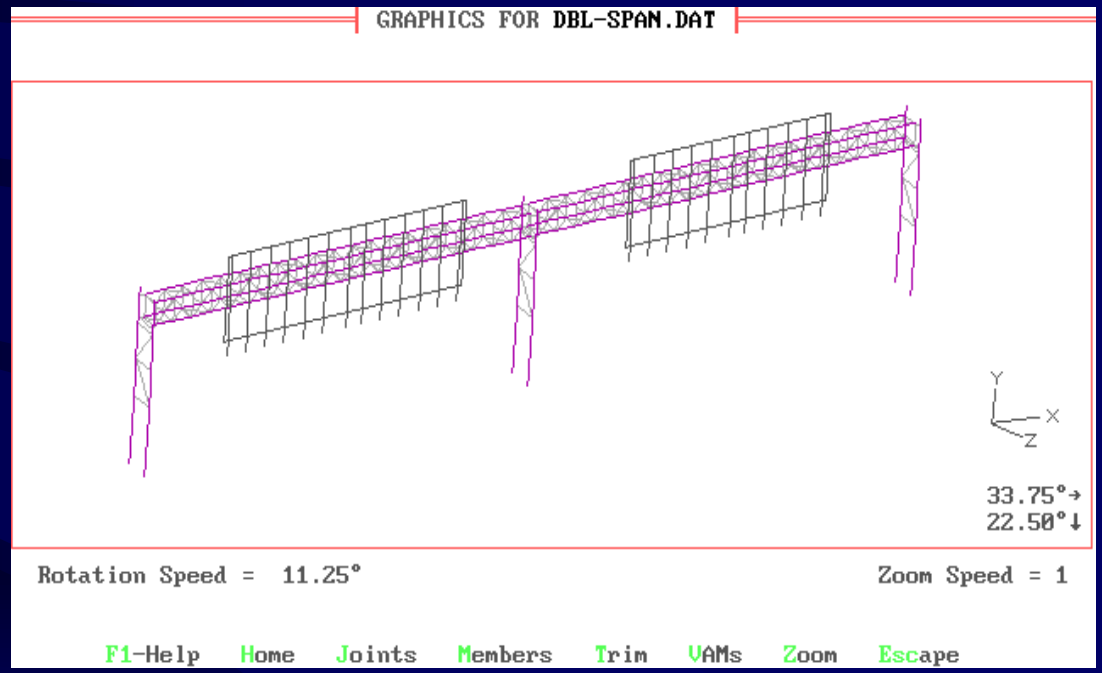
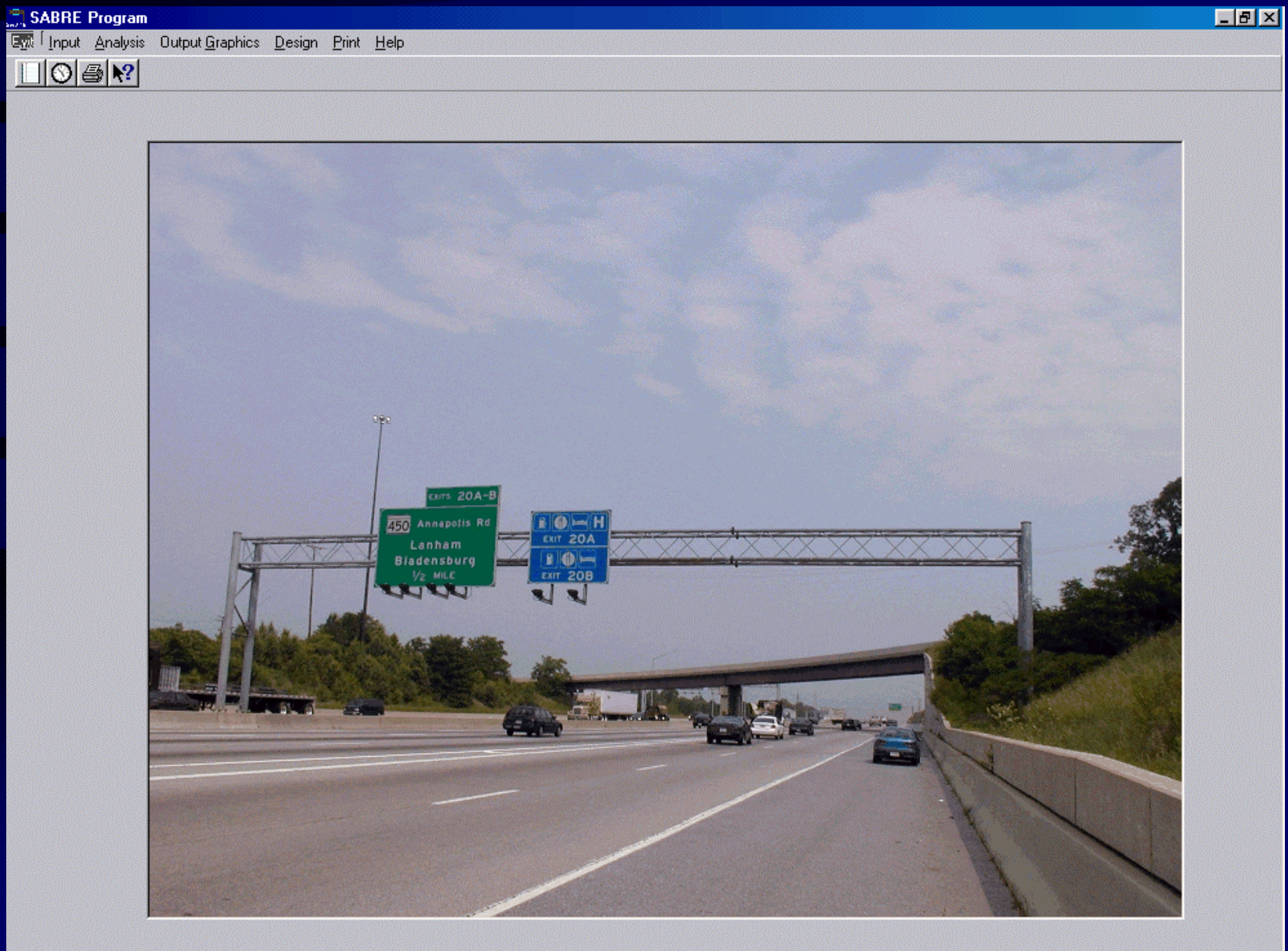
MERLIN-SABRE

