN CRITERIA, MATERIAL SPECIFICATIONS, AND FOUNDATION LOCATIONS REFER TO DRAWING H-14-106759 "BULK VITRIFICATION -CIVIL SITE IMPROVEMENTS"

1. PRE-ENG METAL BUILDING RIGID FRAMES SHALL USE ANCHOR BOLT PATTERN SHOWN AND SHALL HAVE "PINNED" BASES.

2. MAXIMUM DESIGN LOADS AT RIGID FRAME BASES (UNFACTORED)

VERTICAL (DOWN) = 114000LB
(UP) = 17500LB
HORIZONTAL (L/W) = 18000LB
(W/L) = 15000LB

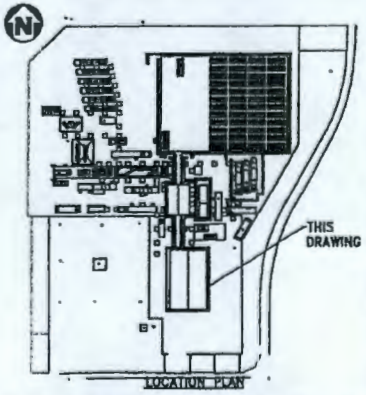
3. OVERHAL AND DOOR FRAMING WILL BE SECURED TO FOUNDATION USING DRILLED AND GROUTED ANCHORS.
DESIGN AND SUPPLY BY PRE-ENGINEERED METAL BUILDING VENDOR.

4. CONCRETE SHALL CONFORM TO CONSTRUCTION SPECIFICATION SECTION 3300 "CAST-IN-PLACE CONCRETE".

THE FOLLOWING SPECIFIC REQUIREMENTS APPLY TO CAST-IN-PLACE CONCRETE. REFER TO THE CONSTRUCTION SPECIFICATION FOR DETAILS.

a) MINIMUM COMPRESSIVE STRENGTH @ 28 DAYS = 4000 PSI.
b) MAXIMUM WATER/CEMENT RATIO = 0.5
c) AIR CONTENT SHALL BE 5% - 8%.
d) CONSTRUCTION AND CONTRACTION JOINTS SHALL BE PER ACI 224.3R AND ACI 302.1R.

5. COMPACTED CRUSHED GRAVEL AND COMPACTION OF NATIVE MATERIAL SHALL CONFORM TO CONSTRUCTION SPECIFICATION SECTION 02270.



LOCATION PLAN

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	

NO	REVISIONS				
C	ISSUED FOR CROW HILL REVIEW	7 DEC 94	BPK	PM	TN
B	ISSUED FOR REVIEW, EXTERNAL	30 NOV 94	BPK	PM	TN
A	ISSUED FOR REVIEW, INTERNAL	15 NOV 94	BPK	PM	TN

H-14-106797 C

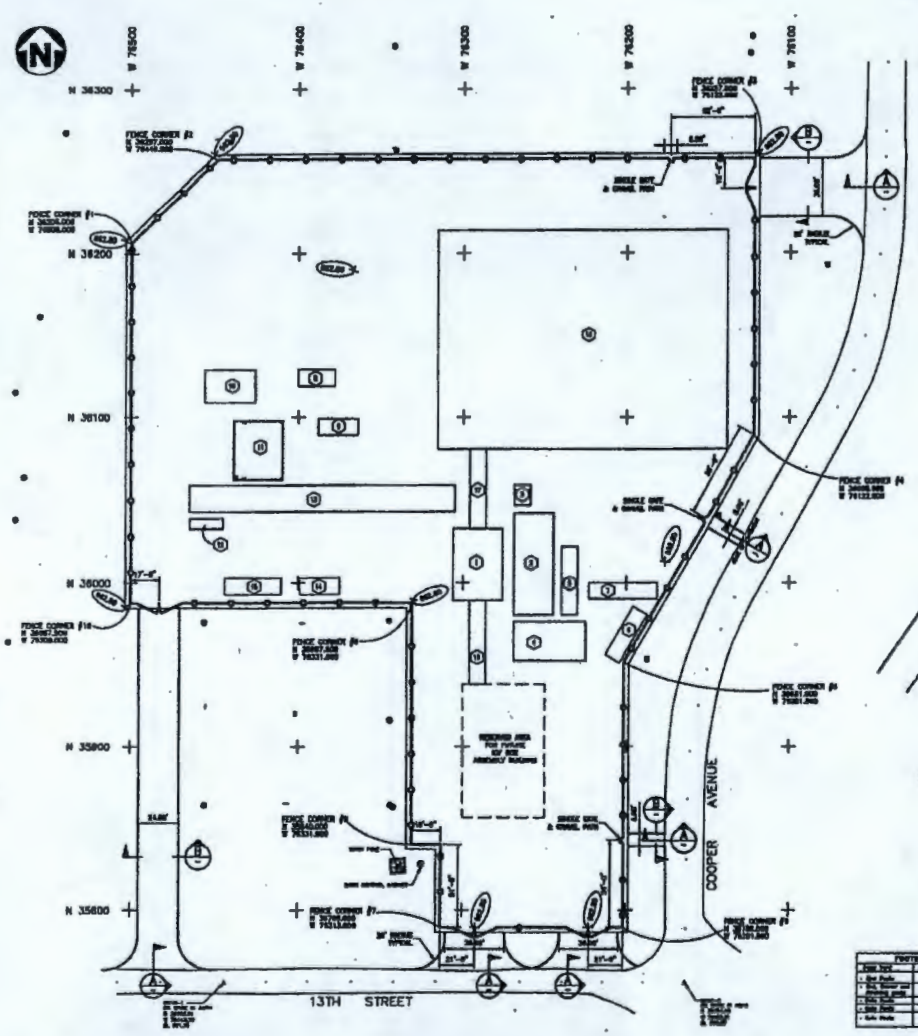
145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX ASSEMBLY BUILDING
FDN - PLAN & DETAILS

F2410011 H-14-106797 C

AS NOTED



LEGEND

- SURVEY CONTROL POINT
- BOLLARD
- UNDERGROUND CABLE MARKER
- TELEPHONE BOX
- MONITORING WELL
- RURAL GROUND MARKER POST
- DOE – RD BAD MATERIAL AREA
- PROPOSED SPOT ELEVATION
- FOUNDATION MARKER

Equipment Foundation Locations				
		Center of Foundation		Drawing #
FDN #	Equipment Name	Northing	Westing	(Reference)
1	Melt Area Support Structure (Superfial)	36011.00	76291.00	H-14-106792
2	Waste Dryer Support Structure	36011.00	76257.00	H-14-106793
3	Clean Soil Baghouse Equipment	34053.00	76264.00	H-14-106794
4	Dryer Chiller Equipment	34964.00	76247.00	H-14-106794
5	Waste Dryer Steam Supply Skid	34001.00	76235.00	H-14-106794
6	Boiler Diesel Fuel Storage Tank	35968.00	76200.00	H-14-106794
7	Liquid Waste Pump skid	35995.00	76202.00	H-14-106794
8	Secondary Waste Pump Skid	36124.00	76389.00	H-14-106795
9	Compressed Air Skid	36084.00	76378.00	H-14-106795
10	Off-gas Stack	36119.00	76441.00	H-14-106795
11	Tri-Mer Scrubber	36080.00	76424.00	H-14-106795
12	Liquid Ammonia Storage Tank	36036.00	76455.00	H-14-106795
13	Off-gas Treatment Equipment	36051.00	76385.00	H-14-106795
14	480V Generator Sol	35988.00	76387.00	H-14-106791
15	Diesel Generator Fuel Tank	35958.00	76427.00	H-14-106791
16	Melt Area Assess Slab South	35843.35	76291.00	H-14-106792
17	Melt Area Assess Slab North (Superfial)	36036.75	76291.00	H-14-106792
18	KV Bar Storage Area (Superfial)	36147.00	76227.00	H-14-106790

DRAWING NOTES:

1) THE ENTRY LINES FOR FILL OPERATIONS SHOWN TO A FEET BEYOND THE FENCE ONCE WRAPPED. FILL WILL ALSO BE REQUIRED AT CONNECTIONS TO EXISTING ROAD.

2) ALL AREAS WITHIN THE ENTRY LINES SHALL BE BROUGHT TO ELEVATION ENTLAN WITH COMPACTED FABRIC BOX WITH ALL GROUND MATERIAL REMOVED. IF MONITORING MATERIAL IS FOUNDED TO WITHIN THIS ELEVATION, IT SHALL BE "FF OUR SAND AND GRAVEL" AS LISTED IN THE SPECIFICATIONS.

3) ALL AREAS BETWEEN FOUNDATIONS AND SLABS SHALL BE BROUGHT UP TO ELEVATION INCLUDABLE WITH COMPACTED CRUSHED GRAVEL AS LISTED IN THE SPECIFICATIONS.

4) AREAS OUTSIDE ENTRY LINES SHALL BE SLOPED AT A MAXIMUM OF 4:1 TO MEET EXISTING GRADES. WHERE FILL IS REQUIRED, IT SHALL BE COMPACTED WITH SOIL.

