FINITE ELEMENT MODELLING OF A BUILDING FRAME

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DEPARTMENT:

UNIVERSITY:

FINITE ELEMENT MODELLING OF A BUILDING FRAME

BATCH

By

NAME SEAT NO:

DEPARTMENT :

UNIVERSITY:

CERTIFICATE

This is to certify that the following students of batch 2011-2012 have successfully completed the final year project in partial fulfillment of requirements for a Masters Degree in ____from________________.

PROJECT SUPERVISOR

____________________________ ____________________________

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NOTATIONS

ACI	American Concrete Institute
C_a	Seismic coefficient
C_t	Numerical coefficient
C_v	Seismic coefficient
C_r	Centre of rigidity
C_m	Centre of mass
D	Dead load
E	Earthquake load
E_c	Modulus of elasticity of concrete
E_s	Modulus of elasticity of steel
f_c’	Compressive strength of concrete
FEM	Finite element method
f_y	Tensile strength of steel
h_n	Height of the building from the base
I	Importance Factor of Building
IMRF	Intermediate Moment Resisting Frame
Kips	Kilo pounds
MDM	Matrix Displacement Method
L	Live load
Pcf	Pounds per cubic foot
Psf	Pounds per square foot
Psi	Pounds per square inch
R	Ductility and over strength factor
T	Fundamental period of structure
UBC-9	Uniform Building Code, 1997
V	Design Base Shear
W	Service dead load+25% of service live load
Z	Seismic Zone Factor

ACKNOWLEDGEMENT

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We also express our deep gratitude to our parents and friends for their help and encouragement.

ABSTRACT

In this project, an eight storey ductile space frame is selected. It is analyzed by Matrix Displacement Method (MDM) and Portal Frame Method for gravity and seismic analysis respectively, as defined in the books of Structural Analysis as well as used by Professional Engineers.

In the later part of the project, the same frame is analyzed by using Finite Element Method (FEM).

At the end, the results of the two methods are compared. Conclusion is;
"Selected building frame have been found balanced in respect of end moments and forces by using all the methods used individually. However difference is found, in comparison; this may be because MDM and Portal Frame Method does not consider variation of displacement/deflection along length of a member whereas FEM incorporates all possible deformations at every section of the member as well as at each joint of the frame."

Reader of this project can understand the philosophy, technique and usage of each method as well as the possible differences that can appear in the results of classical methods when compared with the finite element method.

DEDICATION

The project is dedicated to our parents and our supervisor for helping us out during the completion of the entire project.

CHAPTER NO. 1

INTRODUCTION

1.1 GENERAL

Classical methods of structural analysis involves solution of simultaneous equations which is always a tedious and difficult task; matrix operation helps in making ease in solution of equations; things have extended in last four decades and Finite Element Method have evolved, somewhat extension of Matrix Method of Structural Analysis.

CK Wang described a Matrix Method of Analysis in his book “Intermediate Structural Analysis” [1].

Daryl L. Logan described Finite Element Method in his book “A First Course of Finite Element Method”. [2]

Both these books are widely in use of engineering students as well as professional structure Engineers.

In this project an effort has been made to see the difference in the analysis made by Matrix Method and that of Finite Element Method (Described by CK Wang and Logan respectively).

A model building frame is selected and analyzed by using both methods; single line diagram of frame is considered during analysis. The diaphragm effect of floor slabs are not considered in this project.

1.2 OBJECTIVES

- To analyse a given building frame subjected to Earthquake Loads by Portal Frame Method.
- To analyse a given building frame subjected to Gravity by Matrix Displacement Method.
- To analyse the same frame by using FEM.
- To compare the two results.

1.3 LIMITATIONS

- Reinforced concrete building frame.
- UBC-1997 is used for determination of seismic forces.
- Portal Frame Method is used for frame Analysis subjected to Earthquake lateral forces.

1.4 PROCEDURE

- Portal frame analysis.
- Matrix displacement analysis for gravity loads.
- Superposition of Gravity and Earthquake end Moments.
- Finite Element Analysis.
- Comparison of the calculated values.

CHAPTER NO. 2

BASIC DATA FOR ANALYSIS

2.1 MULTISTORIED BUILDING

Taking into consideration the technique of analysis the multistoried buildings are classified as:

- A high-rise structure whose height ranges between 75 feet (23m) and 491 feet (150m).
- A Skyscraper whose height is greater than 492 feet (150m).

2.2 STRUCTURAL LOADS

The types of loads specified by ACI-318 are given under.

2.2.1 GRAVITY LOADS

2.2.1.1 DEAD LOADS

Dead loads consist of the weight of all materials and fixed equipment incorporated into the building or other structure.

2.2.1.2 LIVE LOAD

Live loads are those loads produced by the use and occupancy of the building or other structure like construction load, or environmental loads such as wind load, snow load, rain load, earthquake load or flood load.

Occupancy Live Loads prescribed by American National Standard Institute (ANSI), is used in this project. **See Table 5, Appendix D.**

2.2.2 LATERAL LOADS

Lateral loads on the super structure of a building frame are generally considered due to the blowing wind and earthquake. In this project lateral earthquake forces are calculated by using UBC-97.

2.3 BUILDING DESCRIPTION

The main features of building are stated below:

a) No. of stories = Ground+8

b) No. of levels below ground = Zero

c) Storey height from ground to 4^{th} floor is 16'-0" and 4^{th} floor to roof is 14'-0"

Plan and elevation attached in Appendix A.

2.3.1 MATERIAL PROPERTIES

f'_c =4000 psi

f_y = 60000 psi

E_c= 57000$\sqrt{f_{c'}}$

E_s=29 x10^6 psi

2.3.2 BUILDING FRAMING SYSTEM

Beam-Column Ductile Building Frame System is used.

2.3.3 DIMENSIONS OF ELEMENTS

Table 2.1: Dimensions of Elements

Slab	Beam	Column	Masonry
6$''$ thick	8$''$x24$''$	18$''$x18$''$	13$'$-6$''$ height
Length and Breadth calculated by Tributary areas		24$'$x24$''$	11$'$-6$''$ height

2.3.4 DEAD LOAD

Fig 2.1 shows integral elements of typical slab section that creates the dead load.

i. SLAB LOAD

Dead Load of Slab include

- Self-Weight
- CC Plaster
- Finishes
- Partition

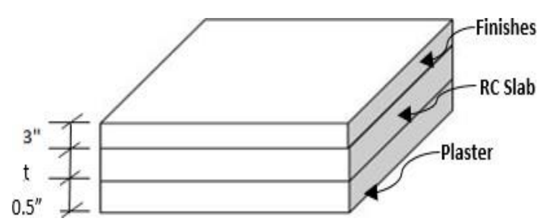


Figure 2.1: Integral Slab Element

Self-Weight Of Slab

Considering the Weight of Slab for 1 Square feet of Area

Volume =$\frac{t}{12} \times \frac{12*12}{144}$ = 0.08333t ft^3 where,

γ_c =150 pcf - t is the thickness of Slab

$W_{\text{self-Weight}} = V \times \gamma_c$

$W_{\text{self-Weight}} = 0.0833t \times 150$

$W_{\text{self-Weight}} = 12.5t\ lb/ft^2$

CC Plaster

Volume = $\frac{0.5}{12} \times \frac{12*12}{144}$ = 0.0416 ft^3

γ_c =145 pcf

$W_{\text{CC Plaster}} = V \times \gamma_c$

$W_{\text{CC Plaster}} = 0.0416 \times 145$

$W_{\text{CC Plaster}} = 6.04\ lb/ft^2$

Finishes

Volume = $\frac{3}{12} \times \frac{12*12}{144}$ = 0.25 ft^3

γ_c =145 pcf

$W_{\text{Finishes}} = V \times \gamma_c$

$W_{\text{Finishes}} = 0.25 \times 145$

$W_{\text{Finishes}} = 36.25\ lb/ft^2$

Partition

From Standard ACI Codes:

$W_{\text{Partitions}} = 30\ lb/ft^2$

Total Weight of Slab

$W_{\text{slab}} = W_{\text{Partitions}} + W_{\text{Finishes}} + W_{\text{CC Plaster}} + W_{\text{self-Weight}}$

W_{slab} =30+36.25+6.04+12.5t

W_{slab} =72.29+12.5t

For t=6$^{//}$

W_{slab} =72.29+12.5(6/12)

$W_{\text{slab}} = 147.29\ lb/ft^2$

ii. BEAM LOAD

Considering the Weight of beam for 1 feet of length,

$$\text{Volume} = 1 \times \frac{8}{12} \times \frac{24}{12} = 1.333\ \text{ft}^3$$

γ_c =150 pcf

$W_{Beam} = V \times \gamma_c$

$W_{Beam} = 1.3333 \times 150$

$W_{Beam} = 200\ lb/ft$

$W_{Beam} = 0.2\ K/ft$

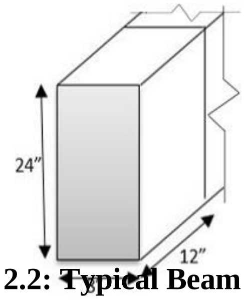


Figure 2.2: Typical Beam Section

iii. COLUMN LOAD

C1

Volume = $h \times \frac{18}{12} \times \frac{18}{12} = 0.444h\ ft^3$

γ_c =150 pcf

$W_{c1} = V \times \gamma_c$

$W_{c1} = 0.444h \times 150$

$W_{c1} = 337.5h$ lb.

$W_{c1} = 0.34h$ Kips

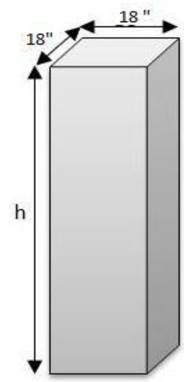


Figure 2.3: Typical Column Section (C1)

C2

Volume = $h \times \frac{24}{12} \times \frac{24}{12} = 4h\ ft^3$

γ_c =150 pcf

$W_{c1} = V \times \gamma_c$

$W_{c1} = 4h \times 150$

$W_{c1} = 600h$ lb.

$W_{c1} = 0.6h$ Kips

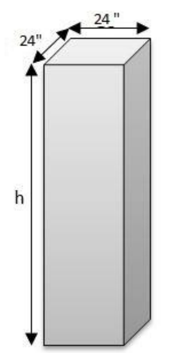


Figure 2.4: Typical Column Section (C2)

iv. MASONARY LOAD

Considering the Weight of Masonry for 1 feet of length,

Volume = $1 \times \frac{6}{12} \times h = 0.5h\ ft^3$

Where,

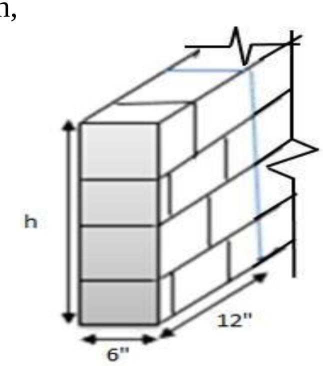
- h is the height of Masonry Wall

γ_c =145 pcf

$W_{Masonry} = V \times \gamma_c$

$W_{Masonry} = 0.5h \times 145$

$W_{Masonry} = 72.5h$



= 0.073h K/ft

Figure 2.5: Typical Masonry Wall

2.3.5 LIVE LOAD

Live load= 70 psf **(Table 5, Appendix D)**

2.3.6 WEIGHT OF BUILDING

Total load of the building is calculated manually consisting of dead and live load as shown in the table below:

Table 2.2: Weight of Building

Total Load For Floor 1				Commulative Load			
D.L		L.L		D.L		L.L	
Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
74.23	89.076	16.45	26.32	557.158	668.473	131.6	210.56
74.23	89.076	16.45	26.32	557.158	668.473	131.6	210.56
46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
74.23	89.076	16.45	26.32	557.158	668.433	131.6	210.56
74.23	89.076	16.45	26.32	557.158	668.433	131.6	210.56
46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
1272.108	1526.5296	290.6	464.96	9563.26	11472.6168	2324.8	3719.48

2.4 SEISMIC DESIGN REQUIREMENTS

Seismic design parameters are taken from UBC-97.

2.4.1 BASE SHEAR

It is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of the structure.

Base Shear can be calculated as, $\mathbf{V} = \frac{\boldsymbol{C_V \times I}}{\boldsymbol{R \times T}} \times \boldsymbol{W}$ **(Eq. 2.1)**

2.4.1.1 BASE SHEAR CALCULATION

Summary of the base shear calculation is shown under.

Table 2.3: Base Shear Calculation

Seismic Zone	**2B**	**-**	**-**
Soil Profile	**S_c**	**-**	**-**
Seismic Zone Factor	**Z**	**0.2**	**UBC1997,Table 16-I**
Seismic importance factor	**I**	**1**	**UBC1997,Table 16-K**
Structural system factor (Moment Resisting Concrete Frame)	**R**	**8.5**	**UBC1997,Table 16-N**
Seismic Coefficient	**C_v**	**0.32**	**UBC1997,Table 16-R**
Seismic coefficient for time period	**C_t**	**0.03**	**For Concrete moment Frames**
Height of Building in ft.	**h_n**	**120**	**-**
Building Period in Seconds	**$T=C_t x h_n^{3/4}$**	**1.088**	**Eq. 2.7**
Weight of building in Kips	**W**	**10108.4**	**-**
Base Shear in Kips	**$V=(C_v I/RT)xW$**	**353.794**	**UBC (Eq.30.4)**

Note: All the tables of UBC-1997 are attached in appendix D.

2.4.2 STOREY FORCES

Static Base Shear Force is distributed along the height of building at each story level using the relation given under.

$$F_x = \frac{(V-F_t)(W_x \times h_x)}{\sum(W_x \times h_x)}$$ UBC-97, Eq.30-15 **(Eq. 2.3)**

Where,

V = Base shear

F_t = Extra force at the top

W_x = Portion of total weight acting on each floor

h_x = Height of each floor

Table 2.4: Storey force

Storey Level	h_x	w_x	$h_x * w_x$	$\frac{h_x * wx}{\sum hx * wx}$	F_t	$V-F_t$	$\frac{(V-Ft)*hx*w}{\sum hx * wx}$
	(ft)	(kips)	(kft)		Kips	Kpis	Kips
8	120	949.32	113918.4	0.177230072	23.76	331.3	82.76
7	106	1188.18	125947.08	0.195943851	23.76	331.3	64.9154337
6	92	1188.18	109312.56	0.170064475	23.76	331.3	56.34169717
5	78	1188.18	92678.04	0.144185098	23.76	331.3	47.76796065
4	64	1231.12	78791.68	0.122581208	23.76	331.3	40.61067616
3	48	1272.12	61061.76	0.094997648	23.76	331.3	31.47235039
2	32	1272.12	40707.84	0.063331766	23.76	331.3	20.98156693
1	16	1272.12	20353.92	0.031665883	23.76	331.3	10.49078346
∑			642771.28				355.3404685

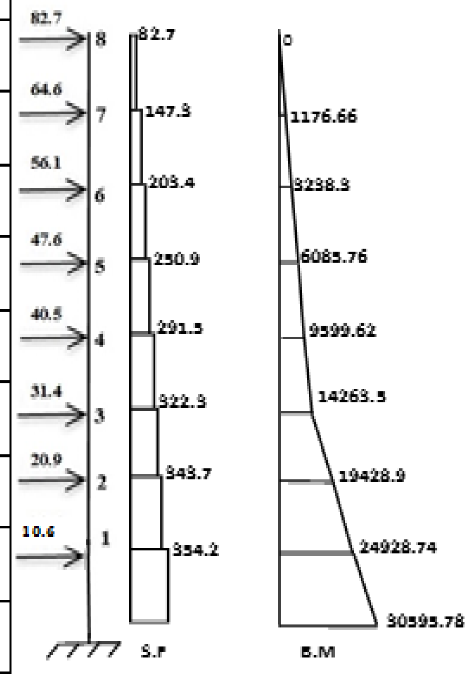


Figure 2.6: SF and BM at Each Storey

2.5 TORSION CHECK

To check whether the building is under action of torsion with respect to the vertical axis of the building frame, the location of centre of mass and centre of rigidity has been calculated; calculation is given under.

2.5.1 CENTRE OF MASS

The point where the entire weight of a body is concentrated such that if the body is supported at this point, it will remain in equilibrium in any position. It is calculated as under,

$$\boldsymbol{COM = \frac{\sum(Moment\ of\ Area)}{\sum Area}} \quad \textbf{(Eq. 2.4)}$$

X_m= 33 ft

Y_m= 30 ft

2.5.2 CENTRE OF RIGIDITY

Resistance of the floor and of the building subjected to external lateral loads is created at the center of rigidity. In other words the total stiffness of the floor as well as of the building concentrates at the Centre of rigidity. It is calculated by the following formula;

$$\boldsymbol{COR} = \frac{\sum(\boldsymbol{Moment\ of\ I})}{\sum(\boldsymbol{I})} \qquad \textbf{(Eq. 2.5)}$$

Where; I is the moment of inertia of columns

X_r= 33 ft

Y_r= 30 ft

The centre of mass coincides with the centre of rigidity.

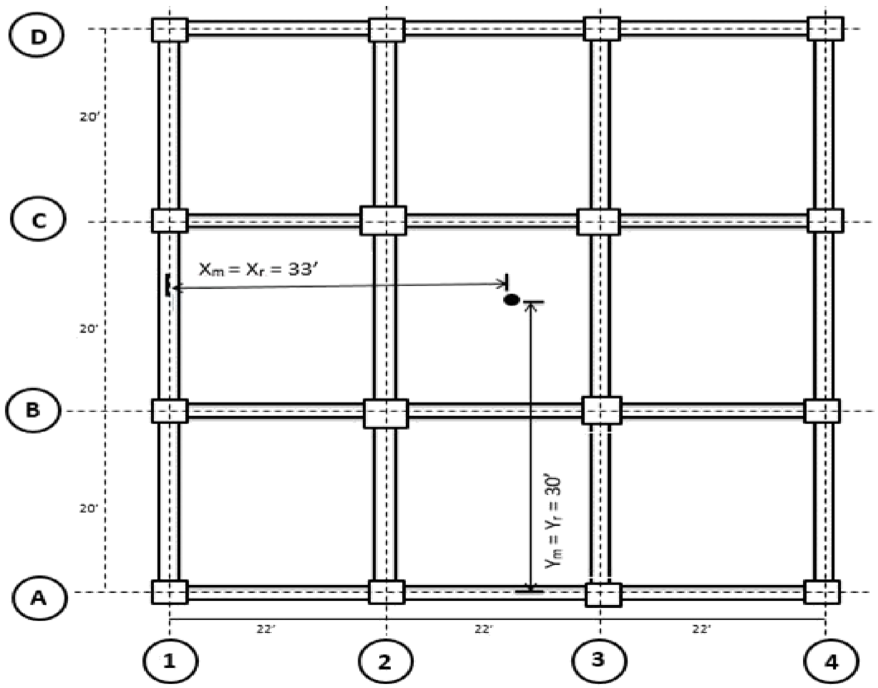


Figure 2.7: Location of Center of Rigidity and Center of Mass

CHAPTER NO. 3

THEORY OF ANALYSIS

The techniques of analysis used in this project for given building frame are;

1) Matrix Displacement Method described by CK Wang in his book, “Intermediate Structural Analysis”.

2) Finite Element Method described by Daryl L. Logan in his book, “A First Course in Finite Element Method”.

3.1 APPROACH OF THE MATRIX DISPLACEMENT METHOD

Matrix Displacement Method can be applied for analysis by any one of the following approaches.

A. FIRST PRINCIPLE APPROACH

1) Displacement matrix, [B]
2) Static matrix, [A]
3) Element stiffness matrix, [S]
4) Global matrix, [K]= [A]×[S]×[B] = [ASB]
5) Inverse of Global matrix, $[K]^{-1}$
6) Load matrix, [P]
7) Fixed end moment matrix, $[F_o]$
8) Joint displacement matrix, $[X]= [K]^{-1} [P]$
9) Force matrix, [F]=[S]×[B]×[X]
10) End forces, $[F^*]=[F]+[F_o]$
11) Member displacement matrix, [e]=[B]×[X]

B. DRECT STIFFNESS APPROACH

1) Local stiffness matrix of an element, [k]
2) Transformation of local matrices to global matrix, [K]
3) Inverse of global matrix, $[K]^{-1}$
4) Fixed end moment matrix, $[F_o]$
5) Load matrix, [P]
6) Joint displacement matrix, $[X]= [K]^{-1} [P]$

7) Member displacement matrix, [e]
8) Element stiffness matrix, [S]
9) Force matrix, [F]=[S]×[e]
10) End forces, [F*]=[F]+[F_o]

Direct stiffness approach is used for analysis in this project

3.1.1 DIRECT STIFFNESS APPROACH

1) LOCAL STIFFNESS MATRIX OF AN ELEMENT

CK Wang Considered a flexural member having four degrees of freedom is shown under.

Figure 3.1: Degree of Freedom of a member

Standard local stiffness matrix for a flexural member is given under.

Figure 3.2: Typical Local Stiffness Matrix for Flexural Member

	θ_1	θ_2	Δ_1	Δ_2
M_1	$4EI/L$	$2EI/L$	$6EI/L^2$	$-6EI/L^2$
M_2	$2EI/L$	$4EI/L$	$6EI/L^2$	$-6EI/L^2$
V_1	$6EI/L^2$	$6EI/L^2$	$12EI/L^3$	$-12EI/L^3$
V_2	$-6EI/L^2$	$-6EI/L^2$	$-12EI/L^3$	$12EI/L^3$

2) TRANSFORMATION TO GLOBAL STIFFNESS MATRIX

The Global stiffness matrix for the whole structure is determined through transformation of local matrices.

3) LOAD MATRIX

Load matrix is obtained by considering the load applied directly to the joint and by converting the span load to joint loads through fixed end moment calculation.

4) FIXED END MOMENT MATRIX

The matrix is developed by determining the fixed end moments at the joints of the members.

5) **MEMBER DISPLACEMENT MATRIX**

The matrix is developed by considering the joint displacement at the ends of each member.

6) **MEMBER STIFFNESS MATRIX**

The stiffness matrix expresses the forces in members and it is a square matrix.

$$S = \frac{EI}{L}$$

Calculation of each step is shown in Appendix C.

3.1.2 CONVENTIONS OF MATRIX DISPLACEMENT METHOD

↻	Considered Positive
↓	Considered Positive
→	Considered Positive
L	Local degree of freedom
G	Global degree of freedom
K	Global stiffness matrix
K	Local stiffness matrix

3.2 FINITE ELEMENT METHOD

The finite element method is a numerical method for solving problems of engineering and mathematical physics. Problems involving complicated geometrics, loadings and material properties, require solution of a series of ordinary or partial differential equations, that need a cumbersome calculations and sometimes solution may not be achieved as desired. Hence there is need to rely on numerical methods, such as the finite element method, for acceptable solutions.

3.2.1 APPROACH OF THE FINITE ELEMENT METHOD

Typically, for the structural stress-analysis problem, determination of end displacements and end forces due to applied loads is the core issue.

There are two general approaches associated with the finite element method. One approach, called the force, or flexibility method, uses internal forces as the unknown of the problem. The second approach, called the displacement, or stiffness method, assumes the displacements of the nodes as the unknowns of the problem. Therefore, the fundamental approach of FEM is to formulate equations of “Compatibility of Deformation” and “Equilibrium of Forces” at ends (nodes) of a structural member.

3.2.1.1 PROCEDURE

Procudure for Analysis through Finite Element Method, defined by Logan, adopted in this project, can be summerised as,

1. Divide the member in to finite elements with predefined interconnected nodes.
2. Global degree of freedom
3. Local degree of freedom
4. Load matrix (with respect to global axis)
5. Element global stiffness matrix. [k]

Element stiffness matrix with respect to global axes is given by following matrix.

Figure 3.3: Typical Element Stiffness Matrix

	$\hat{d}ix$	$\hat{d}iy$	$\hat{\Phi}i$	$\hat{d}jx$	$\hat{d}jx$	$\hat{\Phi}j$
$\hat{d}ix$	$AC^2+\frac{12I}{L^2}S^2$	$\left(A-\frac{12I}{L^2}\right)CS$	$\frac{6I}{L}S$	$-\quad+\frac{12I}{L^2}S^2)$	$-\left(A-\frac{12I}{L^2}\right)CS$	$-\frac{6I}{L}S$
$\hat{d}iy$	$\left(A-\frac{12I}{L^2}\right)CS$	$AS^2+\frac{12I}{L^2}C^2$	$\frac{6I}{L}C$	$-\left(A-\frac{12I}{L^2}\right)CS$	$-\quad+\frac{12I}{L^2}C^2)$	$\frac{6I}{L}C$
$\hat{\Phi}i$	$-\frac{6I}{L}S$	$\frac{6I}{L}C$	$4I$	$\frac{6I}{L}S$	$-\frac{6I}{L}S$	$2I$
$\hat{d}jx$	$-\quad+\frac{12I}{L^2}S^2)$	$-\left(A-\frac{12I}{L^2}\right)CS$	$\frac{6I}{L}S$	$AC^2+\frac{12I}{L^2}S^2$	$\left(A-\frac{12I}{L^2}\right)CS$	$\frac{6I}{L}S$
$\hat{d}jx$	$-\left(A-\frac{12I}{L^2}\right)CS$	$-\quad+\frac{12I}{L^2}C^2)$	$\frac{6I}{L}S$	$\left(A-\frac{12I}{L^2}\right)CS$	$AS^2+\frac{12I}{L^2}C^2$	$-\frac{6I}{L}C$
$\hat{\Phi}j$	$-\frac{6I}{L}S$	$\frac{6I}{L}C$	$2I$	$\frac{6I}{L}S$	$-\frac{6I}{L}C$	$4I$

x E/L

Where;

A= Area of Member I= Moment of Inertia of Member

L= Span length of Member C= CosΘ S= SinΘ

6. Assembly of all defined element to obtain the global or total Stiffness Matrix [K]
7. Force-Displacement Relationship.

Force – displacement relationship is given by following equation

$$F = K . d$$

or

$$d = K^{-1} . F$$

8. Solve for the Displacments

9. Element local stiffness matrix $[\hat{k}]$

Figure 3.4: Typical Element Local Stiffness Matrix

$\hat{d}ix$	$\hat{d}iy$	$\hat{\Phi}i$	$\hat{d}jx$	$\hat{d}jx$	$\hat{\Phi}j$	
C_1	0	0	$-C_1$	0	0	$\hat{d}ix$
0	$12C_2$	$6C_2L$	0	$-12C_2$	$-6C_2L$	$\hat{d}iy$
0	$6C_2L$	$4C_2L^2$	0	$-6C_2L$	$-4C_2L^2$	$\hat{\Phi}i$
$-C_1$	0	0	C_1	0	0	$\hat{d}jx$
0	$-12C_2$	$-6C_2L$	0	$12C_2$	$6C_2L$	$\hat{d}jx$
0	$-6C_2L$	$-4C_2L^2$	0	$6C_2L$	$4C_2L^2$	$\hat{\Phi}j$

Where;

$$C_1 = \frac{AE}{L} \quad ; \quad C_2 = \frac{EI}{L^3}$$

10. Element local forces $[\hat{f}]$

$$\hat{f} = \hat{k} . [T\ d]$$

where;

T= Transformation matrix

Figure 3.5: Transformation Matrix

C	S	0	0	0	0
	C	0	0	0	0
0	0	1	0	0	0
0	0	0	C	S	0
0	0	0		C	0
0	0	0	0	0	1

11. Free Body Diargam.

3.2.2 CONVENTIONS OF FINITE ELEMENT METHOD

 Considered Positive

 Considered Positive

K Global stiffness matrix

^

K Local stiffness matrix

CHAPTER NO. 4
SIMULATION

4.1 GENERAL

Prior to start of work on the given building frame model, two solved examples are selected.

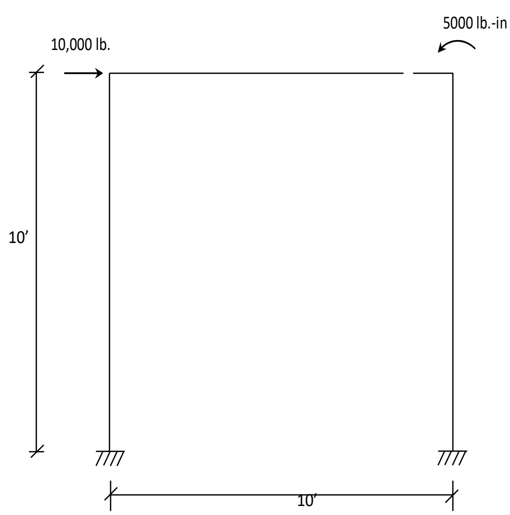
1. An **example 5.1** of the Finite Element Method is taken from the book of Daryl L. Logan and is re-analyzed by Matrix Displacement Method described by CK Wang.
2. An **example 12.3.4** of Matrix Displacement Method is taken from the book of CK Wang and is re-analyzed by Finite Element Method described by Daryl L. Logan.

4.1.1 SINGLE STOREY FRAME SYSTEM

a. Example (5.1), from Daryl L. Logan

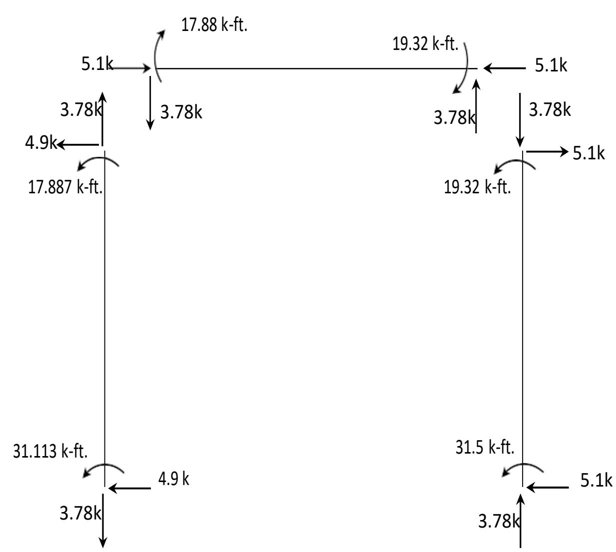
Single Storey frame **Example: 5.1** selected from the book "A First Course in Finite Element Method" by Daryl L. Logan is given under.

Example



RESULTS

End moments and End forces solved in the book.



4.1.1.1 REANALYSIS BY MATRIX DISPLACEMENT METHOD

The above example is solved using Matrix Displacement Method the Steps involved for solution are;

1) **LOCAL STIFFNESS MATRIX**

Element 1

K_1 =

	L1	L2(G1)	L3	L4(G3)
L1	0.8	0.4	0.12	-0.12
L2(G1)	0.4	0.8	0.12	-0.12
L3	0.12	0.12	0.024	-0.024
L4(G3)	-0.12	-0.12	-0.024	0.024

x EI

Element 2

K_2 =

	L1(G1)	L2(G2)	L3	L4
L1(G1)	0.4	0.2	0.06	-0.06
L2(G2)	0.2	0.4	0.06	-0.06
L3	0.06	0.06	0.012	-0.012
L4	-0.06	-0.06	-0.012	0.012

x EI

Element 3

K_3 =

	L1	L2(G2)	L3	L4(G3)
L1	0.8	0.4	0.12	-0.12
L2(G2)	0.4	0.8	0.12	-0.12
L3	0.12	0.12	0.024	-0.024
L4(G3)	-0.12	-0.12	-0.024	0.024

x EI

2) **GLOBAL STIFFNESS MATRIX**

K =

	G1	G2	G3
G1	1.2	0.2	-0.12
G2	0.2	1.2	-0.12
G3	-0.12	-0.12	0.048

x EI

3) INVERSE OF GLOBAL MATRIX [K^{-1}]

K^{-1} =

	G1	G2	G3
G1	1.125	0.125	3.125
G2	0.125	1.125	3.125
G3	3.125	3.125	36.45833

x 1/EI

4) LOAD MATRIX [P]

P =

P_1	0	Kip
P_2	-0.4167	Kft
P_3	10	Kip

5) DEFORMATION MATRIX [B]

[e] = [B][X]

B =

0	0	-0.1
1	0	-0.1
1	0	0
0	1	0
0	1	-0.1
0	0	-0.1

6) JOINT ROTATION [X]

X =

X_1	3.12E+01	Radian
X_2	3.08E+01	Radian
X_3	3.63E+02	Inches

x 1/EI

7) FORCE MATRIX [F*]

F =

F_1	-31.1146
F_2	-18.6354
F_3	18.6354
F_4	18.5521
F_5	-18.9688
F_6	-31.2813

Note: All Values are in K-ft

8) FREE BODY DAIGRAM

The end forces and moments for the frame re-analysed by Matrix displacement method is shown under.