Sign Bridge Analysis and Evaluation Program



MERLIN-SABRE Banner Page



MERLIN-SABRE Development

- Began in 1980
- Microcomputer version with graphic interface in 1988
- Utility for splice and base plate design in 1989
- SI version in 1994
- WINDOWS, WINDOWS/NT & Network version in 2000
- New AASHTO Guide Specifications

Introduction

- Windows-based computer analysis and design program for 3-D sign bridge structures
- Pre- and post-processors included
- 30 different types of sign support structures
- Cantilevered or overhead sign bridges
- Prismatic or tapered tubular member shapes
- AASHTO DL, WL, ICE and LL
- Arbitrary loading
- All structural properties are automatically calculated
- A dedicated sign bridge program

Sign Bridge Components

- 5 sign bridge configurations
- 2 tower types (single or double)
- 8 beam types
- 6 sign bridge types
- 4 member types
- 8 section types
- 1 sign type
- 1 walkway type
- 1 vertical attachment member (VAM) type

TABLE 1 - SIGN BRIDGE CONFIGURATIONS

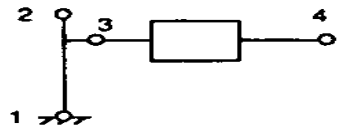
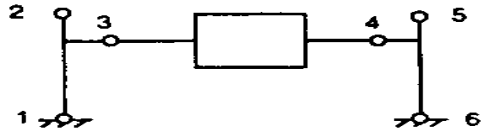
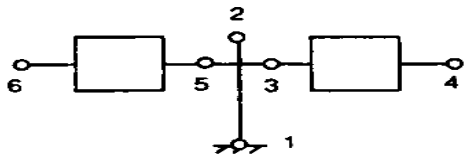
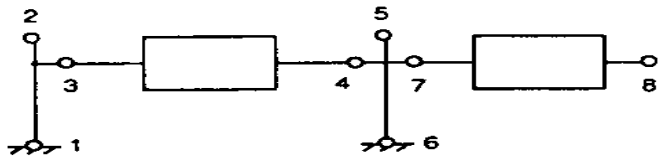
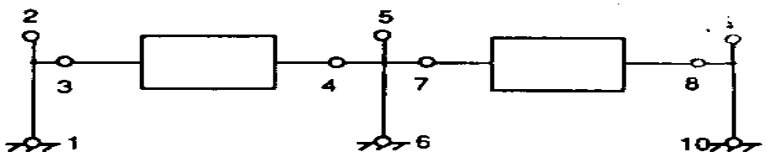
CONFIG. NUMBER	DESCRIPTION	BASIC JOINT AND MEMBER NUMBERING SEQUENCE
1	Cantilever	
2	Single Span	
3	Butterfly	
4	Single Span with Canti-lever	
5	Double Span	

