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30m Maxiflex evaluation

FTL DESIGN ENGINEERING STUDIO

157 Chambers Street • New York, NY 10007
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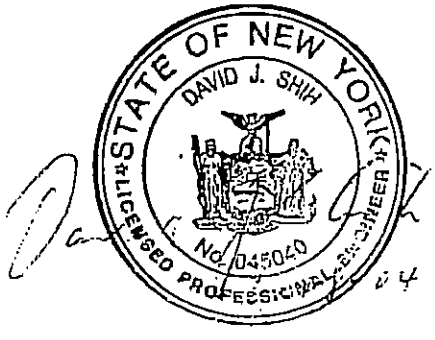
30 M LOSBERGER FRAME TENT

STRUCTURAL EVALUATION

(3.8 M EAVE HEIGHT – MAXIFLEX PROFILE)



Prepared for:

Doug Remsberg
Losberger U.S. LLC
95 Monocacy Boulevard, B20
Frederick, MD 21705
March 18, 2004

30 M LOSBERGER FRAME TENT
STRUCTURAL EVALUATION

Prepared for
Losberger U.S. LLC
March 18, 2001

EVALUATION SUMMARY

This report documents the structural evaluation of the 30 m Losberger Frame Tent (30 m H 3.80) in accordance with applicable U.S. building codes. This study is based on the technical background information provided by Losberger U.S. LLC. The structure is intended for temporary use only and any of the following load assumptions should not be exceeded at any time for the conclusions of this report to remain valid.

F.T.L Design Engineering Studio compiled this report based on the existing tent system with reference to the applicable building codes in the U.S. This report includes the loads used in the analysis and gives an indication as to what wind exposure the structure is suitable for. Certification of this document only shows that the Professional Engineer of that particular State is in agreement with the report's contents. It does not, however, imply that the structure is generally suitable for use within that State, or that every installation is covered by the report.

Note: Temporary lightweight structures are not designed for seismic or snow loads.

WIND ZONE RATING

Wind Zone	:	90 mph (3-second gust Speed)
Exposure Class	:	Class C (Open Country or Terrain)
Return Period	:	2 Years (Accounts for the Temporary Nature of the Structure)
Wind Pressure	:	8.3 psf (Design Pressure)

It has been found that for the abovementioned wind zone, exposure class and return period, the structure satisfies the requirements of the American Society of Civil Engineers: Minimum Design Loads for Buildings and Other Structures (ASCE 7-98). In addition, for the above wind zone, exposure class and return period, the structure is also in accordance with the following building codes in the U.S.:

International Building Code (IBC)
Uniform Building Code (UBC)
Building Officials and Code Administrators (BOCA)
Southern Building Code Congress Int'l: Standard Building Code (SBCCI-SBC)
South Florida Building Code (SFBC)

As for the other wind zones and exposure classes, refer to Table 0-1 for rating and allowable installation parameters.

BASE REACTIONS

The maximum forces at the foundations / supports due to the rated load and exposure class are as follows:

Maximum Vertical Down Load	:	1.50 K (Class C, 90 mph, 1000 lbs fixture loads)
Maximum Vertical Uplift	:	3.70 K (Class C, 90 mph)
Maximum Shear	:	3.16 K (Class C, 90 mph)

The values given are per base plate.

ALLOWABLE HANGING LOADS ON FRAMES

The maximum allowable live load hung from the rafters is 1000 lbs distributed as follows:

Left Rafter Centerspan	:	250 lbs
Ridge	:	500 lbs
Right Rafter Centerspan	:	250 lbs

ALLOWABLE DOWNLOADS ON FRAMES

The tent is not engineered for snow loads. The maximum allowable plan projected download on the structure, in addition to its dead weight, is only 1.5 psf.

ADDITIONAL EXPOSURE AND (3-SECOND GUST) WIND SPEED COMBINATIONS

The 30 m version is suitable for up to a Class C, 90 mph 3-second gust wind exposure. For other exposure and wind zone combinations refer to the following chart (where the stricken values are the unsuitable pressures for the tent):

30 M LOSBERGER FRAME TENT (29.00 FT MAXIMUM HEIGHT)
ANSI/ASCE 7-98 WIND PRESSURES, q (psf)

Exposure	85 mph	90 mph	95 mph	100 mph
Class A	5.53	6.20	6.91	7.65
Class B	5.69	6.38	7.11	7.88
Class C	7.40	8.29	~~9.24~~	~~10.24~~
Class D	8.94	~~10.03~~	~~11.17~~	~~12.38~~

Table 0-1 30 m Losberger Frame Tent Allowable Exposure Chart

Exposure classes according to ANSI/ASCE 7-98, p. 14 are defined as follows:

Exposure A

Large city centers with at least 50% of the buildings having a height in excess of 70 feet. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least one-half mile or 10 times the height of the building or structure, whichever is greater. Possible channeling effects or increased velocity pressures due to the building or structure being located in the wake of adjacent buildings shall be taken into account.

Exposure B

Urban or sub-urban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Use of this exposure category shall be limited to those areas for which terrain representative of Exposure B prevails in the upwind direction for a distance of at least 1500 feet or 10 times the height of the building or structure, whichever is greater.

Exposure C

Open terrain with scattered obstructions having heights generally less than 30 feet. This category includes flat, open country and grasslands.

Exposure D

Flat, unobstructed areas exposed to wind flowing over large bodies of water. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1500 feet or 10 times the height of the building or structure, whichever is greater.

TABLE OF CONTENTS

Evaluation Summary

Table of Contents

This report is a condensed and recompiled version of the original. Refer to the complete structural evaluation report for further details.

From Part 2 Structural Framing Plan

From Part 3 Section and Material Properties

- 3.1 Section Assignment
- 3.2 Section Properties

From Part 4 Load Assumptions

- 4.1 Dead Loads
- 4.2 Live Loads
- 4.3 Wind Loads
- 4.4 General Load Cases and Combinations

From Part 5 Structural Analysis and Results

- 5.2 ROBOT MILLENIUM Results
  - 5.2.1 Displacements, Axial Forces, Bending Moments (Critical cases)
  - 5.2.2 Maximum Applied Loads
  - 5.2.3 Maximum Base Reactions

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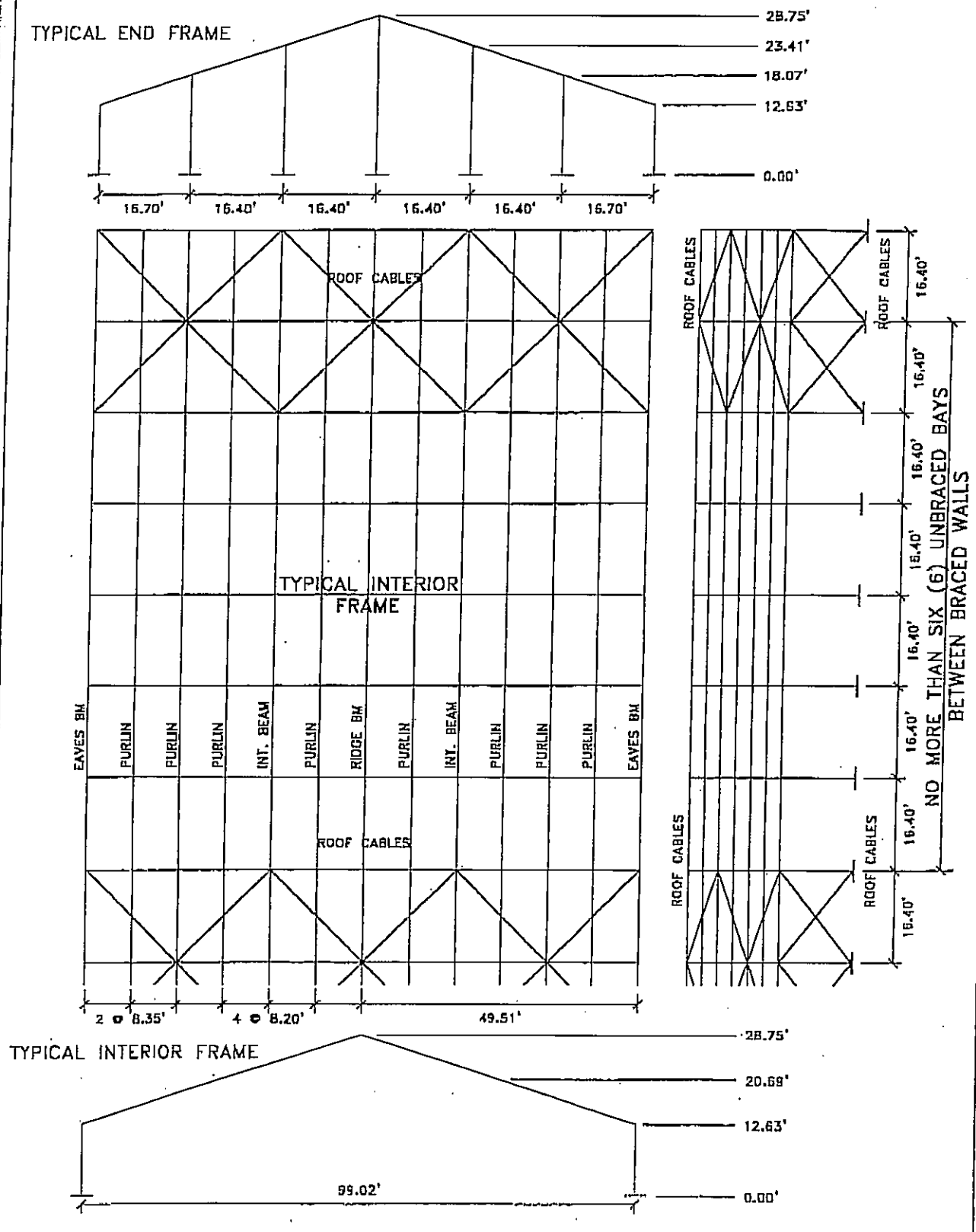
PROJECT	PROJECT #	DESCRIPTION	PAGE #
30 METAL SIMPLEX (98)	2308.1	FIG 2.1a - STRUCTURAL FRAMING PLAN	3
AUTHOR	DATE		CHECKED BY
AJ			