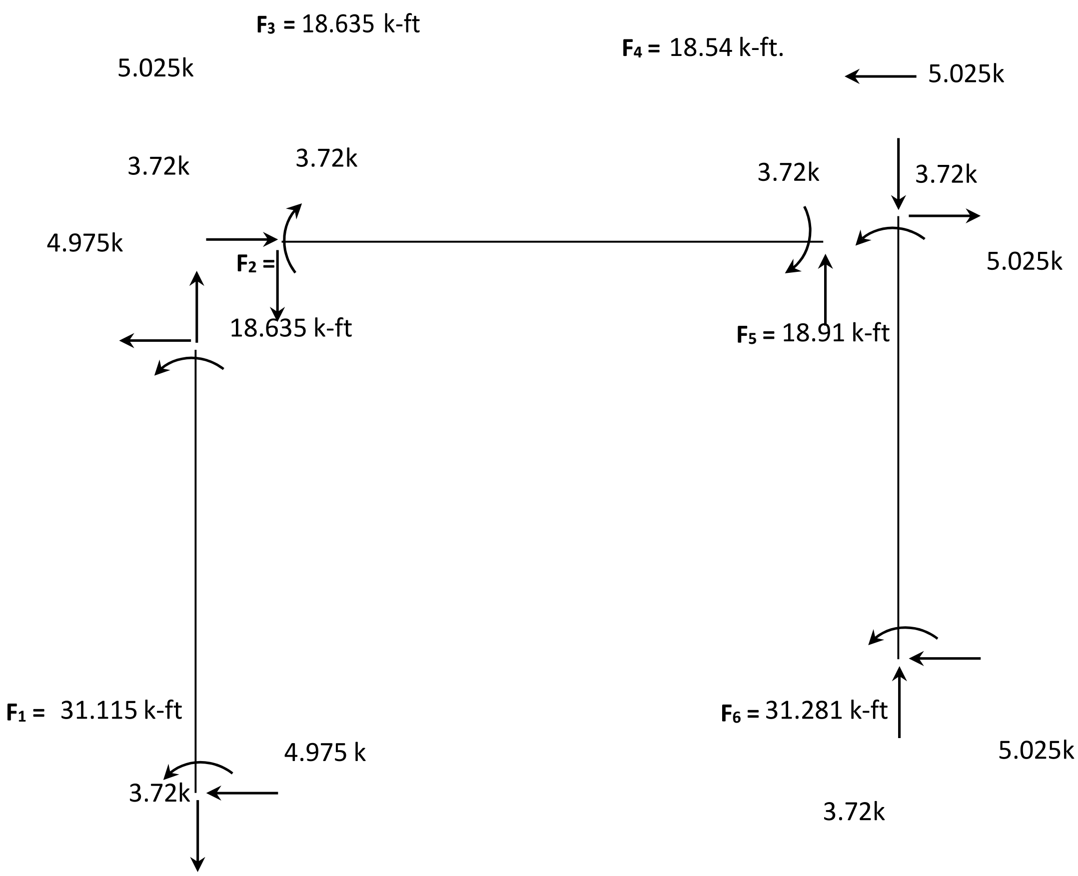


Figure 4.1: Results from Matrix Displacement Method

4.1.1.2 COMPARISON OF RESULTS

Comparision b/w FEM and MDM												
Joints	Fx				Fy				Moment			
	MDM	FEM	Difference	%age accuracy	MDM	FEM	Difference	%age accuracy	MDM	FEM	Difference	%age accuracy
A	-4.95	-4.9	-0.05	98.97959184	-3.72	-3.78	0.06	98.41269841	-31.115	-31.113	-0.002	99.99357182
B_1	4.95	4.9	0.05	98.97959184	3.72	3.78	-0.06	98.41269841	-18.635	-17.887	-0.748	95.81819198
B_2	5.025	5.1	-0.075	98.52941176	-3.72	-3.78	0.06	98.41269841	18.635	17.88	0.755	95.77740492
C_1	-5.025	-5.1	0.075	98.52941176	3.72	3.78	-0.06	98.41269841	18.52	19.92	-1.4	92.97188755
C_2	5.025	5.1	-0.075	98.52941176	-3.72	-3.78	0.06	98.41269841	-18.961	-19.32	0.359	98.14182195

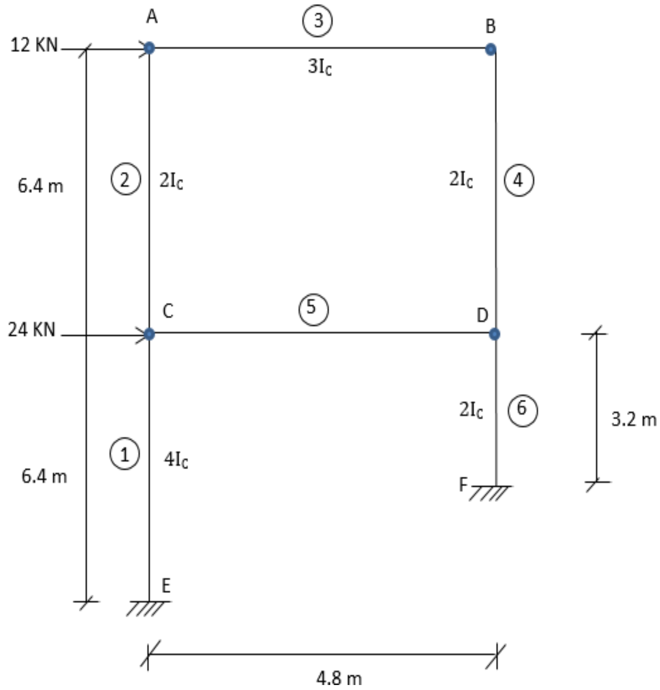
D	-5.025	-5.1	0.075	98.52941176	3.72	3.78	-0.06	98.41269841	-31.2813	-31.5667	0.2853667	99.09598733

Note: All 'F' values in Kips and 'M' values in kip-feet.

4.1.2 DOUBLE STOREY FRAME SYSTEM

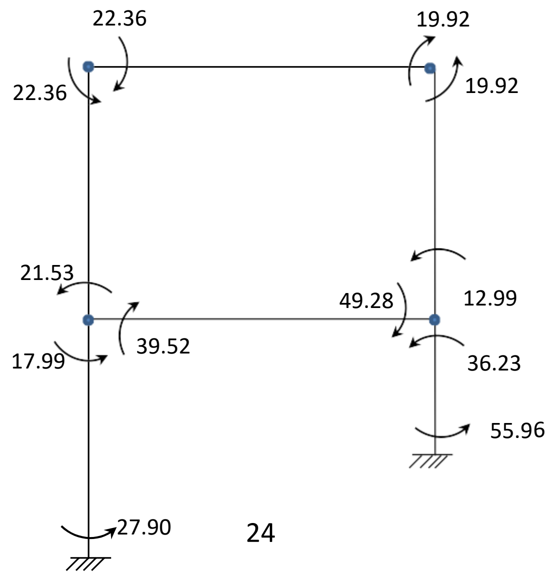
b. Example (12.3.4), from CK Wang

A double Storey frame system selected from the book "Intermediate Structures" by CK Wang is given under.



RESULTS

Solution of example reproduced under. (All Results are in kN-m)



4.1.2.1 REANALYSIS BY FINITE ELEMENT METHOD

The double Storey Frame is solved by using Finite Element Method the Steps involved for solution are;

1) **GLOBAL DISPLACEMENT**

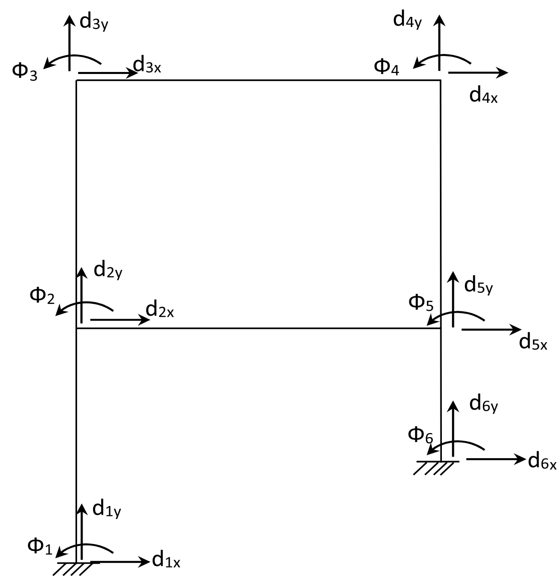


Figure 4.2: Global displacements

2) **LOCAL DISPLACEMENT**

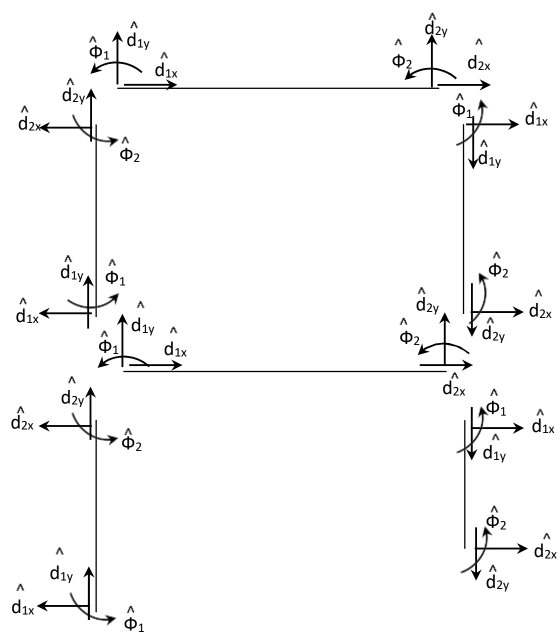


Figure 4.3: Local displacements

3) LOAD MATRIX

F_{2X}	=	24
F_{2Y}	=	0
M_2	=	0
F_{3X}	=	12
F_{3Y}	=	0
M_3	=	0
F_{4X}	=	0
F_{4Y}	=	0
M_4	=	0
F_{5X}	=	0
F_{5Y}	=	0
M_5	=	0

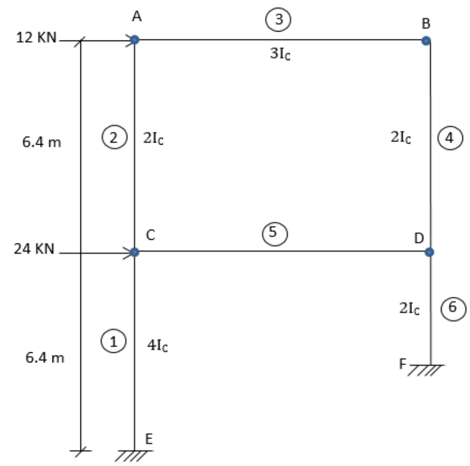


Figure 4.4: Load Diagram

Note: All 'F' values are in Kips and 'M' values in kip-feet.

4) ELEMENT STIFFNESS MATRIX

K =

Element 1							
1	1	1	2	2	2		
dix	diy	Φi	djx	djx	Φj		
2812500	0	0	-2812500	0	0	dix	1
0	24719.24	79101.56	0	-24719.2	79101.56	diy	1
0	79101.56	337500	0	-79101.6	168750	Φi	1
-2812500	0	0	2812500	0	0	djx	2
0	-24719.2	-79101.6	0	24719.24	-79101.6	djx	2
0	79101.56	168750	0	-79101.6	337500	Φj	2

K =

Element 2							
2	2	2	3	3	3		
dix	diy	Φi	djx	djx	Φj		
2812500	0	0	-2812500	0	0	dix	2
0	12359.62	39550.78	0	-12359.6	39550.78	diy	2
0	39550.78	168750	0	-39550.8	84375	Φi	2
-2812500	0	0	2812500	0	0	djx	3
0	-12359.6	-39550.8	0	12359.62	-39550.8	djx	3
0	39550.78	84375	0	-39550.8	168750	Φj	3

K =

Element 3							
3	3	3	4	4	4		
dix	diy	Φi	djx	djx	Φj		
3750000	0	0	-3750000	0	0	dix	3
0	43945.31	105468.8	0	-43945.3	105468.8	diy	3
0	105468.8	337500	0	-105469	168750	Φi	3
-3750000	0	0	3750000	0	0	djx	4
0	-43945.3	-105469	0	43945.31	-105469	djx	4
0	105468.8	168750	0	-105469	337500	Φj	4

K =

Element 4							
4	4	4	5	5	5		
dix	diy	Φi	djx	djx	Φj		
2812500	0	0	-2812500	0	0	dix	4
0	12359.62	39550.78	0	-12359.6	39550.78	diy	4
0	39550.78	168750	0	-39550.8	84375	Φi	4
-2812500	0	0	2812500	0	0	djx	5
0	-12359.6	-39550.8	0	12359.62	-39550.8	djx	5
0	39550.78	84375	0	-39550.8	168750	Φj	5

K =

Element 5							
2	2	2	5	5	5		
dix	diy	Φi	djx	djx	Φj		
3750000	0	0	-3750000	0	0	dix	2
0	43945.31	105468.8	0	-43945.3	105468.8	diy	2
0	105468.8	337500	0	-105469	168750	Φi	2
-3750000	0	0	3750000	0	0	djx	5
0	-43945.3	-105469	0	43945.31	-105469	djx	5
0	105468.8	168750	0	-105469	337500	Φj	5

K =

Element 6							
5	5	5	6	6	6		
dix	diy	Φi	djx	djx	Φj		
5625000	0	0	-5625000	0	0	dix	5
0	98876.95	158203.1	0	-98877	158203.1	diy	5
0	158203.1	337500	0	-158203	168750	Φi	5
-5625000	0	0	5625000	0	0	djx	6
0	-98877	-158203	0	98876.95	-158203	djx	6
0	158203.1	168750	0	-158203	337500	Φj	6

5) MODIFIED GLOBAL ELEMENT STIFFNESS MATRIX

The transformed global matrix of 18*18 is reduced to 12*12 after applying boundary conditions and is shown below.

[K] =

2	2	2	3	3	3	4	4	4	5	5	5		
dix	diy	Φi	djx	djx	Φj	dix	diy	Φi	djx	djx	Φj		
3787078.857	0	39550.78125	-12359.61914	0	-39550.78125	0	0	0	-3750000	0	0	2	dix
0	5668945.313	105468.75	0	-2812500	0	0	0	0	0	-43945.3125	105468.75	2	diy
39550.78125	105468.75	843750	39550.78125	0	84375	0	0	0	0	-105468.75	168750	2	Φi
-12359.61914	0	39550.78125	3762359.619	0	39550.78125	-3750000	0	0	0	0	0	3	djx
0	-2812500	0	0	2856445.313	105468.75	0	-43945.3125	105468.75	0	0	0	3	djx
-39550.78125	0	84375	39550.78125	105468.75	506250	0	-105468.75	168750	0	0	0	3	Φj
0	0	0	-3750000	0	0	3762359.619	0	-39550.78125	-12359.61914	0	-39550.78125	4	dix
0	0	0	0	-43945.3125	-105468.75	0	2856445.313	-105468.75	0	-2812500	0	4	diy
0	0	0	0	105468.75	168750	-39550.78125	-105468.75	506250	39550.78125	0	84375	4	Φi
-3750000	0	0	0	0	0	-12359.61914	0	39550.78125	3861236.572	0	-118652.3438	5	djx
0	-43945.3125	-105468.75	0	0	0	0	-2812500	0	0	8481445.313	-105468.75	5	djx
0	105468.75	168750	0	0	0	-39550.78125	0	84375	-118652.3438	-105468.75	843750	5	Φj

6) FORCE – DISPLACEMENT RELATIONSHIP

"Force Displacement" relationship is given as,

$$F = k \cdot d$$

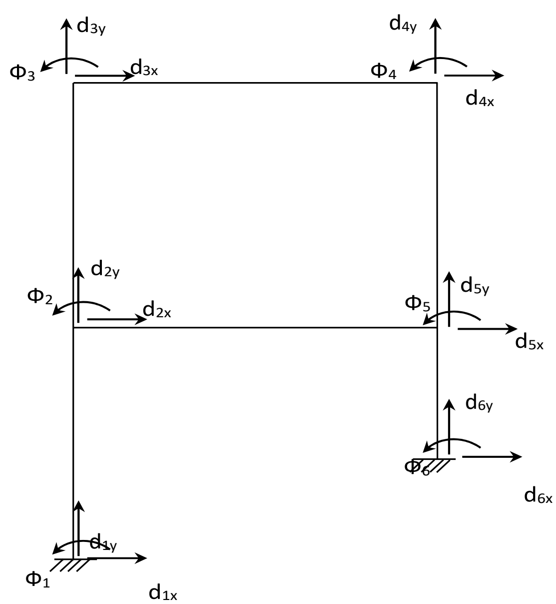
or

$$d = K^{-1} \cdot F$$

DISPLACEMENT MATRIX

[D] =

0	d1x
0	d1y
0	Φ1
0.000682	d2x
-1.7E-06	d2y
-0.00016	Φ2
0.00219	d3x
-1.5E-06	d3x
-0.00013	Φ3
0.002189	d4x
6.12E-07	d4y
0.000126	Φ4
0.000674	d5x
8.58E-07	d5x
0.000218	Φ5
0	d6x
0	d6y
0	Φ6



Global Displacements

Note: All'd' values are in feet and 'θ' values in radians.

7) ELEMENT LOCAL FORCES

From the global displacements the local forces in elements are obtained by the following equation

$$\hat{f} = \hat{k} \,.\, T \,.\, d$$

f_1 =

ELEMENT 1		
4.824104	fix	1
3.820342	fiy	1
26.12018	mi	1
-4.8241	fjx	2
-3.82034	fjx	2
-1.66999	mj	2

f_2 =

ELEMENT 2		
-0.690032	fix	2
6.9066325	fiy	2
20.727985	mi	2
0.6900323	fjx	3
-6.906632	fjx	3
23.474463	mj	3

f_3 =

ELEMENT 3		
5.093368	fix	3
-0.69003	fiy	3
-23.4745	mi	3
-5.09337	fjx	4
0.690032	fjx	4
20.16231	mj	4

f_4 =

ELEMENT 4		
-0.69003	fix	4
-5.09337	fiy	4
-20.1623	mi	4
0.690032	fjx	5
5.093368	fjx	5
-12.4352	mj	5

f_5 =

ELEMENT 5		
27.08629	fix	2
5.5141364	fiy	2
-19.058	mi	2
-27.08629	fjx	5
-5.514136	fjx	5
45.525853	mj	5

f_6 =

ELEMENT 6		
4.824104	fix	5
-32.1797	fiy	5
-33.0906	mi	5
-4.8241	fjx	6
32.17966	fjx	6
-69.8843	mj	6

Note: All 'F' values in Kips and 'M' values in kip-feet.

8) RESULTS FROM FEM

All units are in KN-m.

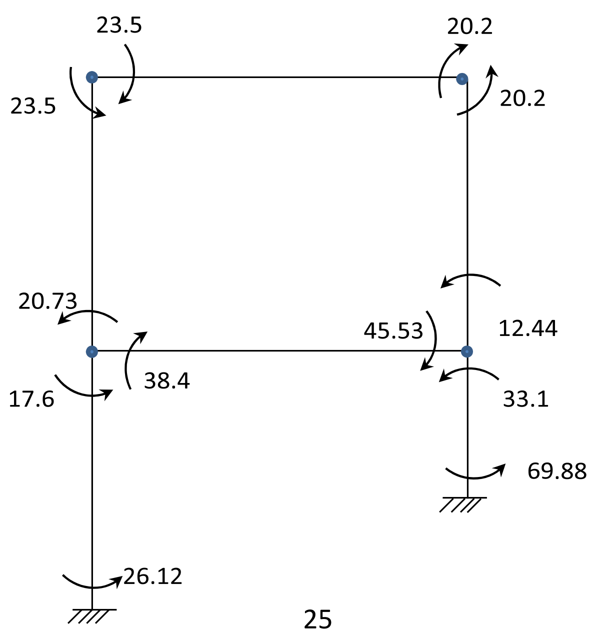


Figure 4.5: Results from FEM

4.1.2.2 COMPARISON OF RESULTS

Comparison Between FEM and MDM				
S.No	Moment			
	MDM	FEM	Difference	%age accuracy
MEMBER 1				
i) Joint E	-27.9	-26.12	-1.78	93.18529862
ii) Joint C	-17.99	-17.6	-0.39	97.78409091
MEMBER 2				
i) Joint C	-21.53	-20.73	-0.8	96.14085866
ii) Joint A	-22.36	-23.5	1.14	95.14893617
MEMBER 3				
i) Joint A	22.36	23.5	-1.14	95.14893617
ii) Joint B	19.92	20.2	-0.28	98.61386139
MEMBER 4				
i) Joint B	-19.92	-20.2	0.28	98.61386139
ii) Joint D	-12.99	-12.44	-0.55	95.57877814
MEMBER 5				
i) Joint C	39.52	38.4	1.12	97.08333333
ii) Joint D	49.28	45.53	3.75	91.7636723
MEMBER 6				
i) Joint D	-36.23	-33.1	-3.13	90.54380665
ii) Joint F	-55.96	-69.88	13.92	80.08013738

Note: All values are in kip-feet.

CHAPTER NO. 5

FRAME ANALYSIS

5.1 ANALYSIS THROUGH CLASSICAL METHOD

5.1.1 EARTHQUAKE ANALYSIS

5.1.1.1 PORTAL FRAME METHOD

Through portal frame method, end moments and shear forces of Beams and Columns are calculated. Assumptions for portal frame method are:

i) Column shear in interior column is always doubled of that of exterior column

ii) Point of contra-flexure lies at mid span of Columns and Beams.

The output for frame A is shown under.

a) SHEAR FORCE

The shear force in column is determined using storey shear and is transferred to the beams using the moments.

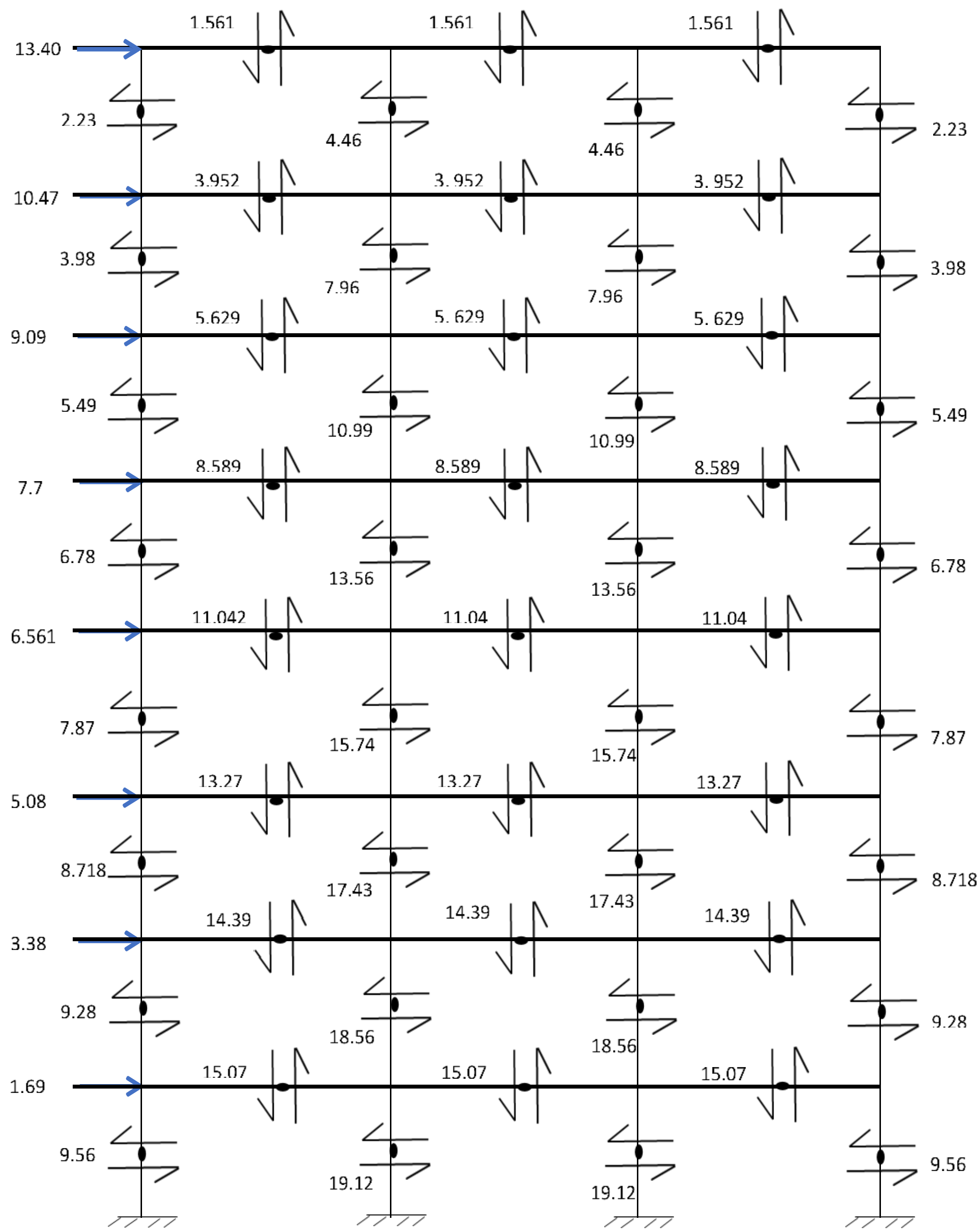


Figure 5.1: Shear Distribution (kips)

b) END MOMENTS

The end moment is shown under.

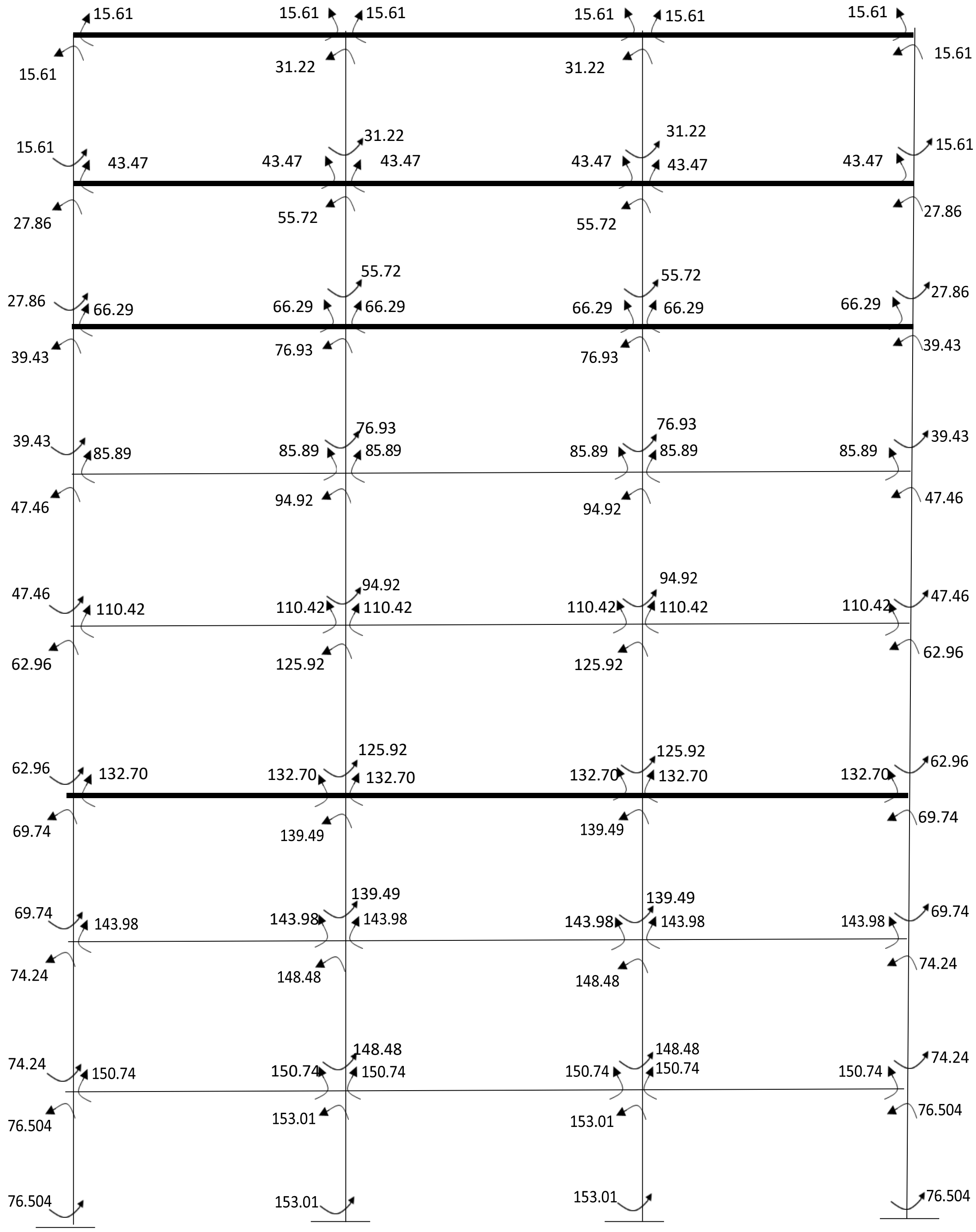


Figure 5.2: End Moments (k-ft)

5.1.2 GRAVITY ANALYSIS

The approach of work through Gravity Analysis for the given building frame is given under.

a) LOAD FROM SLAB TO BEAM:

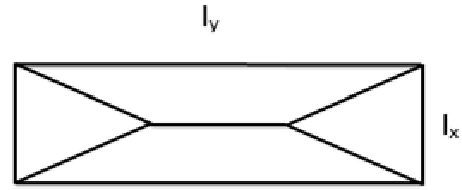


Figure 5.3: Typical Two Way Slab

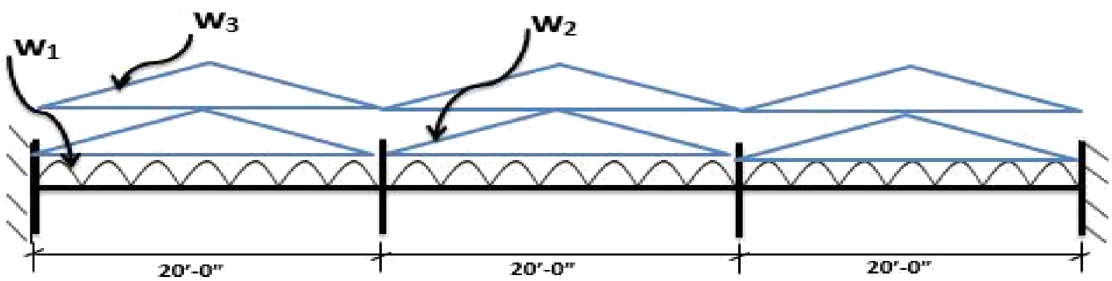


Figure 5.4: Load from Slab to Beam

w_1 = Self Weight Of beam,

$w_2 = w_3$ = Factored load coming from slab.

b) LOAD TRANSFORMATION TO UDL:

Trapezoidal and triangular loading is transformed to UDL by using the following relationships.