TABLE 2 - SIGN BRIDGE TOWER TYPES

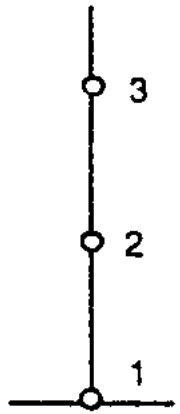
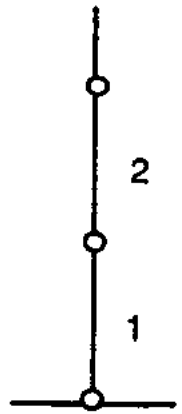
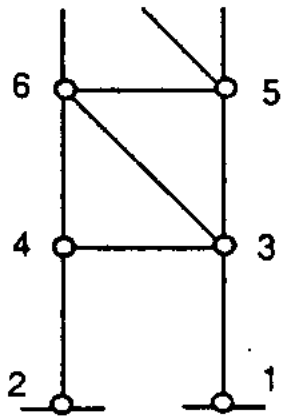
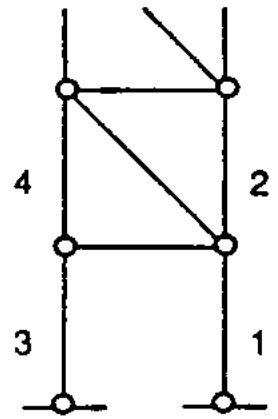
TYPE ID	DESCRIPTION	BASIC JOINT NUMBERING SEQUENCE	BASIC MAIN MEMBER NUMBERING SEQUENCE
1	Single Post		
2	Double Post		

TABLE 3 - SIGN BRIDGE BEAM TYPES

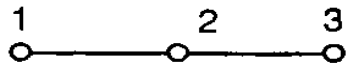
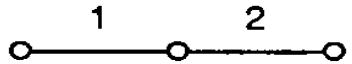
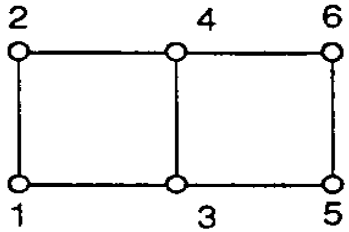
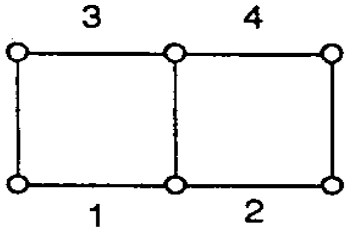
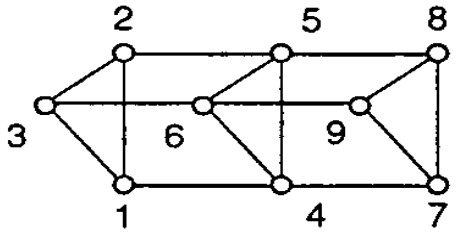
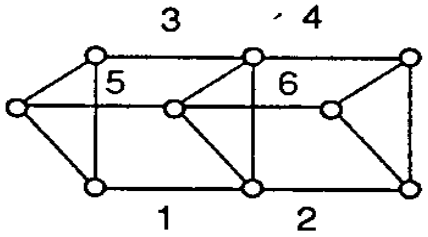
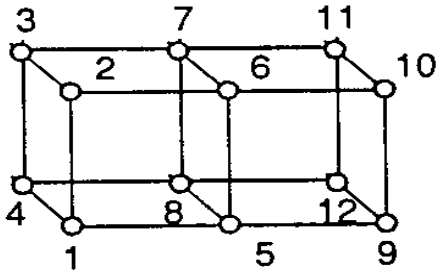
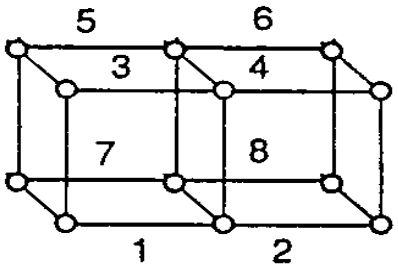
TYPE ID	DESCRIPTION	BASIC JOINT NUMBERING SEQUENCE	BASIC MAIN MEMBER NUMBERING SEQUENCE
1	Monotube, Cantilever		
2	Plane Truss, Cantilever		
3	Trichord Truss, Cantilever		
4	Box Truss, Cantilever		