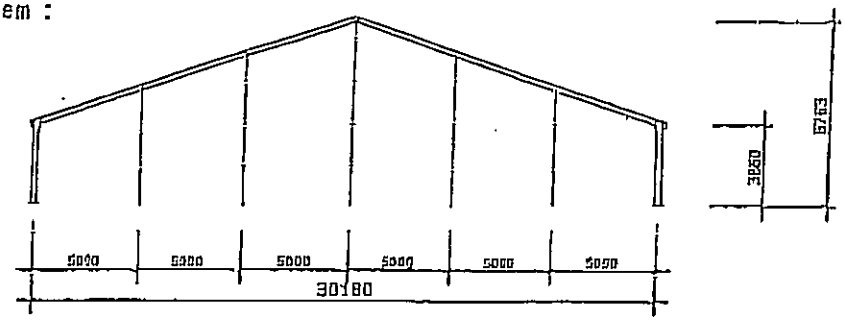


LOSBERGER 312

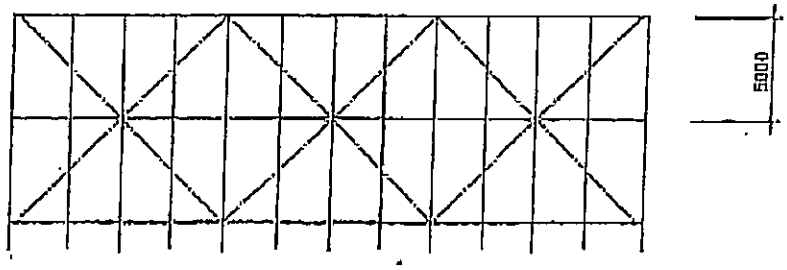
Fest- und Ausstellungshalle 30.5/400

Rahmen-System :

M = 1 : 350

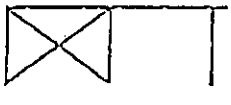


Dachverband : M = 1 : 350



Vertikalverband : M = 1 : 350

Strebenverband



Technische Daten :

Dachneigung :	18°	Binderprofil :	300 x 120
Traufhöhe :	3060	Giebelstielprofil :	200 x 120
Firsthöhe :	8763	Gewicht pro m^2:	8 kg
Binderabstand :	5000	Längstes Gerüstteil :	10612
Statik :	ja	Prüfung :	ja

Techn. Änderungen vorbehalten !

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PROJECT	PROJECT #	DESCRIPTION	PAGE#
30M MAXIFLEX (748)	23081	FIG 3-1a - SECTION ASSIGNMENT	6
AUTHOR	DATE		CHECKED BY
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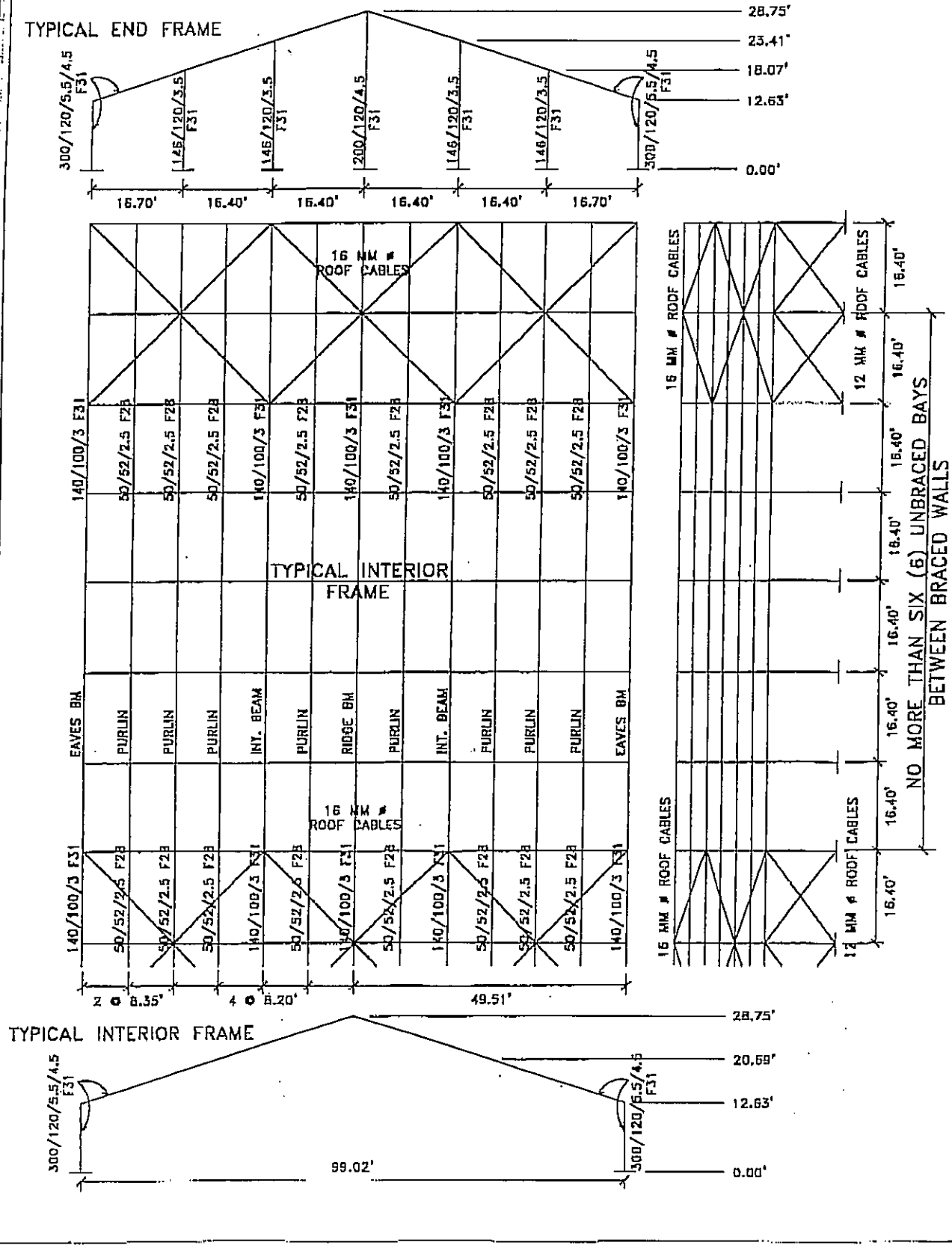


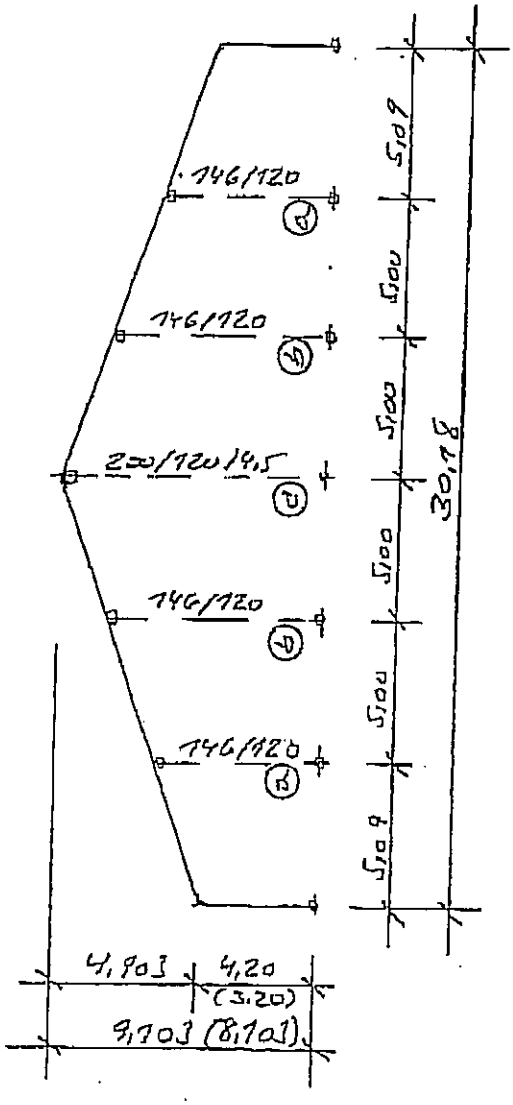
FTL DESIGN ENGINEERING STUDIO

PROJECT: 30M TRIFLEX (7-98)	PROJECT #: 2308	DESCRIPTION: FIG 3-16 SECTION ASSIGNMENT (END WALL)	PAGE# 7
AUTHOR: AD	DATE:		CHECKED BY:

System Type 30/420 (30/320)

M = 1:250

Dachneigung 18°



Vierkantprofil 300/120/5,5/4,5 AL Mg Si1 F31
Vierkantprofile gemäß obiger Eintragung AL Mg Si1 F31

Maße in Klammer ( ) für Type 320/320
Rahmenprofil:
Giebelstiele (gestrichelt)

FTL DESIGN ENGINEERING STUDIO

PROJECT 30 M MAXIFLEX (7-98)	PROJECT # 2308	DESCRIPTION Fig 3-1c: SECTION ASSIGNMENT (END BAY)	PAGE# 8
AUTHOR A.9	DATE		CHECKED BY

alternativ:

Dachverband zu Zelttype 30/520 –30/320

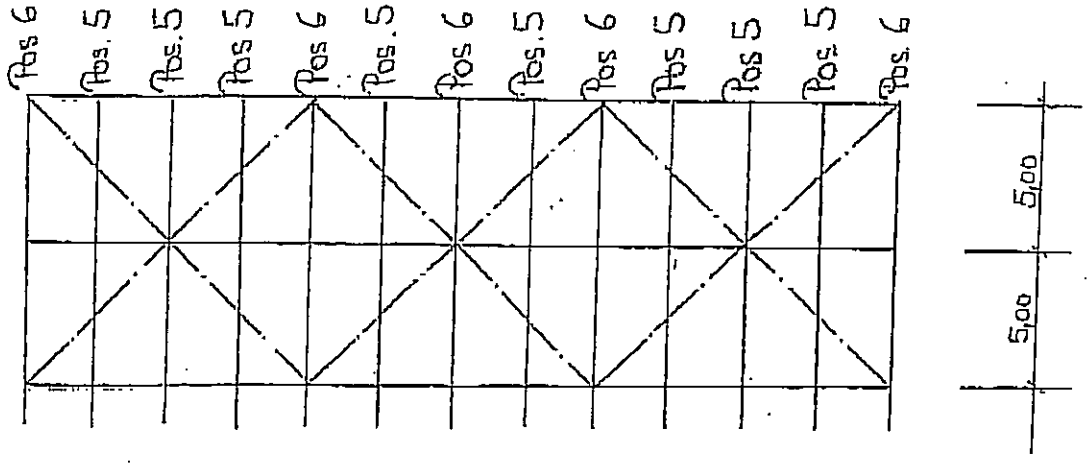
M = ca. 1:250

Alle Diagonalen:

Seil 16 DIN 3060-FE-verz. 1770 sZ

Pfetten (Pos.6, Stäbe 70-80 usw.): Pfettenprofil 140*100*3.0 Al Mg Si1 F31

Zwischenpfetten (Pos.5) Pfettenprofil 80×80×2,75 AlMgSi F28



FTL DESIGN ENGINEERING STUDIO

PROJECT 30 M MAXIFLEX (Y-98)	PROJECT # 23087	DESCRIPTION FIG 3.16. SECTION PROPERTIES (IMPERIAL SYSTEM)	PAGE# 9
AUTHOR A.D	DATE		CHECKED BY

SECTION PROPERTIES
3/12/2004 15:24

Imperial System

Section	Type	Axx (in^2)	Iyy (in^4)	Syy (in^3)	ryy (in)	Izz (in^4)	Szz (in^3)	rzz (in)	Weight (plf)
50/52/2.5	Al Mg Si 1 - F28	0.77	0.42	0.41	0.74	0.41	0.42	0.73	0.909
80/80/2.75	Al Mg Si 1 - F28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
140/100/3	Al Mg Si 1 - F31	2.65	11.51	4.18	2.08	6.20	3.15	1.53	3.116
146/120/3.5	Al Mg Si 1 - F31	3.38	16.43	5.72	2.21	11.41	4.83	1.84	3.969
200/120/4.5	Al Mg Si 1 - F31	5.10	44.54	11.31	2.96	18.19	7.70	1.89	5.994
300/120/5.5/4.5	Al Mg Si 1 - F31	7.47	137.90	23.31	4.29	28.59	12.08	1.96	8.786
283/104	Al Mg Si 1 - F31	9.20	142.59	25.69	3.94	22.51	11.00	1.56	10.818

Section	Type	Axx (in^2)	Iyy (in^4)	Syy (in^3)	ryy (in)	Izz (in^4)	Szz (in^3)	rzz (in)	Weight (plf)
110/70/4	St 52	2.13	5.48	2.53	1.60	2.69	1.95	1.12	7.257

General Notes:
1. Weights are based on the following densities:
   a. Aluminum: 169.34 pcf (or 26611.83 N/m^3)
   b. Steel: 490.00 pcf (or 77003.63 N/m^3)
2. Refer to the tabulation of cross sectional properties for the corresponding areas.

FTL DESIGN ENGINEERING STUDIO

PROJECT	PROJECT #	DESCRIPTION	PAGE#
30 M MAXFLEX (7-98)	23087	FIG 3-1a - SECTION PROPERTIES (METRIC SYSTEM)	10
AUTHOR A.B	DATE		CHECKED BY

SECTION PROPERTIES
3/12/2004 15:23

Metric System

Section	Type	Axx (cm^2)	Iyy (cm^4)	Syy (cm^3)	ryy (cm)	Izz (cm^4)	Szz (cm^3)	rzz (cm)	Weight (kN/m)
50/52/2.5	Al Mg Si 1 - F28	4.99	17.59	6.76	1.88	17.18	6.87	1.86	0.013
80/80/2.75	Al Mg Si 1 - F28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000
140/100/3	Al Mg Si 1 - F31	17.10	479.16	68.45	5.29	258.25	51.65	3.89	0.045
146/120/3.5	Al Mg Si 1 - F31	21.78	683.97	93.69	5.60	475.07	79.18	4.67	0.058
200/120/4.5	Al Mg Si 1 - F31	32.88	1853.87	185.39	7.51	757.02	126.17	4.80	0.088
300/120/5.5/4.5	Al Mg Si 1 - F31	48.20	5740.00	382.00	10.90	1190.00	198.00	4.97	0.128
283/104	Al Mg Si 1 - F31	59.35	5935.00	420.92	10.00	937.00	180.19	3.97	0.158

Section	Type	Axx (cm^2)	Iyy (cm^4)	Syy (cm^3)	ryy (cm)	Izz (cm^4)	Szz (cm^3)	rzz (cm)	Weight (kN/m)
110/70/4	St 52	13.76	228.13	41.48	4.07	111.84	31.95	2.85	0.106

General Notes:
1. Weights are based on the following densities:
   a. Aluminum: 169.34 pcf (or 26611.83 N/m^3)
   b. Steel: 490.00 pcf (or 77003.63 N/m^3)
2. Refer to the tabulation of cross sectional properties for the corresponding areas.

FTL DESIGN ENGINEERING STUDIO

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PROJECT: 3014 MAXIFLEX (7-98) | PROJECT #: 23081 | DESCRIPTION: FIG 4-2 DEAD & LIVE LOADS | PAGE # 15

AUTHOR: 4.10 | DATE: | CHECKED BY:

EAD LOADS									
iform Load Distribution on the Inclined Main Members									
Weight of the Main Member	7.92 plf								
Weight of the Purlins and Beams			0.91 plf	*	16.40 ft	*	4.00 pcs	=	59.62 lbs
			3.12 plf	*	16.40 ft	*	1.00 pc	=	51.12 lbs
	2.13 plf	=	110.74 lbs	/	49.51 ft	*	0.95		
Weight of the Roof Fabric	3.42 plf	=	0.21 psf	*	16.40 ft				
Weight of Minor Components, Cables, Bolts, etc.	3.50 plf								
Total	16.97 plf								
oint Load on the Ridge									
Weight of the Ridge Beam	51.12 lbs	=	3.12 plf	*	16.40 ft				
Total	51.12 lbs								
oint Load on the Eaves									
Weight of the Eaves Beam	51.12 lbs	=	3.12 plf	*	16.40 ft				
Weight of the Wall Fabric	42.61 lbs	=	0.21 psf	*	16.40 ft	*	12.47 ft		
Total	93.72 lbs								
IVE LOAD									
Uniform Load Distribution on the Inclined Main Members									
Weight of Snow	0.00 plf								
Point Loads on the Inclined Main Members									
Weight of the Fixtures									
Left Rafter Midlength	250.00 lbs								
Ridge	500.00 lbs								
Right Rafter Midlength	250.00 lbs								
Total	1000.00 lbs								

PROJECT	PROJECT #	DESCRIPTION	PAGE#
30M MAXIFLEX (7-98)	23087	TABLE 4-1 ASCE 7-98 WIND LOADS	15
AUTHOR A.D	DATE		CHECKED BY

WIND LOADS (ASCE 7-98 / IBC 2000)

Mean Structure Height, h 20.51 ft
Tributary Width, b 16.40 ft

Wind Pressure Equation from ANSI/ASCE 7-93
$q = 0.00256 (G_f K_z K_{zt} K_d I) (I_r V)^2$
where V, the wind velocities are:

V1 =	85.00 mph
V2 =	90.00 mph
V3 =	95.00 mph
V4 =	100.00 mph

I Factor	1.0			h/L	0.31	
K_{zt}	1.0					
G_f factor	0.85					
K_d	0.85					
K_z factor	h=z 21.0	Exp A 0.88	Exp B 0.70	Exp C 0.91	Exp D 1.10	

EQUATION CONSTANTS

Exposure	q	Ir	Kz
Class A	0.00125773 (Ir V)2	0.78	0.60
Class B	0.00126472 (Ir V)2	0.78	0.70
Class C	0.00168314 (Ir V)2	0.78	0.91
Class D	0.00203466 (Ir V)2	0.78	1.10

WIND PRESSURES, q (psf)

Exposure	85 mph	90 mph	95 mph	100 mph
Class A	5.53	6.20	6.91	7.65
Class B	5.80	6.36	7.11	7.88
Class C	7.40	8.29	9.24	10.24
Class D	8.94	10.03	11.17	12.38

DISTRIBUTED WIND LOADS, P (plf)

Exposure	85 mph	90 mph	95 mph	100 mph
Class A	90.69	101.68	113.29	125.53
Class B	95.38	104.07	116.62	129.22
Class C	121.37	136.07	151.60	167.80
Class D	146.71	164.47	[illegible]	203.06

LOAD CASES (C-90 EXPOSURE)