5) FOUNDATIONS MUST BE ELECTRICALLY GROUNDED. SEE DRAWINGS H-14-106812 AND H-14-106813 FOR DETAILS. SEE DRAWING H-14-106800 FOR ELECTRICAL SITE GROUND ARRANGEMENT.

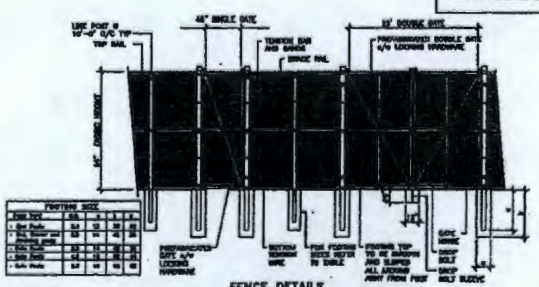
6) ALL ELEVATIONS IN FEET.

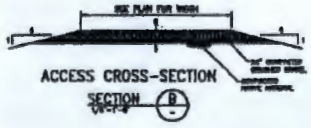
GENERAL NOTES:

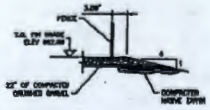
* ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE "CONSTRUCTION SPECIFICATION FOR THE SITE IMPROVEMENTS AT THE HOMESTAKE-BAX VITRIFICATION SITE," DOCUMENT # [illegible].

* THE FOLLOWING SPECIFIC REQUIREMENTS APPLY TO CAST-IN-PLACE CONCRETE. REFER TO THE CONSTRUCTION SPECIFICATION FOR DETAILS.

A) MINIMUM COMPRESSIVE STRENGTH SHALL BE 4000 PSI AT 28 DAYS
B) MAXIMUM WATER/CEMENT RATIO SHALL BE 0.5
C) AIR CONTENT SHALL BE 5-8%
D) ALL EXPOSED HORIZONTAL CONCRETE SURFACES WHERE LOADED AIR PALLET TRAFFIC WILL OCCUR MUST BE "SURFACED" CONCRETE AND HAVE A MINIMUM FLATNESS BLOCKED OF S=100 AND F=50 AS DEFINED IN ACI 302.1R. ALL OTHER CONCRETE SHALL HAVE MINIMUM FLATNESS OF S=20 AND F=15.
E) CONSTRUCTION JOINTS SHALL BE PER ACI 302R FOR FOR ROX STORAGE SLAB. SEE DRAWING C-0005 FOR DETAILS.
F) SPACE FOUNDATION CONSTRUCTION / CONTRACTION JOINTS SHALL BE PER ACI 224.3R AND ACI 302.1R AND AS DETAILED.







DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		NOT USED ON END ITEM	REFERENCES

REVISIONS

1	MINOR FENCE REVS.		

amec

NAME	DATE
D.A. BRANDOVER	8/31/99
J.M. BOWDEN	8/31/99
J.M. SMITH	8/31/99
J.M. BOWDEN	8/31/99
J.M. BOWDEN	8/31/99

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
CIVIL
SITE IMPROVEMENTS PLAN

F 2416 | 0110 | H-14-106789 | 1

1"=30' | 831144

Attachment: 145579-C-CA-014
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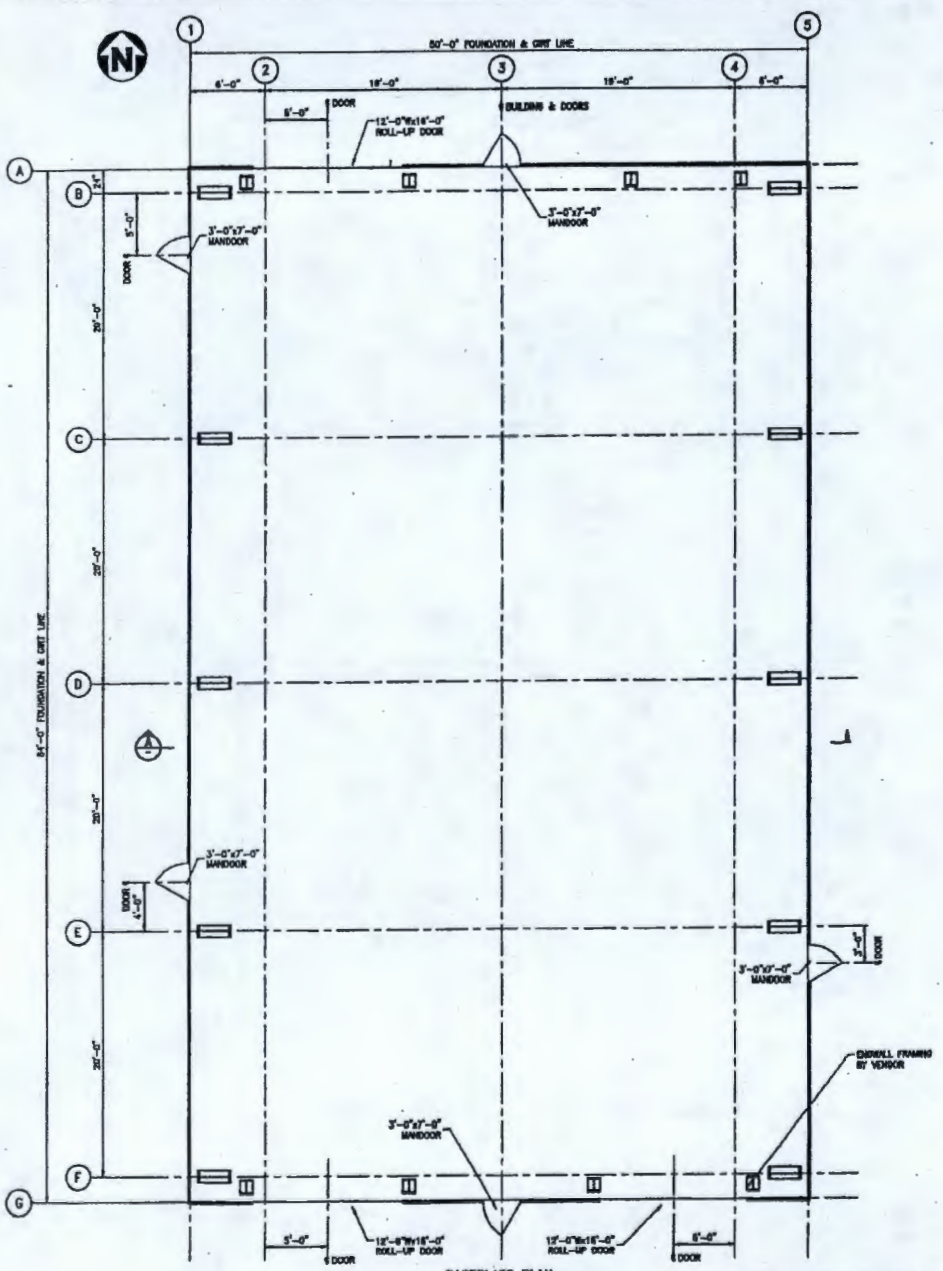
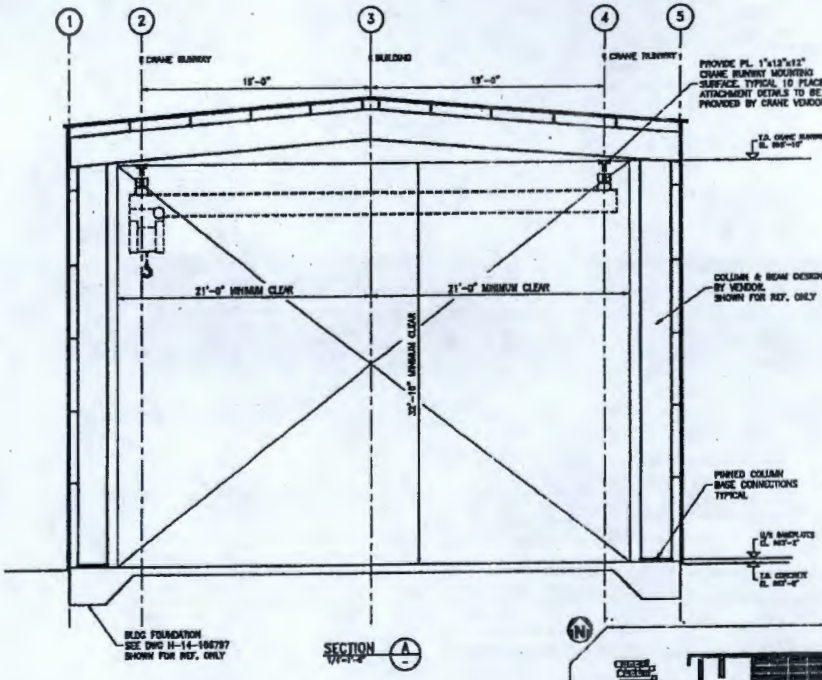


BASEPLATE PLAN
1/8"=1'-0"



SECTION A
1/4"=1'-0"

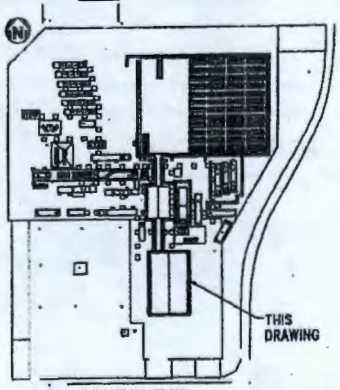
NOTES:

1. FOR WEATHER ENCLOSURE GENERAL NOTES SEE DRAWING F-145579-00-B-0011.
2. SEE DRAWING F-145579-00-B-0016 FOR EXTERIOR ELEVATIONS.
3. CRANE LOADS:

   CRANE CAPACITY = 15 TONS

   CRANE RUNWAY AND WHEEL LOADS TO BE PROVIDED BY CRANE VENDOR.