TABLE 4 - ACTUAL STRUCTURE TYPE vs. MODEL

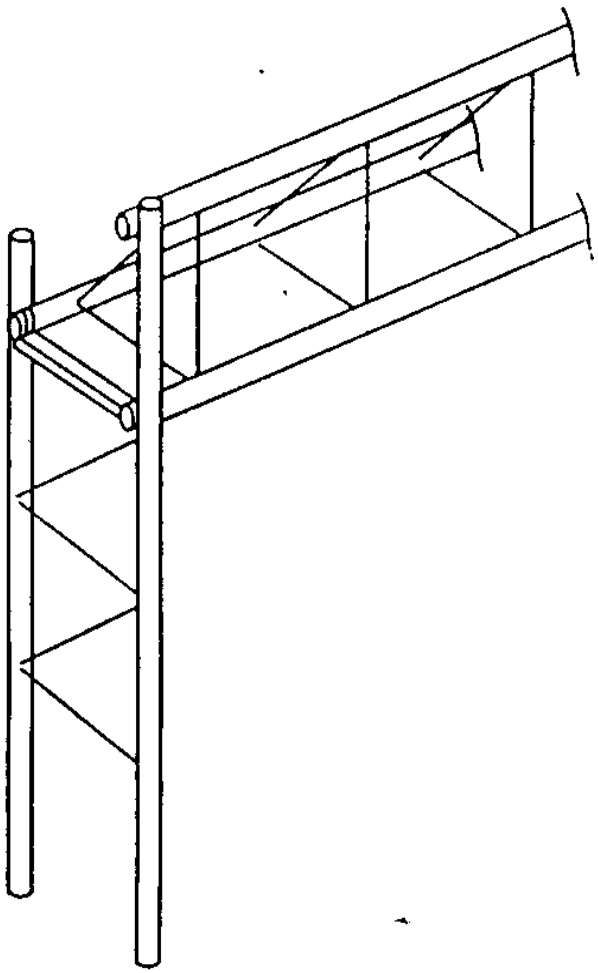
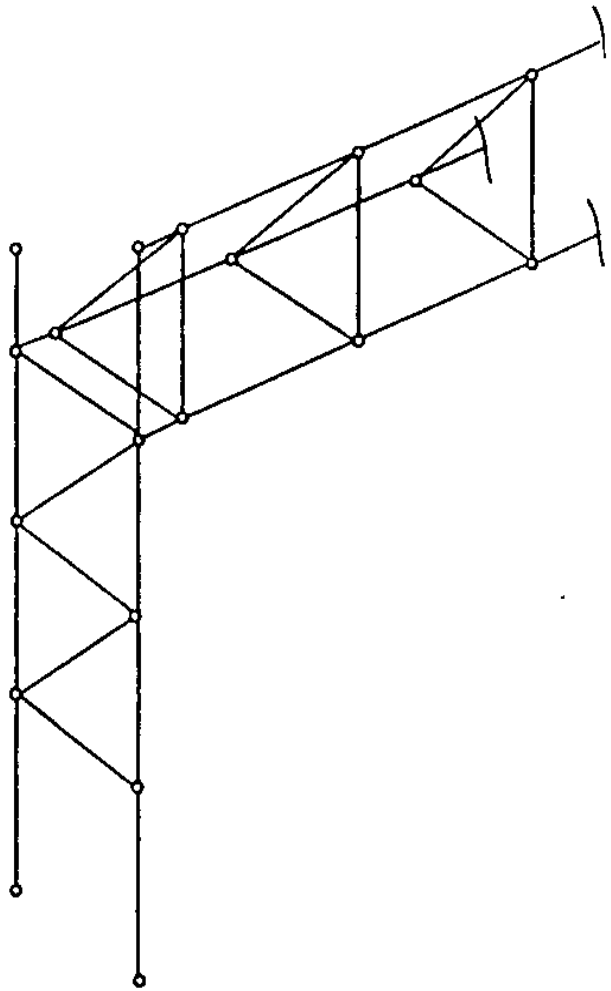
TYPE ID	SIGN BRIDGE TYPE	MODEL
5		