For Short Span Beam: $\frac{1}{3} W_u * l_x$ **(Eq. 5.1)**

For Long Span Beam: $\frac{1}{2} W_u * l_x (1- \frac{1}{3} k^2)$ **(Eq. 5.2)**

Where;

W_u = factored load on slab

lx =20 ft

k=ly/lx

Frame on Grid A:

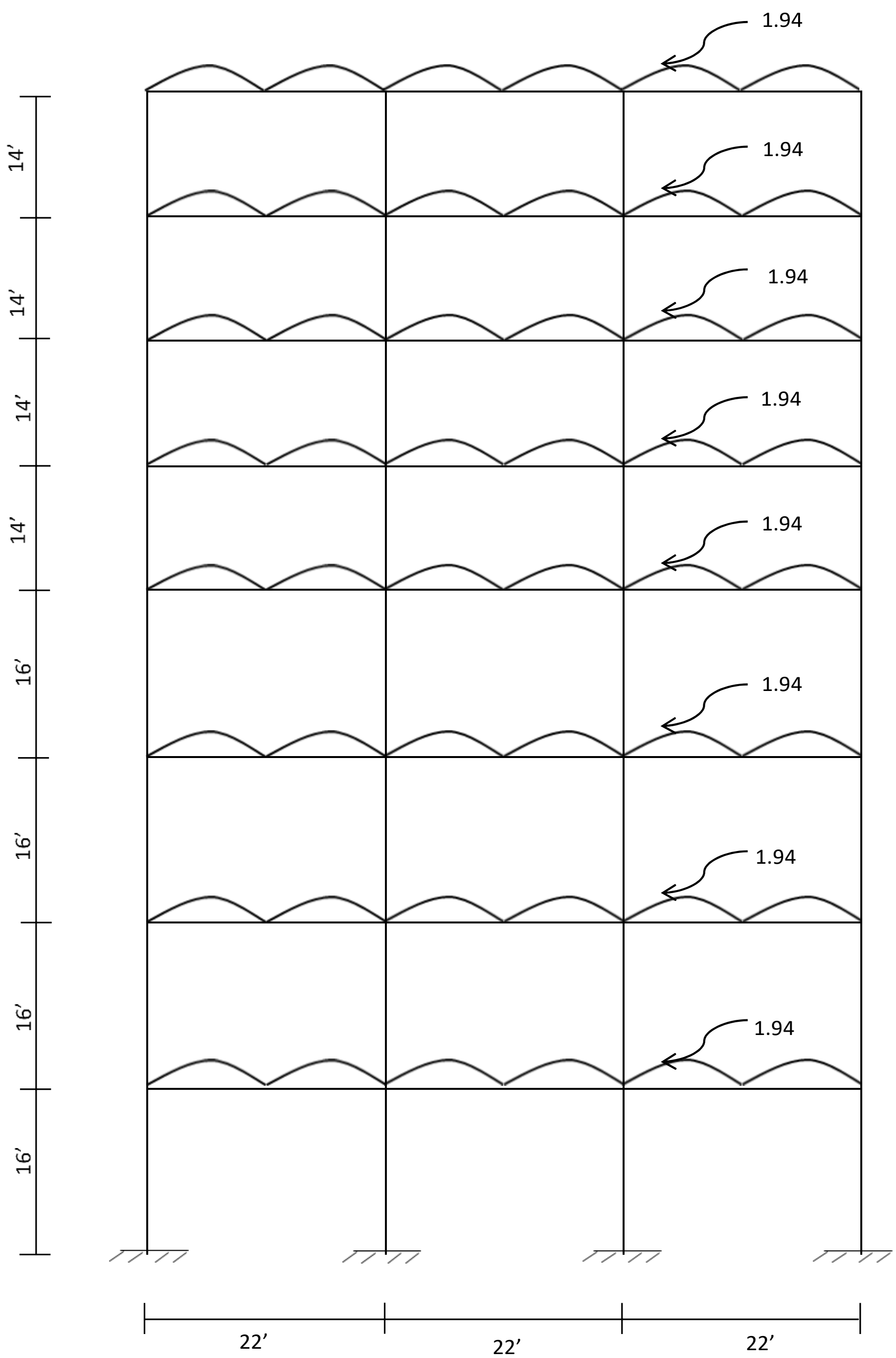


Figure 5.5: UDL (K/ft) on frame at Grid A

c) FIXED END MOMENTS

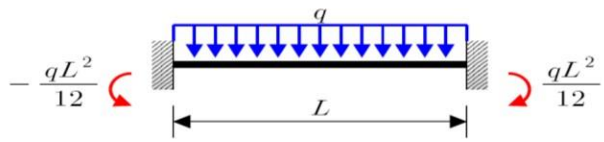


Figure 5.6: Typical Fixed End Moment Condition

by Using Formula mentioned above the Fixed End Moments are:

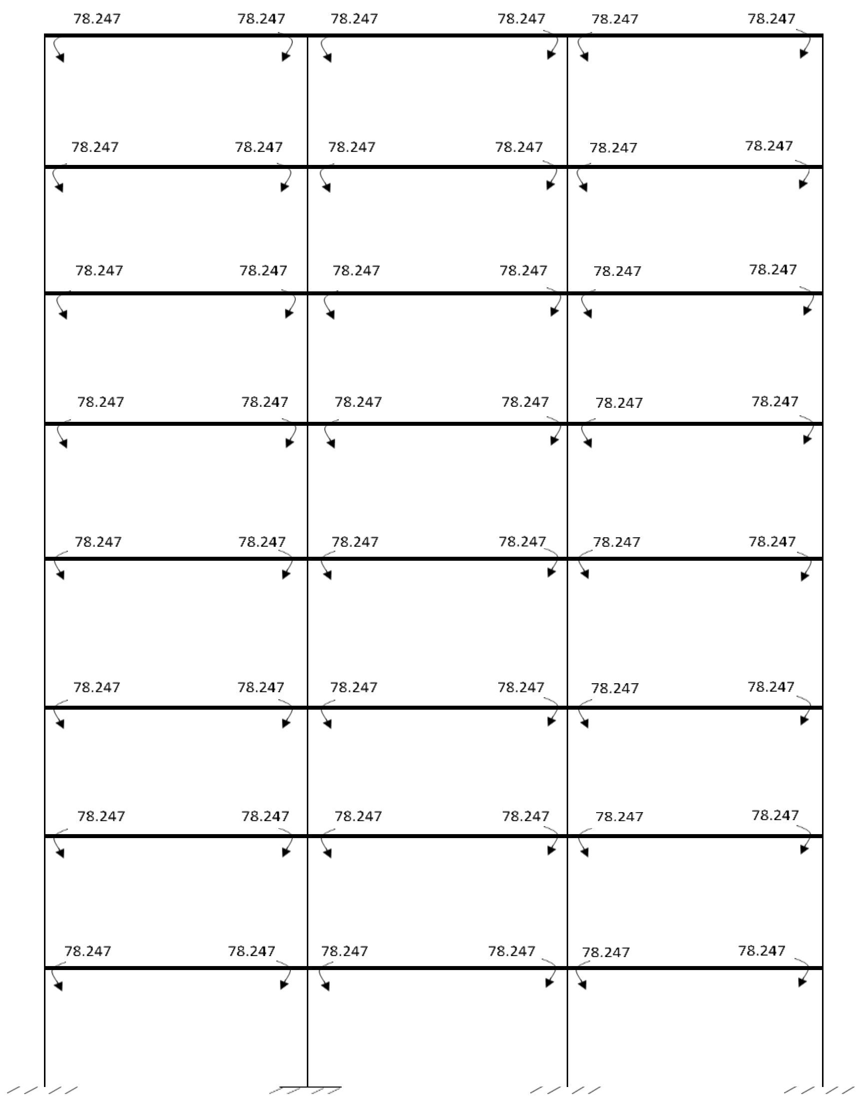


Figure 5.7: Fixed End Moment (k-ft) on Frame at Grid A

5.1.2.1 MATRIX DISPLACEMENT METHOD

a) **LOCAL STIFFNESS MATRIX OF AN ELEMENT [k]**

The local matrices of elements 13, 37, 41 are shown below. The following matrices will govern for the rest of the elements.

BEAM

ELEMENT 13

- When L = 22'-0"
- Inertia I = 9216 in^4

[k] = E x

	L1 (G17)	L2 (G18)	L3	L4
L1 (G17)	139.64	69.8182	0.7934	-0.793
L2 (G18)	69.818	139.636	0.7934	-0.793
L3	0.7934	0.79339	0.006	-0.006
L4	-0.793	-0.7934	-0.006	0.006

COLUMN

ELEMENT 37

- When L = 14'-0"
- Inertia I = 8750.6 in^4

[k] = E x

	L1 (G17)	L2 (G13)	L3 (G37)	L4 (G36)
L1 (G17)	208.3474	104.1737	1.860245	-1.86024
L2 (G13)	104.1737	208.3474	1.860245	-1.86024
L3 (G37)	1.860245	1.860245	0.022146	-0.02215
L4 (G36)	-1.86024	-1.86024	-0.02215	0.022146

ELEMENT 41

- When L = 16'-0"
- Inertia I = 8750.6 in^4

K = E x

	L1 (G21)	**L2 (G17)**	**L3 (G38)**	**L4 (G37)**
L1 (G36)	182.3	91.152	1.4243	-1.424
L2 (G17)	91.152	182.304	1.4243	-1.424
L3 (G38)	1.4243	1.42425	0.0148	-0.015
L4 (G37)	-1.424	-1.4243	-0.015	0.0148

b) GLOBAL STIFFNESS MATRIX [K]

The transformed global matrix of 36*36 is reduced to 32*32 after applying boundary conditions and is shown below.

c) INVERSE OF GLOBAL MATRIX $[K]^{-1}$

The inverse of the global matrix is as under.

d) FIXED END MOMENT MATRIX [F_o]

To transfer the load of span on node fixed end moments are calculated and are shown under.

F_{o1}	=	-938.964	F_{o29}	=	-938.964	F_{o57}	=	0	F_{o85}	=	0
F_{o2}	=	938.964	F_{o30}	=	938.964	F_{o58}	=	0	F_{o86}	=	0
F_{o3}	=	-938.964	F_{o31}	=	-938.964	F_{o59}	=	0	F_{o87}	=	0
F_{o4}	=	938.964	F_{o32}	=	938.964	F_{o60}	=	0	F_{o88}	=	0
F_{o5}	=	-938.964	F_{o33}	=	-938.964	F_{o61}	=	0	F_{o89}	=	0
F_{o6}	=	938.964	F_{o34}	=	938.964	F_{o62}	=	0	F_{o90}	=	0
F_{o7}	=	-938.964	F_{o35}	=	-938.964	F_{o63}	=	0	F_{o91}	=	0
F_{o8}	=	938.964	F_{o36}	=	938.964	F_{o64}	=	0	F_{o92}	=	0
F_{o9}	=	-938.964	F_{o37}	=	-938.964	F_{o65}	=	0	F_{o93}	=	0
F_{o10}	=	938.964	F_{o38}	=	938.964	F_{o66}	=	0	F_{o94}	=	0
F_{o11}	=	-938.964	F_{o39}	=	-938.964	F_{o67}	=	0	F_{o95}	=	0
F_{o12}	=	938.964	F_{o40}	=	938.964	F_{o68}	=	0	F_{o96}	=	0
F_{o13}	=	-938.964	F_{o41}	=	-938.964	F_{o69}	=	0	F_{o97}	=	0
F_{o14}	=	938.964	F_{o42}	=	938.964	F_{o70}	=	0	F_{o98}	=	0
F_{o15}	=	-938.964	F_{o43}	=	-938.964	F_{o71}	=	0	F_{o99}	=	0
F_{o16}	=	938.964	F_{o44}	=	938.964	F_{o72}	=	0	F_{o100}	=	0
F_{o17}	=	-938.964	F_{o45}	=	-938.964	F_{o73}	=	0	F_{o101}	=	0
F_{o18}	=	938.964	F_{o46}	=	938.964	F_{o74}	=	0	F_{o102}	=	0
F_{o19}	=	-938.964	F_{o47}	=	-938.964	F_{o75}	=	0	F_{o103}	=	0
F_{o20}	=	938.964	F_{o48}	=	938.964	F_{o76}	=	0	F_{o104}	=	0
F_{o21}	=	-938.964	F_{o49}	=	0	F_{o77}	=	0	F_{o105}	=	0
F_{o22}	=	938.964	F_{o50}	=	0	F_{o78}	=	0	F_{o106}	=	0
F_{o23}	=	-938.964	F_{o51}	=	0	F_{o79}	=	0	F_{o107}	=	0
F_{o24}	=	938.964	F_{o52}	=	0	F_{o80}	=	0	F_{o108}	=	0
F_{o25}	=	-938.964	F_{o53}	=	0	F_{o81}	=	0	F_{o109}	=	0
F_{o26}	=	938.964	F_{o54}	=	0	F_{o82}	=	0	F_{o110}	=	0
F_{o27}	=	-938.964	F_{o55}	=	0	F_{o83}	=	0	F_{o111}	=	0
F_{o28}	=	938.964	F_{o56}	=	0	F_{o84}	=	0	F_{o112}	=	0

Note: All values in k-in.

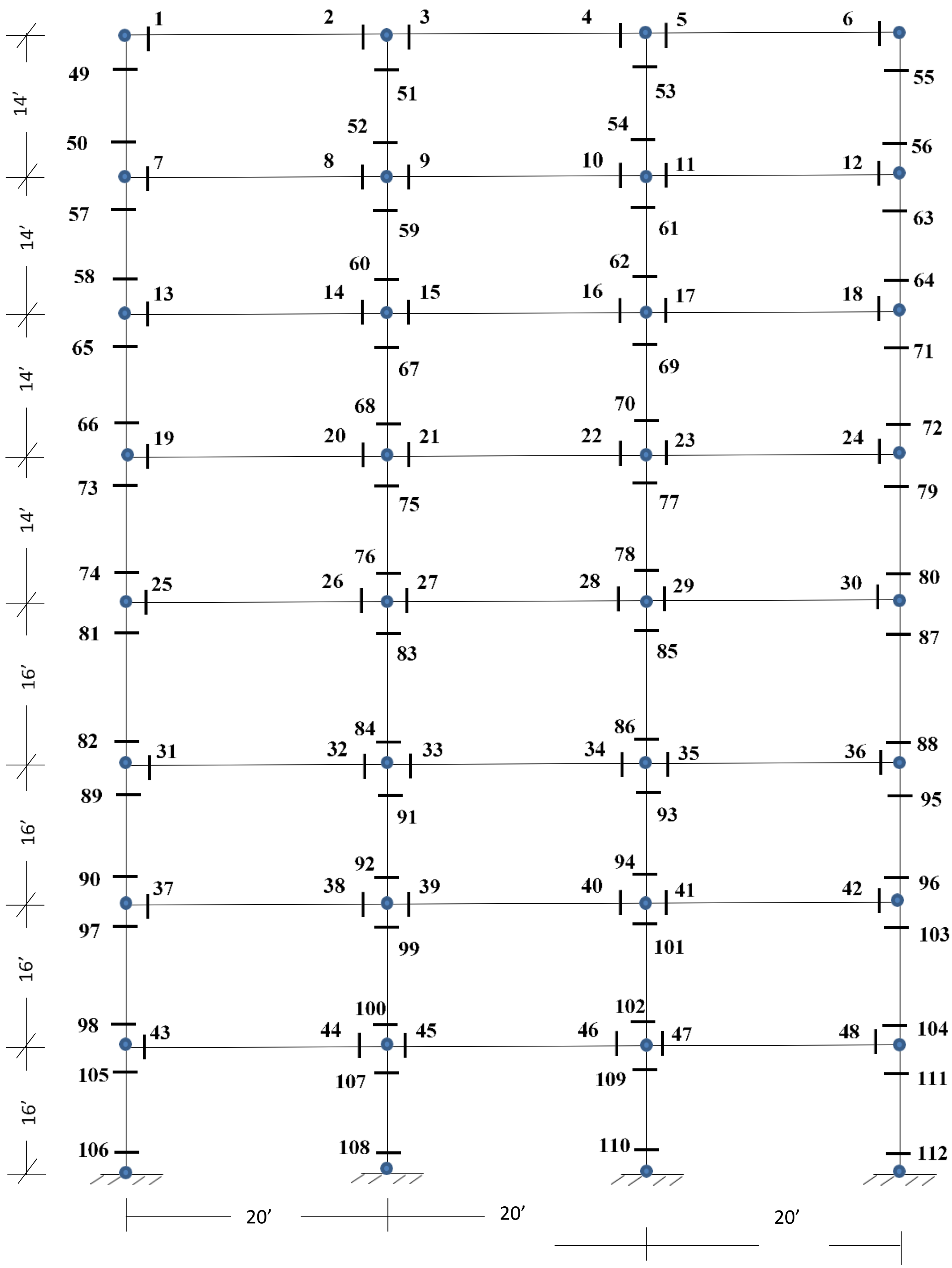


Figure 5.8: Location of Fixed end moment

e) LOAD MATRIX [P]

The load matrix is obtained by considering the loads at the node of the member and is shown below.

P_1	=	938.964
P_2	=	0
P_3	=	0
P_4	=	-938.964
P_5	=	938.964
P_6	=	0
P_7	=	0
P_8	=	-938.964
P_9	=	938.964
P_{10}	=	0
P_{11}	=	0
P_{12}	=	-938.964
P_{13}	=	938.964
P_{14}	=	0
P_{15}	=	0
P_{16}	=	-938.964
P_{17}	=	938.964
P_{18}	=	0
P_{19}	=	0
P_{20}	=	-938.964
P_{21}	=	938.964
P_{22}	=	0
P_{23}	=	0
P_{24}	=	-938.964
P_{25}	=	938.964
P_{26}	=	0
P_{27}	=	0
P_{28}	=	-938.964
P_{29}	=	938.964
P_{30}	=	0
P_{31}	=	0
P_{32}	=	-938.964

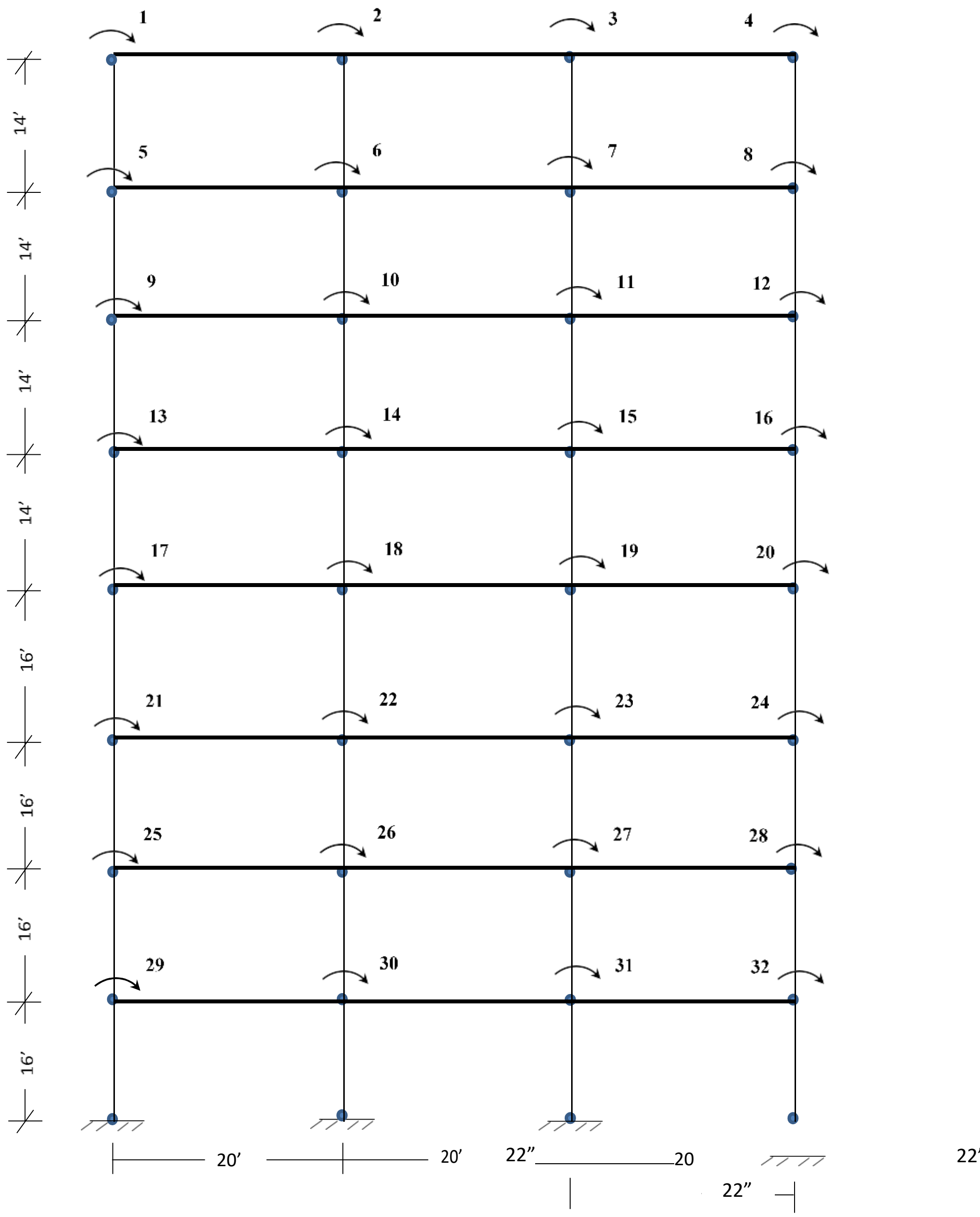


Figure 5.9: Location of Loads

Note: All values in k-in.

$X_1 \quad = \quad 2.519983711$

X_2	=	-0.563209697
X_3	=	0.563267227
X_4	=	-2.520158463
X_5	=	0.973116893
X_6	=	0.006664175
X_7	=	-0.00679737
X_8	=	-0.972571708
X_9	=	1.29214033
X_{10}	=	-0.128946098
X_{11}	=	0.129502298
X_{12}	=	-1.29478781
X_{13}	=	1.226182599
X_{14}	=	-0.097993909
X_{15}	=	0.095812827
X_{16}	=	-1.212961957
X_{17}	=	1.238655195
X_{18}	=	-0.102385148
X_{19}	=	0.109001564
X_{20}	=	-1.3051494
X_{21}	=	1.418229442
X_{22}	=	-0.138513178
X_{23}	=	0.136351511
X_{24}	=	-1.40546451
X_{25}	=	1.32300525
X_{26}	=	-0.109918612
X_{27}	=	0.110450217
X_{28}	=	-1.325469728
X_{29}	=	1.648300313
X_{30}	=	-0.183000924
X_{31}	=	0.182887917
X_{32}	=	[illegible]

f) JOINT DISPLACEMENT MATRIX [X]

$$[X] = [K]^{-1}[P]$$

Note: All values in radians.

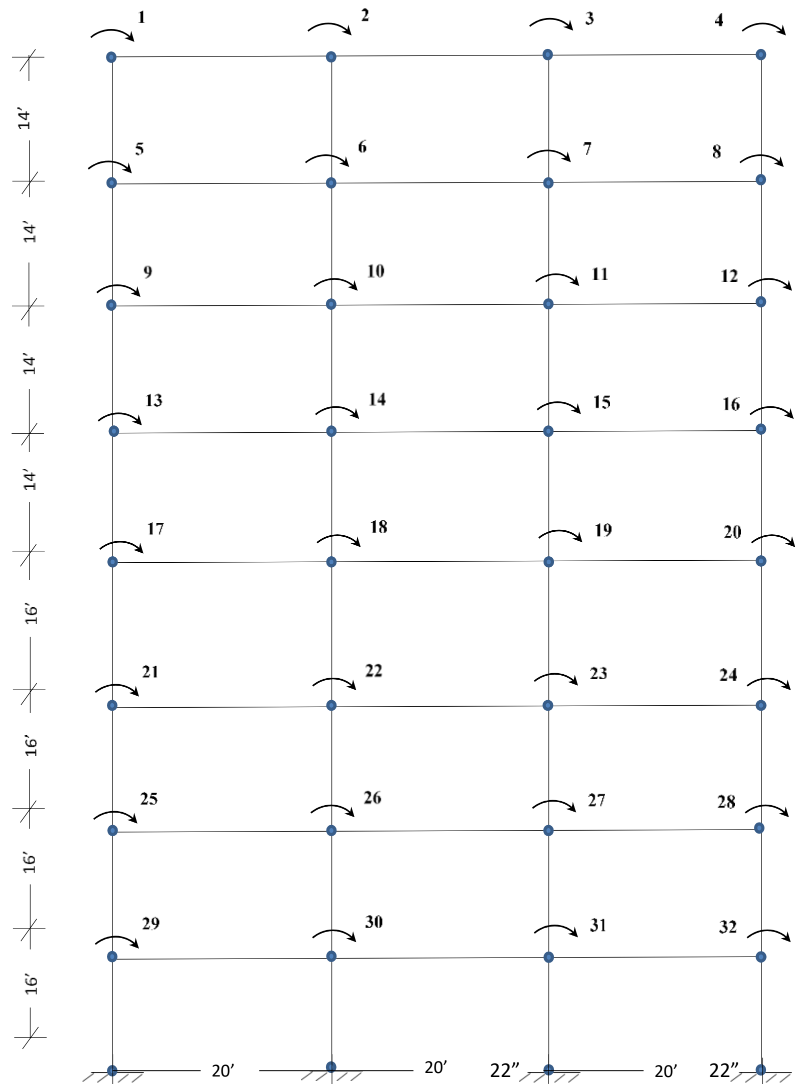


Figure 5.10: Location of Joint displacements

g) MEMBER DISPLACEMENT MATRIX [e]

The displacement matrix is obtained by considering the joint rotation of the member.

e_1	=	2.519984	e_7	=	0.973117	e_{13}	=	1.29214	e_{19}	=	1.226183
e_2	=	-0.56321	e_8	=	0.006664	e_{14}	=	-0.12895	e_{20}	=	-0.09799
e_3	=	-0.56321	e_9	=	0.006664	e_{15}	=	-0.12895	e_{21}	=	-0.09799
e_4	=	0.563267	e_{10}	=	-0.0068	e_{16}	=	0.129502	e_{22}	=	0.095813
e_5	=	0.563267	e_{11}	=	-0.0068	e_{17}	=	0.129502	e_{23}	=	0.095813
e_6	=	-2.52016	e_{12}	=	-0.97257	e_{18}	=	-1.29479	e_{24}	=	-1.21296

e_{25}	=	1.238655	e_{47}	=	0.182888	e_{69}	=	0.129502	e_{91}	=	-0.13851
e_{26}	=	-0.10239	e_{48}	=	-1.64784	e_{70}	=	0.095813	e_{92}	=	-0.10992
e_{27}	=	-0.10239	e_{49}	=	2.519984	e_{71}	=	-1.29479	e_{93}	=	0.136352
e_{28}	=	0.109002	e_{50}	=	0.973117	e_{72}	=	-1.21296	e_{94}	=	0.11045
e_{29}	=	0.109002	e_{51}	=	-0.56321	e_{73}	=	1.226183	e_{95}	=	-1.40546
e_{30}	=	-1.30515	e_{52}	=	0.006664	e_{74}	=	1.238655	e_{96}	=	-1.32547
e_{31}	=	1.418229	e_{53}	=	0.563267	e_{75}	=	-0.09799	e_{97}	=	1.323005
e_{32}	=	-0.13851	e_{54}	=	-0.0068	e_{76}	=	-0.10239	e_{98}	=	1.6483
e_{33}	=	-0.13851	e_{55}	=	-2.52016	e_{77}	=	0.095813	e_{99}	=	-0.10992
e_{34}	=	0.136352	e_{56}	=	-0.97257	e_{78}	=	0.109002	e_{100}	=	-0.183
e_{35}	=	0.136352	e_{57}	=	0.973117	e_{79}	=	-1.21296	e_{101}	=	0.11045
e_{36}	=	-1.40546	e_{58}	=	1.29214	e_{80}	=	-1.30515	e_{102}	=	0.182888
e_{37}	=	1.323005	e_{59}	=	0.006664	e_{81}	=	1.238655	e_{103}	=	-1.32547
e_{38}	=	-0.10992	e_{60}	=	-0.12895	e_{82}	=	1.418229	e_{104}	=	-1.64784
e_{39}	=	-0.10992	e_{61}	=	-0.0068	e_{83}	=	-0.10239	e_{105}	=	1.6483
e_{40}	=	0.11045	e_{62}	=	0.129502	e_{84}	=	-0.13851	e_{106}	=	0
e_{41}	=	0.11045	e_{63}	=	-0.97257	e_{85}	=	0.109002	e_{107}	=	-0.183
e_{42}	=	-1.32547	e_{64}	=	-1.29479	e_{86}	=	0.136352	e_{108}	=	0
e_{43}	=	1.6483	e_{65}	=	1.29214	e_{87}	=	-1.30515	e_{109}	=	0.182888
e_{44}	=	-0.183	e_{66}	=	1.226183	e_{88}	=	-1.40546	e_{110}	=	0
e_{45}	=	-0.183	e_{67}	=	-0.12895	e_{89}	=	1.418229	e_{111}	=	-1.64784
e_{46}	=	0.182888	e_{68}	=	-0.09799	e_{90}	=	1.323005	e_{112}	=	0

Note: All values in radians.

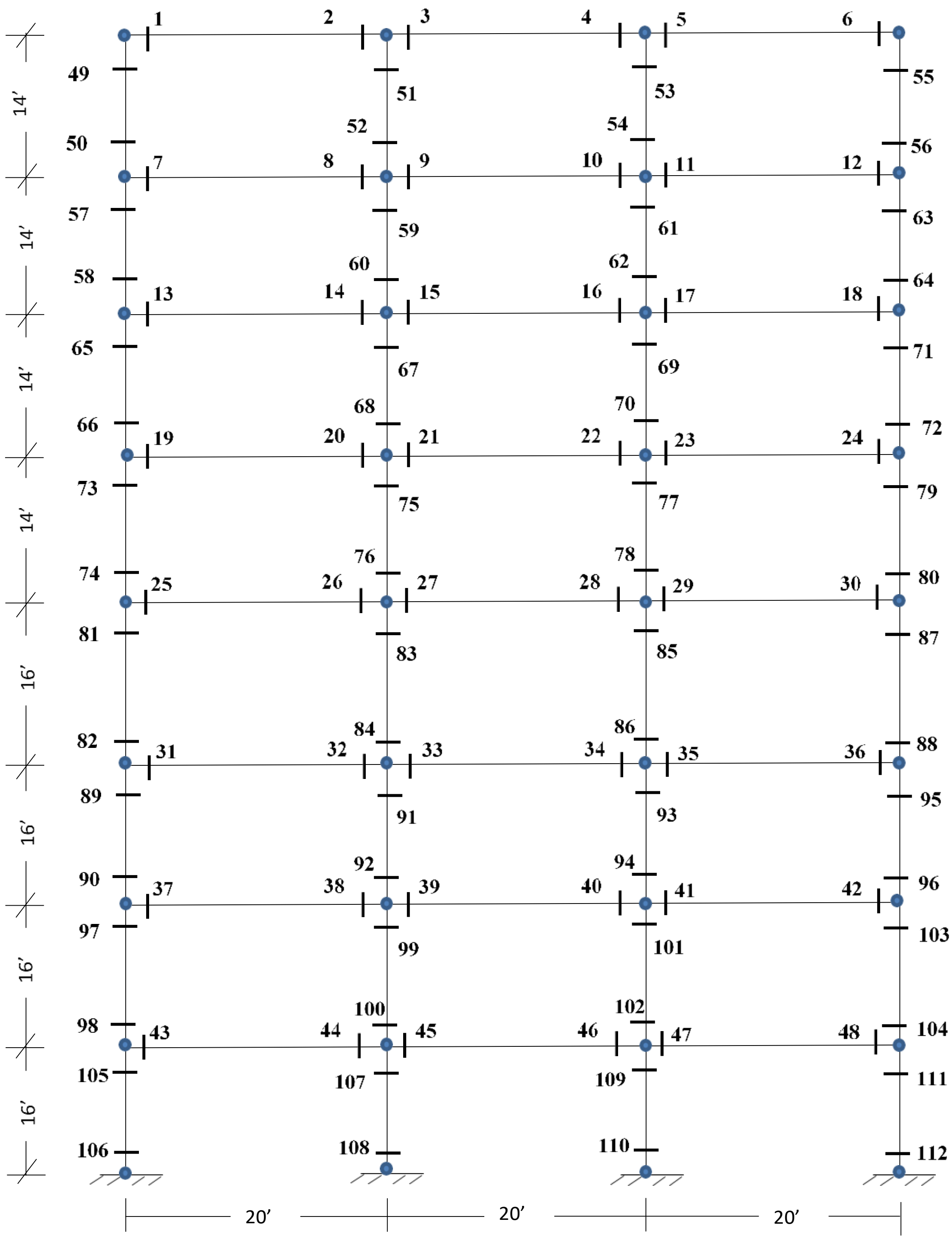


Figure 5.11: Location of member displacements

h) ELEMENT STIFFNESS MATRIX [S]

The stiffness matrix of frame is obtained by using the standard stiffness matrix of an elements.

i) FORCE MATRIX [F]

$$[F] = [S]\ [e]$$

F_{1}	=	312.559
F_{2}	=	97.2961
F_{3}	=	-39.3183
F_{4}	=	39.3303
F_{5}	=	-97.3003
F_{6}	=	-312.579
F_{7}	=	136.348
F_{8}	=	68.8718
F_{9}	=	0.45598
F_{10}	=	-0.48388
F_{11}	=	-68.8523
F_{12}	=	-136.281
F_{13}	=	171.427
F_{14}	=	72.2093
F_{15}	=	-8.96395
F_{16}	=	9.08045
F_{17}	=	-72.3165
F_{18}	=	-171.758
F_{19}	=	164.378
F_{20}	=	71.9263
F_{21}	=	-6.99404
F_{22}	=	6.5372
F_{23}	=	-71.3078
F_{24}	=	-162.684
F_{25}	=	165.813
F_{26}	=	72.184
F_{27}	=	-6.6864
F_{28}	=	8.07224

F_{29}	=	-75.9026
F_{30}	=	-174.636
F_{31}	=	188.366
F_{32}	=	79.6767
F_{33}	=	-9.82166
F_{34}	=	9.36889
F_{35}	=	-79.0873
F_{36}	=	-186.734
F_{37}	=	177.065
F_{38}	=	77.0212
F_{39}	=	-7.6372
F_{40}	=	7.74855
F_{41}	=	-77.119
F_{42}	=	-177.372
F_{43}	=	217.386
F_{44}	=	89.5277
F_{45}	=	-12.7847
F_{46}	=	12.761
F_{47}	=	-89.5113
F_{48}	=	-217.329
F_{49}	=	626.22
F_{50}	=	465.125
F_{51}	=	-116.615
F_{52}	=	-57.2662
F_{53}	=	116.613
F_{54}	=	57.2445
F_{55}	=	-626.199
F_{56}	=	-465.029

F_{57}	=	337.254
F_{58}	=	370.478
F_{59}	=	-12.0408
F_{60}	=	-26.1636
F_{61}	=	12.0709
F_{62}	=	26.2656
F_{63}	=	-337.416
F_{64}	=	-370.972
F_{65}	=	396.833
F_{66}	=	389.964
F_{67}	=	-37.063
F_{68}	=	-33.8395
F_{69}	=	36.9517
F_{70}	=	33.4432
F_{71}	=	-396.007
F_{72}	=	-387.486
F_{73}	=	384.393
F_{74}	=	385.692
F_{75}	=	-31.0734
F_{76}	=	-31.5307
F_{77}	=	31.3082
F_{78}	=	32.6817
F_{79}	=	-388.565
F_{80}	=	-398.165
F_{81}	=	354.981
F_{82}	=	371.345
F_{83}	=	-31.2817
F_{84}	=	-34.5739

F_{85}	=	32.2906
F_{86}	=	34.7828
F_{87}	=	-365.936
F_{88}	=	-375.078
F_{89}	=	379.031
F_{90}	=	370.354
F_{91}	=	-35.2604
F_{92}	=	-32.6547
F_{93}	=	34.9148
F_{94}	=	32.5546
F_{95}	=	-376.929
F_{96}	=	-369.64
F_{97}	=	391.319
F_{98}	=	420.962
F_{99}	=	-36.7086
F_{100}	=	-43.3683
F_{101}	=	36.7952
F_{102}	=	43.3961
F_{103}	=	-391.726
F_{104}	=	-421.102
F_{105}	=	300.403
F_{106}	=	150.201
F_{107}	=	-33.3519
F_{108}	=	-16.676
F_{109}	=	33.3313
F_{110}	=	16.6657
F_{111}	=	-300.319
F_{112}	=	-150.159

Note: All values in k-in.