   ALL CRANE COMPONENTS INCLUDING RUNWAYS BY CRANE VENDOR.



LOCATION PLAN

Attachment: 3
Calc. No.: 145579-C-CA-014
Rev. No.: 0
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REV	REVISED FOR CRAN WALL REVIEW	23 NOV 04	DPK		PM	TM
B	ISSUED FOR INTERNAL APPROVAL	23 NOV 04	DPK		PM	TM
A	ISSUED FOR INTERNAL REVIEW	04 NOV 04	DPK		PM	TM
Rev.	REVISION DESCRIPTION	Date	By	Chk'd	Appr'd	Appr'd

DWG NO F-145579-00-B-0015 REV C

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U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX ASSEMBLY BUILDING
PLAN & SECTION

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	

REV	DESCRIPTION	Z	W	R	DATE
REVISIONS					

Attachment: 3
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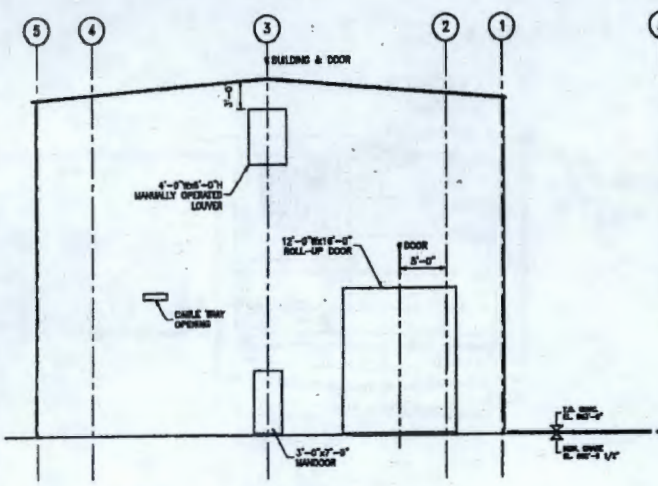
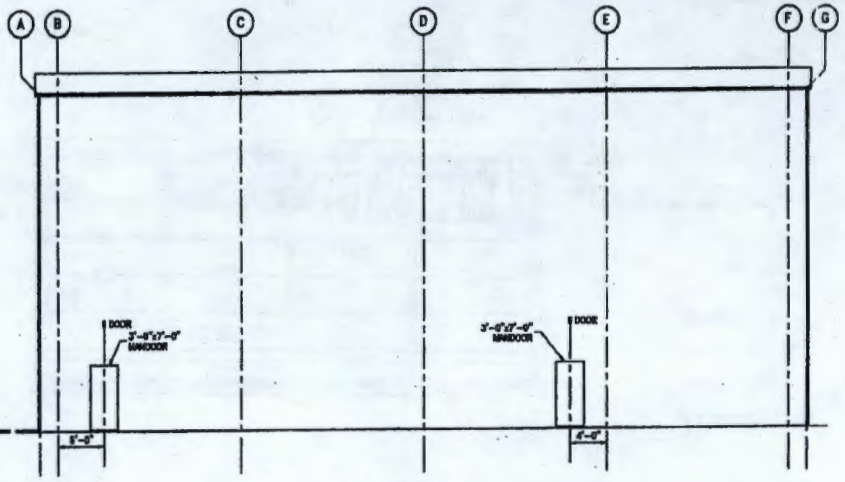
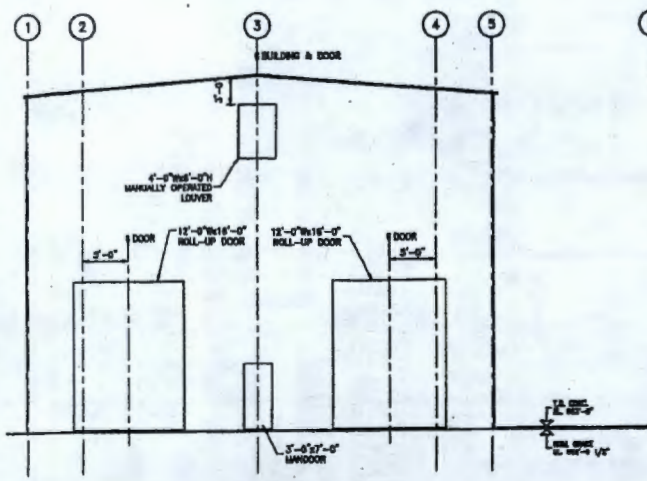


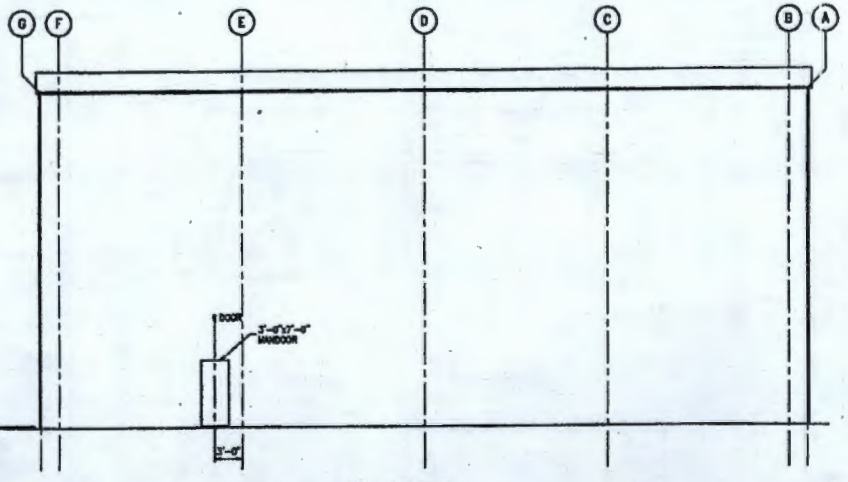
NORTH ELEVATION
3/16"=1'-0"



WEST ELEVATION
3/16"=1'-0"



SOUTH ELEVATION
3/16"=1'-0"



EAST ELEVATION
3/16"=1'-0"

NOTES:

1. SEE DRAWING F-145579-00-B-0011 FOR WEATHER ENCLOSURE GENERAL NOTES.
2. SEE DRAWING F-145579-00-B-0015 FOR PLAN & SECTION OF THIS ENCLOSURE.
3. THIS ENCLOSURE TO HAVE INSULATED WALLS AND ROOF. SEE CONSTRUCTION SPECIFICATION FOR DETAILS.
4. FOR FOUNDATION PLAN SEE H-14-108787.
5. VENDOR SHALL DESIGN RIGID FRAMES ASSUMING "PINNED" COLUMN BASES.
6. DESIGN OF ANCHOR BOLTS SHALL BE BY VENDOR ASSUMING CAST-IN-PLACE ASTM A36 BOLTS.
7. BUILDING BRACING SHALL NOT INTERFERE WITH FOUNDATIONS SHOWN ON THIS DRAWING.