TABLE 5 - MEMBER TYPE AND CATEGORY WITHIN UNIT

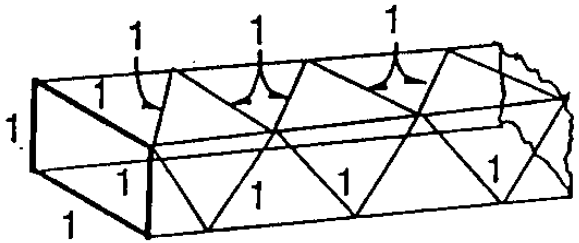
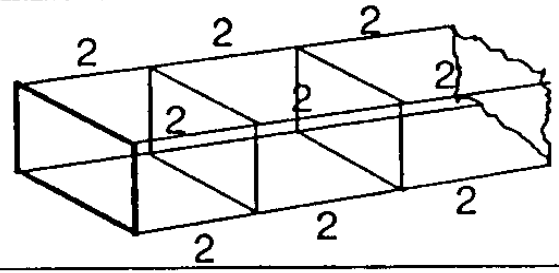
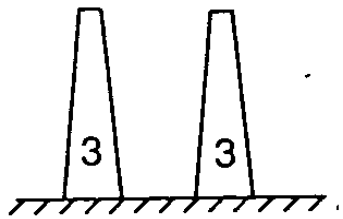
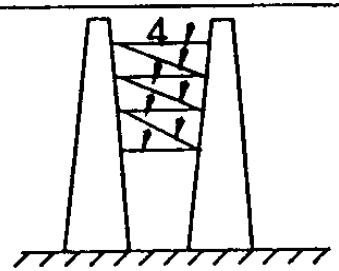
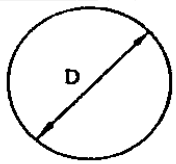
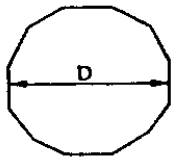
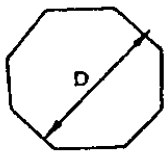
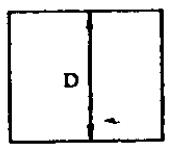
MEMBER		STRUCTURAL COMPONENT	
TYPE	CATEGORY	DESCRIPTION	FIGURE
1	Secondary	Interior truss members for plane, trichord and box trusses	
2	Primary	Exterior truss members for plane, trichord and box trusses	
3	Primary	Vertical (tower) members	
4	Secondary	Interior truss members for tower	

TABLE 6 - TUBULAR SHAPES

SHAPE ID	TYPE	FIGURE	STRESS CONCENTRATION FACTOR	COMMENTS
1		Not Used		
2	Round		Not Required	Note the definition of the outer diameter D.
3	Dodecagonal		Table 1.3.1 B(3) AASHTO Spec.	Note the definition of the outer diameter D.
4	Octagonal		Table 1.3.1 B(3) AASHTO Spec.	Note the definition of the outer diameter D.
5	Square		Table 1.3.1 B(3) AASHTO Spec.	Note the definition of the outer diameter D.