			Windward Wall		Windward Roof		Leeward Roof		Leeward Wall	
Case	q (psf)	P (plf)	w = Cpww x P	Cpww	w = Cpwr x P	Cpwr	w = Cplr x P	Cplr	w = Cplw x P	Cplw
WSUCTION	8.29	136.07	108.85	0.80	-51.70	-0.38	-76.20	-0.56	-68.03	-0.50
WPRESSURE	8.29	136.07	108.85	0.80	18.33	0.13	-76.20	-0.56	-68.03	-0.50
WPARALLEL	8.29	136.07	-95.25	-0.70	-95.25	-0.70	-95.25	-0.70	-95.25	-0.70

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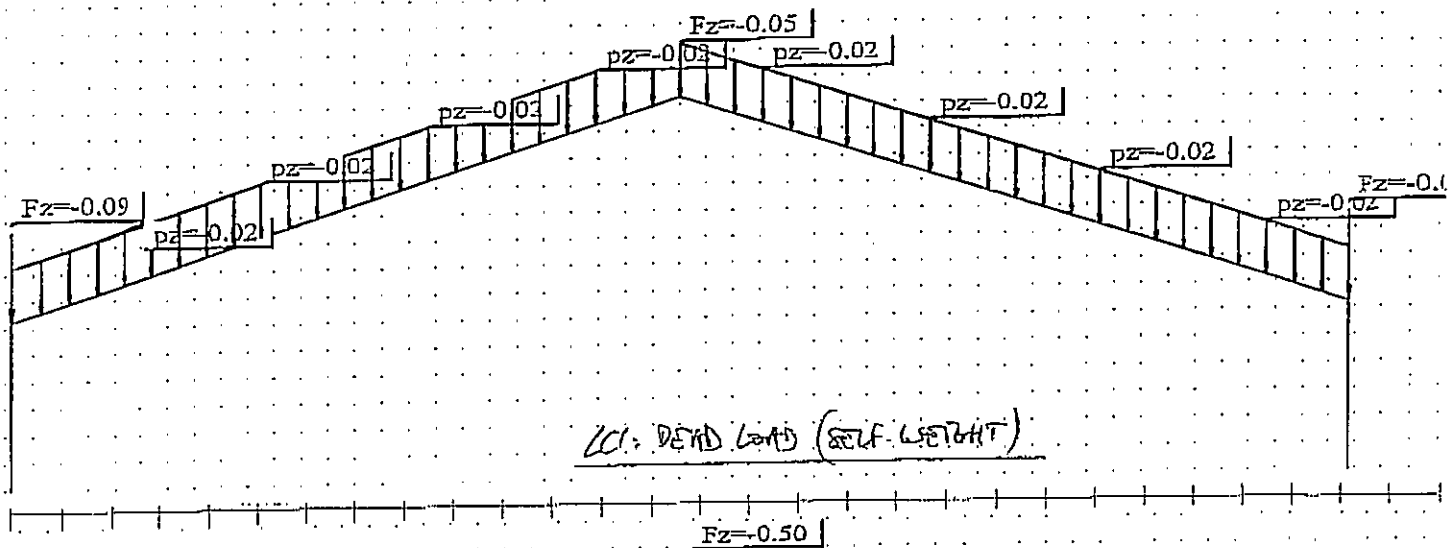
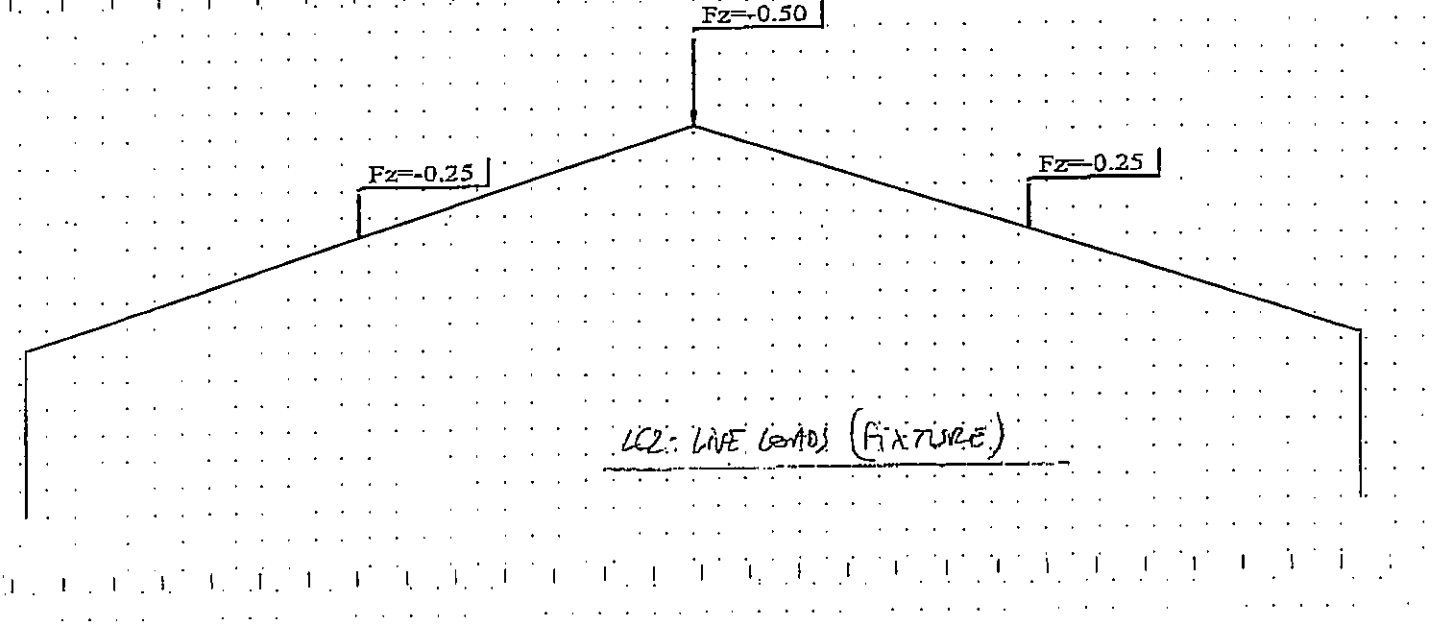
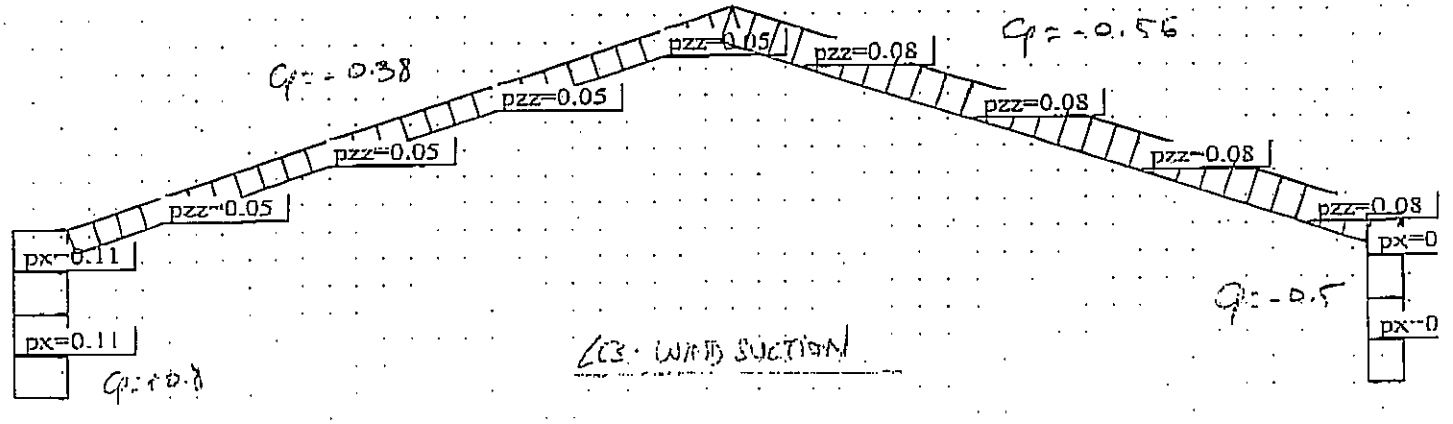
PROJECT	PROJECT #	DESCRIPTION	PAGE#
30 M MAGNIFLEX (7-98)	2308	LOAD CASES	17
AUTHOR	DATE		CHECKED BY
A.D			