4	ISSUED FOR CDRR PEER REVIEW	28 NOV 94	BPC		PM	TH
3	ISSUED FOR REVISION APPROVAL	23 NOV 94	BPC		PM	TH
2	ISSUED FOR ORIGINAL REVIEW	04 NOV 94	BPC		PM	TH
Rev.	REVISION DESCRIPTION	Date	By	Chk'd	Appr'd	Appr'd

F-145579-00-B-0016 | C

amec

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX ASSEMBLY BUILDING
ELEVATIONS

F

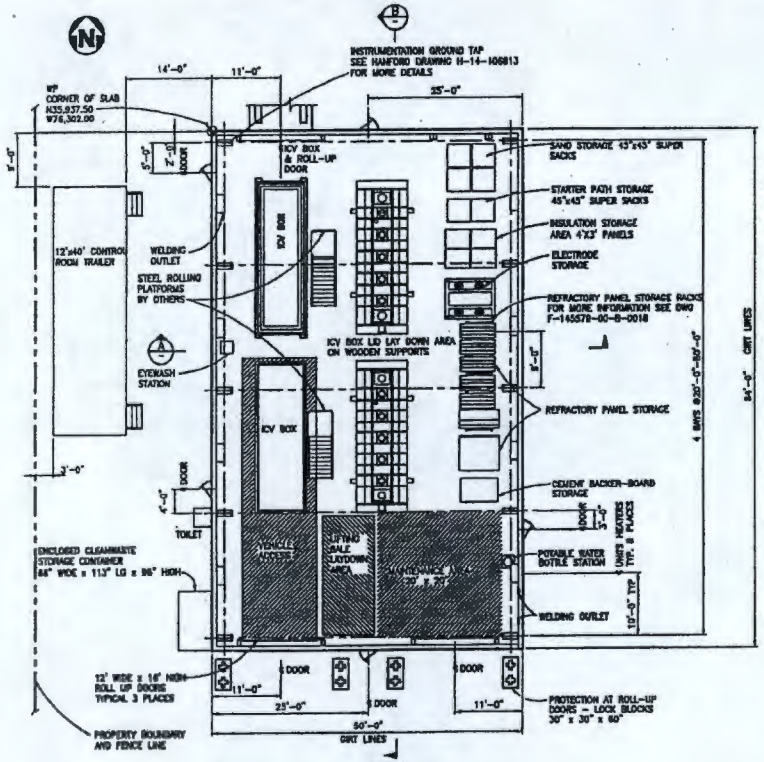
3/16"=1'-0"

DWG NO	TITLE
DRAWING TRACEABILITY LIST	

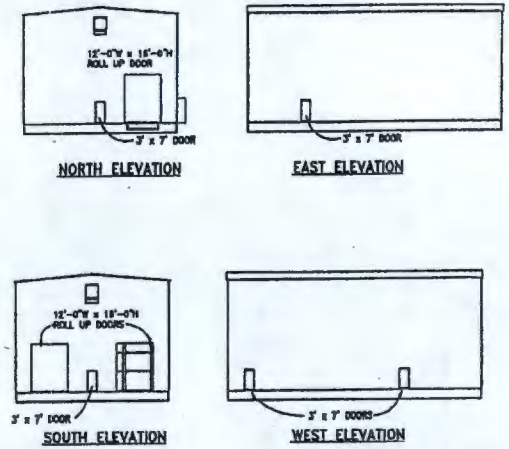
KEY NUMBER	TITLE
REFERENCES	

NOT USED ON

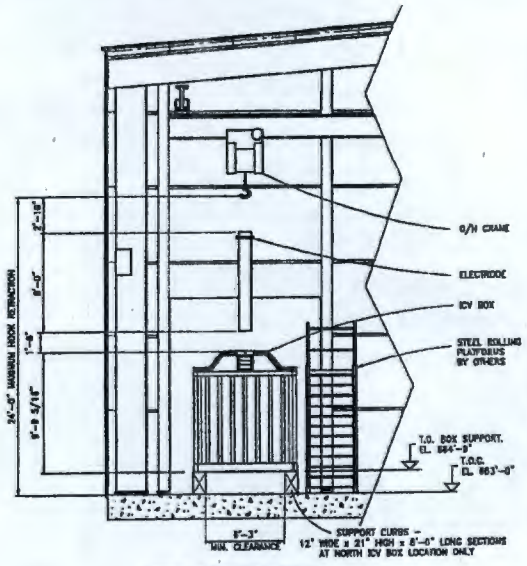
Rev	Description	Date	By	Chk'd	Appr'd
	REVISIONS				



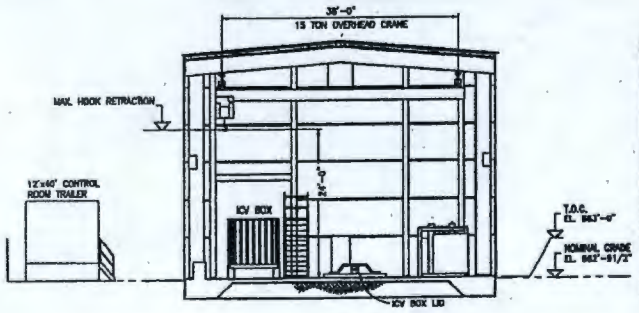
PLAN



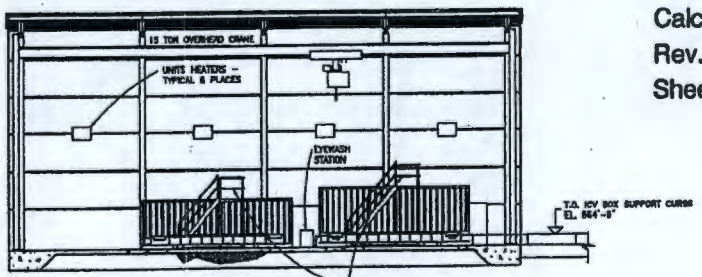
ASSEMBLY BUILDING ELEVATIONS SCALE 1/16" = 1 FOOT



CRANE CLEARANCE DETAIL



SECTION A



SECTION B

EQUIPMENT LAYOUTS SCALE 1/8" = 1 FOOT

Attachment: 3
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Rev. No.: 0
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Rev.	REVISION DESCRIPTION	Date	By	Rev'd	Appd	Appr
C	ISSUED FOR APPROVAL	10 NOV 04	JMM	TW	CJ	TH
B	ISSUED FOR REVISION APPROVAL	15 OCT 04	JMM	TW	PKS	JDB
A	ISSUED FOR REVIEW	12 SEP 04	MMB	T.H.	PKS	JDB

DWG NUMBER F-145579-35-D-0018 REV C

amec

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

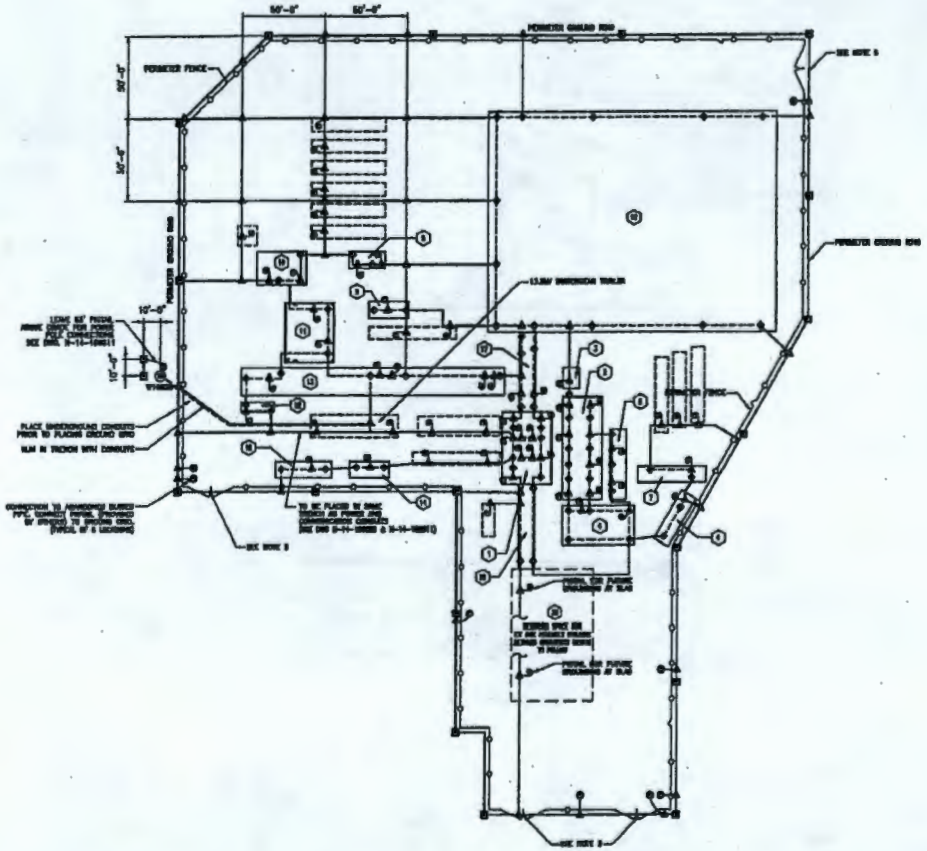
BULK VITRIFICATION ASSEMBLY ENCLOSURE G.A. PLANS AND ELEVATIONS

SIZE F SCALE AS NOTED

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	

NEXT USED ON

REVISIONS



SCALE BAR

NOTES:

1. ALL GROUND CONDUCTORS TO BE #4/0 BARE MEDIUM SOFT DRAWN STRANDED COPPER.

2. ALL GROUND CONDUCTORS TO BE PROTECTED WITH AT LEAST 6" OF RUBBER HOSE OR PVC PIPE WHERE CONDUCTOR GOES INTO OR OUT OF CONCRETE OR SOIL. (SEE DETAIL 5 ON DRAWING H-14-106812).

3. THE ENTIRE INSTALLATION, INCLUDING UPER ELECTRODES, SUBJECT TO INSPECTION BY A CHEM HILL APPROVED NRC ELECTRICAL INSPECTOR PRIOR TO BACKFILLING OR POURING CONCRETE.