Program Features

- Window pull-down menu
- Data entry, error checking and editing
- Automatic joint and member renumbering
- Shape files
- On-screen help
- On-screen graphics
- On-screen printing
- Post Design on based plate and splice plate


Graphics for c:\winsabre\dbl-span.dat
Exit
Home
Joints
Member
VAMs
Zoom
UnZoom
Right
Left
Up
Down

Structural Analysis Capabilities

- 30 most commonly used configurations
- X, Y, Z coordinate system
- Various boundary conditions
- Prismatic or tapered members
- Automatic and manual input loading
- Sign bridge details
- 3-D structural analysis
- AASHTO stress analysis and investigation
- Design capabilities

SABRE Code Check Output

- Joint Deformation for Group 3
- Member-end-action for Group 3
- Truss Member Allowable at 133%
- Combined Stresses in Truss Members

SABRE Base Plate Design Utility

Design File - C:\WinSabre\Sample.out

Splice Plate Design Parameters | Base Plate Design Parameters

Exit | Calculate | Import

ENG/SI UNIT: 0 - English

YIELD STRESSES

BOLT	55.00	ksi(MPa)
BASE PLATE	36.00	ksi(MPa)
COLUMN	55.00	ksi(MPa)

COLUMN PARAMETERS

OUTSIDE DIAMETER	10.	in(mm)
WALL THICKNESS	1.	in(mm)
CROSS-SECTION SHAPE	2 - Round cross section	

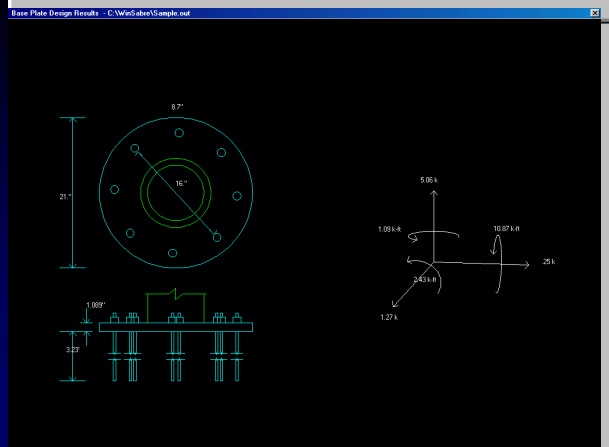
BASE FORCES

X DIR.	.245	kips(KN)
Y DIR.	5.061	kips(KN)
Z DIR.	1.274	kips(KN)

BASE MOMENTS

X-X AXIS	10.866	k-ft(KN-m)
Y-Y AXIS	1.094	k-ft(KN-m)
Z-Z AXIS	2.433	k-ft(KN-m)

ALLOWABLE WELD STRESS	12.40	ksi(MPa)
GROUP LOAD NO.	2	
BASE PLATE SHAPE	2 - Round cross section	
DES. NO OF BOLTS	0	



Base Plate Design Results

NO. OF BOLTS	= 8
BOLT DIAMETER	= 1 in.
BOLT AREA (EACH)	= .785 in.^2
EMBEDMENT LENGTH	= 3.2 ft.
WELD THROAT LENGTH	= .221 in.
WELD LEG LENGTH	= .313 in.
PLATE SHAPE	= Round
PLATE O.D.	= 21 in.
PLATE SIDE LENGTH	= 8.7 in.
PLATE THICKNESS	= 1.09 in.

Graph | Print

TABLE 9.6 : JOINT DEFORMATIONS FOR GROUP 3 --DL +ICE +.5W

(WIND COMBINATION 1 IN THE +Z DIRECTION)

0JOINT NO.	X-JOINT COORD (FT)	Y-JOINT COORD (FT)	Z-JOINT COORD (FT)	X DEFLECTION (FT)	Y DEFLECTION (FT)	Z DEFLECTION (FT)
1	.00	.00	2.50	.00000	.00000	.00000
2	.00	.00	-2.50	.00000	.00000	.00000
3	.00	15.00	2.50	.00059	-.00012	.00507
4	.00	15.00	-2.50	.00064	-.00005	.00511
5	.00	20.00	2.50	.00065	-.00013	.00657
6	.00	20.00	-2.50	.00067	-.00006	.00661
7	1.00	15.00	2.50	.00059	-.00019	.00520
8	1.00	20.00	2.50	.00065	-.00018	.00671
9	1.00	20.00	-2.50	.00067	-.00008	.00671
10	1.00	15.00	-2.50	.00064	-.00008	.00520
11	10.00	15.00	2.50	.00064	-.00058	.00526
12	10.00	20.00	2.50	.00064	-.00055	.00672
13	10.00	20.00	-2.50	.00065	-.00027	.00672
14	10.00	15.00	-2.50	.00064	-.00025	.00527
15	19.00	15.00	-2.50	.00064	-.00006	.00521
16	19.00	20.00	-2.50	.00063	-.00008	.00672
17	19.00	20.00	2.50	.00064	-.00018	.00672
18	19.00	15.00	2.50	.00068	-.00018	.00520
19	20.00	20.00	-2.50	.00063	-.00006	.00662
20	20.00	20.00	2.50	.00064	-.00013	.00658
21	20.00	15.00	-2.50	.00064	-.00006	.00511
22	20.00	15.00	2.50	.00068	-.00012	.00508
23	20.00	.00	-2.50	.00000	.00000	.00000
24	20.00	.00	2.50	.00000	.00000	.00000