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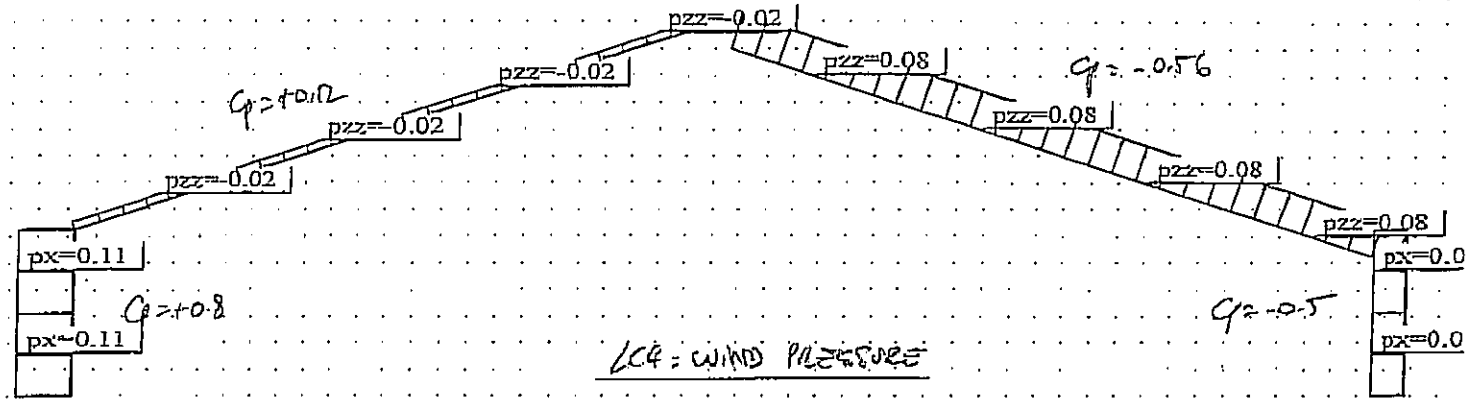
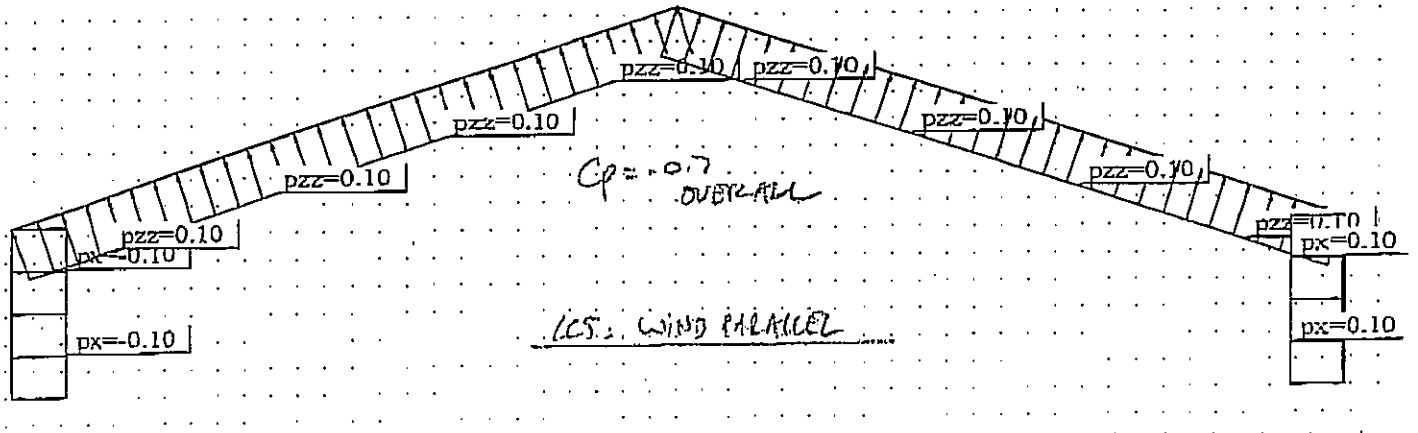
PROJECT	PROJECT #	DESCRIPTION	PAGE #
20M MAXIFLEX (7.98)	2351	LOAD CASES	18
AUTHOR	DATE		CHECKED BY
AJD			



LC4 = WIND PRESSURE



LC5 = WIND PARALLEL

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PROJECT	PROJECT #	DESCRIPTION	PAGE# 19
AUTHOR	DATE	LOAD CASE & COMBINATION SUMMARY.	CHECKED BY

LOAD CASE SUMMARY

Case No.	Description
1	Dead Loads
2	Live Loads
3	Wind Load Perpendicular to the Ridge Suction on the Windward Side of the Roof
4	Wind Load Perpendicular to the Ridge Positive Pressure on the Windward Side of the Roof
5	Wind Load Parallel to the Ridge Suction on All Sides

LOAD COMBINATION SUMMARY

Case No.	Description
6	DL
7	DL + LL
8	DL + LL + WSUCTION
9	DL + LL + WPRESSURE
10	DL + LL + WPARALLEL
11	DL + WSUCTION
12	DL + WPRESSURE
13	DL + WPARALLEL

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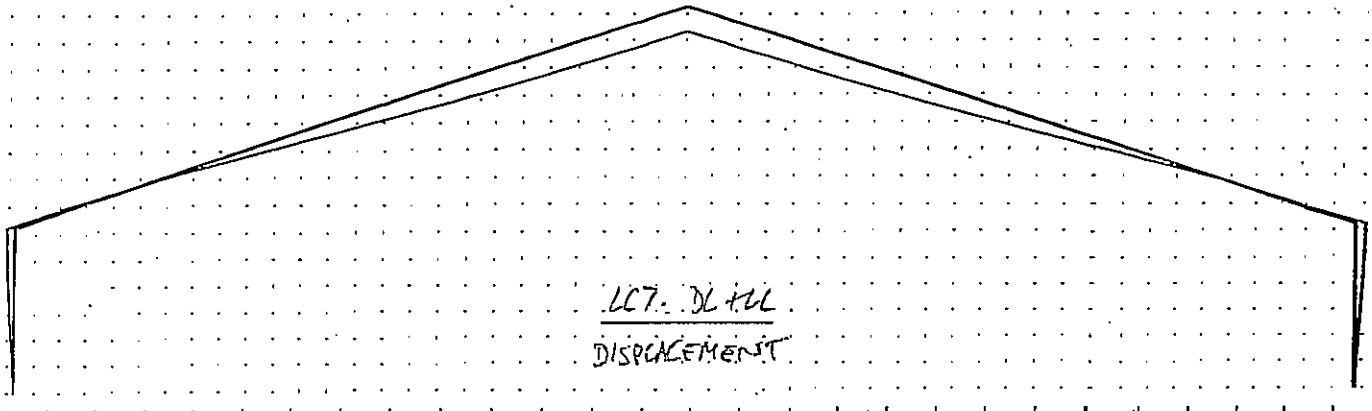
PROJECT	PROJECT #	DESCRIPTION	PAGE# 25
AUTHOR	DATE	LC7: DL+LL	CHECKED BY



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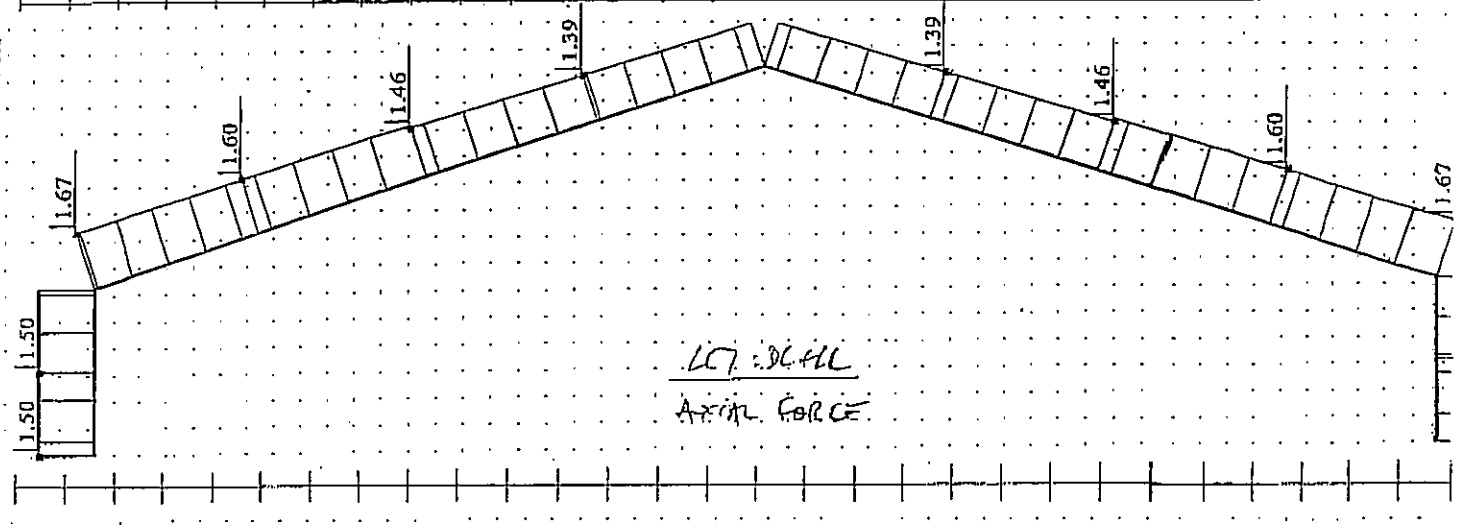
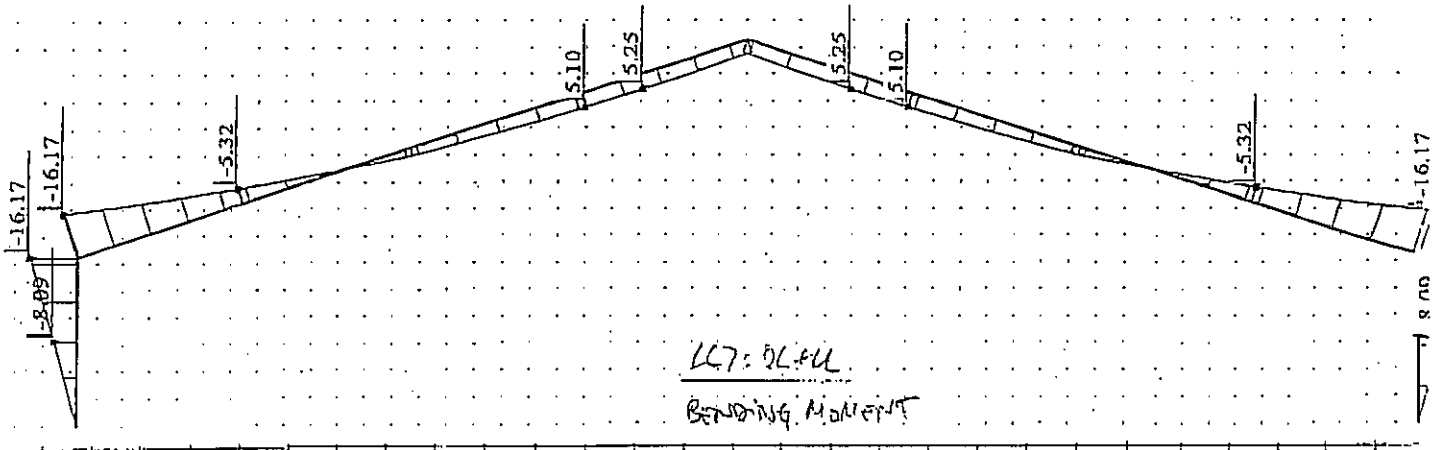
DISPLACEMENT