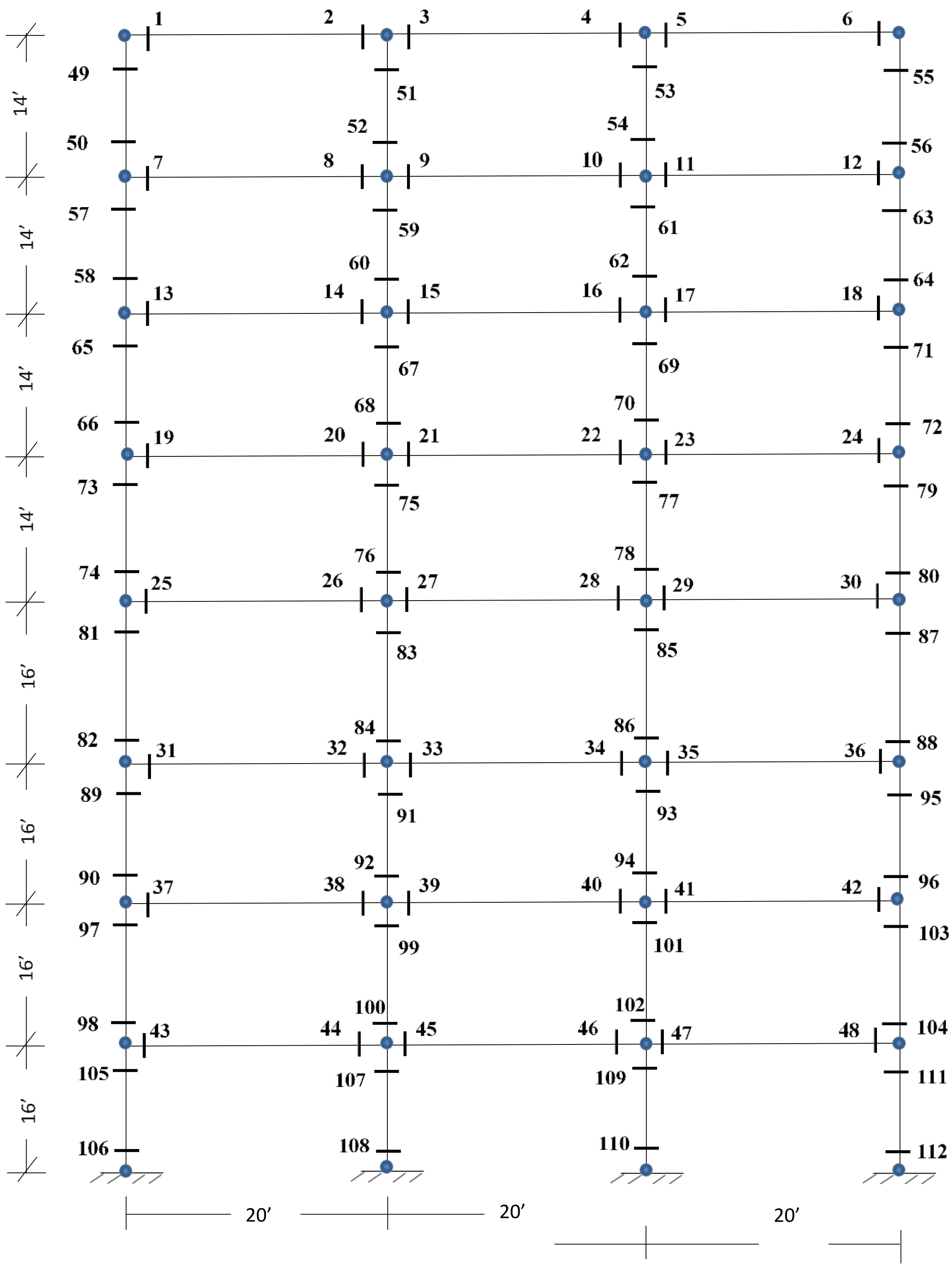


Figure 5.12: Location of Forces

j) END FORCE MATRIX [F*]

$$[F^*] = [F_o] + [F]$$

F^*_{1}	=	-626.4	F^*_{29}	=	-1014.9	F^*_{57}	=	337.25	F^*_{85}	=	32.291
F^*_{2}	=	1036.3	F^*_{30}	=	764.33	F^*_{58}	=	370.48	F^*_{86}	=	34.783
F^*_{3}	=	-978.28	F^*_{31}	=	-750.6	F^*_{59}	=	-12.041	F^*_{87}	=	-365.94
F^*_{4}	=	978.29	F^*_{32}	=	1018.6	F^*_{60}	=	-26.164	F^*_{88}	=	-375.08
F^*_{5}	=	-1036.3	F^*_{33}	=	-948.79	F^*_{61}	=	12.071	F^*_{89}	=	379.03
F^*_{6}	=	626.38	F^*_{34}	=	948.33	F^*_{62}	=	26.266	F^*_{90}	=	370.35
F^*_{7}	=	-802.62	F^*_{35}	=	-1018.1	F^*_{63}	=	-337.42	F^*_{91}	=	-35.26
F^*_{8}	=	1007.8	F^*_{36}	=	752.23	F^*_{64}	=	-370.97	F^*_{92}	=	-32.655
F^*_{9}	=	-938.51	F^*_{37}	=	-761.9	F^*_{65}	=	396.83	F^*_{93}	=	34.915
F^*_{10}	=	938.48	F^*_{38}	=	1016	F^*_{66}	=	389.96	F^*_{94}	=	32.555
F^*_{11}	=	-1007.8	F^*_{39}	=	-946.6	F^*_{67}	=	-37.063	F^*_{95}	=	-376.93
F^*_{12}	=	802.68	F^*_{40}	=	946.71	F^*_{68}	=	-33.84	F^*_{96}	=	-369.64
F^*_{13}	=	-767.54	F^*_{41}	=	-1016.1	F^*_{69}	=	36.952	F^*_{97}	=	391.32
F^*_{14}	=	1011.2	F^*_{42}	=	761.59	F^*_{70}	=	33.443	F^*_{98}	=	420.96
F^*_{15}	=	-947.93	F^*_{43}	=	-721.58	F^*_{71}	=	-396.01	F^*_{99}	=	-36.709
F^*_{16}	=	948.04	F^*_{44}	=	1028.5	F^*_{72}	=	-387.49	F^*_{100}	=	-43.368
F^*_{17}	=	-1011.3	F^*_{45}	=	-951.75	F^*_{73}	=	384.39	F^*_{101}	=	36.795
F^*_{18}	=	767.21	F^*_{46}	=	951.73	F^*_{74}	=	385.69	F^*_{102}	=	43.396
F^*_{19}	=	-774.59	F^*_{47}	=	-1028.5	F^*_{75}	=	-31.073	F^*_{103}	=	-391.73
F^*_{20}	=	1010.9	F^*_{48}	=	721.63	F^*_{76}	=	-31.531	F^*_{104}	=	-421.1
F^*_{21}	=	-945.96	F^*_{49}	=	626.22	F^*_{77}	=	31.308	F^*_{105}	=	300.4
F^*_{22}	=	945.5	F^*_{50}	=	465.12	F^*_{78}	=	32.682	F^*_{106}	=	150.2
F^*_{23}	=	-1010.3	F^*_{51}	=	-116.61	F^*_{79}	=	-388.56	F^*_{107}	=	-33.352
F^*_{24}	=	776.28	F^*_{52}	=	-57.266	F^*_{80}	=	-398.17	F^*_{108}	=	-16.676
F^*_{25}	=	-773.15	F^*_{53}	=	116.61	F^*_{81}	=	354.98	F^*_{109}	=	33.331
F^*_{26}	=	1011.1	F^*_{54}	=	57.244	F^*_{82}	=	371.34	F^*_{110}	=	16.666
F^*_{27}	=	-945.65	F^*_{55}	=	-626.2	F^*_{83}	=	-31.282	F^*_{111}	=	-300.32
F^*_{28}	=	947.04	F^*_{56}	=	-465.03	F^*_{84}	=	-34.574	F^*_{112}	=	-150.16

Note: All values in k-in.

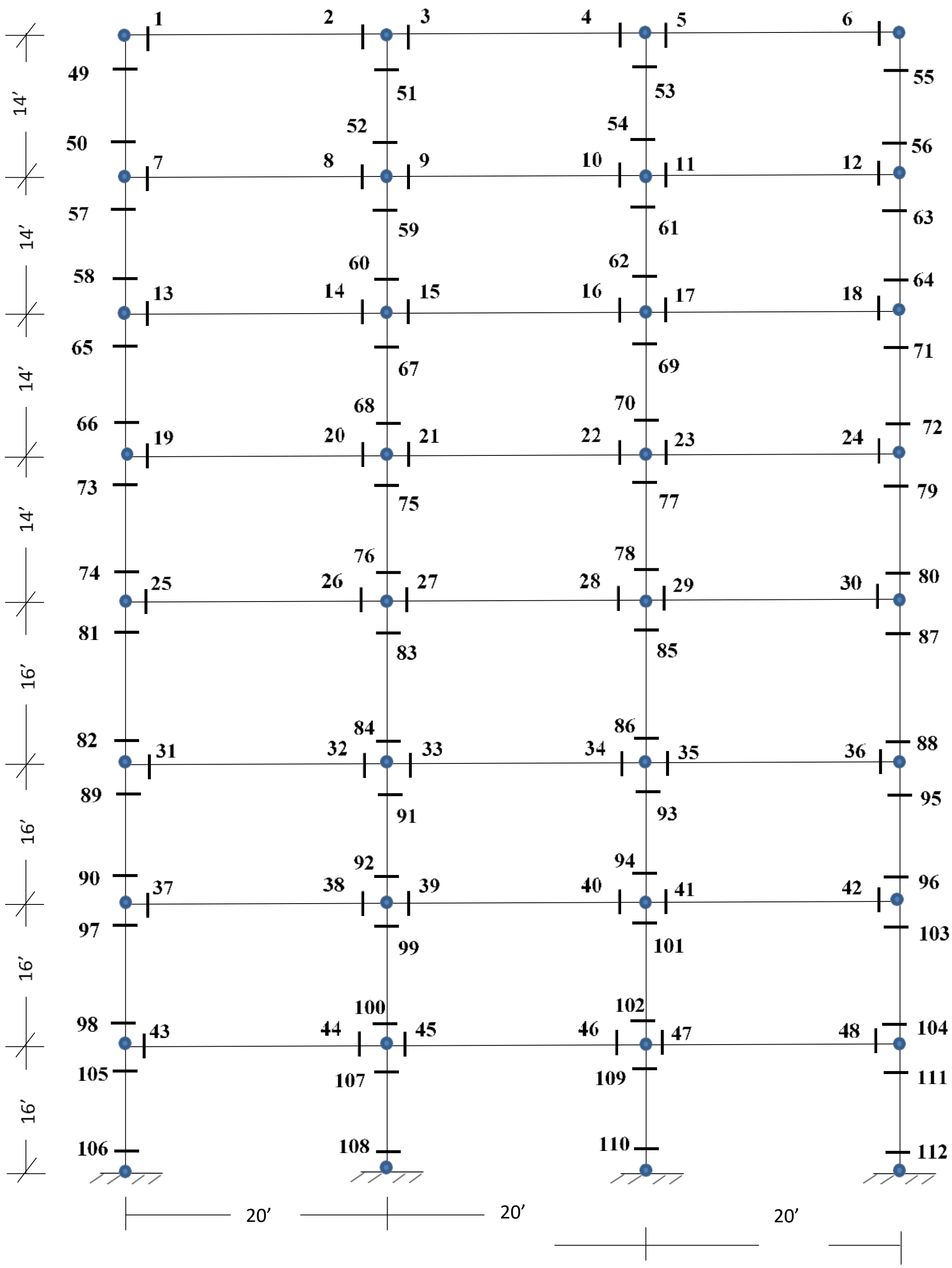


Figure 5.13: Location of End Forces

5.1.3 SUPERPOSITION

Gravity and Seismic moments are superimposed for Comparison.

(See Appendix C)

5.2 ANALYSIS THROUGH FINITE ELEMENT METHOD

The calculations for the frame on Grid A is given under.

a) DISCRETIZATION OF ELEMENT

The structure is divided into finite elements.

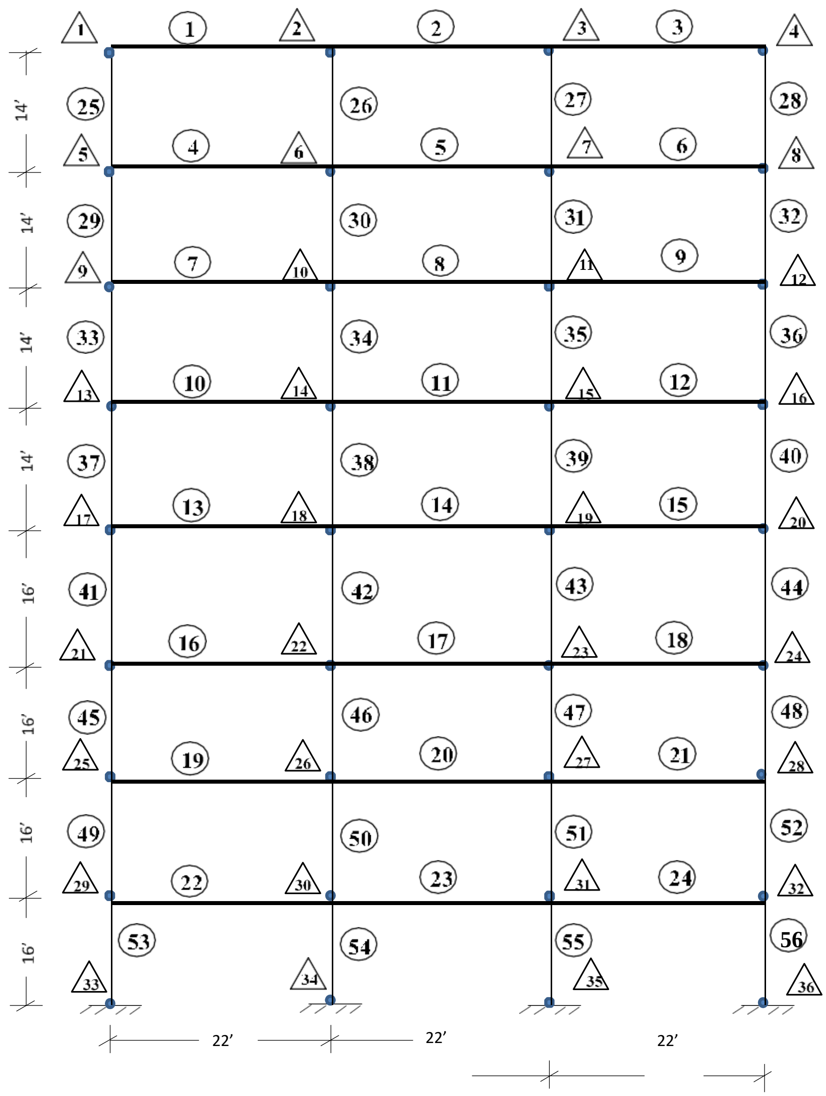
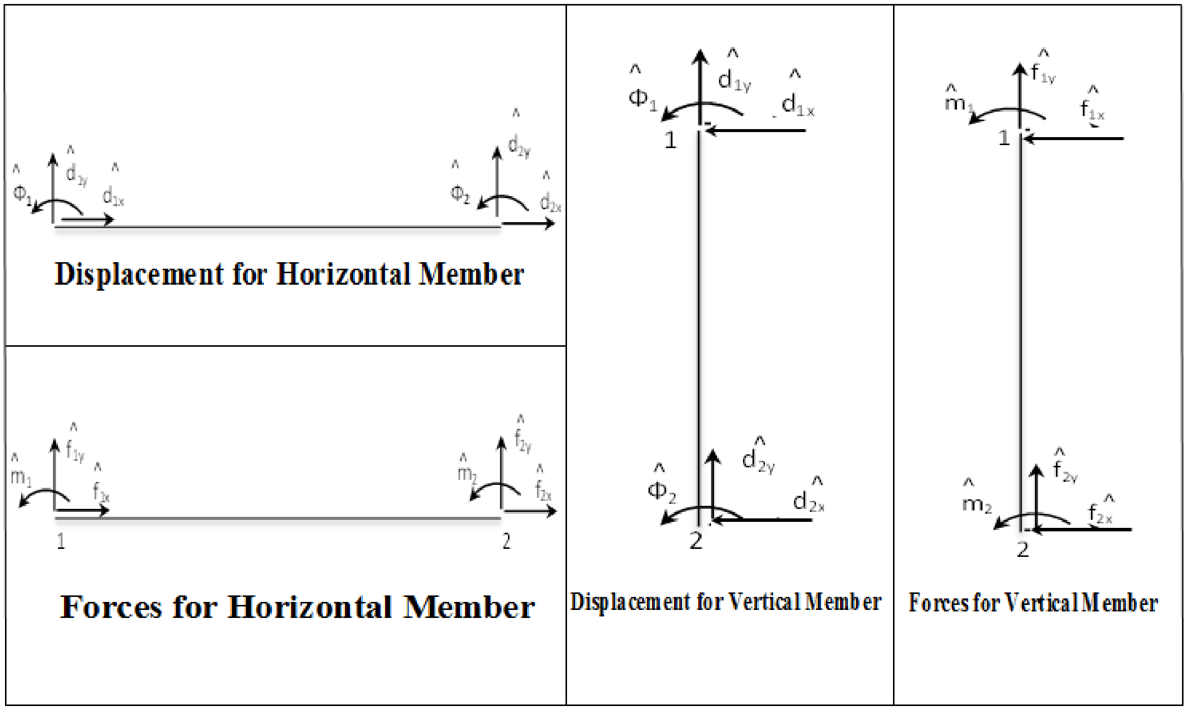


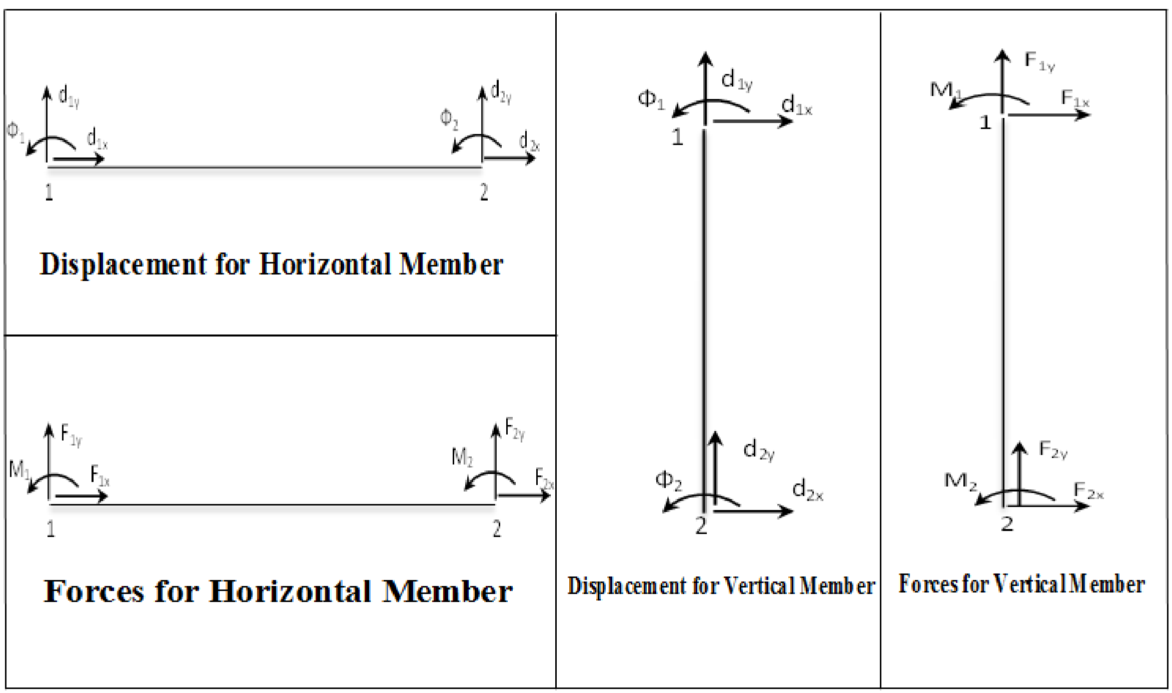
Figure 5.14: Member and Node Location

b) DEGREE OF FREEDOM

The degree of freedom for a flexural member is shown under.



Local Direction



Global Direction

Figure 5.15: Degree of Freedom

c) LOAD MATRIX [P]

The load matrix is obtained by considering the loads at the node of the member and is shown below.

F1x	=	13.407
F1y	=	-21.34
M1	=	-938.96
F2x	=	0
F2y	=	-42.68
M2	=	0
F3x	=	0
F3y	=	-42.68
M3	=	0
F4x	=	0
F4y	=	-21.34
M4	=	938.96
F5x	=	10.47
F5y	=	-21.34
M5	=	-938.96
F6x	=	0
F6y	=	-42.68
M6	=	0
F7x	=	0
F7y	=	-42.68
M7	=	0
F8x	=	0
F8y	=	-21.34
M8	=	938.96
F9x	=	9.09
F9y	=	-21.34
M9	=	-938.96
F10x	=	0
F10y	=	-42.68
M10	=	0
F11x	=	0
F11y	=	-42.68
M11	=	0

F12x	=	0
F12y	=	-21.34
M12	=	938.96
F13x	=	7.7
F13y	=	-21.34
M13	=	-938.96
F14x	=	0
F14y	=	-42.68
M14	=	0
F15x	=	0
F15y	=	-42.68
M15	=	0
F16x	=	0
F16y	=	-21.34
M16	=	938.96
F17x	=	6.561
F17y	=	-21.34
M17	=	-938.96
F18x	=	0
F18y	=	-42.68
M18	=	0
F19x	=	0
F19y	=	-42.68
M19	=	0
F20x	=	0
F20y	=	-21.34
M20	=	938.96
F21x	=	5.08
F21y	=	-21.34
M21	=	-938.96
F22x	=	0
F22y	=	-42.68
M22	=	0

F23x	=	0
F23y	=	-42.68
M23	=	0
F24x	=	0
F24y	=	-21.34
M24	=	938.96
F25x	=	3.38
F25y	=	-21.34
M25	=	-938.96
F26x	=	0
F26y	=	-42.68
M26	=	0
F27x	=	0
F27y	=	-42.68
M27	=	0
F28x	=	0
F28y	=	-21.34
M28	=	938.96
F29x	=	1.69
F29y	=	-21.34
M29	=	-938.96
F30x	=	0
F30y	=	-42.68
M30	=	0
F31x	=	0
F31y	=	-42.68
M31	=	0
F32x	=	0
F32y	=	-21.34
M32	=	938.96

Note: All 'F' values in Kip and 'M' Values in k-in.

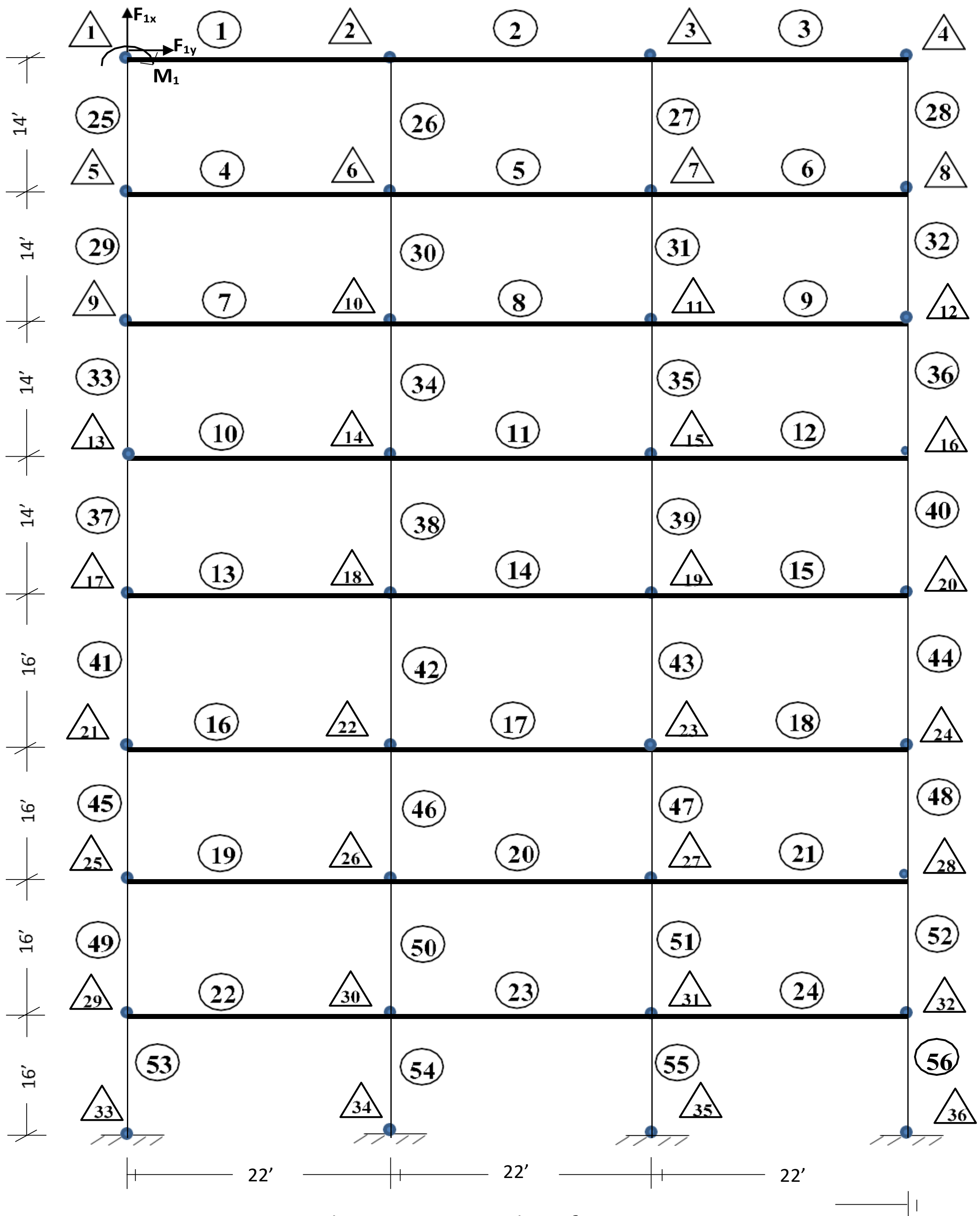


Figure 5.16: Location of Forces

Note: All the loads are acting on the nodes.

d) ELEMENT GLOBAL STIFFNESS MATRIX [k]

The Global matrices of elements 13, 37, 41 are shown below. The following matrices will govern for the rest of the elements.