TABLE 10.6 : MEMBER-END-ACTIONS FOR GROUP 3 --DL +ICE +.5W

(WIND COMBINATION 1 IN THE +Z DIRECTION)

UNIT NO.	MEM NO.	JOINT NO.	AXIAL LOAD (K)	SHEAR Y (K)	SHEAR Z (K)	MOMENT Y-Y (FT-K)	MOMENT Z-Z (FT-K)	TORSION X-X (FT-K)
1	1	1	6.61	.03	-.54	5.44	.46	.54
1	1	3	-6.61	-.03	.54	2.72	-.02	-.54
1	2	3	2.62	-1.04	-.12	-.70	-2.88	.12
1	2	5	-2.62	1.04	.12	1.30	-2.31	-.12
2	3	2	2.97	.10	-.55	5.50	.84	.40
2	3	4	-2.97	-.10	.55	2.78	.65	-.40
2	4	4	1.34	-.44	-.11	-.71	-1.18	.08
2	4	6	-1.34	.44	.11	1.27	-1.03	-.08
0	5	3	-1.01	2.90	-.42	.42	2.90	2.02
0	5	7	1.01	-2.90	.42	.00	.00	-2.02
3	6	7	-4.39	.15	-.01	-.02	.30	.45
3	6	11	4.39	-.15	.01	.13	1.04	-.45
0	7	5	1.10	2.31	-.12	.12	2.31	1.30
0	7	8	-1.10	-2.31	.12	.00	.00	-1.30
4	8	8	.95	.11	.00	-.01	.11	.15
4	8	12	-.95	-.11	.00	.02	.89	-.15
0	9	6	.50	1.03	-.08	.08	1.03	1.27
0	9	9	-.50	-1.03	.08	.00	.00	-1.27
5	10	9	2.01	.06	-.01	.03	.08	.30
5	10	13	-2.01	-.06	.01	.03	.46	-.30
0	11	4	-.48	.54	-.32	.32	.54	2.07
0	11	10	.48	-.54	.32	.00	.00	-2.07
6	12	10	.16	.09	-.02	.02	.29	.36
6	12	14	-.16	-.09	.02	.16	.55	-.36
0	13	7	-.69	-.10	-.07	.11	-.25	-.01
0	13	8	.69	.10	.07	.25	-.26	.01
0	14	8	-.04	.50	.00	.01	1.26	.04
0	14	9	.04	-.50	.00	.01	1.26	-.04
0	15	9	.25	-.04	.07	-.24	-.11	-.01
0	15	10	-.25	.04	-.07	-.11	-.10	.01
0	16	10	.22	-.66	.00	.00	-1.65	.04
0	16	7	-.22	.66	.00	-.01	-1.66	-.04
0	17	11	-1.99	.00	-.14	.33	.01	.00
0	17	12	1.99	.00	.14	.39	.01	.00
0	18	12	-.32	.34	.00	.00	.88	.00
0	18	13	.32	-.34	.00	.00	.84	.00
0	19	13	.95	.00	.15	-.43	.01	.00
0	19	14	-.95	.00	-.15	-.32	.01	.00
0	20	14	.32	-.43	.00	.00	-1.09	.00
0	20	11	-.32	.43	.00	.00	-1.07	.00
0	21	7	3.75	.00	-.01	.02	-.01	.05
0	21	12	-3.75	.00	.01	.07	.04	-.05
0	22	8	.29	.05	.00	.00	.23	.04
0	22	13	-.29	-.05	.00	.00	.26	-.04
0	23	9	-1.68	.00	.01	-.06	-.01	-.01
0	23	14	1.68	.00	-.01	-.05	.02	.01
0	24	10	-.78	-.05	.00	.00	-.28	.03
0	24	11	.78	.05	.00	.01	-.24	-.03