LC7: DL+LL
AXIAL FORCE



LC7: DL+LL
BENDING MOMENT

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PROJECT	PROJECT # 23087	DESCRIPTION LC9 : DL+LL+WPRESS	PAGE 27
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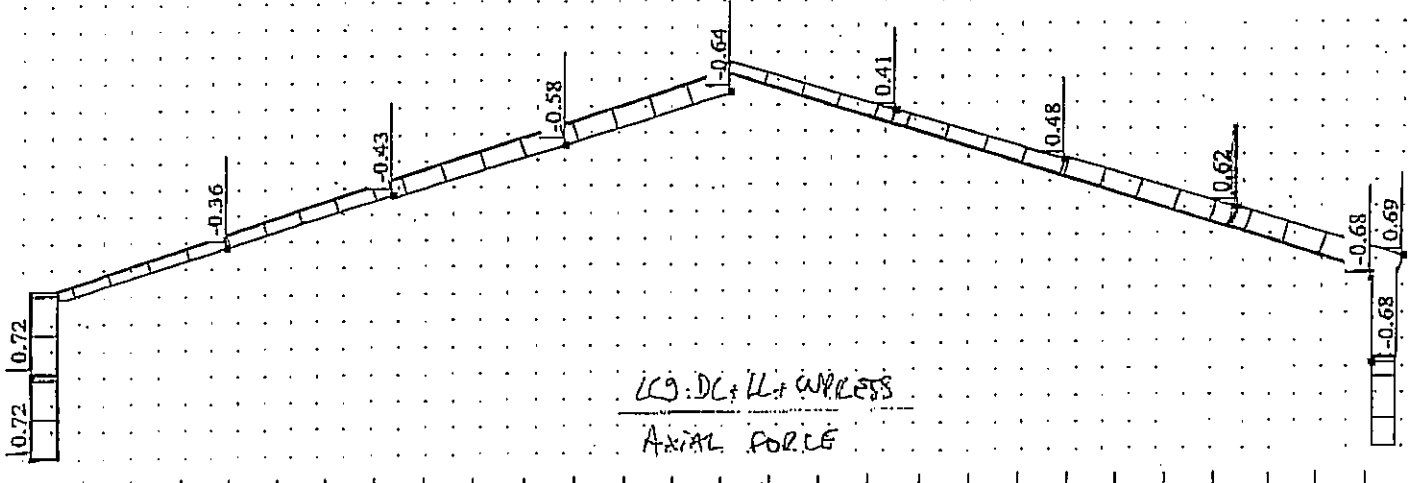
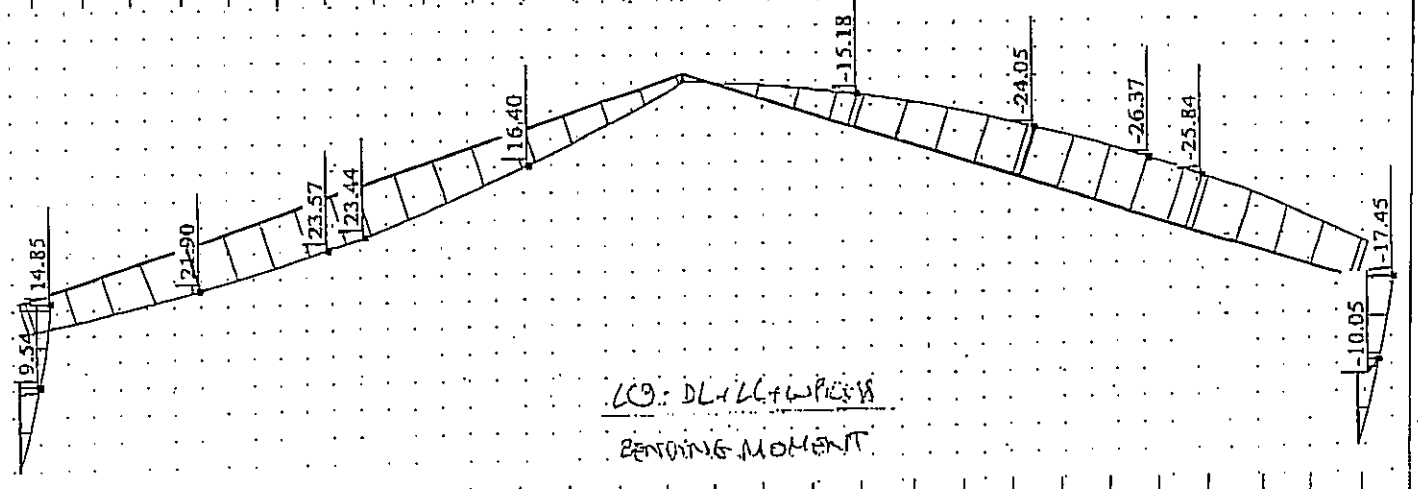
LC9 : DL+LL+WPRESS
DISPLACEMENT