BEAM

ELEMENT 13

- When L = 22'-0"
- Inertia I = 9216 in^4

k=

	d_{17x}	d_{17y}	$Ø_{17}$	d_{18x}	d_{18y}	$Ø_{18}$
d_{17x}	3277.2	0	0	-3277.2	0	0
d_{17y}	0	42.32	5586.12	0	-42.32	5586.12
$Ø_{17}$	0	5586.12	983160	0	-5586.12	491580
d_{18x}	-3277.2	0	0	3277.2	0	0
d_{18y}	0	-42.32	-5586.12	0	42.32	-5586.12
$Ø_{18}$	0	5586.12	491580	0	-5586.12	983160

COLUMN

ELEMENT 37

- When L = 14'-0"
- Inertia I = 8750.6 in^4

k=

	d_{17x}	d_{17y}	$Ø_{17}$	d_{13x}	d_{13y}	$Ø_{13}$
d_{17x}	79.802	0	-6704.08	-79.802	0	-6704.08
d_{17y}	0	6952.392	0	0	-6952.39	0
$Ø_{17}$	-6704.08	0	7.50E+05	6704.08	0	3.75E+05
d_{13x}	-79.802	0	6704.08	79.802	0	6704.08
d_{13y}	0	-6952.39	0	0	6952.392	0
$Ø_{13}$	-6704.08	0	3.75E+05	6704.08	0	7.50E+05

ELEMENT 41

- When L = 16'-0"
- Inertia I = 8750.6 in^4

k=

	d_{21x}	d_{21y}	$Ø_{21}$	d_{17x}	d_{17y}	$Ø_{17}$
d_{21x}	53.455	0	-5132.89	-53.455	0	-5132.89
d_{21y}	0	6083.424	0	0	-6083.42	0
$Ø_{21}$	-5132.89	0	6.50E+05	5132.889	0	3.20E+05
d_{17x}	-53.455	0	5132.889	53.455	0	5132.889
d_{17y}	0	-6083.42	0	0	6083.424	0
$Ø_{17}$	-5132.89	0	3.20E+05	5132.889	0	6.50E+05

e) TOTAL GLOBAL STIFFNESS MATIX [K]

The transformed global matrix of 108*108 is reduced to 96*96 after applying boundary conditions.

f) INVERSE OF GLOBAL STIFFNESS MATRIX $[K]^{-1}$

g) DISPLACEMENT MATRIX [d]

$$[d] = [K]^{-1}\,[P]$$

d_{1x}	=	2.64298
d_{1y}	=	-0.08881
θ_{1}	=	-0.00117
d_{2x}	=	2.637113
d_{2y}	=	-0.24509
θ_{2}	=	-0.00028
d_{3x}	=	2.63224
d_{3y}	=	-0.2424
θ_{3}	=	-8.5E-05
d_{4x}	=	2.629171
d_{4y}	=	-0.16426
θ_{4}	=	0.000464
d_{5x}	=	2.532248
d_{5y}	=	-0.08596
θ_{5}	=	-0.00101
d_{6x}	=	2.530292
d_{6y}	=	-0.23904
θ_{6}	=	-0.0005
d_{7x}	=	2.529218
d_{7y}	=	-0.23612
θ_{7}	=	-0.00026
d_{8x}	=	2.529126
d_{8y}	=	-0.16102
θ_{8}	=	-0.00016
d_{9x}	=	2.360027
d_{9y}	=	-0.08033
θ_{9}	=	-0.0013
d_{10x}	=	2.357766
d_{10y}	=	-0.22702
θ_{10}	=	-0.00063
d_{11x}	=	2.356431
d_{11y}	=	-0.22369
θ_{11}	=	-0.00043

d_{12x}	=	2.355885
d_{12y}	=	-0.15392
θ_{12}	=	-0.00036
d_{13x}	=	2.127096
d_{13y}	=	-0.07228
θ_{13}	=	-0.00148
d_{14x}	=	2.125197
d_{14y}	=	-0.20892
θ_{14}	=	-0.00076
d_{15x}	=	2.124117
d_{15y}	=	-0.20514
θ_{15}	=	-0.00058
d_{16x}	=	2.123755
d_{16y}	=	-0.14268
θ_{16}	=	-0.00059
d_{17x}	=	1.83765
d_{17y}	=	-0.06214
θ_{17}	=	-0.00175
d_{18x}	=	1.836572
d_{18y}	=	-0.18464
θ_{18}	=	-0.0009
d_{19x}	=	1.836111
d_{19y}	=	-0.18051
θ_{19}	=	-0.00074
d_{20x}	=	1.835999
d_{20y}	=	-0.12707
θ_{20}	=	-0.00084
d_{21x}	=	1.395208
d_{21y}	=	-0.04857
θ_{21}	=	-0.00199
d_{22x}	=	1.394022
d_{22y}	=	-0.1497
θ_{22}	=	-0.001

d_{23x}	=	1.393406
d_{23y}	=	-0.14551
θ_{23}	=	-0.0009
d_{24x}	=	1.393206
d_{24y}	=	-0.10378
θ_{24}	=	-0.00109
d_{25x}	=	0.903251
d_{25y}	=	-0.03353
θ_{25}	=	-0.00203
d_{26x}	=	0.902473
d_{26y}	=	-0.10739
θ_{26}	=	-0.00104
d_{27x}	=	0.902129
d_{27y}	=	-0.10374
θ_{27}	=	-0.00099
d_{28x}	=	0.901981
d_{28y}	=	-0.07487
θ_{28}	=	-0.00122
d_{29x}	=	0.391056
d_{29y}	=	-0.0173
θ_{29}	=	-0.00204
d_{30x}	=	0.391749
d_{30y}	=	-0.05756
θ_{30}	=	-0.00092
d_{31x}	=	0.392135
d_{31y}	=	-0.05523
θ_{31}	=	-0.00097
d_{32x}	=	0.392142
d_{32y}	=	-0.04023
θ_{32}	=	-0.00119

Note: All‘d’ values in inches and ‘θ’ values in radians.

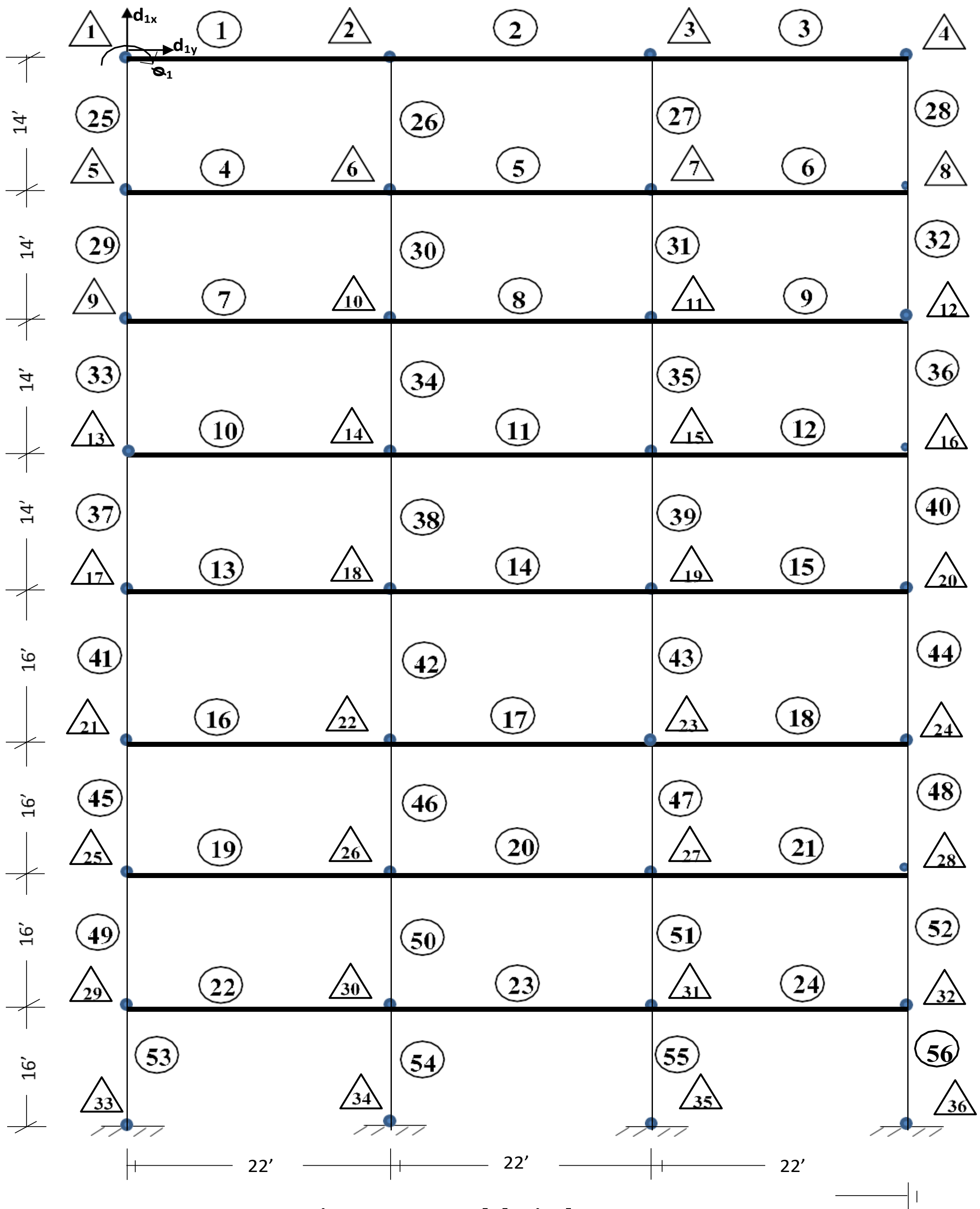


Figure 5.17: Nodal Displacements

Note: The displacements on page # 45 are nodal displacements

h) ELEMENT LOCAL STIFFNESS MATRIX $[\hat{k}]$

The local matrices of elements 13, 37 and 41 are shown below. The following matrices will govern for the rest of the elements.

BEAM

ELEMENT 13

- L= 22 ft

$[\hat{k}]=$

COLUMN

ELEMENT 37

- L= 14 ft

$\hat{d}_{17x}$
$\hat{d}_{17y}$
$\hat{\phi}_{17}$
$\hat{d}_{13x}$
$\hat{d}_{13y}$
$\hat{\phi}_{13}$

$[\hat{k}]=$

ELEMENT 41

- L= 16 ft

$[\hat{k}]=$

i) ELEMENT LOCAL FORCES [$\hat{f}$]

585.2 -2380.1 1119.8 -2466.8 1551.8 -1390.7
34.5 34.5 23.10 23.10 14.6 14.6

33.24 46.84 34.94 45.14 40.65 39.43
6.51 33.24 11.43 81.78 8.50 85.79 14.6

-585.4 1260.1 915.12 1390.6
-518.1 660.5 11.43 513.1 8.50 14.6 1062.6
6.51 85.79

33.24 502.1 -2779.6 81.78 454.4 -3050.4 745.85 -2410.1
15.99 15.99 10 10 0.85 0.85

31.34 48.7 30.21 49.8 33.93 46.15

0.69 64.56 17.42 160.73 17.66 169.6
15.86 1407.0 1389.2 15.45 1228.7

-132.5 1241.2 17.42 1224.7 17.66 1248.5
0.69 64.56 160.73 169.6 15.45

16.24 -91.6 16.24 -3382.4 9.19 -131.2 9.19 -3666.3 3.21 245.9 3.21 -2875.6

26.88 53.2 25.66 54.42 30.08 50
2.04 91.46 24.5 239.6 23.64 254.1 18.66

223.6 2272.6 2195.5 1626.9
118.6 1837.5 24.5 1776.3 23.64 18.66 1507.4
2.04 254.1
91.46 -582.6 -3915.5 239.6 -671.6 -4200.3 -252.2 -3356.9
15.99 15.99 10 10 0.85 0.85

31.34 48.7 30.21 49.8 33.93 46.15

4.76 114.5 29.87 318.24 28.89 338.96 21.37
463.82 2749.4 2675.9 1849.3

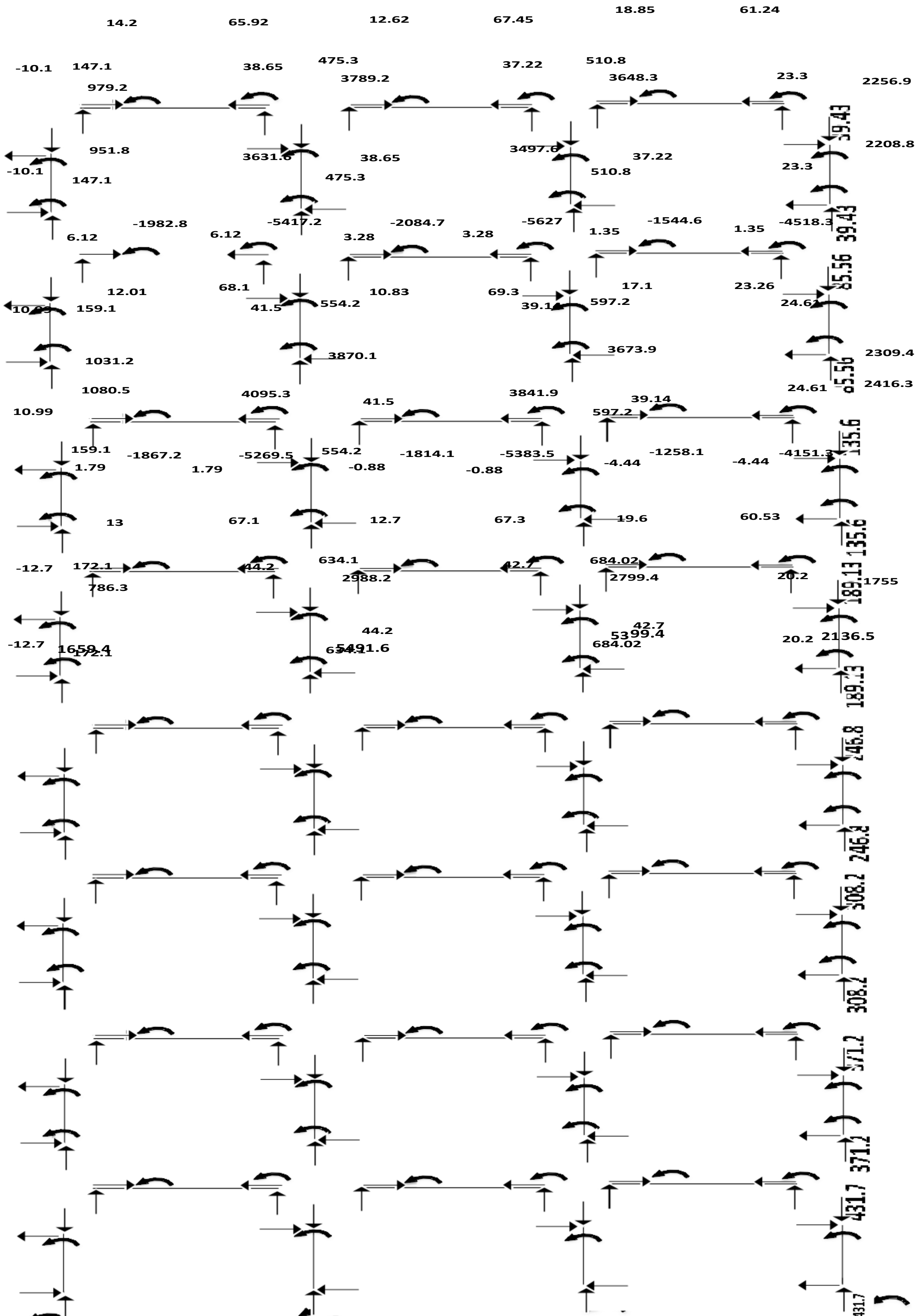
336.32 2268.5 29.87 2177.2 28.89 1740.6
4.76 114.5 318.24 338.96 21.37

10.29 -1168.2 10.29 -4533.1 5.14 -1285.9- 5.14 -4821.9 0.16 -806.7 0.16 3847.7

18.44 61.64 16.9 63.2 22.4 57.67
8.16 132.9 35.02 396.8 33.88 424.5 21.53

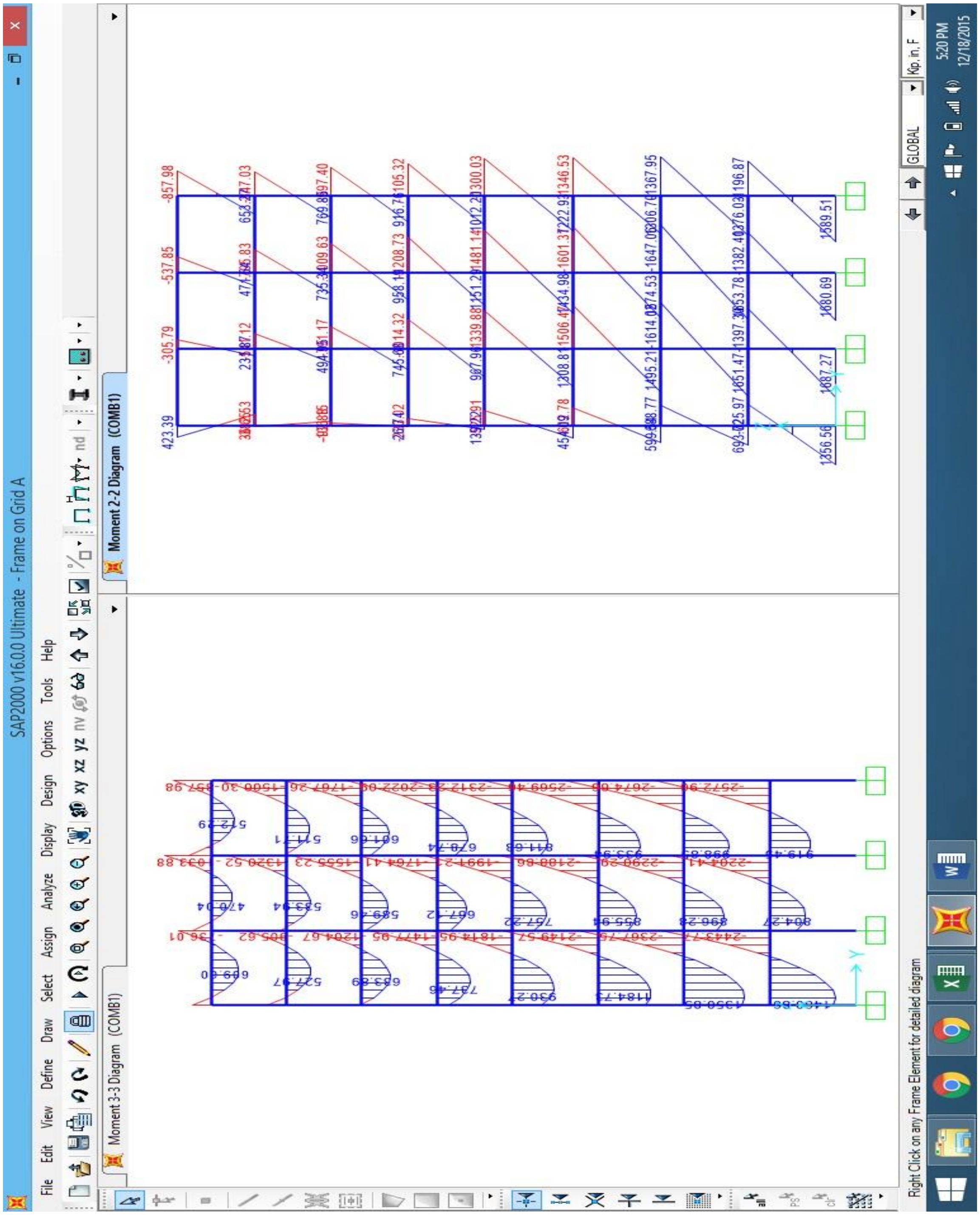
831.8 3550.3 3450.5 2107.1
736.3 3172.9 35.02 3053.6 33.88 21.53 2026.8
8.16 424.5

132.9 -1715.6- -5116.4 396.8 -1845.8 -5319.3 -1310.7 -4283.8
8.70 8.70 5.06 5.06 1.73 1.73



14.2
65.92
12.62
67.45
18.85
61.24
-10.1
147.1
38.65
475.3
37.22
510.8
23.3
2256.9
979.2
3789.2
3648.3
39.43
951.8
3631.6
38.65
3497.6
37.22
2208.8
-10.1
147.1
475.3
510.8
23.3
6.12
-1982.8
6.12
-5417.2
3.28
-2084.7
3.28
-5627
1.35
-1544.6
1.35
-4518.3
39.43
12.01
68.1
10.83
69.3
17.1
23.26
85.56
159.1
41.5
554.2
39.1
597.2
24.61
3870.1
3673.9
2309.4
1031.2
85.56
1080.5
4095.3
3841.9
24.61
2416.3
10.99
41.5
39.14
597.2
135.6
159.1
-1867.2
-5269.5
554.2
-1814.1
-5383.5
-1258.1
-4151.3
1.79
1.79
-0.88
-0.88
-4.44
-4.44
13
67.1
12.7
67.3
19.6
60.53
135.6
-12.7
172.1
44.2
634.1
42.7
684.02
189.13
2988.2
2799.4
20.2
1755
786.3
44.2
42.7
-12.7
5399.4
20.2
2136.5
684.02
189.13
246.8
246.8
308.2
308.2
371.2
371.2
431.7
431.7

5.3 SAP2000 ANALYSIS RESULTS



CHAPTER NO. 6

RESULTS

- In the first sample example of frame there are three members and about 90% results of analysis by MDM have been matched with that by FEM.

- In the second sample example of frame there are six members and about 80% results of analysis by MDM have been matched with that by FEM.

- **COMPARISION OF SOFTWARE RESULTS WITH FEM**

1. The directions of end moments calculated manually by finite element method are same as that of obtained by software calculations (SAP2000).
2. The maximum difference among the results of manual analysis through FEM and software analysis (SAP) is 4023.86kip-in, whereas, the minimum and average difference is 41.52kip-in and 1176kip-in, respectively.
3. The reason of difference in result could be, software analysis (SAP) incorporates cross- section of the elements, whereas, manual calculation through FEM do not incorporate cross- section.

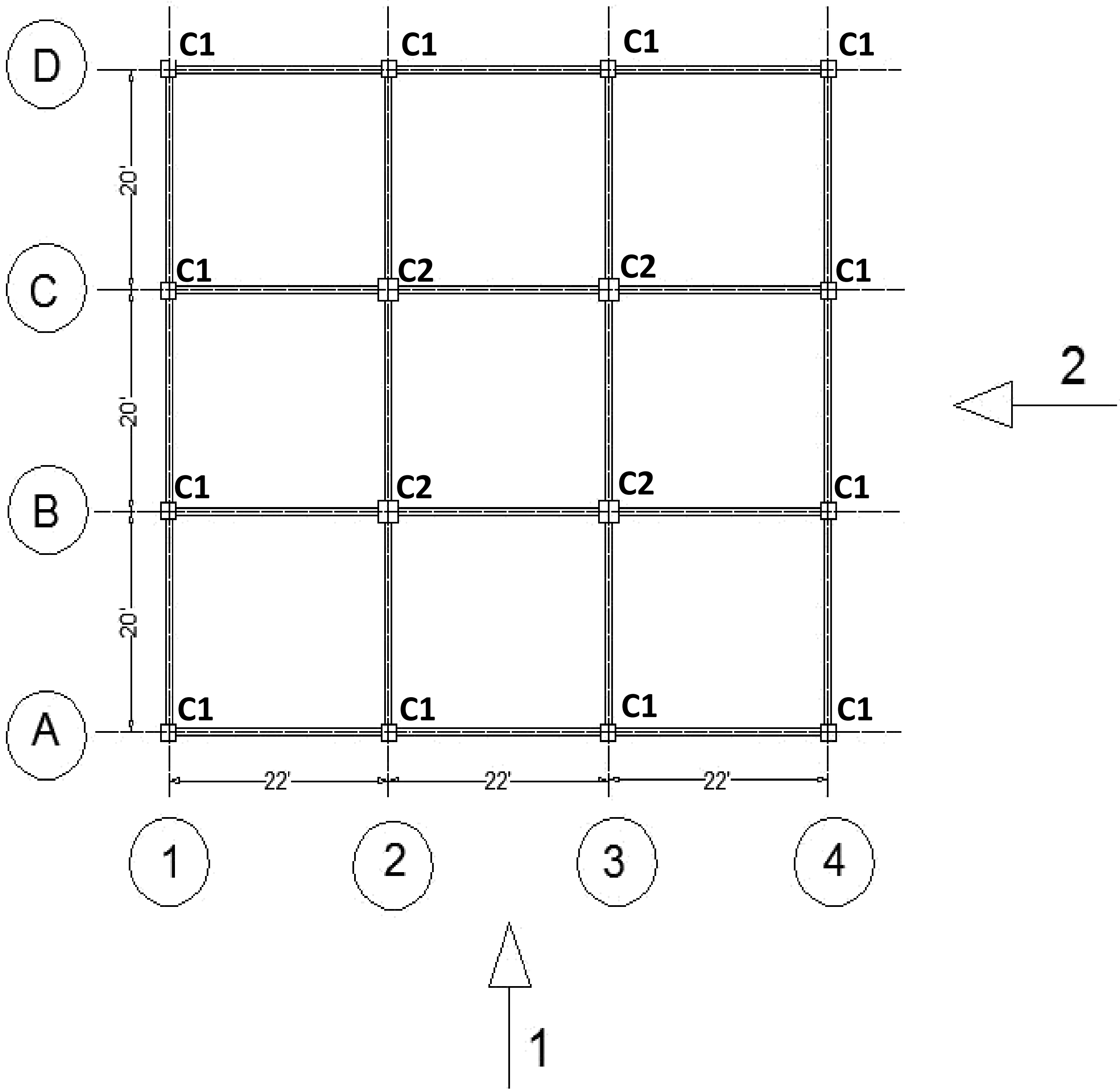
- **COMPARISION OF SOFTWARE RESULTS WITH FEM**

1. The direction of end moments calculated by classical method are different with that of software analysis (SAP2000). The difference in terms of values cannot be measured due to difference in directions.
2. The reason of difference in results could be, the classical method used in this project are portal frame method and matrix displacement method whereas, portal frame method is an approximate method, it has many assumptions regarding point of contra flexure and distribution of horizontal shear. If only matrix displacement method had been used then no such difference would have observed.

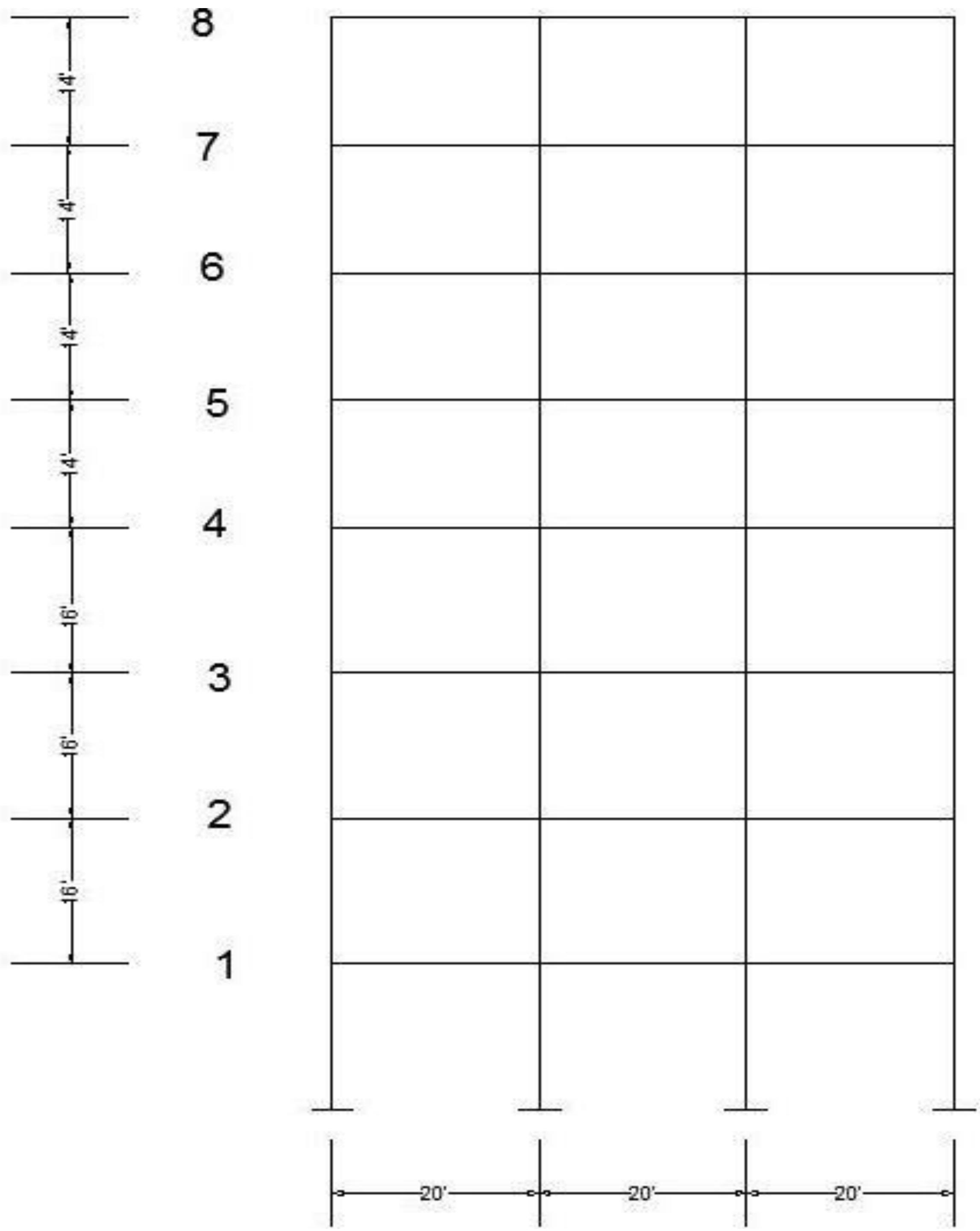
APPENDIX A

DRAWINGS

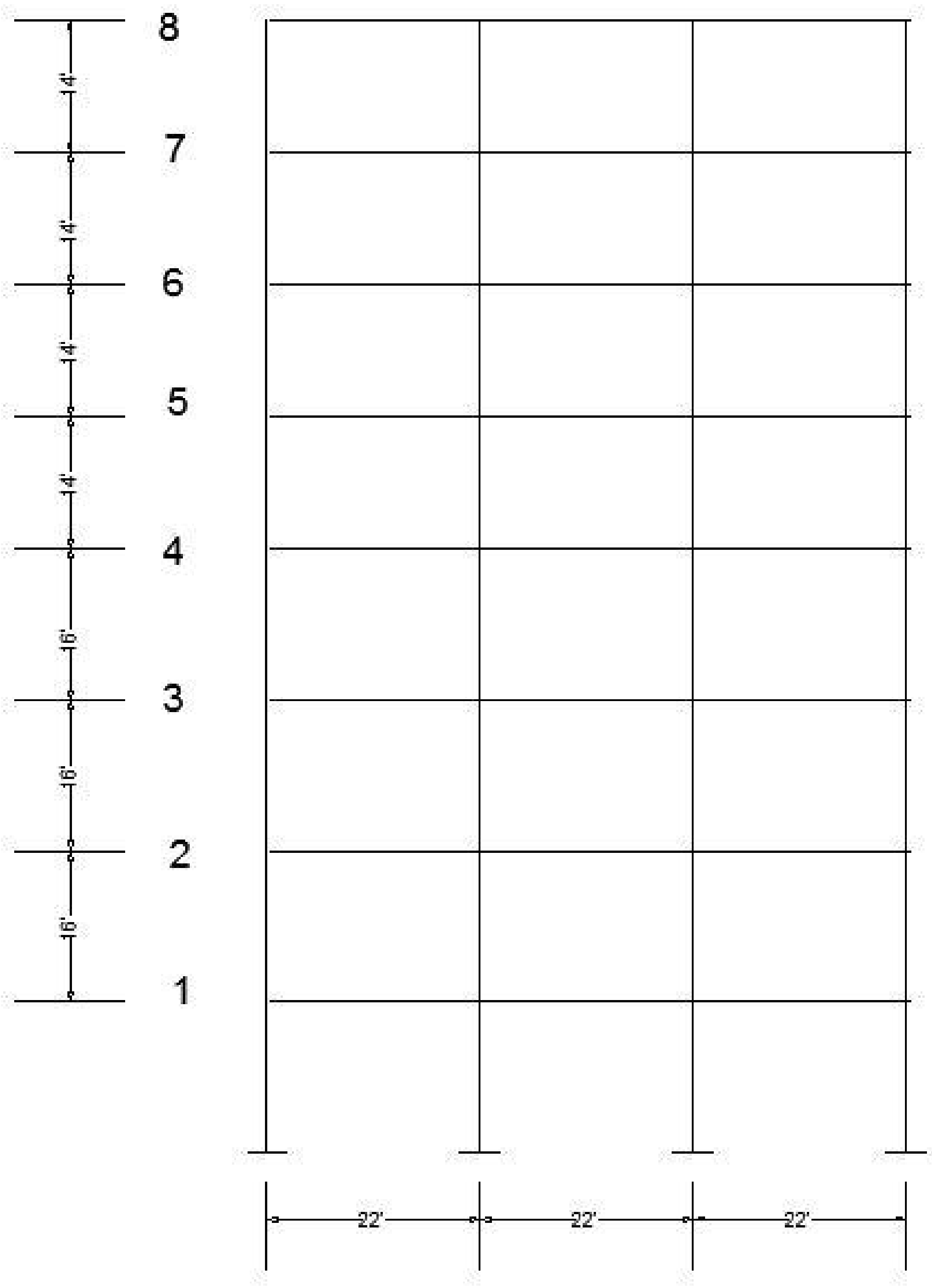
(Plan, Elevations)