TABLE 12.3 : TRUSS MEMBER ALLOWABLES AT 133.% (GROUPS 2 AND 3)

UNIT NO.	MEM NO.	SECTION ID	AXIAL ALLOWABLES				BENDING ALLOWABLES				SHEAR	
			COMP. (KSI)	EQ ID	TENS. (KSI)	EQ ID	COMP. (KSI)	EQ ID	TENS. (KSI)	EQ ID	ALLOW (KSI)	EQ ID
	5	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
3	6	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	7	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
4	8	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	9	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
5	10	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	11	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
6	12	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	13	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	14	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	15	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	16	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	17	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	18	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	19	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	20	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	21	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	22	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	23	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	24	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	25	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	26	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	27	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	28	ROUND	34.43	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	29	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	30	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	31	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	32	ROUND	40.30	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
7	33	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	34	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
8	35	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	36	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
9	37	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	38	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
10	39	ROUND	40.97	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1
	40	ROUND	43.65	A3	43.89	T1	48.28	B1	48.28	T1	24.14	V1

TABLE 12.4 : COMBINED STRESSES IN TRUSS MEMBERS

UNIT NO.	MEM NO.	JOINT NO.	CONTROLLING CASE GROUP NO.	CONTROLLING CASE WIND COMB	CONTROLLING CASE WIND DIR.	CONTROLLING MAX STRESS AXIAL (KSI)	CONTROLLING MAX STRESS BENDING (KSI)	CONTROLLING MAX STRESS SHEAR (KSI)	COMBINED STRESS RATIO
3	6	7	2	1	+Z	.18	.08	.10	.006
4	8	8	1			.02	.04	.01	.002
5	10	9	2	1	-Z	.17	.08	.07	.006
6	12	10	2	1	+Z	.03	.09	.08	.003
7	33	14	2	1	-Z	.10	.19	.08	.006
8	35	13	2	1	-Z	.17	.23	.07	.009
9	37	12	1			.02	.14	.01	.004
10	39	11	2	1	+Z	.18	.26	.10	.009
	5		2	1	+Z	.05	.71	.62	.016
	7		2	1	+Z	.05	.64	.46	.015
	9		2	1	-Z	.02	.49	.40	.011
	11		2	1	-Z	.02	.90	.70	.020
	13		2	1	+Z	.10	.77	.05	.018
	14		2	1	+Z	.01	3.31	.24	.069
	15		2	1	-Z	.19	.76	.05	.020
	16		2	1	+Z	.04	4.38	.31	.092
	17		2	1	+Z	.23	1.06	.06	.028
	18		2	1	-Z	.08	2.34	.14	.050
	19		2	1	-Z	.19	1.15	.06	.028
	20		2	1	-Z	.04	3.00	.18	.063
	21		2	1	+Z	.39	.21	.05	.013
	22		2	1	+Z	.05	.64	.05	.014
	23		2	1	-Z	.46	.16	.01	.017
	24		2	1	+Z	.15	.79	.06	.021
	25		2	1	+Z	.15	.78	.06	.021
	26		2	1	-Z	.37	.16	.01	.014
	27		2	1	+Z	.06	.64	.05	.014
	28		2	1	+Z	.49	.21	.06	.015
	29		2	1	+Z	.04	4.38	.31	.092
	30		2	1	-Z	.05	.73	.05	.016
	31		2	1	+Z	.01	3.32	.24	.069
	32		2	1	+Z	.00	.80	.05	.017
	34		2	1	-Z	.05	.62	.61	.015
	36		2	1	-Z	.05	.69	.47	.016
	38		2	1	+Z	.02	.43	.39	.010
	40		2	1	+Z	.02	1.01	.72	.022

* INDICATES THAT MAXIMUM STRESS CASE OCCURS AT JK END RATHER THAN JJ END