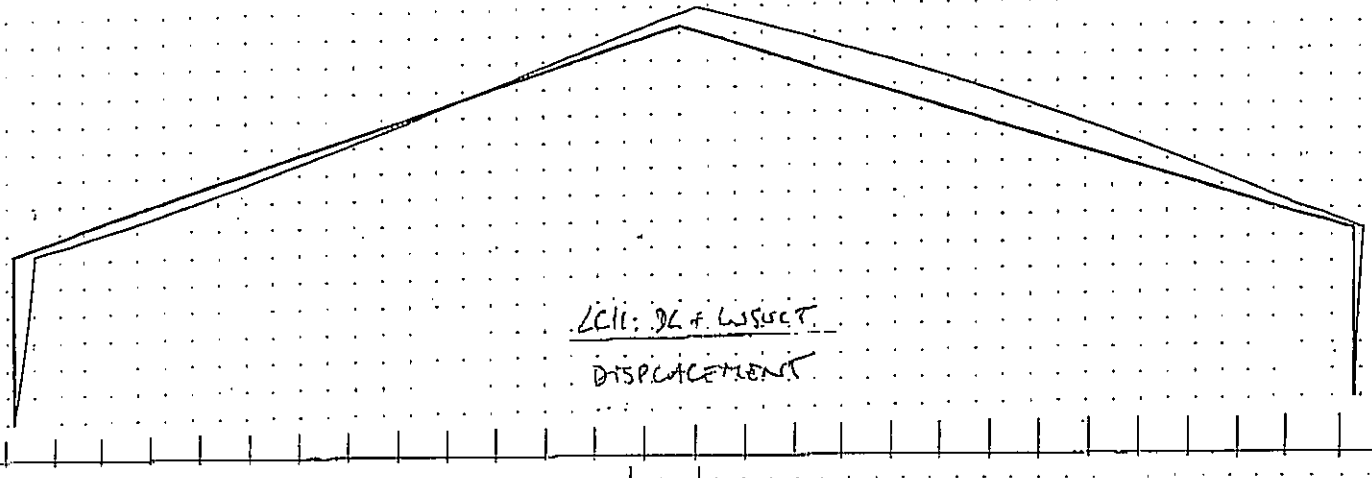
LC9 : DL+LL+WPRESS
AXIAL FORCE



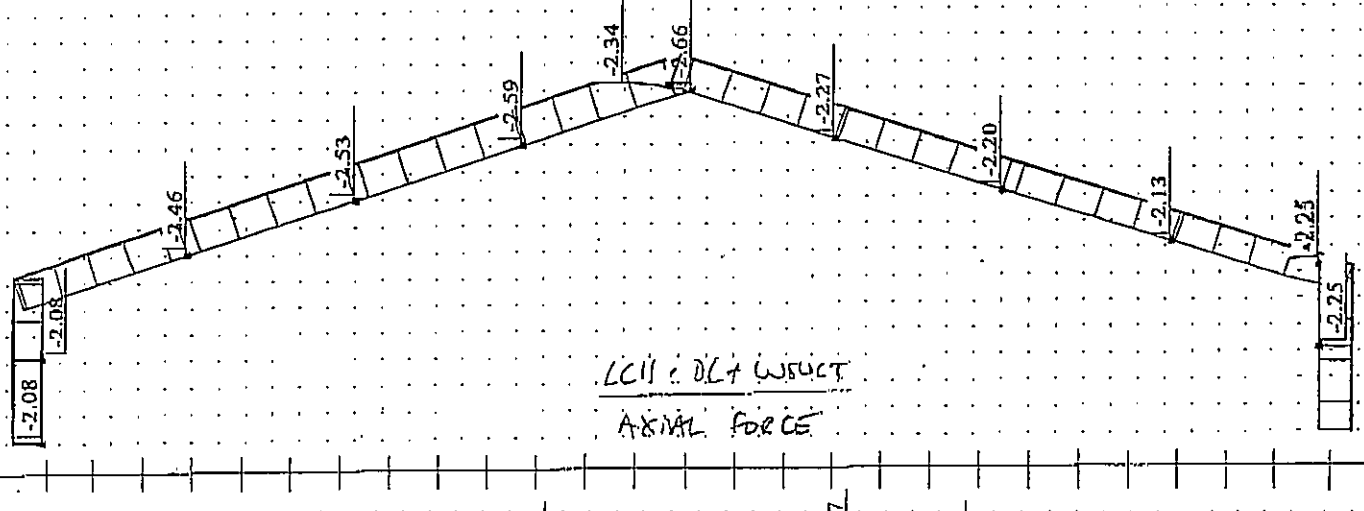
LC9 : DL+LL+WPRESS
BENDING MOMENT

FTL DESIGN ENGINEERING STUDIO

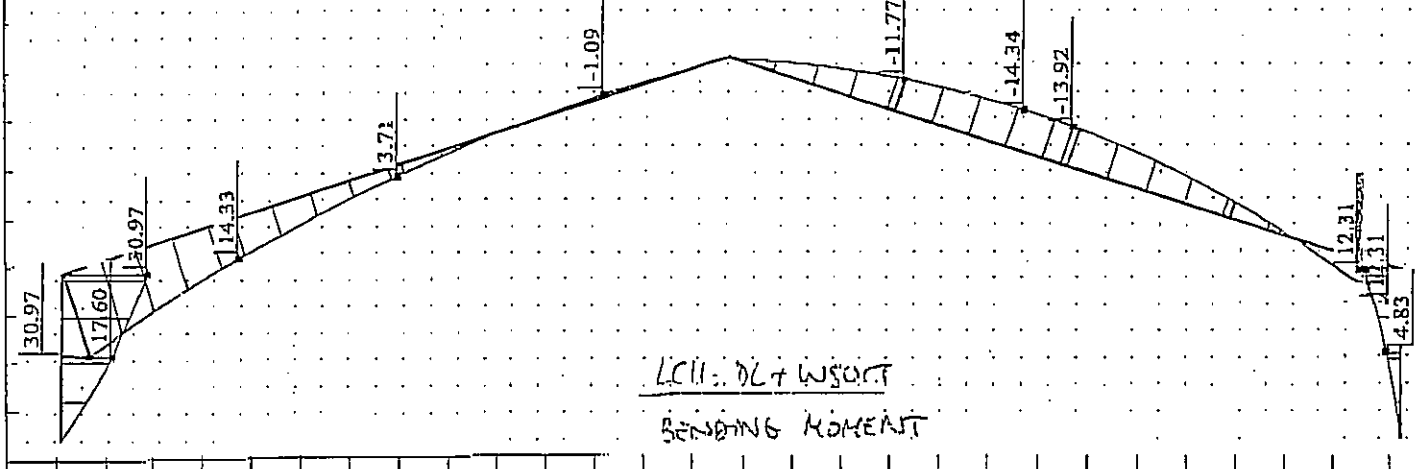
PROJECT	PROJECT #	DESCRIPTION	PAGE# 29
AUTHOR	DATE	LC11 : DL + WSUCTION	CHECKED BY