PLAN



ELEVATION 1

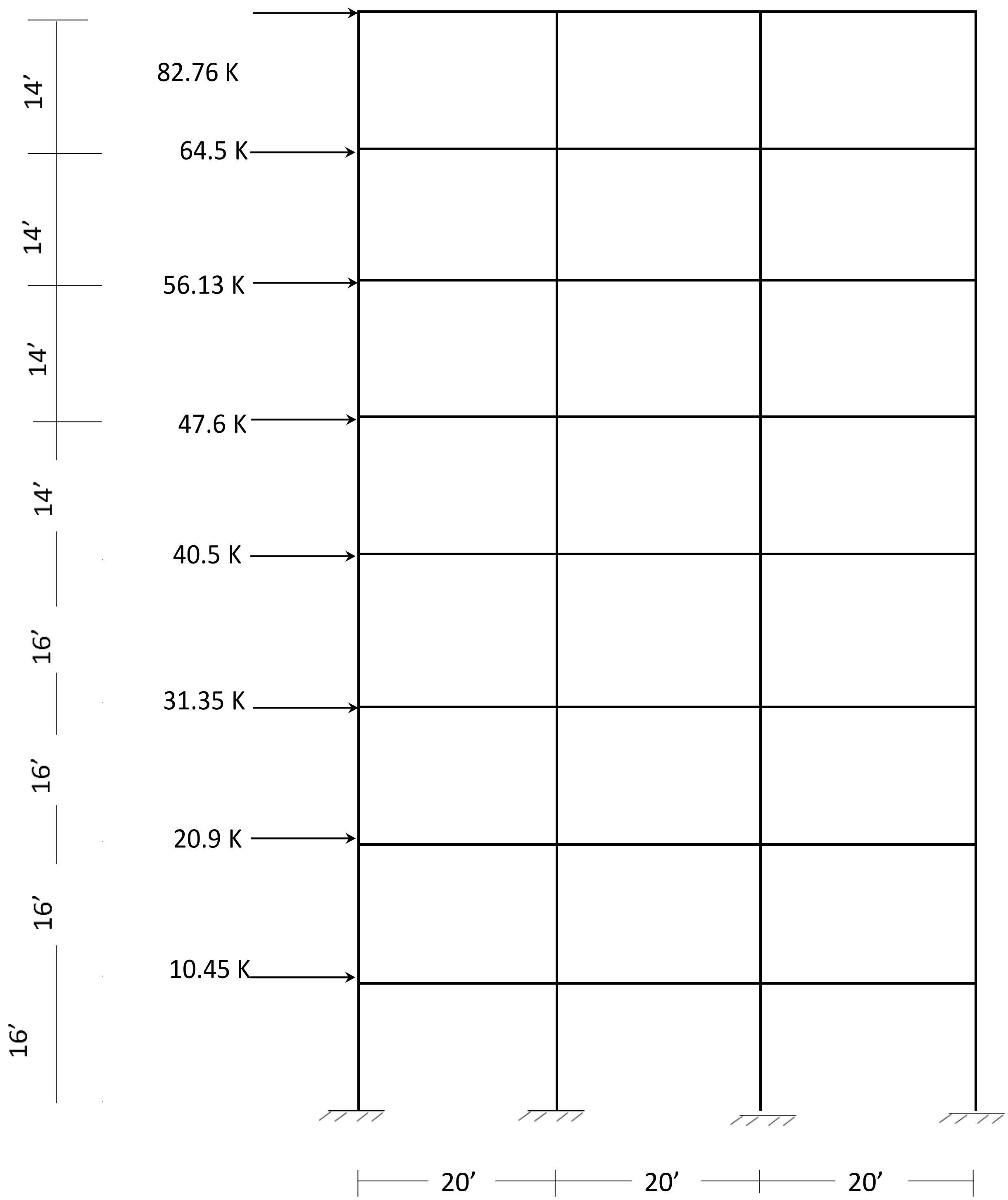


ELEVATION 2

APPENDIX B

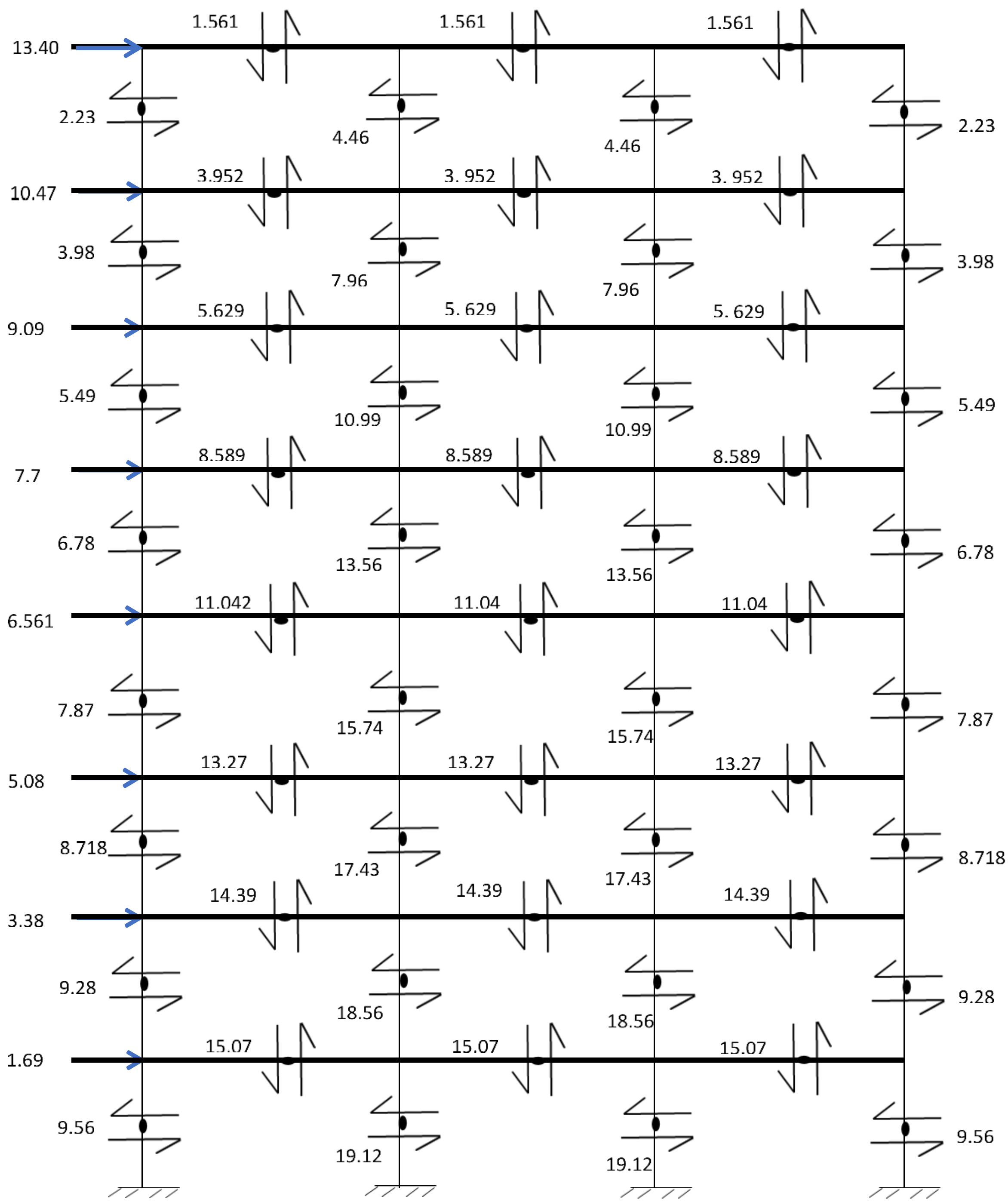
EARTHQUAKE ANALYSIS

STOREY FORCES



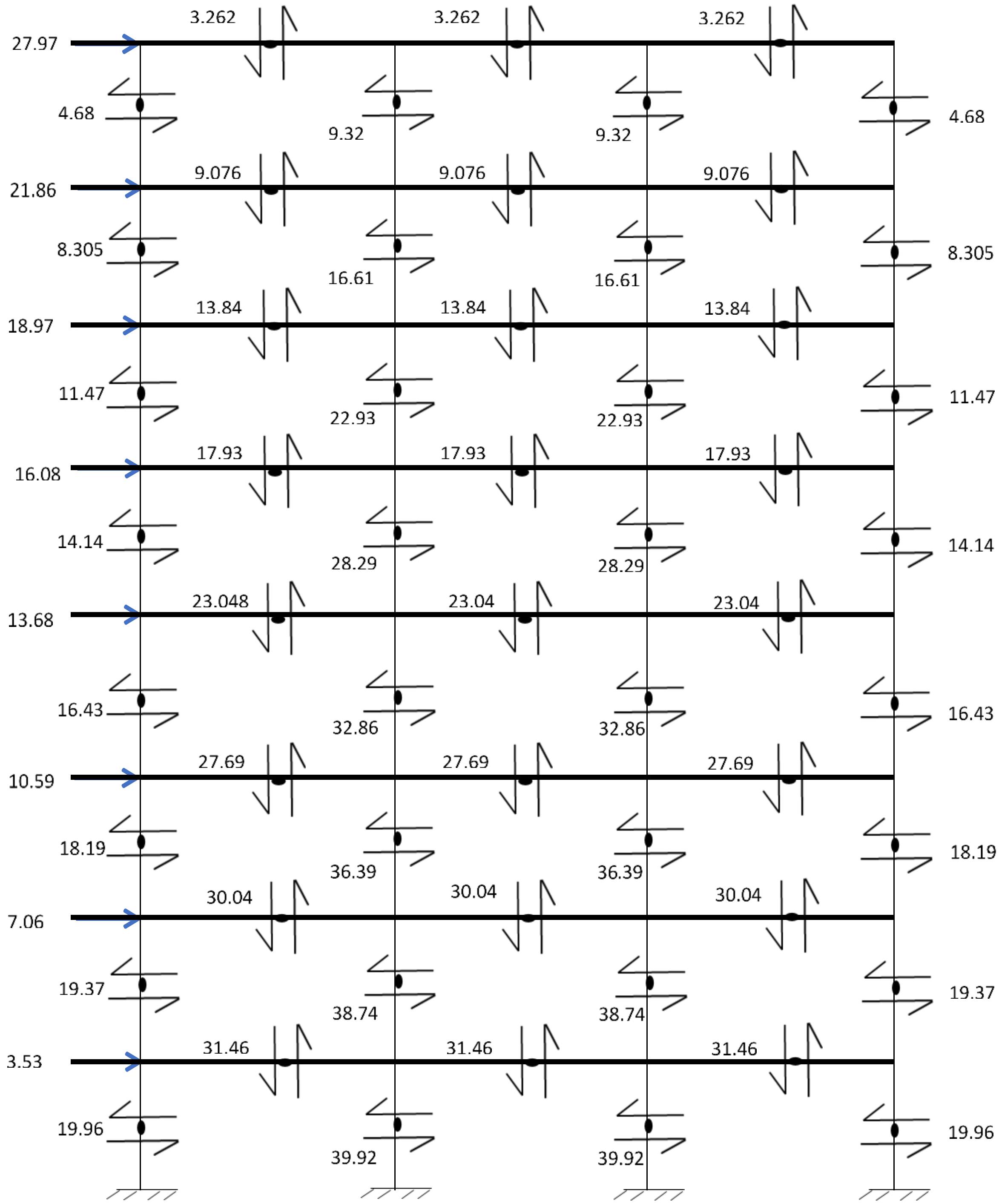
STOREY FORCES

SHEAR DISTRIBUTION



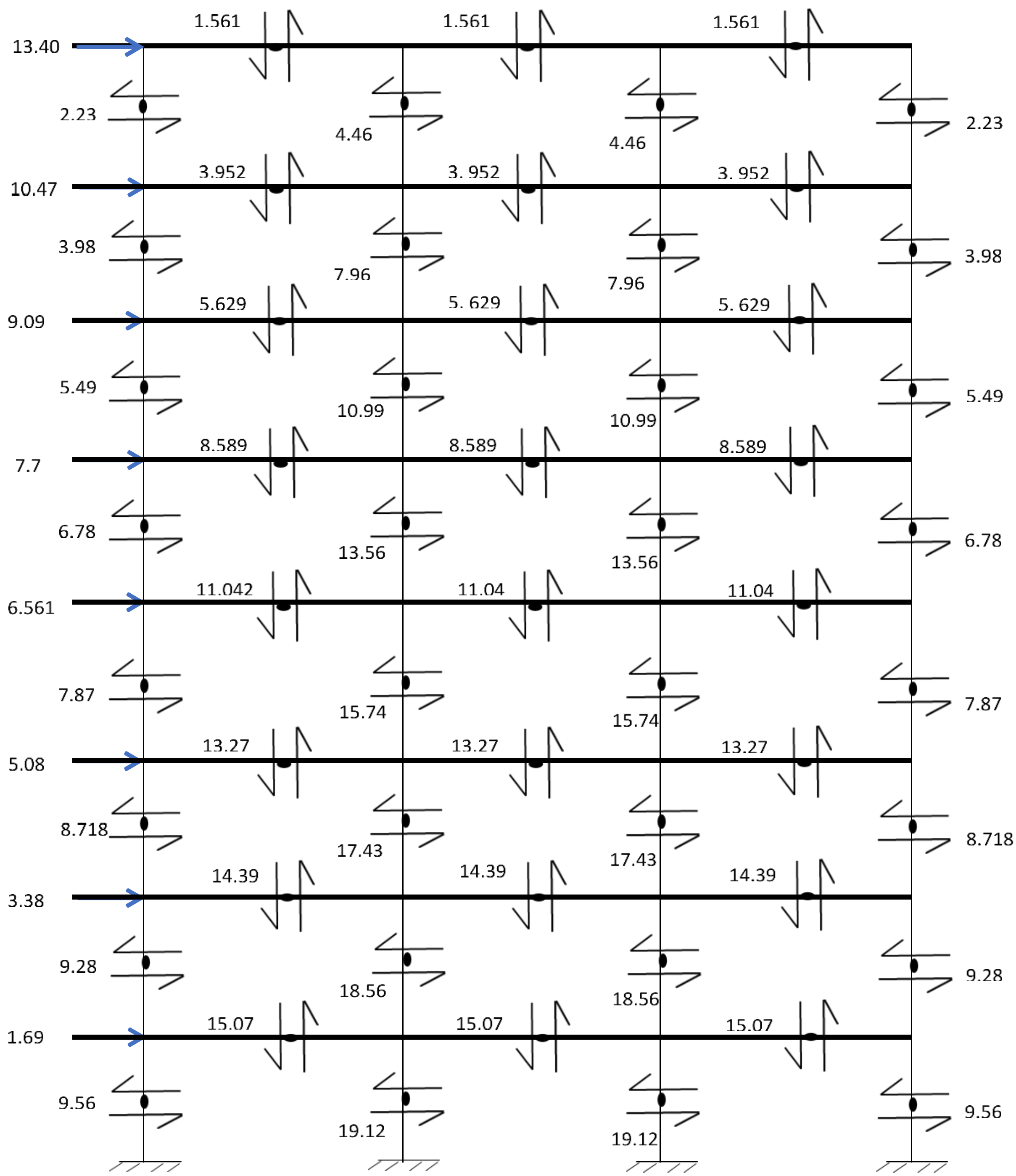
GRID 1&4

Note: All values are in kips.



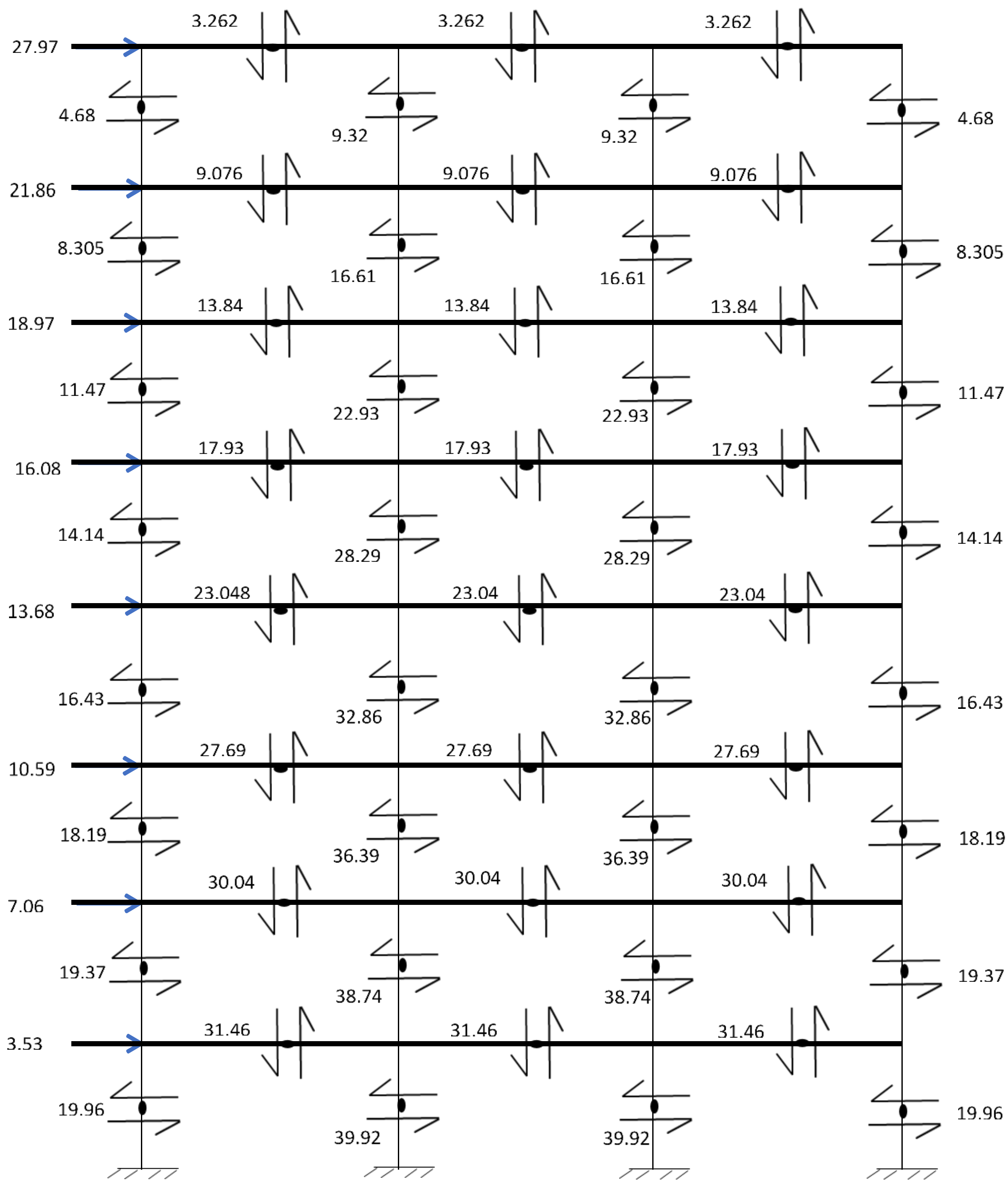
GRID 2&3

Note: All values are in kips.



GRID A&D

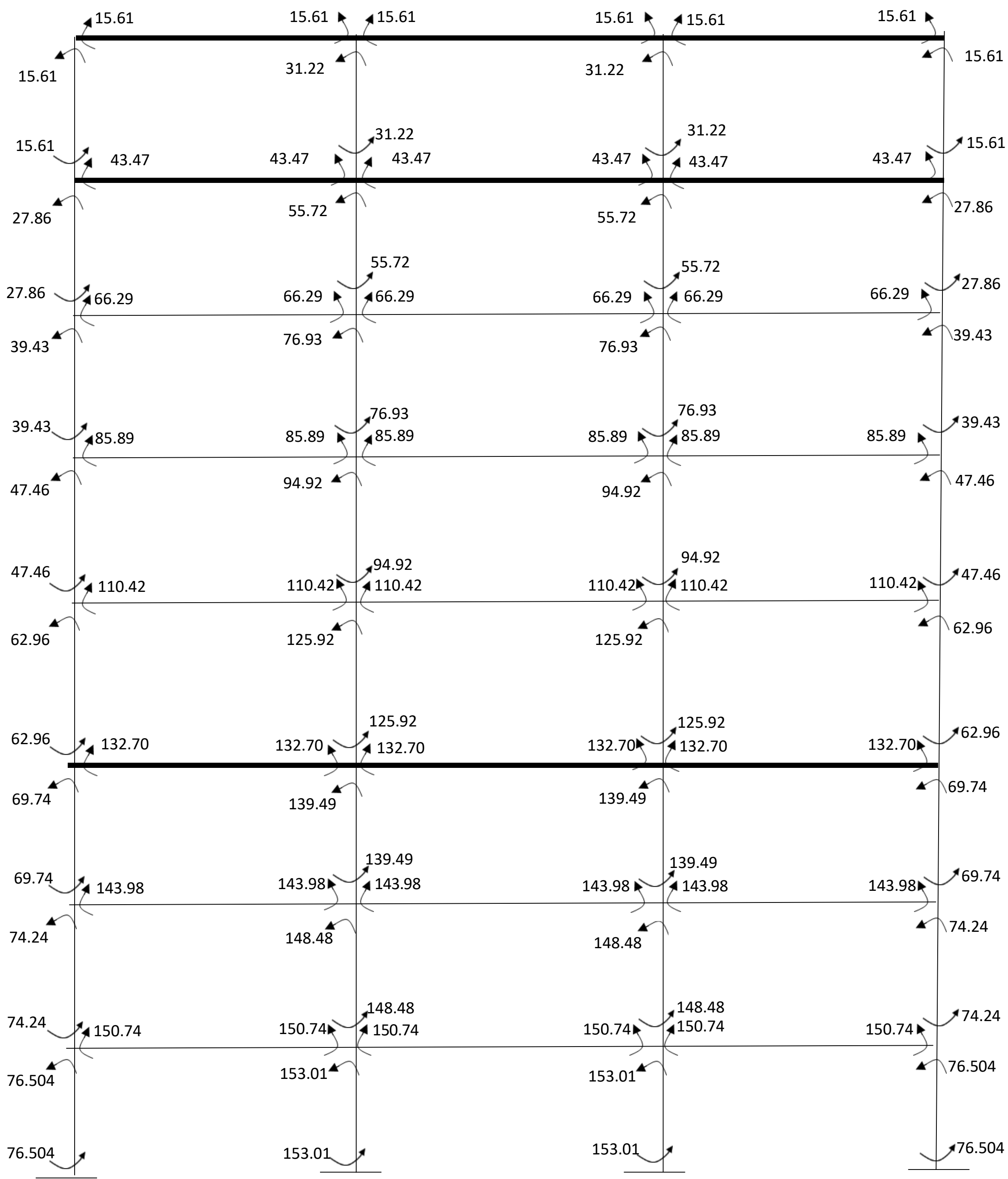
Note: All values are in kips.



GRID B&C

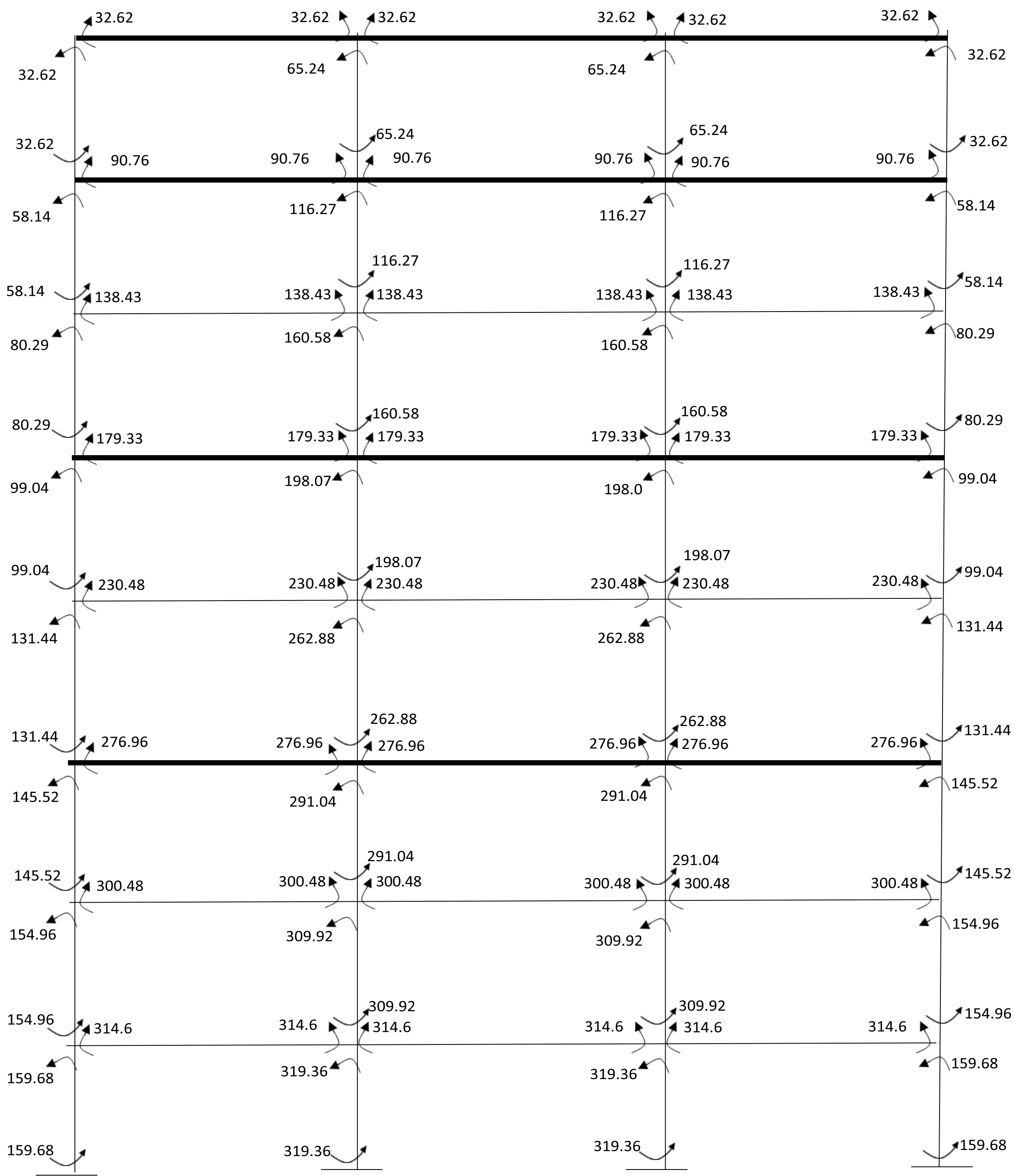
Note: All values are in kips.

END MOMENTS ON BEAMS AND COLUMNS



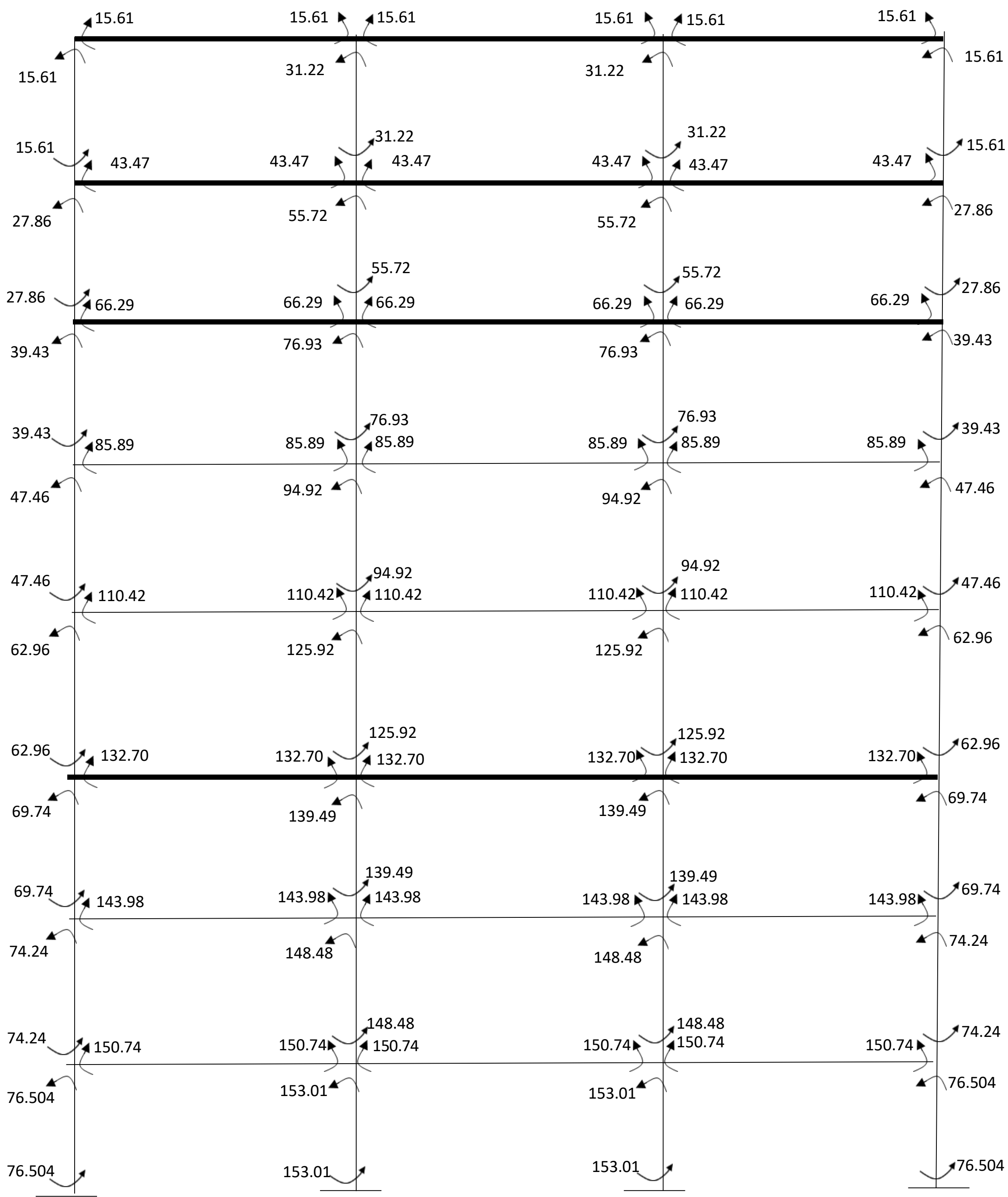
GRID 1&4

Note: All values are in kip-ft.



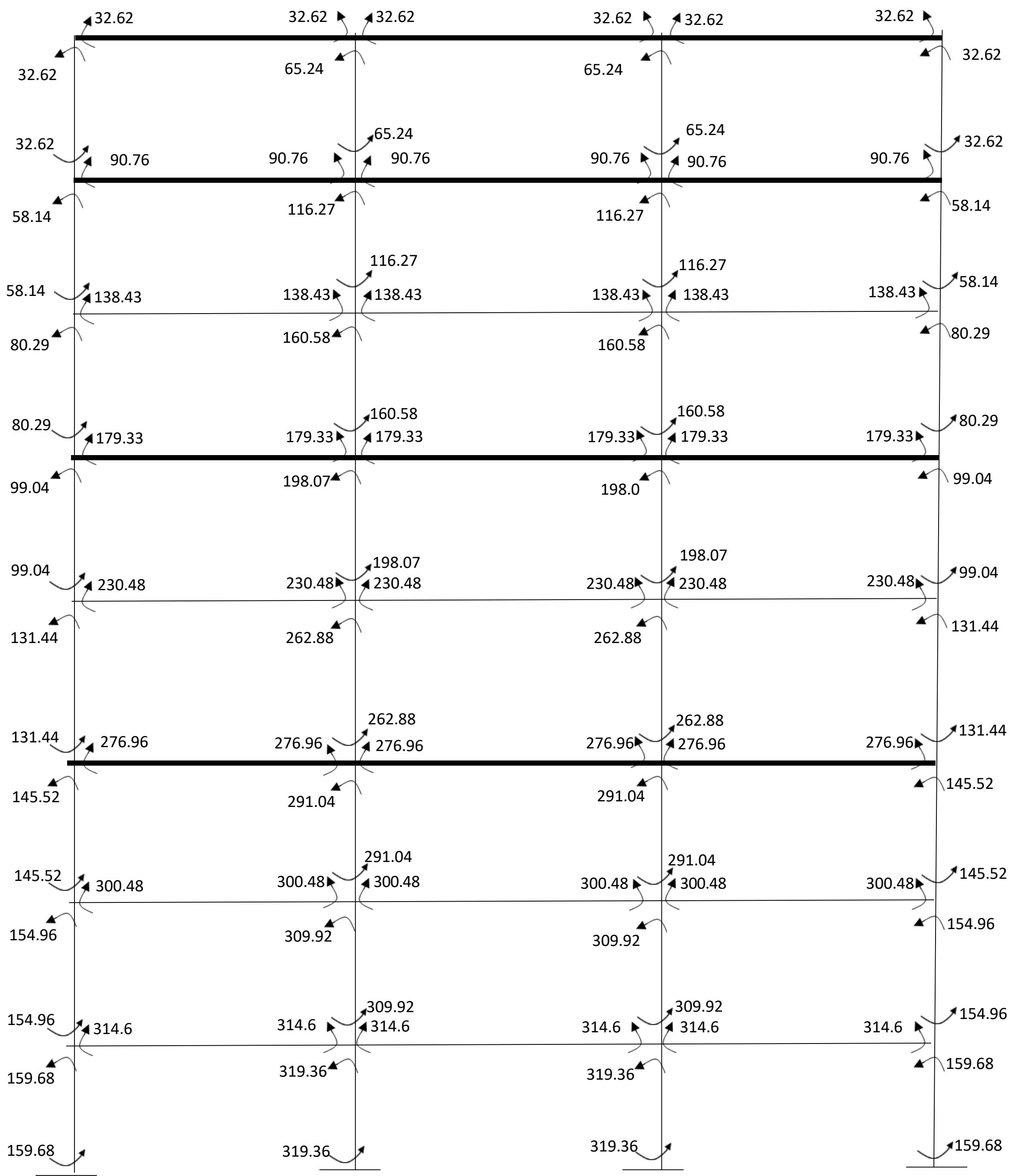
GRID 2&3

Note: All values are in kip-ft.