4. AFTER INSTALLATION, THE GROUND GRID MUST BE TESTED FROM ONE OF THE GROUND ROD TEST WELLS USING THE FALL OF POTENTIAL TEST (SEE STUDY). IF TEST RESULTS ARE ABOVE 3.0 OHMS, SALT SHALL BE PLACED AROUND THE PERIMETER GRID, ESPECIALLY NEAR THE GROUND RODS, AND THEN THE SALT THOUROUGHLY SOAKED INTO THE SOIL. THEN THE GROUND MUST BE RETESTED TO CONFIRM IT IS BELOW 3.0 OHMS. A COPY OF ALL GROUNDING TESTS ARE TO BE GIVEN TO THE SITE ENGINEER. IF THERE ARE ANY FURTHER DIFFICULTIES, THE DESIGN OR SITE ENGINEERS SHOULD BE CONSULTED FOR FURTHER ADVICE.

5. PERIMETER GROUND RING TO BE CONTINUOUS UNDER ROADS.

6. TRANSFERRING THE GROUND POTENTIAL RISE MAY CREATE UNSAFE CONDITIONS. THEREFORE AN ELECTRICAL ENGINEER MUST REVIEW THE DESIGNS WHENEVER:
- THE FENCE IS EXTENDED BEYOND THE SITE BOUNDARIES (ISOLATING SECTIONS SHALL BE INSTALLED)
- THE FENCE IS CONNECTED TO ANOTHER FENCE OUTSIDE THE SITE BOUNDARIES
- THERE IS NEW COMMUNICATIONS WIRING THAT CROSSES THE SITE BOUNDARIES, SUCH AS TELEPHONE OR WLAN (WAFORD LOCAL AREA NETWORK) (ISOLATOR SHALL BE USED)
- ANY NEW CONDUCTIVE PIPE THAT CROSSES THE SITE BOUNDARIES WILL NEED TO HAVE A SUFFICIENTLY LONG LENGTH OF DIELECTRIC PIPE
- ANY NEW POWER OR SIGNAL WIRING THAT CROSSES THE SITE BOUNDARIES INCLUDING WIRING FOR LIGHTING
- THE SITE BOUNDARIES ARE GENERALLY THE PERIMETER GROUND RING.

7. PRIMALS SHALL PROTRUDE FROM CONCRETE FOUNDATIONS APPROXIMATELY 6" FROM THE OUTER EDGE, GENERALLY IN THE POSITIONS SHOWN.

8. PREVIOUSLY AMES DRAWING F-143843-GD-E-0020.

LEGEND

- GROUND PATCH. - LEAVE EXTRA 20' ABOVE FINAL GRADE (LOCATIONS ARE APPROXIMATE. EXACT LOCATIONS TO BE DETERMINED WITH SITE ENGINEER) SEE DETAIL 2 ON DRAWING H-14-106813
- CONNECTION OF #4/0 BARE COPPER GROUND CONDUCTORS TO REBAR SEE DETAIL 2 ON DRAWING H-14-106813
- CONNECTION OF #4/0 BARE COPPER GROUND CONDUCTORS SEE DETAIL 1 ON DRAWING H-14-106813
- 3/4"X20' COPPER CLAD STEEL GROUND ROD SEE DETAIL 6 ON DRAWING H-14-106813
- 3/4"X20' COPPER CLAD STEEL GROUND ROD INSTALLED IN AN ACCESSIBLE GROUND TEST WELL SEE DETAIL 7 ON DRAWING H-14-106813
- EXOTHERMIC CONNECTOR, 4/4 20'-#4/0 Cu PIGTAIL, TO ABANDONED BURIED PIPING. (GROUND PIGTAIL INSTALLED BY GROUNDING CONTRACTOR) CONNECT PIGTAIL TO MAIN GROUND GRID. (REFER TO SITE CLEARING & GRADING FOR DETAILS OF EXISTING U/G PIPING. SEE DWG. H-14-106756).
- #4/0 BARE COPPER GROUND CONDUCTOR TO BE BURIED MINIMUM 20" BELOW FINAL GRADE
- #4/0 BARE COPPER GROUND CONDUCTOR ENCASED IN CONCRETE (UPER) TO BE WOVEN THROUGH THE BOTTOM REBAR OR TIE-WRAPPED. SEE DETAIL 4 ON DRAWING H-14-106813
- PERIMETER FENCING (NOT PART OF ELECTRICAL CONTRACT DOES NOT NEED TO BE INTERCONNECTED TO THE GROUND GRID)
- EQUIPMENT FOUNDATION NUMBER DESIGNATION SEE DRAWING H-14-106700 FOR DESCRIPTIONS.

	MAXIMUM CALCULATED	MAXIMUM PERMISSIBLE
TOUCH POTENTIAL *	816V	637V
STEP POTENTIAL *	104V	2016V

* FOR MORE DETAILS OF THE VOLTAGE CRITERIA REFER TO THE CALCULATIONS IN 145579-C-CA-003

Attachment: 3
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 6 of 7

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON END ITEM	

REVISIONS

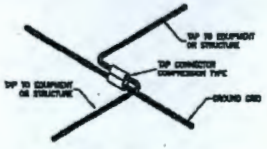
145579-FINAL DBVS DESIGN
U.S. DEPARTMENT OF ENERGY
Office of River Protection
BULK VITRIFICATION
GROUNDING LAYOUT
GENERAL ARRANGEMENT
F 2418 7301 H-14-106812 1

GRID CROSS CONNECTION

SINGLE TAP CONNECTION

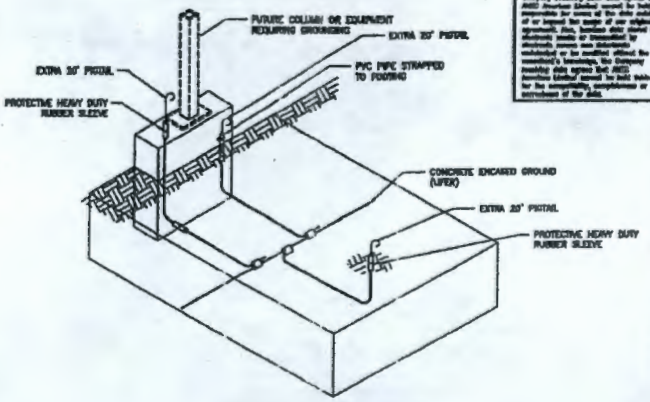
DETAIL 1 N.T.S.

(ALL 3 METHODS ARE ACCEPTABLE)



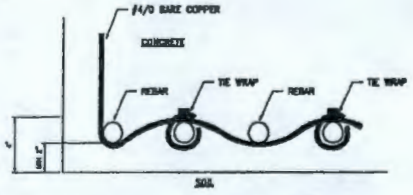
GRID TEE/DOUBLE TAP CONNECTION

DETAIL 2 N.T.S.



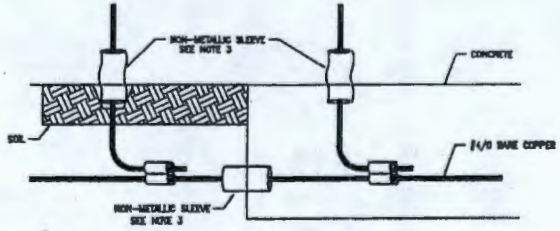
SEE NOTE 7

DETAIL 3 N.T.S.

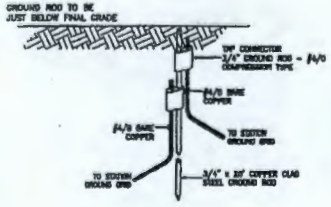


CONCRETE ENCASED ELECTRODE (UFER)
SEE NOTE 2

DETAIL 4 N.T.S.

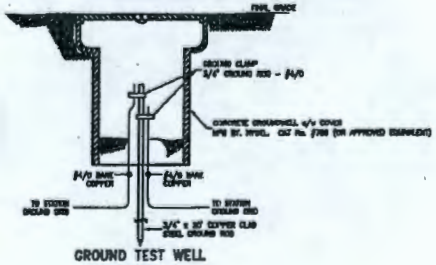


DETAIL 5 N.T.S.



GROUND ROD
(TYPICAL)

DETAIL 6 N.T.S.



GROUND TEST WELL
(TYPICAL)

DETAIL 7 N.T.S.

NOTES

1. REINFORCING STEEL AND GROUND CONNECTIONS MUST BE CLEANED TO BARE METAL AT CONTACT POINT AND BE WRAPPED WITH PERCHLORIC (OR SIMILAR REINFORCING) REPAIRS CONTRACTOR IS AWARE.