LC11 : DL + WSUCT.
DISPLACEMENT



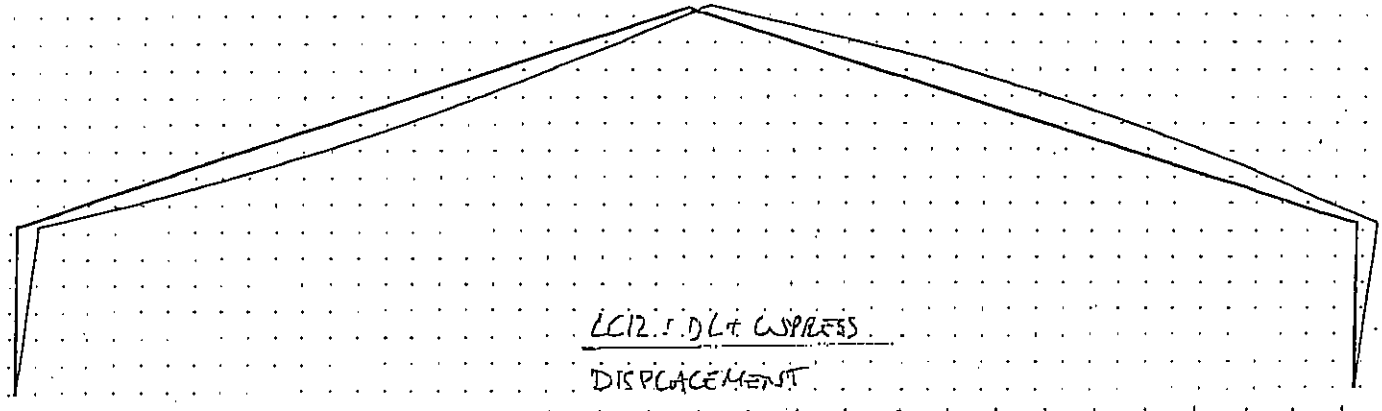
LC11 : DL + WSUCT
AXIAL FORCE



LC11 : DL + WSUCT
BENDING MOMENT

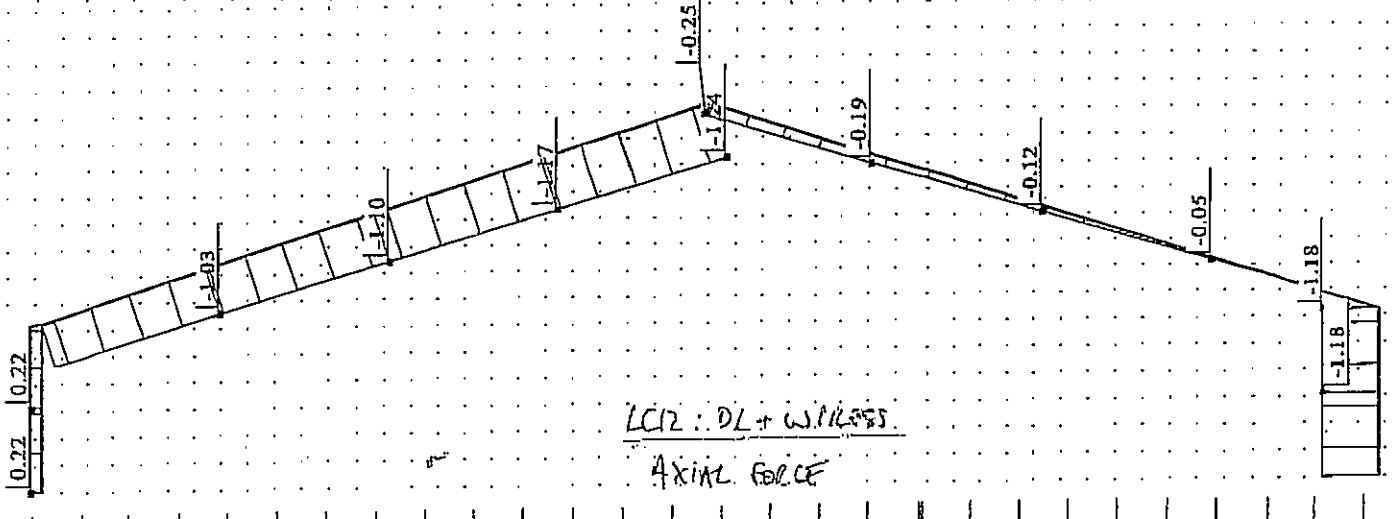
FTL DESIGN ENGINEERING STUDIO

PROJECT	PROJECT #	DESCRIPTION	PAGE# 30
AUTHOR	DATE	LC12: DL+WPRESSURE.	CHECKED BY



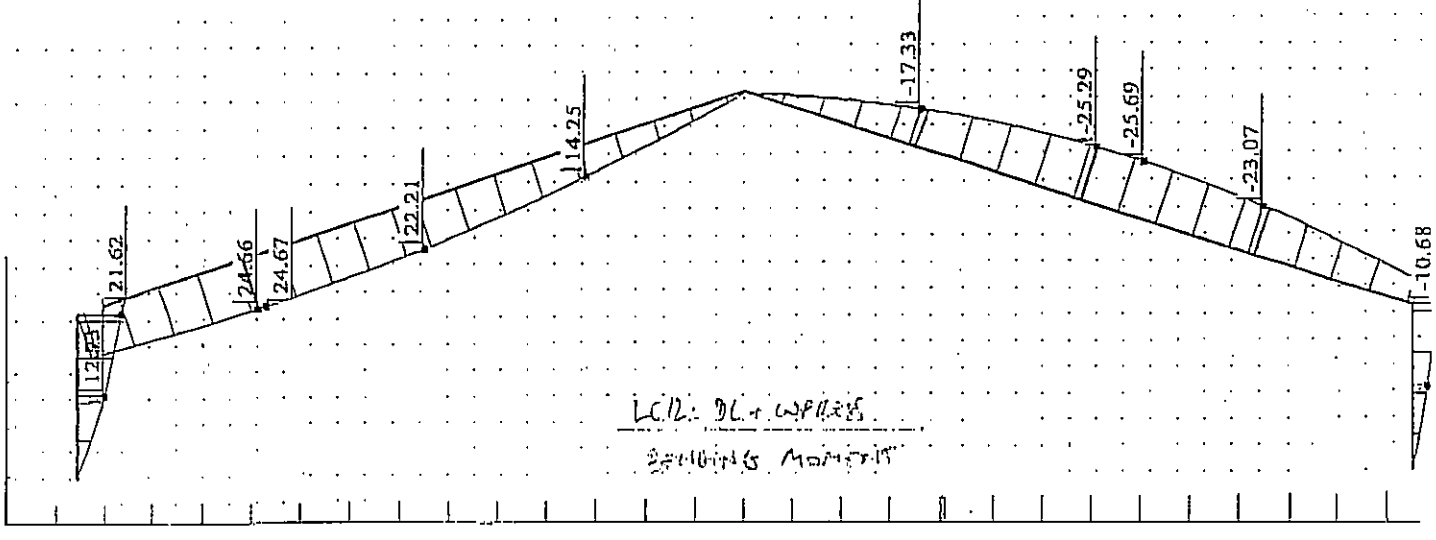
LC12 : DL + WPRESS

DISPLACEMENT



LC12 : DL + WPRESS

AXIAL FORCE



LC12 : DL + WPRESS

BENDING MOMENT

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30M MAXIFLEX (7-98)	23081	LC13: DL+WPARALLEL	31
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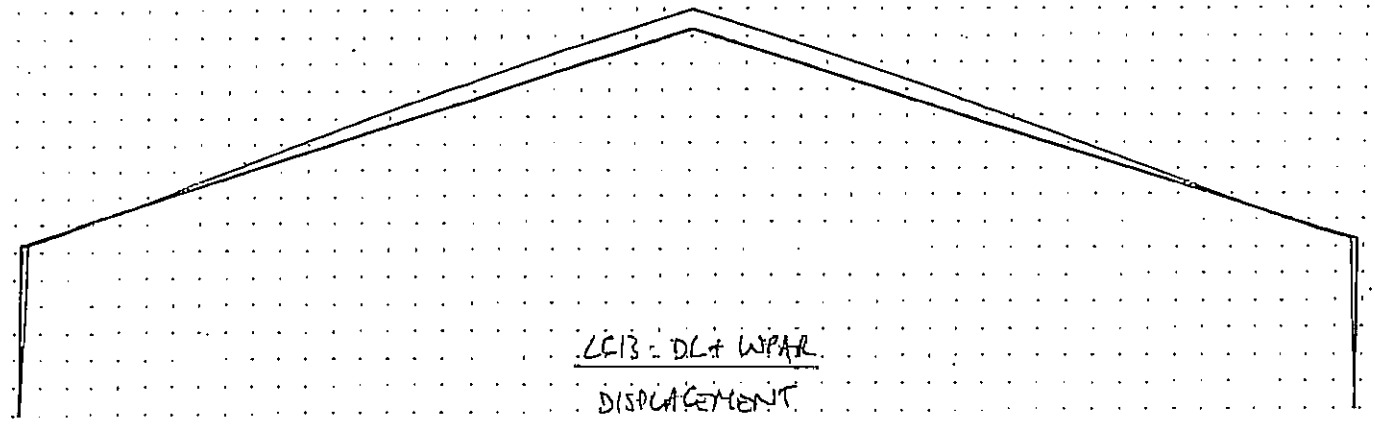
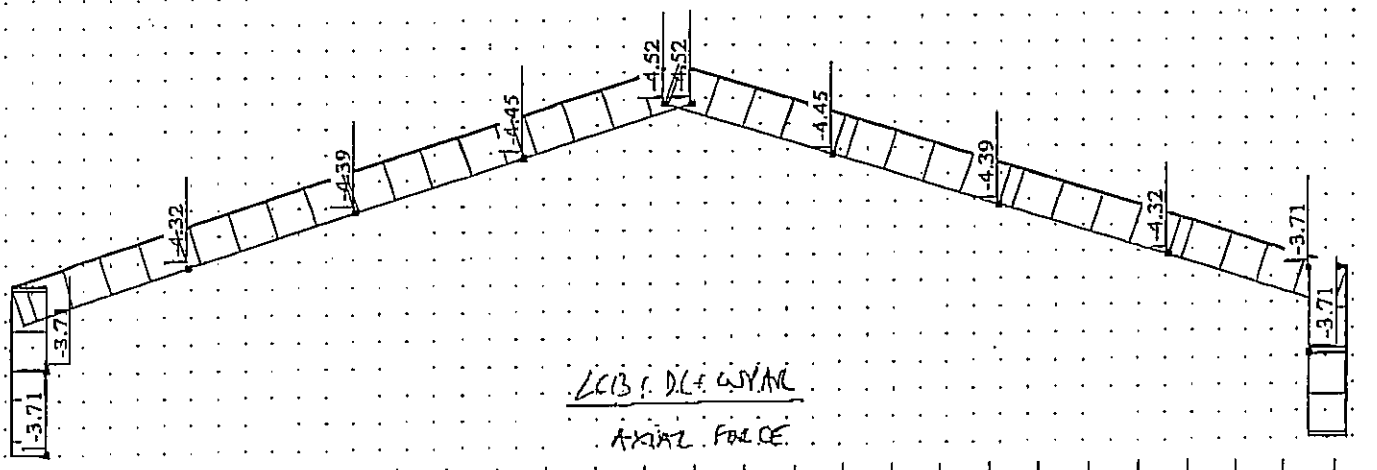
A.M			



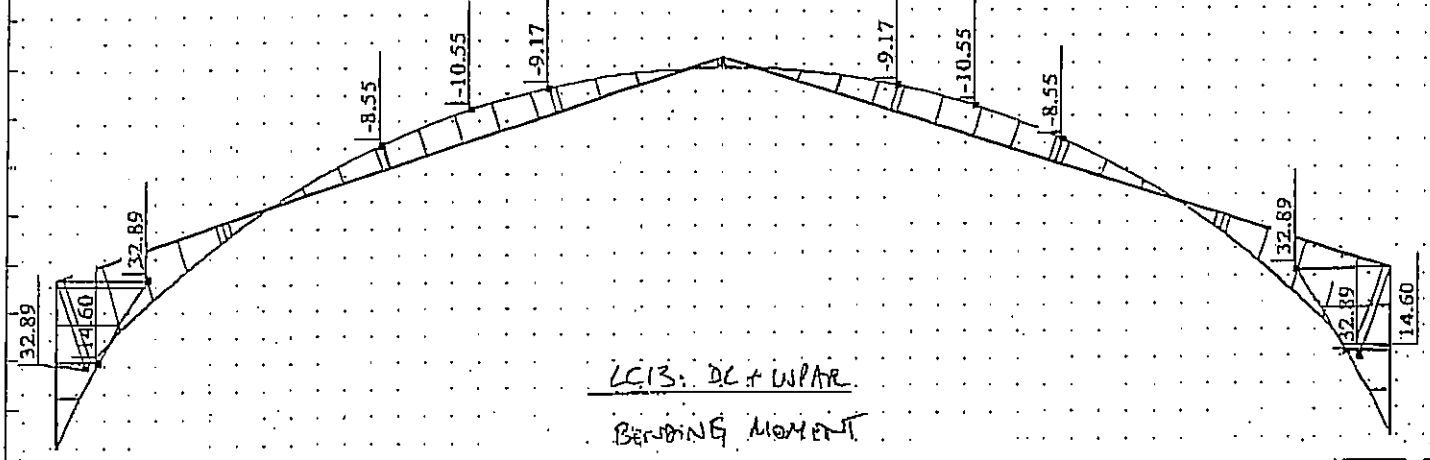
LC13 : DL + WPAR.

DISPLACEMENT



LC13 : DL + WPAR.

AXIAL FORCE



LC13: DL + WPAR.

BENDING MOMENT

30 M LOSBERGER FRAME TENT
15-Mar-04

RAFTER LOADS

Load Combination (#)	C (K)	T (K)	M (Kft)	Nature	Segment	Length (ft)	Unity Check (%)
6	-1.000		9.400	End Moment	Eave	52.056	
7	-1.670		16.170	End Moment	Eave	52.056	46
8		1.790	-24.200	End Moment	Eave	52.056	
9		0.480	23.570	Center Moment and Tension	Middle	52.056	
	-0.480		26.370	Center Moment and Compression	Middle	52.056	64
10		3.650	-26.120	End Moment	Eave	52.056	
11		2.460	-30.970	End Moment	Eave	52.056	
12		0.120	25.690	Center Moment and Tension	Middle	52.056	
		1.030	24.670	Center Moment and Tension	Middle	52.056	
13		4.320	32.890	End Moment	Eave	52.056	77

PROJECT
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PROJECT #
DESCRIPTION
ASCE 7-98; RAFTER Loads
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PAGE: 32

FTL DESIGN ENGINEERING STUDIO

FAX 3019826003

LOSBERGER 60

444 LOSBERGER

30 M LOSBERGER FRAME TENT
15-Mar-04

COLUMN LOADS

Load Combination (#)	C (K)	T (K)	M (Kft)	Nature	Segment	Length (ft)	Unity Check (%)
6	-1.000		9.400	End Moment	Eave	12.467	
7	-1.500		16.170	End Moment	Eave	12.467	39
8		1.580	-24.200	End Moment	Eave	12.467	
9	-0.720		-14.850	End Moment	Eave	12.467	
		0.680	17.450	End Moment	Eave	12.467	
10		3.210	-26.120	End Moment	Eave	12.467	
11		2.080	30.970	End Moment	Eave	12.467	
12	-0.220		-21.620	End Moment	Eave	12.467	49
13		3.710	32.890	End Moment	Eave	12.467	76

FTL DESIGN ENGINEERING STUDIO

PROJECT
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ASCE 7-98: COLUMN Loads
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FTL DESIGN ENGINEERING STUDIO

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30M MAXIFLEX (7.98)	23081	ASCE 7-98 : BASE REACTIONS	34
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A.D.			

30 M LOSBERGER FRAME TENT
15-Mar-04

MAXIMUM BASE REACTIONS

Criteria	ANSI/ASCE 7-93 Load Combination	Fx (K)	Fy (K)
Maximum Vertical Download	LC # 7: DL + LL		1.500
Maximum Vertical Uplift	LC # 13: DL + WPARALLEL		-3.710
Maximum Horizontal Shear	LC # 11: DL + WSUCTION	-3.160	