GRID A&D

Note: All values are in kip-ft.



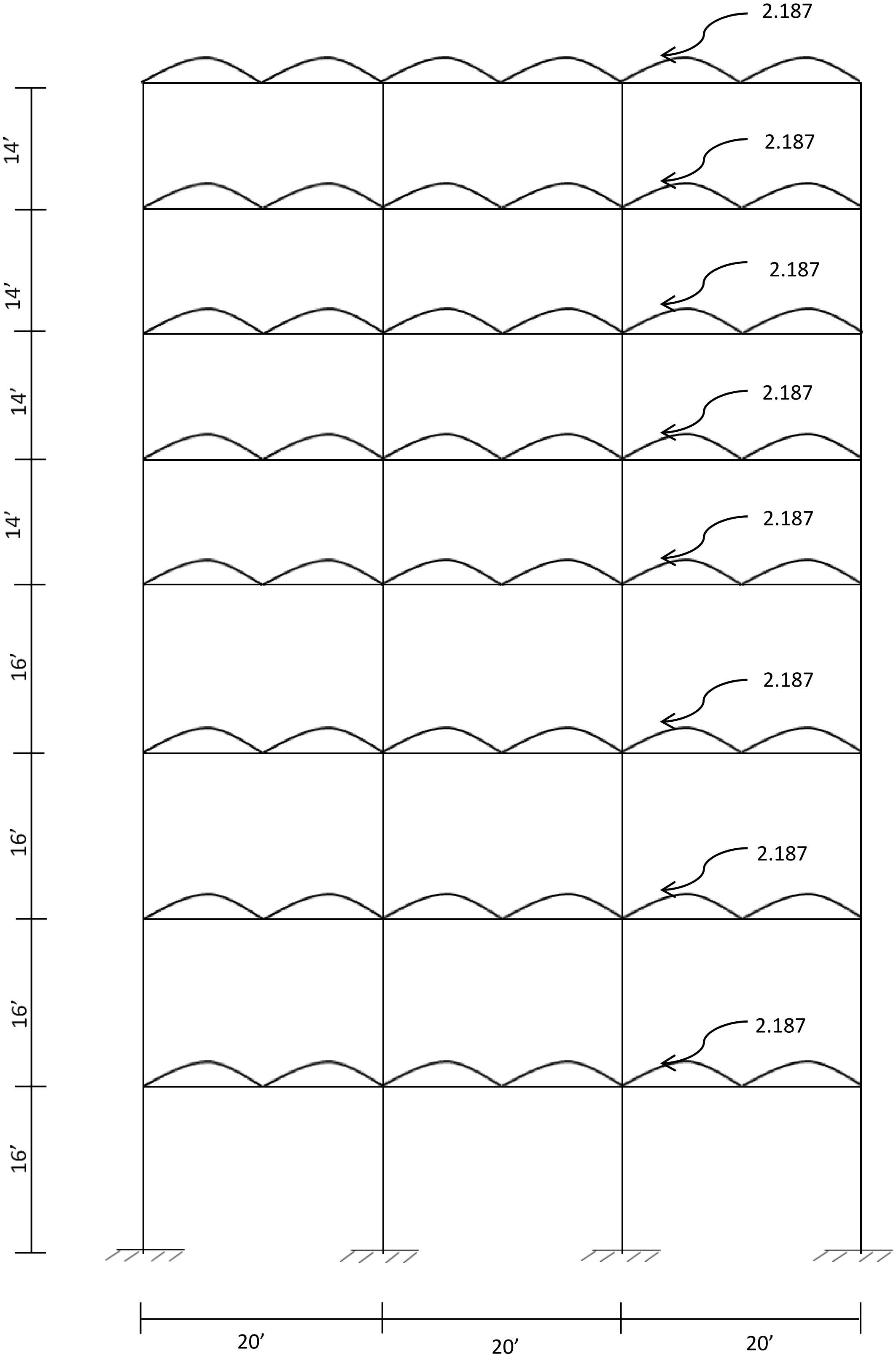
GRID B&C

Note: All values are in kip-ft.

APPENDIX C

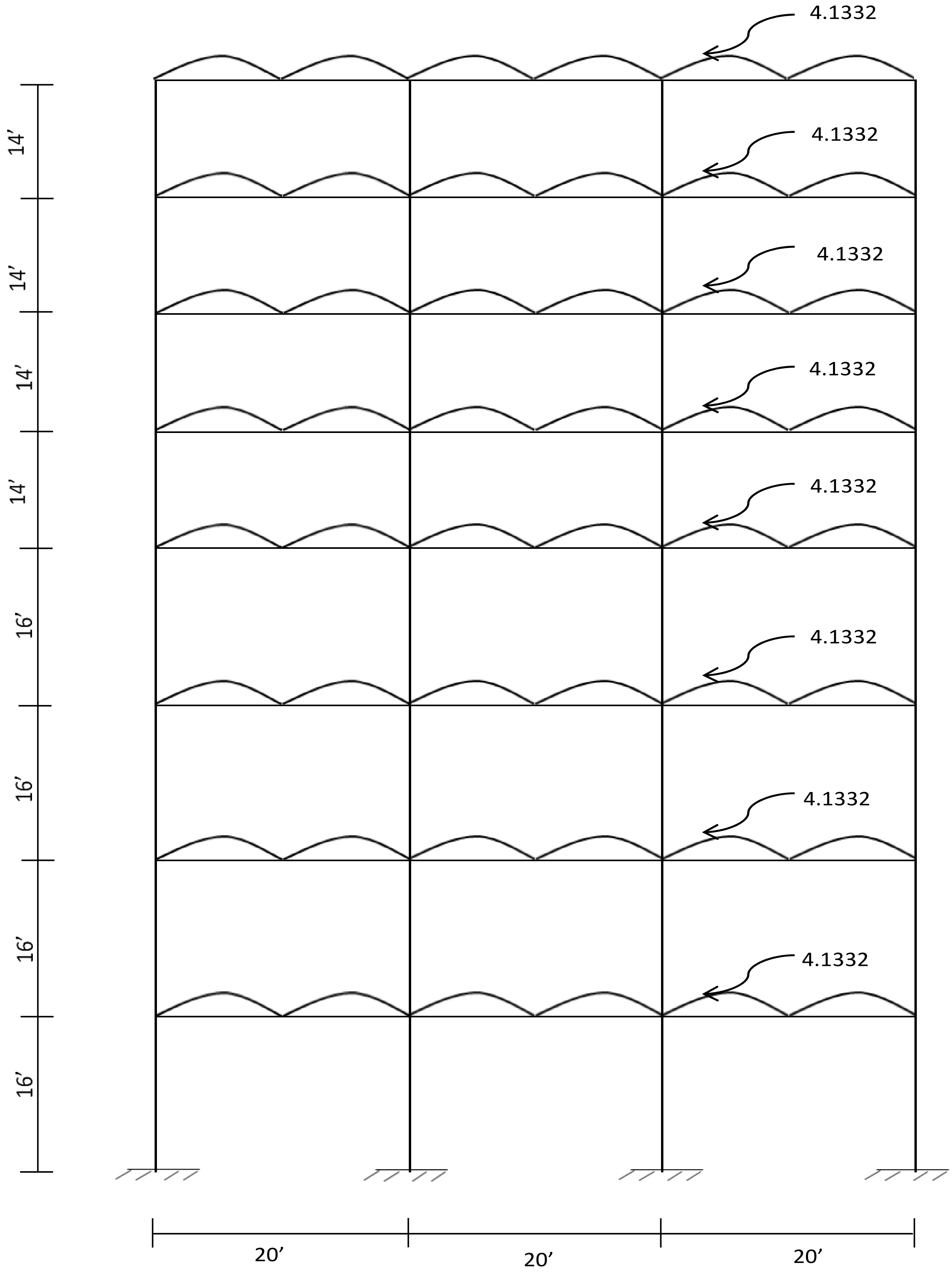
GRAVITY ANALYSIS

GRAVITY LOADS



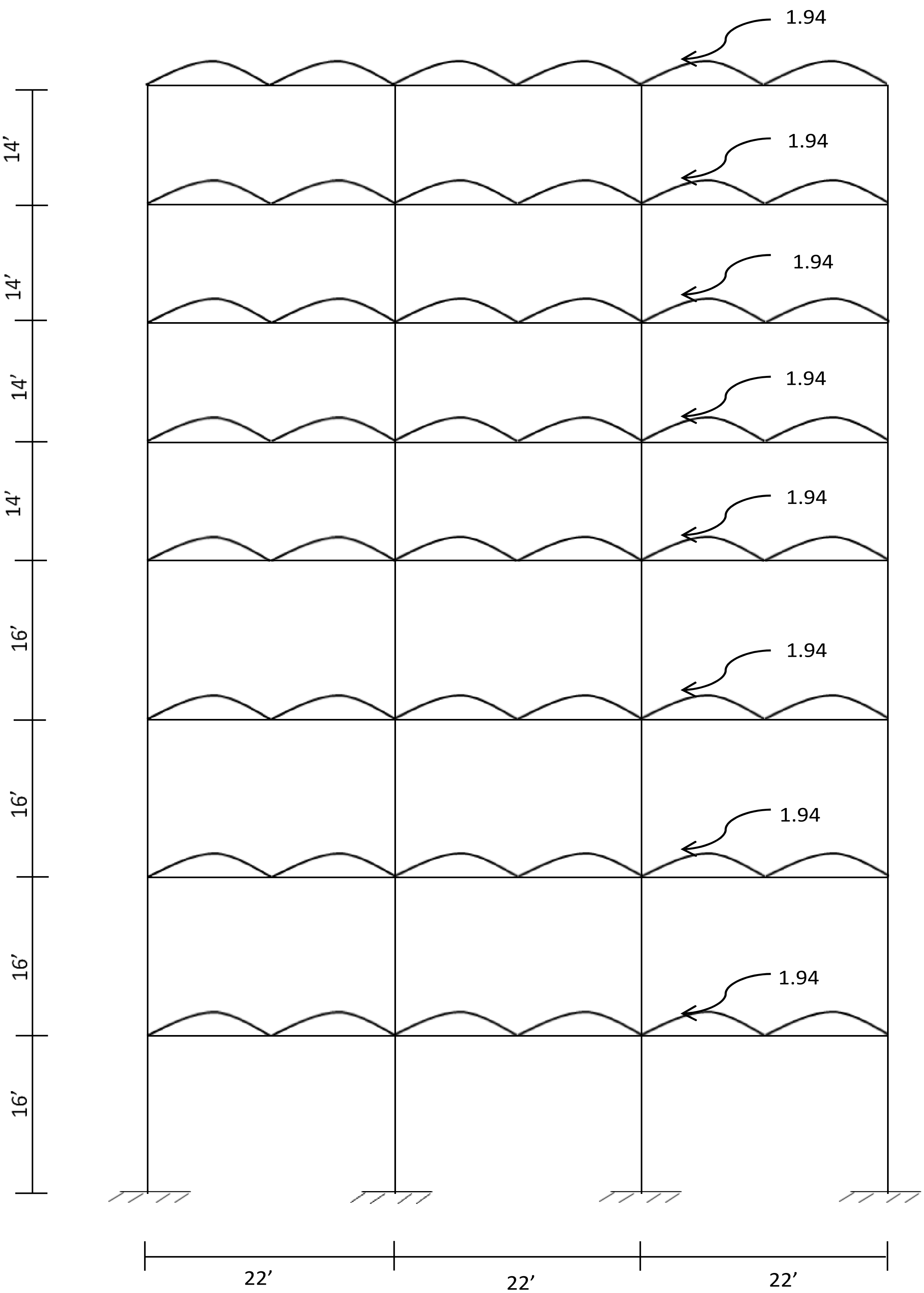
GRID 1&4

Note: All values are in kip/ft.



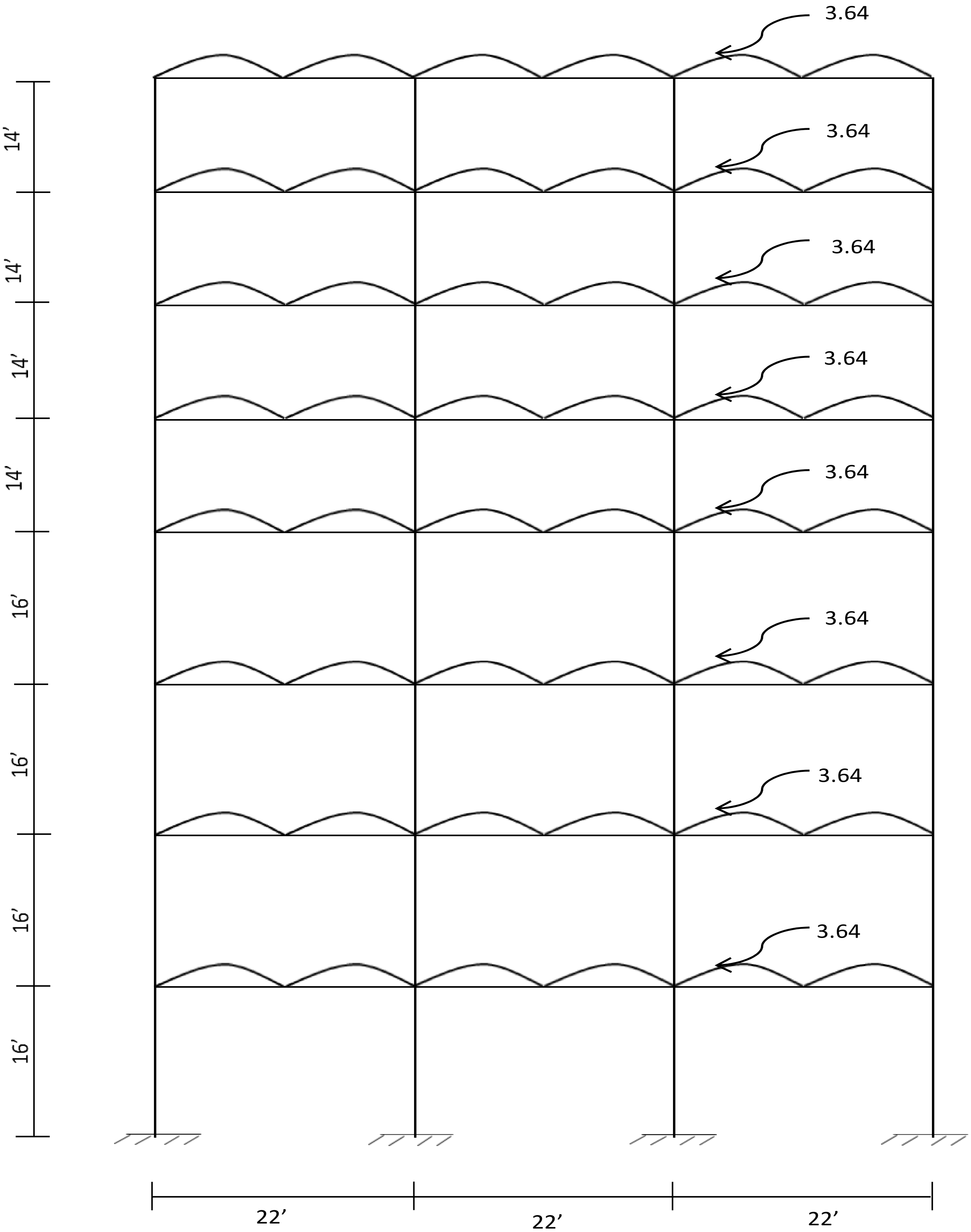
GRID 2&3

Note: All values are in kip/ft.



GRID A&D

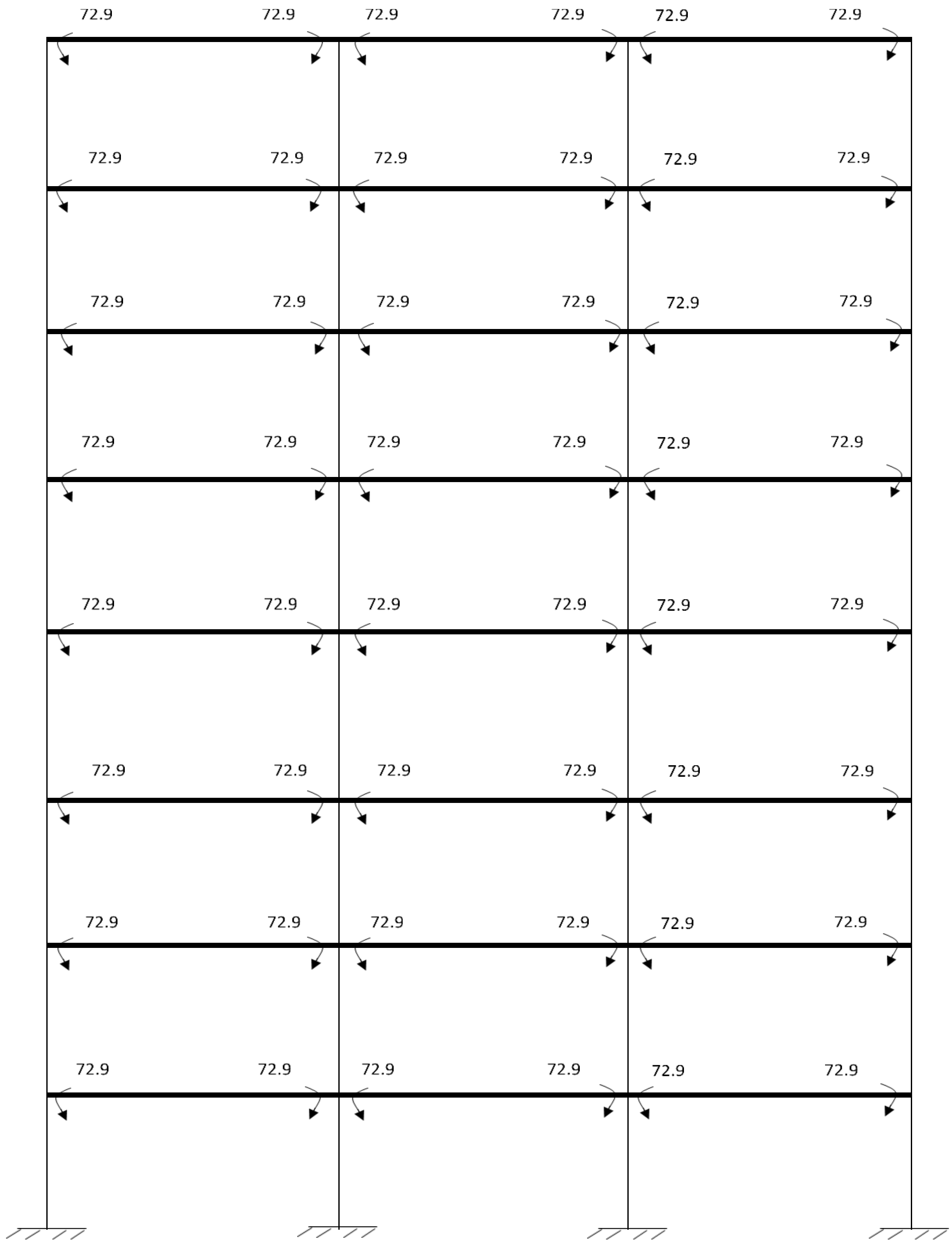
Note: All values are in kip/ft.



GRID B&C

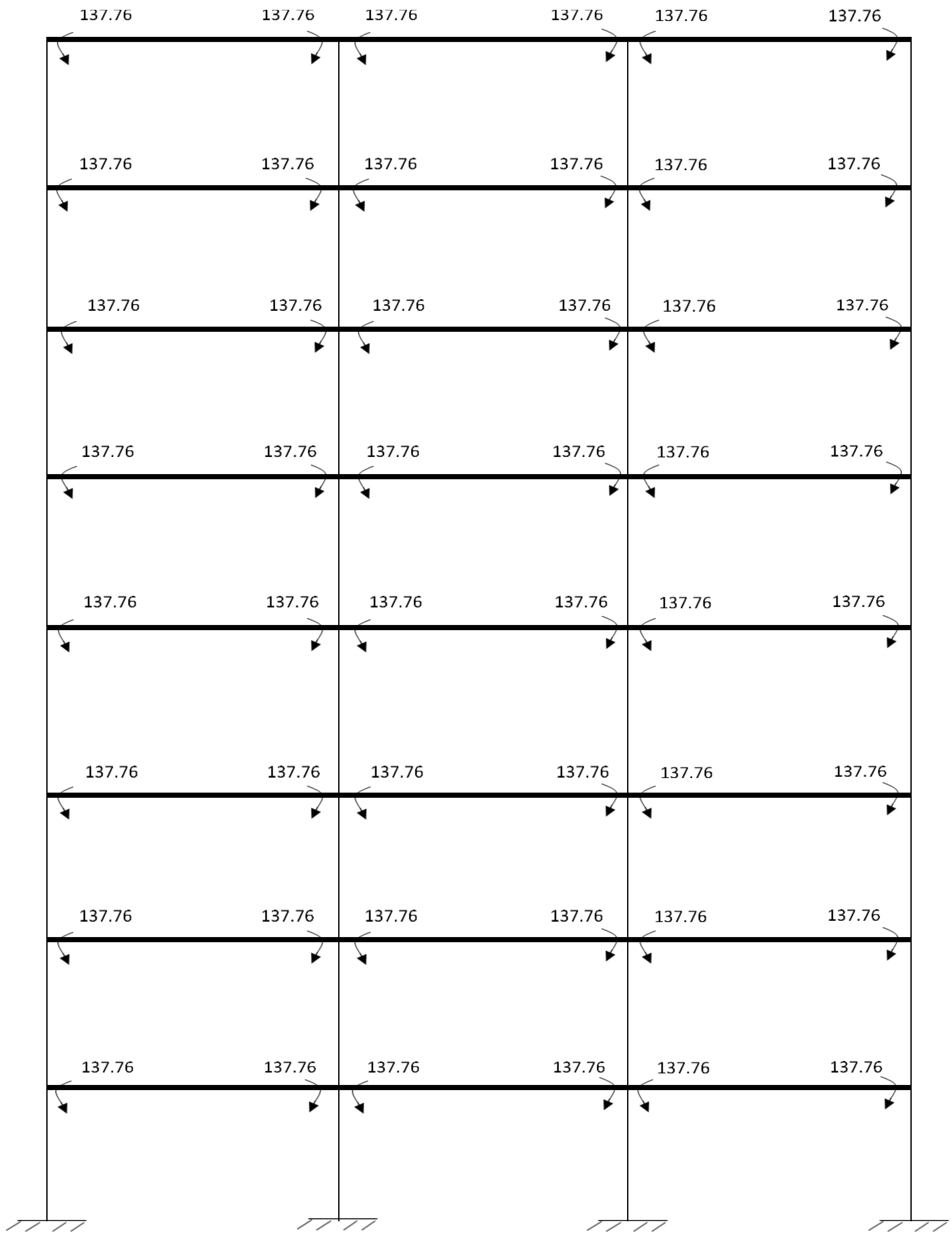
Note: All values are in kip/ft.

FIXED END MOMENTS



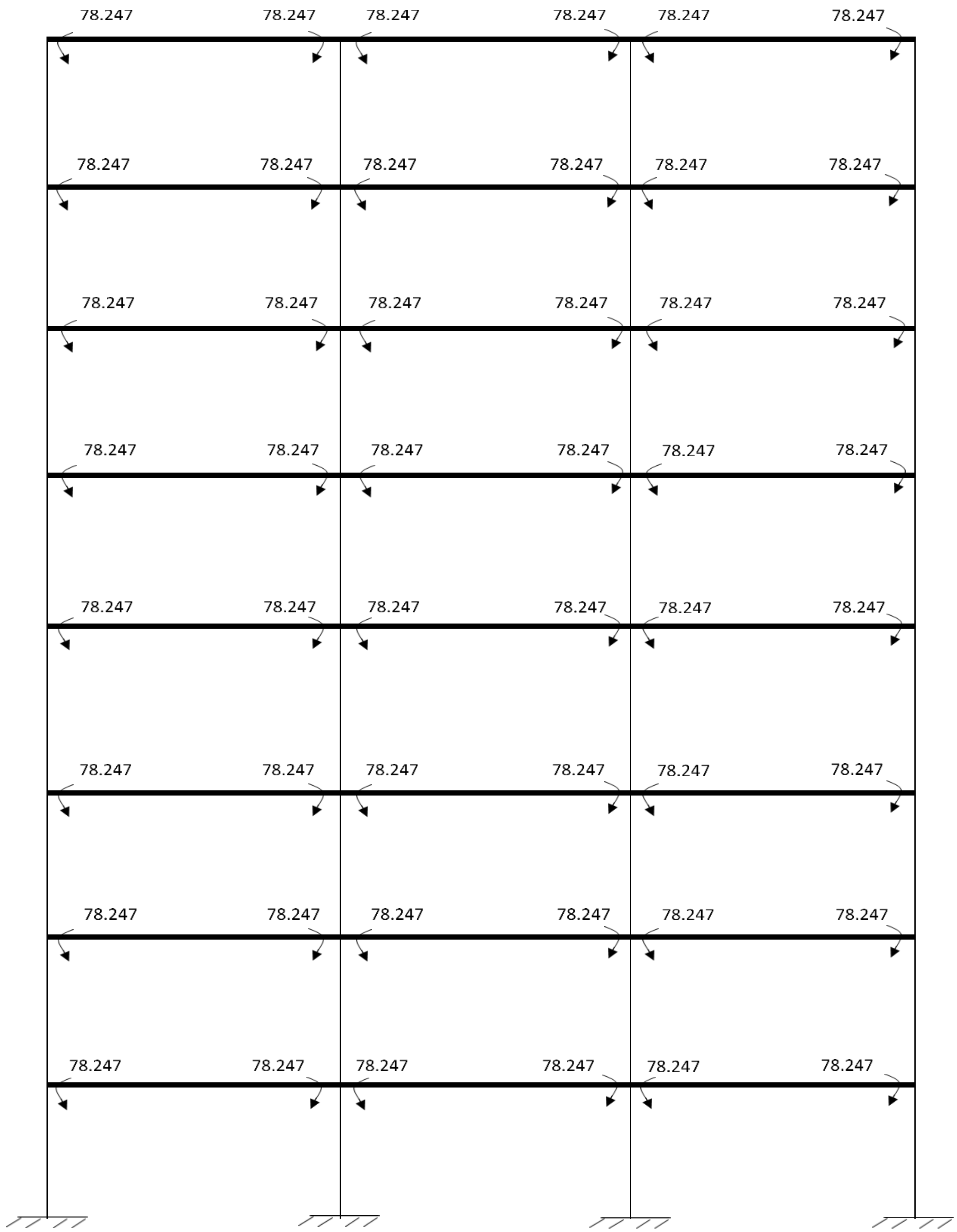
GRID 1&4

Note: All values are in kip-ft.



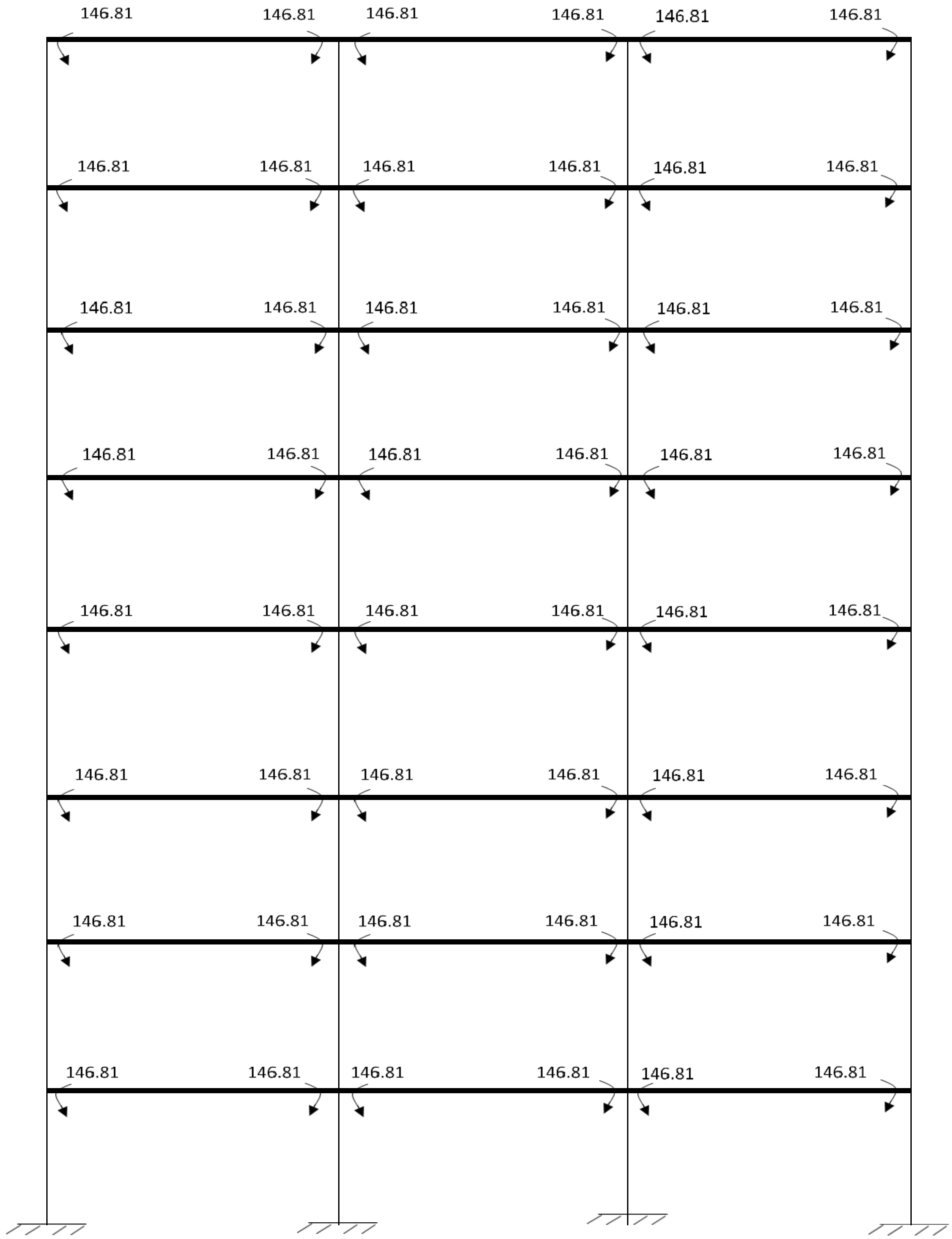
GRID 2&3

Note: All values are in kip-ft.



GRID A&D

Note: All values are in kip-ft.



GRID B&C

Note: All values are in kip-ft.