2. BARE GROUNDING CONTACT #4/0 CONNECTIONS TO BE MADE THROUGH THE TIEWRAP AS SHOWN TO THE REBAR AT A MINIMUM POINT 3 FEET APART TO BE ENCASED WITH A MINIMUM LENGTH OF 20 FEET. UPON TO BE BURIED IN PLACE AS SHOWN ON THE GROUNDING LAYOUT DRAWING BUT AT A MINIMUM TO BE EACH ON FIRST PIECE REBAR 3 OF THE DRAWING, UPTO TO BE EXCAVATED WITH THE PATHS OF THE CONCRETE PATTERN OF BLAN. DEPTH TO BE A MINIMUM OF 6" FROM THE BOTTOM OF THE CONCRETE AND, WHERE POSSIBLE, TO BE NOT WITHIN 4" FROM THE BOTTOM OF THE SLAB.

3. NON-METALLIC SLEEVE TO BE USED FOR HEAVY DUTY RUBBER WHERE FLEXIBILITY IS REQUIRED. MIN. 6" LENGTH TYPICAL FOR ALL TRANSITIONS TO AND FROM CONCRETE AND SOIL.

4. ALL GROUND CONNECTIONS TO BE MADE WITH HEAVY DUTY BRASS EXPANSION BOLTS, USE TO BE #4/0 BARE GROUNDING WIRE, PROCEDURE CONTRACTOR TO BE EXPANDED, USE OF ACID SPLICES OR PIGTAILS.

5. GROUNDING CONNECTIONS TO BE MADE ON THE BARE GROUNDING WIRE.

6. ALL GROUNDING CONNECTIONS TO BE MADE USING THE MANUFACTURER'S RECOMMENDED INSTALLATION INSTRUCTIONS AND PROVIDED BEFORE POURING CONCRETE OR BACKFILLING.

7. EITHER OF THE 3 TYPES OF PIGTAIL IS ACCEPTABLE. EXACT LOCATION TO BE DETERMINED FROM THE DRAWINGS. PIGTAIL TO HAVE A MINIMUM OF 20' EXTRA LENGTH ABOVE FINAL GRADE FOR FUTURE CONNECTION (BY OTHERS) TO EQUIPMENT, BELL OR SEAMWORK.

8. WHERE PIGTAILS PROTRUDE FROM CONCRETE FOUNDATIONS, THE PIGTAIL SHALL BE APPROXIMATELY 6" FROM THE SLAB EDGE AND VERTICALLY IN THE POURED BARRIER OR THE S.A.

9. FOR THE DRAWINGS AS SEE DRAWING H-14-106813.

10. PROPERLY REFE DRAWING F-14210-00-C-0001.

Attachment: 3
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 7 of 7

DWG NO	TITLE	NOT MEMBERS	TITLE
	DRAWING TRACEABILITY LIST	NEXT USED ON END ITEM	REFERENCES

-	1	INITIAL ISSUE, CORRECTED				
-	2	[illegible]				

REVISIONS

amec

NAME	DATE
DR. R. RICHARD	
CHK. [illegible]	
APP. [illegible]	
APP. [illegible]	
APP. [illegible]	

PROJECT 145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
TYPICAL GROUNDING
DETAILS

SIZE	CODE ID NO	SCALE NO	DRAWING NO	REV
F	2410	7301	H-14-106813	1

SCALE N.T.S. | 821145 | SHEET 1 OF 1

145579-C-CA-014

<u>Attachment 4</u>

E-mail Nov 17, 2004 from Dave Shuford, CH2M Hill to Paul Meyer, AMEC

Paul Meyer (Trail)

From: Shuford, David H (Dave) [David_H_Dave_Shuford@RL.gov]
Sent: Wednesday, November 17, 2004 8:19 AM
To: Paul Meyer (Trail); John Stephens (TRL); Tony Heim; Mark Lucas
Cc: Janicek, George P; Hamilton, Dennis W; Leonard, Michael W
Subject: FW: Performance Class of the ICV Box Assembly Building

Please use this as direction that the performance category of the ICV box assembly building is PC-1. Call me if you have any questions. Dave

---

From: Janicek, George P
Sent: Tuesday, November 16, 2004 7:09 AM
To: Shuford, David H (Dave)
Subject: RE: Performance Class of the ICV Box Assembly Building

Dave,

Attachment: 4
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 1 of 1

I concur on the ICV box assembly building being PC-1

George
-----Original Message-----
From: Shuford, David H (Dave)
Sent: Tuesday, November 16, 2004 6:55 AM
To: Janicek, George P
Subject: FW: Performance Class of the ICV Box Assembly Building

George – any reason that the ICV box assembly building should not be PC-1?

From: Paul Meyer (Trail) [mailto:paul.meyer@amec.com]
Sent: Monday, November 15, 2004 6:28 PM
To: Shuford, David H (Dave)
Cc: John Stephens (TRL); Tony Heim; John Hicks; Divana Whitley
Subject: Performance Class of the ICV Box Assembly Building

The notes from the March 11, 2004 meeting included a revision to the spreadsheet "Foundations Chart" providing the PC rating of various Systems, Structures and Components (SSCs) on site. We've been including a copy of the spreadsheet it in our revised calculations to demonstrate to the IQRPE the source of the PC ratings.

On that spreadsheet, there is a reference to "Any Pre-engineered Buildings" and the rating given is " GS (PC-1)"

Is this likely to be specific enough for the IQRPE or would it be preferable for a more specific reference that mentions the ICV Box assembly building by name? If the latter, could you provide that reference?

Thanks.

Paul Meyer, P.Eng.
Senior Structural Engineer
AMEC Americas Limited
Energy and Mining Division
1385 Cedar Avenue
Trail BC Canada V1R 4C3
1-250-368-2407, fax 2455
paul.meyer@amec.com

145579-C-CA-014

Attachment 5

E-mail Dec 17, 2004 from Brad Hupy, P.E. (author of DBVS Geotechnical Report) to P. Meyer

Paul Meyer (Trail)

From: Brad Hupy
Sent: Friday, December 17, 2004 2:47 PM
To: Paul Meyer (Trail)
Subject: RE: Questions about the soils and report at Hanford

In order to have frost heave three things are needed; water, low temperature, and soil fine for enough for capillary potential to raise the water to the freezing front. Because Hanford is a near desert climate, there is little water near the ground surface. Within a The tabulated capillary rise for fine sand is in the range of 1 to 11 feet and for medium sand in the range of 0.3 to 1.5 feet. Hanford certainly is cold enough in the winter to freeze water.

The little water in the near surface soil does freeze but the associated heave is negligible. The sand will not support capillary rise of several hundred feet that would be required to produce (feed) a growing freezing front and cause damaging heave. In our opinion, there is little risk of frost heave in the soil at the project site.

-----Original Message-----
From: Paul Meyer (Trail)
Sent: Friday, December 17, 2004 1:47 PM
To: Brad Hupy
Subject: RE: Questions about the soils and report at Hanford

Question: is it possible to state that a soil identified as "SP" (i.e. sand with few fines) will not be subject to frost heaving? Especially if it is very deep (e.g. our site at Hanford)

-Paul

Attachment: 5
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 1 of 2

-----Original Message-----
From: Brad Hupy
Sent: Tuesday, December 07, 2004 9:09 AM
To: Paul Meyer (Trail)
Cc: Tony Heim
Subject: RE: Questions about the soils and report at Hanford

Paul,

This is really pretty simple. The frost depth cited in our report is from statewide tabulation. If Hanford has determined and published site specific frost depth measurements then they may be used in lieu of the tabulated data. Site specific data is commonly used in this is way. A very good example is seismic ground motions.

-----Original Message-----
From: Paul Meyer (Trail)
Sent: Monday, December 06, 2004 4:33 PM
To: Brad Hupy
Cc: Tony Heim
Subject: Questions about the soils and report at Hanford

We are still awaiting approval from the "Independent Qualified Registered Professional Engineer" (IQRPE) who is checking our foundation designs to ensure they will satisfy all design criteria.

He has raised the following points/questions:

Your report indicates a frost depth of 45 inches for granular soil and recommends a foundation depth of 48 inches for critical structures. This is at odds with Hanford's' own measurements (See pages 26 through 28 of the attached Hanford document) which indicate that a temperature of 32 F has never been achieved at depths of only 36 inches. This is causing some problems for us, as the IQRPE wants us to conform to the requirements of the Geotech report in addition to Hanford's own design criteria

For your information, we have three types of foundations on the site. Foundation depths below grade are 45.6, 36.6 and 21.6 inches. Actual concrete thicknesses are 48, 39 and 24 inches, with the top of concrete set at 663.00 feet, while surrounding grade is at 662.8 feet. We removed the native soil to elevation 661.000 and

brought the local grade up to 662.8 with compacted crushed rock.

The four 48" foundations consist of two chimneys, and two large steel structures. These are all "critical structures" to use the phrase from your report. Foundations are uniformly 48" thick, and are 10'x12' and 20'x30' feet for the two chimneys, and 30x44 and 24x62 for the two steel structures. Foundations are not enclosed.

The single 39" foundation is a pre-engineered building, measuring 50 feet wide by 84 feet long by foundation consist of a single 12" thick slab with a thickened (to 39") edge. The building will be heated, and have an overhead crane.

The many (~100) 24" deep foundations support single pieces of freestanding equipment or "utility poles" that are connected by pipes, cable trays and ducts. Foundations are uniformly 24" thick and vary in size from 44x24 to 6x6 feet. Most are the 6x6 ones. Minor seasonal movement of the foundations would not be a problem. Actual gravity loads are quite light, typical values are substantially under 250 psf, yes, that's 250, not 2500. Foundations are not enclosed.

All the foundations will bear on compacted native soil, which was prepared as recommended in your report. As noted, the native soil is basically a gravelly sand, with few fines. I don't believe it is frost-susceptible.

Could you please reply to the following questions, raised by our reviewers?

1) Is the frost depth of 45 inches correct? Seems deep compared to other references.

2) Is the frost depth of 45 inches still valid, given we have removed some native soil, and the surface is now covered with 1.8 feet (21.6") of compacted crushed rock? Does the crushed rock make a difference?

3) Are the depths of foundations shown above for the various types of foundations suitable for the uses described?

4) IS frost heave an issue for the foundations as described?

Thanks for your help on this. I'll be traveling to Hanford on Tuesday Dec 07, for a meeting Wednesday, Dec 08. I will have e-mail access while there. I will be traveling back to Trail Thursday, Dec 09 and back in the office Friday, Dec 10. Best way to contact me is via e-mail until Friday, phone after that.

Paul Meyer, P.Eng.
Senior Structural Engineer
AMEC Americas Limited
Energy and Mining Division
1385 Cedar Avenue
Trail BC Canada V1R 4C3
1-250-368-2407, fax 2455
paul.meyer@amec.com

Attachment: 5
Calc. No.: 145579-C-CA-014
Rev. No.: 0
Sheet 2 of 2

<< File: HNF-SD-GN-ER-501 (Rev. 1).pdf >>

Attachment JJ Container Management

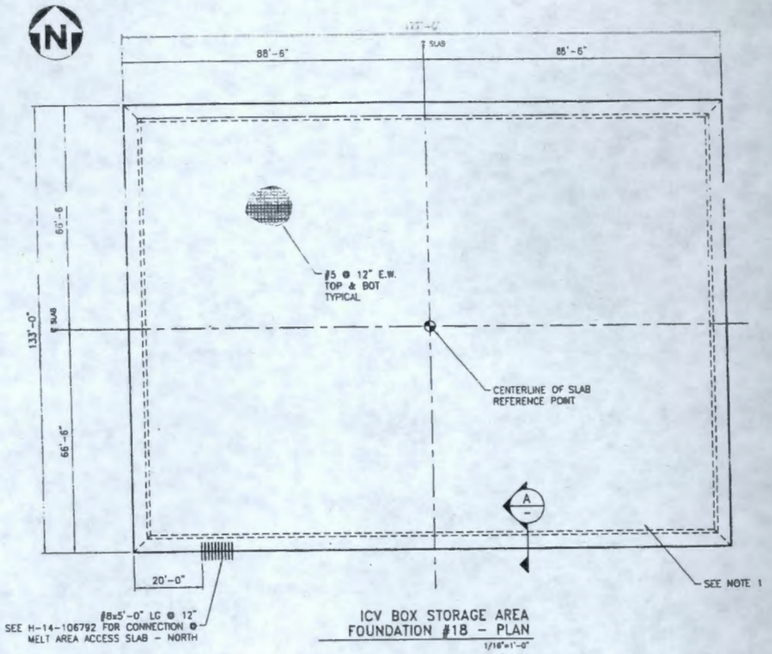
Appendix 1 Container Foundations

Contents

Section 3 Drawings

Drawing H-14-106790, Rev. 0
Drawing H-14-106797, Rev. 0

In making requests for transmittal of data by any electronic media, the requesting party acknowledges that AMEC Americas Limited cannot be held responsible for users of the data outside of or beyond the scope of our original agreement. Also, because data stored on electronic media or transmitted by electronic means can deteriorate undetected or be modified without the knowledge of the requesting party, the requesting party agrees that AMEC Americas Limited cannot be held liable for the compatibility, completeness or correctness of the data



ICV BOX STORAGE AREA
FOUNDATION #18 - PLAN
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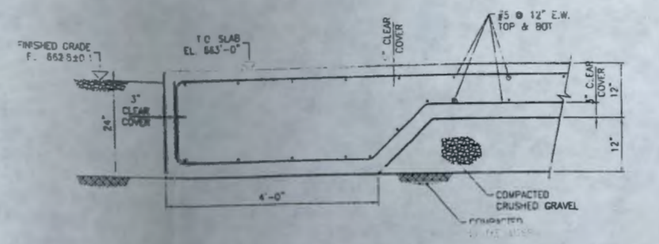
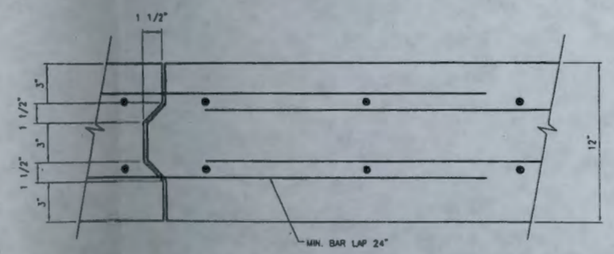
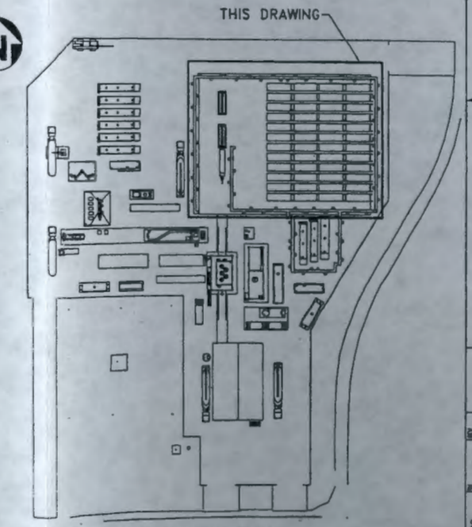


SLAB THICKENING @ PERIMETER
TYPICAL 4 SIDES

SECTION A



CONSTRUCTION JOINT DETAIL
3"=1'-0"



LOCATION PLAN

NOTES:

FOR GENERAL NOTES, DESIGN CRITERIA, MATERIAL SPECIFICATIONS, AND FOUNDATION LOCATIONS REFER TO DRAWING H-14-106789 "BULK VITRIFICATION - CIVIL SITE IMPROVEMENTS"

1. ICV BOX STORAGE AREA SLAB SUPPORTS LOADED AIR PALLET TRAFFIC. CONCRETE SURFACE SHALL BE CLASS 9 "SUPERFLAT" WITH MINIMUM FLATNESS NUMBERS OF Fr=100 AND Fl=50 AS DESCRIBED IN ACI 302.1R.

DRAWING TRACEABILITY LIST

DWG NO	TITLE	REF NUMBER	TITLE
		PREFERENCES	
		NEXT USED ON H-14-106789	

REVISIONS

REV	DATE	DESCRIPTION	DATE	CHECKED BY

MICHAEL RAYMOND SCHUTTER
STATE OF WASHINGTON
21969
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 11-7-04

THIS DRAWING PREVIOUSLY ISSUED AS AMEC DRAWING F-143843-00-C-0005

SEP 3 2004

amec

NAME	DATE
T.P. KROECKER	
R.W. WHITLEY	
D. MEYER	
D. MEYER	
M. MEYER	
J. STEPHENS	

AMEC PROJECT
145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX STORAGE AREA
PLAN / DETAILS

SIZE	DRAWN BY	CHECKED BY	DRAWING NO	REV
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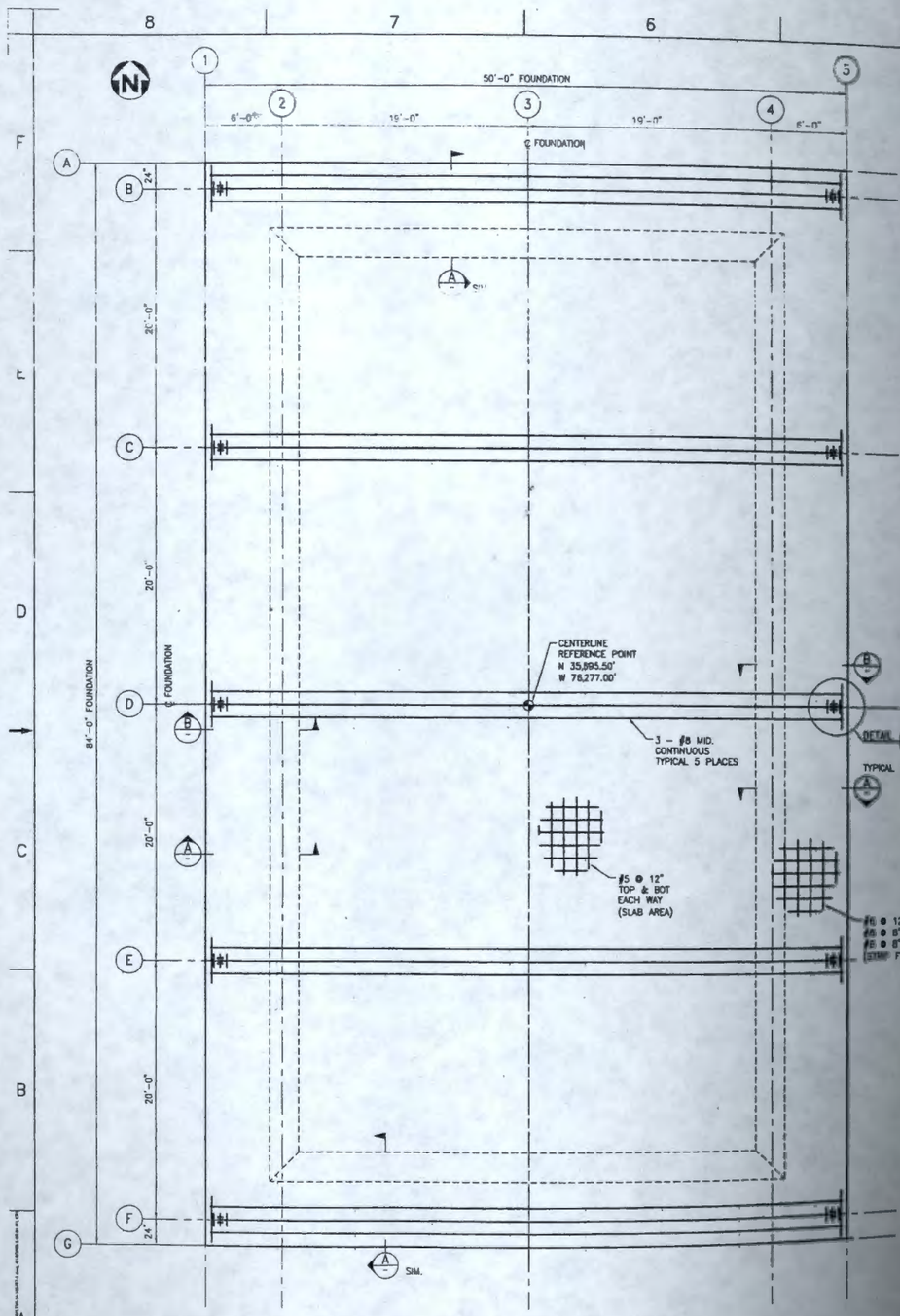
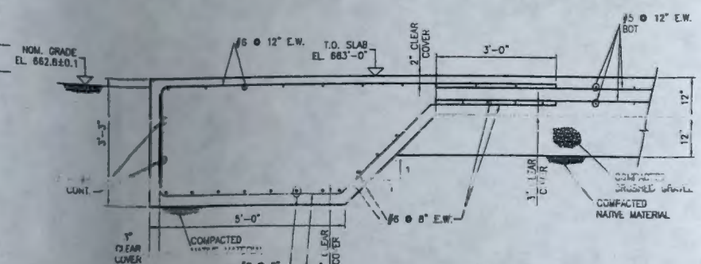
SCALE AS SHOWN | 821145 | SHEET 1 OF 1

1:3120

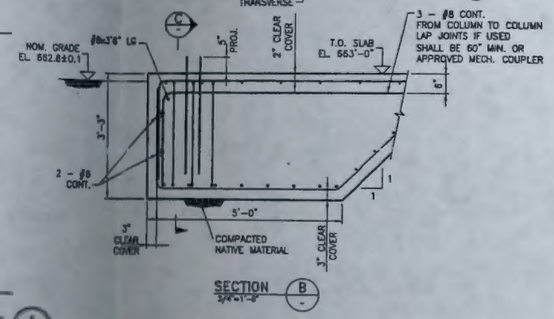
H-14-106790



ASSEMBLY BUILDING
FOUNDATION #20 - PLAN
1/4"=1'-0"



SECTION A
3/4"=1'-0"



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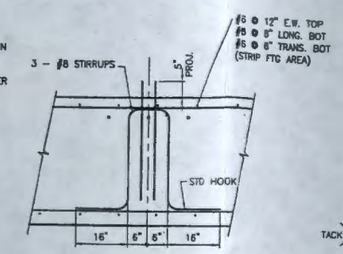
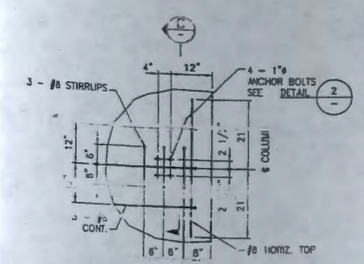
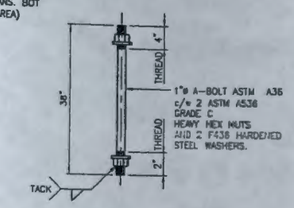


SECTION C
3/4"=1'-0"



DETAIL 1
3/4"=1'-0"



DETAIL 2
N.T.S.
40 REQ'D

NOTES:

FOR GENERAL NOTES AND FOUNDATION LOCATIONS REFER TO DRAWING H-14-106789 "BULK VITRIFICATION - CIVIL SITE IMPROVEMENTS"

FOR DESIGN CRITERIA & MATERIAL SPECIFICATIONS SEE CONSTRUCTION SPECIFICATION 145579-Q-SP-002.

1. PRE-ENG METAL BUILDING RIGID FRAMES SHALL USE ANCHOR BOLT PATTERN SHOWN AND SHALL HAVE "PINNED" BASES.

2. MAXIMUM DESIGN LOADS AT RIGID FRAME BASES (UNFACTORED) FROM CALCULATION 145579-C-CA-014.

VERTICAL	(DOWN)	=	114000LB
	(UP)	=	18000LB
HORIZONTAL	(E/W)	=	19000LB
	(N/S)	=	17000LB

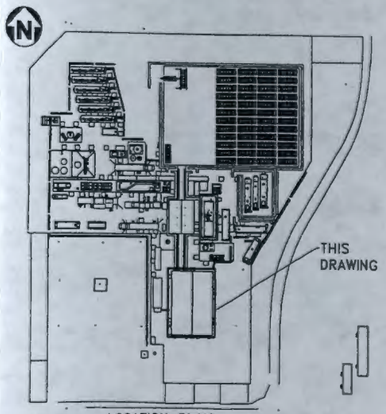
3. ENDWALL AND DOOR FRAMING WILL BE SECURED TO FOUNDATION USING DRILLED AND GROUTED ANCHORS. DESIGN AND SUPPLY BY PRE-ENGINEERED METAL BUILDING VENDOR.

4. CONCRETE SHALL CONFORM TO CONSTRUCTION SPECIFICATION SECTION 3300 "CAST-IN-PLACE CONCRETE".

THE FOLLOWING SPECIFIC REQUIREMENTS APPLY TO CAST-IN-PLACE CONCRETE. REFER TO THE CONSTRUCTION SPECIFICATION FOR DETAILS.

a) MINIMUM COMPRESSIVE STRENGTH @ 28 DAYS = 4000 PSI.
b) MAXIMUM WATER/CEMENT RATIO = 0.6
c) AIR CONTENT SHALL BE 5% - 8%.
d) CONSTRUCTION AND CONTRACTION JOINTS SHALL BE PER ACI 224.3R AND ACI 302.1R.

5. COMPACTED CRUSHED GRAVEL AND COMPACTION OF NATIVE MATERIAL SHALL CONFORM TO CONSTRUCTION SPECIFICATION SECTION 02220.



LOCATION PLAN

APR 1 2005
78

EXPIRES 9-7-06

REV	REVISION DESCRIPTION	Date	By	Ch'k'd	Approved Mgr Rep	Approved Proj Mgr
0	ISSUED FOR CONSTRUCTION	01 APR 05	DPK		PM	TH
D	ISSUED FOR CH2M HILL APPROVAL	27 JAN 05	DPK		PM	TH
C	ISSUED FOR CH2M HILL REVIEW	7 DEC 04	DPK		PM	TH
B	ISSUED FOR INTERNAL APPROVAL	29 NOV 04	DPK		PM	TH
A	ISSUED FOR INTERNAL REVIEW	18 NOV 04	DPK		PM	TH

DWG NO H-14-106797 REV 0

amec

145579-FINAL DBVS DESIGN

U.S. DEPARTMENT OF ENERGY
Office of River Protection

BULK VITRIFICATION
ICV BOX ASSEMBLY BUILDING
FDN - PLAN & DETAILS

SIZE	SCALE CODE	PROJECT NO.	DWG NO.	REV
F	241G	0110	H-14-106797	0

SCALE AS NOTED CDF 821582 SHEET 1 OF 1

23499

DRAWING TRACEABILITY LIST

DWG NO	TITLE	REF NUMBER	TITLE
		NEXT USED ON	REFERENCES

REVISIONS

REV	DESCRIPTION	REV BY DATE	REV BY	CHECKED BY	DCN	COMPANY