LOAD MATRIX [P]

ELEVATION 1

P_1	=	874.8
P_2	=	0
P_3	=	0
P_4	=	-874.8
P_5	=	874.8
P_6	=	0
P_7	=	0
P_8	=	-874.8
P_9	=	874.8
P_{10}	=	0
P_{11}	=	0
P_{12}	=	-874.8
P_{13}	=	874.8
P_{14}	=	0
P_{15}	=	0
P_{16}	=	-874.8
P_{17}	=	874.8
P_{18}	=	0
P_{19}	=	0
P_{20}	=	-874.8
P_{21}	=	874.8
P_{22}	=	0
P_{23}	=	0
P_{24}	=	-874.8
P_{25}	=	874.8
P_{26}	=	0
P_{27}	=	0
P_{28}	=	-874.8
P_{29}	=	874.8
P_{30}	=	0
P_{31}	=	0
P_{32}	=	-874.8

GRID 1&4

P_{33}	=	1653.204
P_{34}	=	0
P_{35}	=	0
P_{36}	=	-1653.204
P_{37}	=	1653.204
P_{38}	=	0
P_{39}	=	0
P_{40}	=	-1653.204
P_{41}	=	1653.204
P_{42}	=	0
P_{43}	=	0
P_{44}	=	-1653.204
P_{45}	=	1653.204
P_{46}	=	0
P_{47}	=	0
P_{48}	=	-1653.204
P_{49}	=	1653.204
P_{50}	=	0
P_{51}	=	0
P_{52}	=	-1653.204
P_{53}	=	1653.204
P_{54}	=	0
P_{55}	=	0
P_{56}	=	-1653.204
P_{57}	=	1653.204
P_{58}	=	0
P_{59}	=	0
P_{60}	=	-1653.204
P_{61}	=	1653.204
P_{62}	=	0
P_{63}	=	0
P_{64}	=	-1653.204

GRID 2&3

Note: All values are in kip-in.

ELEVATION 2

P_{65}	=	938.964
P_{66}	=	0
P_{67}	=	0
P_{68}	=	-938.964
P_{69}	=	938.964
P_{70}	=	0
P_{71}	=	0
P_{72}	=	-938.964
P_{73}	=	938.964
P_{74}	=	0
P_{75}	=	0
P_{76}	=	-938.964
P_{77}	=	938.964
P_{78}	=	0
P_{79}	=	0
P_{80}	=	-938.964
P_{81}	=	938.964
P_{82}	=	0
P_{83}	=	0
P_{84}	=	-938.964
P_{85}	=	938.964
P_{86}	=	0
P_{87}	=	0
P_{88}	=	-938.964
P_{89}	=	938.964
P_{90}	=	0
P_{91}	=	0
P_{92}	=	-938.964
P_{93}	=	938.964
P_{94}	=	0
P_{95}	=	0
P_{96}	=	-938.964

GRID A&D

P_{97}	=	1761.76
P_{98}	=	0
P_{99}	=	0
P_{100}	=	-1761.76
P_{101}	=	1761.76
P_{102}	=	0
P_{103}	=	0
P_{104}	=	-1761.76
P_{105}	=	1761.76
P_{106}	=	0
P_{107}	=	0
P_{108}	=	-1761.76
P_{109}	=	1761.76
P_{110}	=	0
P_{111}	=	0
P_{112}	=	-1761.76
P_{113}	=	1761.76
P_{114}	=	0
P_{115}	=	0
P_{116}	=	-1761.76
P_{117}	=	1761.76
P_{118}	=	0
P_{119}	=	0
P_{120}	=	-1761.76
P_{121}	=	1761.76
P_{122}	=	0
P_{123}	=	0
P_{124}	=	-1761.76
P_{125}	=	1761.76
P_{126}	=	0
P_{127}	=	0
P_{128}	=	-1761.76

GRID B&C

Note: All values are in kip-in.

JOINT ROTATION MATRIX [X]

$[X] = [K]^{-1} [P]$

ELEVATION 1

X_{1}	=	2.235626
X_{2}	=	-0.3849
X_{3}	=	0.384903
X_{4}	=	-2.23563
X_{5}	=	0.913685
X_{6}	=	-0.02708
X_{7}	=	0.027082
X_{8}	=	-0.91369
X_{9}	=	1.180001
X_{10}	=	-0.12047
X_{11}	=	0.120467
X_{12}	=	-1.18
X_{13}	=	1.112808
X_{14}	=	-0.09455
X_{15}	=	0.09455
X_{16}	=	-1.11281
X_{17}	=	1.195239
X_{18}	=	-0.11262
X_{19}	=	0.112621
X_{20}	=	-1.19524
X_{21}	=	1.283766
X_{22}	=	-0.13167
X_{23}	=	0.131674
X_{24}	=	-1.28376
X_{25}	=	1.214579
X_{26}	=	-0.1095
X_{27}	=	0.109495
X_{28}	=	-1.21458
X_{29}	=	1.500709
X_{30}	=	-0.17693
X_{31}	=	0.176929
X_{32}	=	-1.50071

GRID 1&4

X_{33}	=	4.144840338
X_{34}	=	-0.362677875
X_{35}	=	0.362677875
X_{36}	=	-4.144840338
X_{37}	=	1.735980167
X_{38}	=	0.011922575
X_{39}	=	-0.011922575
X_{40}	=	-1.735980167
X_{41}	=	2.212649316
X_{42}	=	-0.098524448
X_{43}	=	0.098524448
X_{44}	=	-2.212649316
X_{45}	=	2.09334241
X_{46}	=	-0.065254427
X_{47}	=	0.065254427
X_{48}	=	-2.09334241
X_{49}	=	2.245303468
X_{50}	=	-0.083337323
X_{51}	=	0.083337323
X_{52}	=	-2.245303468
X_{53}	=	2.408471419
X_{54}	=	-0.10047376
X_{55}	=	0.10047376
X_{56}	=	-2.408471419
X_{57}	=	2.28383781
X_{58}	=	-0.076787068
X_{59}	=	0.076787068
X_{60}	=	-2.28383781
X_{61}	=	2.809281989
X_{62}	=	-0.140106993
X_{63}	=	0.140106993
X_{64}	=	-2.809281989

GRID 2&3

Note: All values are in radians.

ELEVATION 2

X_{65}	=	2.5199837
X_{66}	=	-0.56321
X_{67}	=	0.5632672
X_{68}	=	-2.520158
X_{69}	=	0.9731169
X_{70}	=	0.0066642
X_{71}	=	-0.006797
X_{72}	=	-0.972572
X_{73}	=	1.2921403
X_{74}	=	-0.128946
X_{75}	=	0.1295023
X_{76}	=	-1.294788
X_{77}	=	1.2261826
X_{78}	=	-0.097994
X_{79}	=	0.0958128
X_{80}	=	-1.212962
X_{81}	=	1.2386552
X_{82}	=	-0.102385
X_{83}	=	0.1090016
X_{84}	=	-1.305149
X_{85}	=	1.4182294
X_{86}	=	-0.138513
X_{87}	=	0.1363515
X_{88}	=	-1.405465
X_{89}	=	1.3230052
X_{90}	=	-0.109919
X_{91}	=	0.1104502
X_{92}	=	-1.32547
X_{93}	=	1.6483003
X_{94}	=	-0.183001
X_{95}	=	0.1828879
X_{96}	=	-1.647839

GRID A&D

X_{97}	=	4.79098
X_{98}	=	-1.311269
X_{99}	=	1.311485
X_{100}	=	-4.791321
X_{101}	=	1.786708
X_{102}	=	0.233207
X_{103}	=	-0.233432
X_{104}	=	-1.785712
X_{105}	=	2.422703
X_{106}	=	-0.149048
X_{107}	=	0.14976
X_{108}	=	-2.427526
X_{109}	=	2.286698
X_{110}	=	-0.056328
X_{111}	=	0.053975
X_{112}	=	-2.262415
X_{113}	=	2.314883
X_{114}	=	-0.074465
X_{115}	=	0.080511
X_{116}	=	-2.438163
X_{117}	=	2.642889
X_{118}	=	-0.103831
X_{119}	=	0.101447
X_{120}	=	-2.619463
X_{121}	=	2.472147
X_{122}	=	-0.074959
X_{123}	=	0.075658
X_{124}	=	-2.476629
X_{125}	=	3.066555
X_{126}	=	-0.141427
X_{127}	=	0.141254
X_{128}	=	-3.06572

GRID B&C

Note: All values are in radians.

MEMBER ROTATION MATRIX [e]

$[e] = [B]\,[X]$

ELEVATION 1

e_{1}	=	2.235626
e_{2}	=	-0.3849
e_{3}	=	-0.3849
e_{4}	=	0.384903
e_{5}	=	0.384903
e_{6}	=	-2.23563
e_{7}	=	0.913685
e_{8}	=	-0.02708
e_{9}	=	-0.02708
e_{10}	=	0.027082
e_{11}	=	0.027082
e_{12}	=	-0.91369
e_{13}	=	1.180001
e_{14}	=	-0.12047
e_{15}	=	-0.12047
e_{16}	=	0.120467
e_{17}	=	0.120467
e_{18}	=	-1.18
e_{19}	=	1.112808
e_{20}	=	-0.09455
e_{21}	=	-0.09455
e_{22}	=	0.09455
e_{23}	=	0.09455
e_{24}	=	-1.11281
e_{25}	=	1.195239
e_{26}	=	-0.11262
e_{27}	=	-0.11262
e_{28}	=	0.112621

e_{29}	=	0.112621
e_{30}	=	-1.19524
e_{31}	=	1.283766
e_{32}	=	-0.13167
e_{33}	=	-0.13167
e_{34}	=	0.131674
e_{35}	=	0.131674
e_{36}	=	-1.28376
e_{37}	=	1.214579
e_{38}	=	-0.1095
e_{39}	=	-0.1095
e_{40}	=	0.109495
e_{41}	=	0.109495
e_{42}	=	-1.21458
e_{43}	=	1.500709
e_{44}	=	-0.17693
e_{45}	=	-0.17693
e_{46}	=	0.176929
e_{47}	=	0.176929
e_{48}	=	-1.50071
e_{49}	=	2.235626
e_{50}	=	0.913685
e_{51}	=	-0.3849
e_{52}	=	-0.02708
e_{53}	=	0.384903
e_{54}	=	0.027082
e_{55}	=	-2.23563
e_{56}	=	-0.91369

e_{57}	=	0.913685
e_{58}	=	1.180001
e_{59}	=	-0.02708
e_{60}	=	-0.12047
e_{61}	=	0.027082
e_{62}	=	0.120467
e_{63}	=	-0.91369
e_{64}	=	-1.18
e_{65}	=	1.180001
e_{66}	=	1.112808
e_{67}	=	-0.12047
e_{68}	=	-0.09455
e_{69}	=	0.120467
e_{70}	=	0.09455
e_{71}	=	-1.18
e_{72}	=	-1.11281
e_{73}	=	1.112808
e_{74}	=	1.195239
e_{75}	=	-0.09455
e_{76}	=	-0.11262
e_{77}	=	0.09455
e_{78}	=	0.112621
e_{79}	=	-1.11281
e_{80}	=	-1.19524
e_{81}	=	1.195239
e_{82}	=	1.283766
e_{83}	=	-0.11262
e_{84}	=	-0.13167

e_{85}	=	0.112621
e_{86}	=	0.131674
e_{87}	=	-1.19524
e_{88}	=	-1.28376
e_{89}	=	1.283766
e_{90}	=	1.214579
e_{91}	=	-0.13167
e_{92}	=	-0.1095
e_{93}	=	0.131674
e_{94}	=	0.109495
e_{95}	=	-1.28376
e_{96}	=	-1.21458
e_{97}	=	1.214579
e_{98}	=	1.500709
e_{99}	=	-0.1095
e_{100}	=	-0.17693
e_{101}	=	0.109495
e_{102}	=	0.176929
e_{103}	=	-1.21458
e_{104}	=	-1.50071
e_{105}	=	1.500709
e_{106}	=	0
e_{107}	=	-0.17693
e_{108}	=	0
e_{109}	=	0.176929
e_{110}	=	0
e_{111}	=	-1.50071
e_{112}	=	0

GRID 1&4

Note: All values are in radians.

e_{113}	=	4.14484
e_{114}	=	-0.36268
e_{115}	=	-0.36268
e_{116}	=	0.362678
e_{117}	=	0.362678
e_{118}	=	-4.14484
e_{119}	=	1.73598
e_{120}	=	0.011923
e_{121}	=	0.011923
e_{122}	=	-0.01192
e_{123}	=	-0.01192
e_{124}	=	-1.73598
e_{125}	=	2.212649
e_{126}	=	-0.09852
e_{127}	=	-0.09852
e_{128}	=	0.098524
e_{129}	=	0.098524
e_{130}	=	-2.21265
e_{131}	=	2.093342
e_{132}	=	-0.06525
e_{133}	=	-0.06525
e_{134}	=	0.065254
e_{135}	=	0.065254
e_{136}	=	-2.09334
e_{137}	=	2.245303
e_{138}	=	-0.08334
e_{139}	=	-0.08334
e_{140}	=	0.083337

e_{141}	=	0.083337
e_{142}	=	-2.2453
e_{143}	=	2.408471
e_{144}	=	-0.10047
e_{145}	=	-0.10047
e_{146}	=	0.100474
e_{147}	=	0.100474
e_{148}	=	-2.40847
e_{149}	=	2.283838
e_{150}	=	-0.07679
e_{151}	=	-0.07679
e_{152}	=	0.076787
e_{153}	=	0.076787
e_{154}	=	-2.28384
e_{155}	=	2.809282
e_{156}	=	-0.14011
e_{157}	=	-0.14011
e_{158}	=	0.140107
e_{159}	=	0.140107
e_{160}	=	-2.80928
e_{161}	=	4.14484
e_{162}	=	1.73598
e_{163}	=	-0.36268
e_{164}	=	0.011923
e_{165}	=	0.362678
e_{166}	=	-0.01192
e_{167}	=	-4.14484
e_{168}	=	-1.73598

e_{169}	=	1.73598
e_{170}	=	2.212649
e_{171}	=	0.011923
e_{172}	=	-0.09852
e_{173}	=	-0.01192
e_{174}	=	0.098524
e_{175}	=	-1.73598
e_{176}	=	-2.21265
e_{177}	=	2.212649
e_{178}	=	2.093342
e_{179}	=	-0.09852
e_{180}	=	-0.06525
e_{181}	=	0.098524
e_{182}	=	0.065254
e_{183}	=	-2.21265
e_{184}	=	-2.09334
e_{185}	=	2.093342
e_{186}	=	2.245303
e_{187}	=	-0.06525
e_{188}	=	-0.08334
e_{189}	=	0.065254
e_{190}	=	0.083337
e_{191}	=	-2.09334
e_{192}	=	-2.2453
e_{193}	=	2.245303
e_{194}	=	2.408471
e_{195}	=	-0.08334
e_{196}	=	-0.10047

e_{197}	=	0.083337
e_{198}	=	0.100474
e_{199}	=	-2.2453
e_{200}	=	-2.40847
e_{201}	=	2.408471
e_{202}	=	2.283838
e_{203}	=	-0.10047
e_{204}	=	-0.07679
e_{205}	=	0.100474
e_{206}	=	0.076787
e_{207}	=	-2.40847
e_{208}	=	-2.28384
e_{209}	=	2.283838
e_{210}	=	2.809282
e_{211}	=	-0.07679
e_{212}	=	-0.14011
e_{213}	=	0.076787
e_{214}	=	0.140107
e_{215}	=	-2.28384
e_{216}	=	-2.80928
e_{217}	=	2.809282
e_{218}	=	0
e_{219}	=	-0.14011
e_{220}	=	0
e_{221}	=	0.140107
e_{222}	=	0
e_{223}	=	-2.80928
e_{224}	=	0

GRID 2&3

Note: All values are in radians.

ELEVATION 2

e_{225}	=	2.519984
e_{226}	=	-0.56321
e_{227}	=	-0.56321
e_{228}	=	0.563267
e_{229}	=	0.563267
e_{230}	=	-2.52016
e_{231}	=	0.973117
e_{232}	=	0.006664
e_{233}	=	0.006664
e_{234}	=	-0.0068
e_{235}	=	-0.0068
e_{236}	=	-0.97257
e_{237}	=	1.29214
e_{238}	=	-0.12895
e_{239}	=	-0.12895
e_{240}	=	0.129502
e_{241}	=	0.129502
e_{242}	=	-1.29479
e_{243}	=	1.226183
e_{244}	=	-0.09799
e_{245}	=	-0.09799
e_{246}	=	0.095813
e_{247}	=	0.095813
e_{248}	=	-1.21296
e_{249}	=	1.238655
e_{250}	=	-0.10239
e_{251}	=	-0.10239
e_{252}	=	0.109002

e_{253}	=	0.109002
e_{254}	=	-1.30515
e_{255}	=	1.418229
e_{256}	=	-0.13851
e_{257}	=	-0.13851
e_{258}	=	0.136352
e_{259}	=	0.136352
e_{260}	=	-1.40546
e_{261}	=	1.323005
e_{262}	=	-0.10992
e_{263}	=	-0.10992
e_{264}	=	0.11045
e_{265}	=	0.11045
e_{266}	=	-1.32547
e_{267}	=	1.6483
e_{268}	=	-0.183
e_{269}	=	-0.183
e_{270}	=	0.182888
e_{271}	=	0.182888
e_{272}	=	-1.64784
e_{273}	=	2.519984
e_{274}	=	0.973117
e_{275}	=	-0.56321
e_{276}	=	0.006664
e_{277}	=	0.563267
e_{278}	=	-0.0068
e_{279}	=	-2.52016
e_{280}	=	-0.97257

e_{281}	=	0.973117
e_{282}	=	1.29214
e_{283}	=	0.006664
e_{284}	=	-0.12895
e_{285}	=	-0.0068
e_{286}	=	0.129502
e_{287}	=	-0.97257
e_{288}	=	-1.29479
e_{289}	=	1.29214
e_{290}	=	1.226183
e_{291}	=	-0.12895
e_{292}	=	-0.09799
e_{293}	=	0.129502
e_{294}	=	0.095813
e_{295}	=	-1.29479
e_{296}	=	-1.21296
e_{297}	=	1.226183
e_{298}	=	1.238655
e_{299}	=	-0.09799
e_{300}	=	-0.10239
e_{301}	=	0.095813
e_{302}	=	0.109002
e_{303}	=	-1.21296
e_{304}	=	-1.30515
e_{305}	=	1.238655
e_{306}	=	1.418229
e_{307}	=	-0.10239
e_{308}	=	-0.13851

e_{309}	=	0.109002
e_{310}	=	0.136352
e_{311}	=	-1.30515
e_{312}	=	-1.40546
e_{313}	=	1.418229
e_{314}	=	1.323005
e_{315}	=	-0.13851
e_{316}	=	-0.10992
e_{317}	=	0.136352
e_{318}	=	0.11045
e_{319}	=	-1.40546
e_{320}	=	-1.32547
e_{321}	=	1.323005
e_{322}	=	1.6483
e_{323}	=	-0.10992
e_{324}	=	-0.183
e_{325}	=	0.11045
e_{326}	=	0.182888
e_{327}	=	-1.32547
e_{328}	=	-1.64784
e_{329}	=	1.6483
e_{330}	=	0
e_{331}	=	-0.183
e_{332}	=	0
e_{333}	=	0.182888
e_{334}	=	0
e_{335}	=	-1.64784
e_{336}	=	0

GRID A&D

Note: All values are in radians.

e_{337}	=	4.79098
e_{338}	=	-1.3113
e_{339}	=	-1.3113
e_{340}	=	1.31148
e_{341}	=	1.31148
e_{342}	=	-4.7913
e_{343}	=	1.78671
e_{344}	=	0.23321
e_{345}	=	0.23321
e_{346}	=	-0.2334
e_{347}	=	-0.2334
e_{348}	=	-1.7857
e_{349}	=	2.4227
e_{350}	=	-0.149
e_{351}	=	-0.149
e_{352}	=	0.14976
e_{353}	=	0.14976
e_{354}	=	-2.4275
e_{355}	=	2.2867
e_{356}	=	-0.0563
e_{357}	=	-0.0563
e_{358}	=	0.05397
e_{359}	=	0.05397
e_{360}	=	-2.2624
e_{361}	=	2.31488
e_{362}	=	-0.0745
e_{363}	=	-0.0745
e_{364}	=	0.08051
e_{365}	=	0.08051
e_{366}	=	-2.4382
e_{367}	=	2.64289
e_{368}	=	-0.1038
e_{369}	=	-0.1038
e_{370}	=	0.10145
e_{371}	=	0.10145
e_{372}	=	-2.6195
e_{373}	=	2.47215
e_{374}	=	-0.075
e_{375}	=	-0.075
e_{376}	=	0.07566
e_{377}	=	0.07566
e_{378}	=	-2.4766
e_{379}	=	3.06655
e_{380}	=	-0.1414
e_{381}	=	-0.1414
e_{382}	=	0.14125
e_{383}	=	0.14125
e_{384}	=	-3.0657
e_{385}	=	4.79098
e_{386}	=	1.78671
e_{387}	=	-1.3113
e_{388}	=	0.23321
e_{389}	=	1.31148
e_{390}	=	-0.2334
e_{391}	=	-4.7913
e_{392}	=	-1.7857
e_{393}	=	1.78671
e_{394}	=	2.4227
e_{395}	=	0.23321
e_{396}	=	-0.149
e_{397}	=	-0.2334
e_{398}	=	0.14976
e_{399}	=	-1.7857
e_{400}	=	-2.4275
e_{401}	=	2.4227
e_{402}	=	2.2867
e_{403}	=	-0.149
e_{404}	=	-0.0563
e_{405}	=	0.14976
e_{406}	=	0.05397
e_{407}	=	-2.4275
e_{408}	=	-2.2624
e_{409}	=	2.2867
e_{410}	=	2.31488
e_{411}	=	-0.0563
e_{412}	=	-0.0745
e_{413}	=	0.05397
e_{414}	=	0.08051
e_{415}	=	-2.2624
e_{416}	=	-2.4382
e_{417}	=	2.31488
e_{418}	=	2.64289
e_{419}	=	-0.0745
e_{420}	=	-0.1038
e_{421}	=	0.08051
e_{422}	=	0.10145
e_{423}	=	-2.4382
e_{424}	=	-2.6195
e_{425}	=	2.64289
e_{426}	=	2.47215
e_{427}	=	-0.1038
e_{428}	=	-0.075
e_{429}	=	0.10145
e_{430}	=	0.07566
e_{431}	=	-2.6195
e_{432}	=	-2.4766
e_{433}	=	2.47215
e_{434}	=	3.06655
e_{435}	=	-0.075
e_{436}	=	-0.1414
e_{437}	=	0.07566
e_{438}	=	0.14125
e_{439}	=	-2.4766
e_{440}	=	-3.0657
e_{441}	=	3.06655
e_{442}	=	0
e_{443}	=	-0.1414
e_{444}	=	0
e_{445}	=	0.14125
e_{446}	=	0
e_{447}	=	-3.0657
e_{448}	=	0

GRID B&C

Note: All values are in radians.

[F] MATRIX

ELEVATION 1

F_{1}	=	313.8317	F_{29}	=	-74.4963	F_{57}	=	313.1963	F_{85}	=	32.52393
F_{2}	=	112.5751	F_{30}	=	-174.94	F_{58}	=	340.9312	F_{86}	=	34.2602
F_{3}	=	-29.5605	F_{31}	=	187.0738	F_{59}	=	-18.1866	F_{87}	=	-334.816
F_{4}	=	29.56052	F_{32}	=	78.368	F_{60}	=	-27.9119	F_{88}	=	-342.883
F_{5}	=	-112.575	F_{33}	=	-10.1126	F_{61}	=	18.18658	F_{89}	=	344.6448
F_{6}	=	-313.832	F_{34}	=	10.11258	F_{62}	=	27.91193	F_{90}	=	338.3401
F_{7}	=	138.2622	F_{35}	=	-78.368	F_{63}	=	-313.196	F_{91}	=	-33.9754
F_{8}	=	66.01122	F_{36}	=	-187.074	F_{64}	=	-340.931	F_{92}	=	-31.9543
F_{9}	=	-2.07991	F_{37}	=	178.1501	F_{65}	=	361.6684	F_{93}	=	33.9754
F_{10}	=	2.079907	F_{38}	=	76.46119	F_{66}	=	354.6707	F_{94}	=	31.95432
F_{11}	=	-66.0112	F_{39}	=	-8.40922	F_{67}	=	-34.9382	F_{95}	=	-344.645
F_{12}	=	-138.262	F_{40}	=	8.40923	F_{68}	=	-32.2391	F_{96}	=	-338.34
F_{13}	=	171.9963	F_{41}	=	-76.4612	F_{69}	=	34.93818	F_{97}	=	358.109
F_{14}	=	72.12039	F_{42}	=	-178.15	F_{70}	=	32.23908	F_{98}	=	384.1826
F_{15}	=	-9.25184	F_{43}	=	216.9207	F_{71}	=	-361.668	F_{99}	=	-36.0781
F_{16}	=	9.251854	F_{44}	=	88.07819	F_{72}	=	-354.671	F_{100}	=	-42.223
F_{17}	=	-72.1204	F_{45}	=	-13.5881	F_{73}	=	356.2577	F_{101}	=	36.07811
F_{18}	=	-171.996	F_{46}	=	13.58812	F_{74}	=	364.8423	F_{102}	=	42.22299
F_{19}	=	163.6659	F_{47}	=	-88.0782	F_{75}	=	-31.4219	F_{103}	=	-358.109
F_{20}	=	70.94083	F_{48}	=	-216.921	F_{76}	=	-33.3038	F_{104}	=	-384.183
F_{21}	=	-7.26143	F_{49}	=	560.8028	F_{77}	=	31.42195	F_{105}	=	273.5042
F_{22}	=	7.261392	F_{50}	=	423.1321	F_{78}	=	33.30392	F_{106}	=	136.7521
F_{23}	=	-70.9408	F_{51}	=	-82.9901	F_{79}	=	-356.258	F_{107}	=	-32.2452
F_{24}	=	-163.666	F_{52}	=	-45.7257	F_{80}	=	-364.843	F_{108}	=	-16.1226
F_{25}	=	174.9395	F_{53}	=	82.99012	F_{81}	=	334.8155	F_{109}	=	32.24524
F_{26}	=	74.49594	F_{54}	=	45.72567	F_{82}	=	342.8825	F_{110}	=	16.12262
F_{27}	=	-8.64918	F_{55}	=	-560.803	F_{83}	=	-32.5238	F_{111}	=	-273.504
F_{28}	=	8.649303	F_{56}	=	-423.132	F_{84}	=	-34.2602	F_{112}	=	-136.752

GRID 1&4

Note: All values are in kip-in.

F_{113}	=	608.7938
F_{114}	=	262.6164
F_{115}	=	-27.8537
F_{116}	=	27.85366
F_{117}	=	-262.616
F_{118}	=	-608.794
F_{119}	=	267.5622
F_{120}	=	135.1546
F_{121}	=	0.915654
F_{122}	=	-0.91565
F_{123}	=	-135.155
F_{124}	=	-267.562
F_{125}	=	332.2963
F_{126}	=	154.7981
F_{127}	=	-7.56668
F_{128}	=	7.566678
F_{129}	=	-154.798
F_{130}	=	-332.296
F_{131}	=	316.5259
F_{132}	=	150.7456
F_{133}	=	-5.01154
F_{134}	=	5.01154
F_{135}	=	-150.746
F_{136}	=	-316.526
F_{137}	=	338.4783
F_{138}	=	159.6387
F_{139}	=	-6.40031
F_{140}	=	6.400306

F_{141}	=	-159.639
F_{142}	=	-338.478
F_{143}	=	362.2248
F_{144}	=	169.5378
F_{145}	=	-7.71638
F_{146}	=	7.716385
F_{147}	=	-169.538
F_{148}	=	-362.225
F_{149}	=	344.9002
F_{150}	=	163.6043
F_{151}	=	-5.89725
F_{152}	=	5.897247
F_{153}	=	-163.604
F_{154}	=	-344.9
F_{155}	=	420.7455
F_{156}	=	194.2324
F_{157}	=	-10.7602
F_{158}	=	10.76022
F_{159}	=	-194.232
F_{160}	=	-420.745
F_{161}	=	1044.101
F_{162}	=	793.2354
F_{163}	=	-234.821
F_{164}	=	-111.524
F_{165}	=	234.8214
F_{166}	=	111.5244
F_{167}	=	-1044.1
F_{168}	=	-793.235

F_{169}	=	592.0115
F_{170}	=	641.6532
F_{171}	=	-24.5802
F_{172}	=	-60.933
F_{173}	=	24.58016
F_{174}	=	60.93301
F_{175}	=	-592.011
F_{176}	=	-641.653
F_{177}	=	678.8699
F_{178}	=	666.4449
F_{179}	=	-86.3353
F_{180}	=	-75.3847
F_{181}	=	86.33526
F_{182}	=	75.38468
F_{183}	=	-678.87
F_{184}	=	-666.445
F_{185}	=	669.8456
F_{186}	=	685.6713
F_{187}	=	-70.3859
F_{188}	=	-76.3378
F_{189}	=	70.38594
F_{190}	=	76.3378
F_{191}	=	-669.846
F_{192}	=	-685.671
F_{193}	=	628.6785
F_{194}	=	643.5472
F_{195}	=	-76.9387
F_{196}	=	-81.874

F_{197}	=	76.93874
F_{198}	=	81.87403
F_{199}	=	-628.679
F_{200}	=	-643.547
F_{201}	=	647.0586
F_{202}	=	635.7014
F_{203}	=	-79.9876
F_{204}	=	-73.1658
F_{205}	=	79.98756
F_{206}	=	73.16579
F_{207}	=	-647.059
F_{208}	=	-635.701
F_{209}	=	672.2253
F_{210}	=	720.1064
F_{211}	=	-84.5802
F_{212}	=	-102.816
F_{213}	=	84.58016
F_{214}	=	102.8163
F_{215}	=	-672.225
F_{216}	=	-720.106
F_{217}	=	511.9916
F_{218}	=	255.9958
F_{219}	=	-80.7016
F_{220}	=	-40.3508
F_{221}	=	80.70163
F_{222}	=	40.35081
F_{223}	=	-511.992
F_{224}	=	-255.996

GRID 2&3

Note: All values are in kip-in.

ELEVATION 2

F_{225}	=	312.559	F_{253}	=	-75.9026	F_{281}	=	337.254	F_{309}	=	32.2906
F_{226}	=	97.2961	F_{254}	=	-174.636	F_{282}	=	370.478	F_{310}	=	34.7828
F_{227}	=	-39.3183	F_{255}	=	188.366	F_{283}	=	-12.0408	F_{311}	=	-365.936
F_{228}	=	39.3303	F_{256}	=	79.6767	F_{284}	=	-26.1636	F_{312}	=	-375.078
F_{229}	=	-97.3003	F_{257}	=	-9.82166	F_{285}	=	12.0709	F_{313}	=	379.031
F_{230}	=	-312.579	F_{258}	=	9.36889	F_{286}	=	26.2656	F_{314}	=	370.354
F_{231}	=	136.348	F_{259}	=	-79.0873	F_{287}	=	-337.416	F_{315}	=	-35.2604
F_{232}	=	68.8718	F_{260}	=	-186.734	F_{288}	=	-370.972	F_{316}	=	-32.6547
F_{233}	=	0.45598	F_{261}	=	177.065	F_{289}	=	396.833	F_{317}	=	34.9148
F_{234}	=	-0.48388	F_{262}	=	77.0212	F_{290}	=	389.964	F_{318}	=	32.5546
F_{235}	=	-68.8523	F_{263}	=	-7.6372	F_{291}	=	-37.063	F_{319}	=	-376.929
F_{236}	=	-136.281	F_{264}	=	7.74855	F_{292}	=	-33.8395	F_{320}	=	-369.64
F_{237}	=	171.427	F_{265}	=	-77.119	F_{293}	=	36.9517	F_{321}	=	391.319
F_{238}	=	72.2093	F_{266}	=	-177.372	F_{294}	=	33.4432	F_{322}	=	420.962
F_{239}	=	-8.96395	F_{267}	=	217.386	F_{295}	=	-396.007	F_{323}	=	-36.7086
F_{240}	=	9.08045	F_{268}	=	89.5277	F_{296}	=	-387.486	F_{324}	=	-43.3683
F_{241}	=	-72.3165	F_{269}	=	-12.7847	F_{297}	=	384.393	F_{325}	=	36.7952
F_{242}	=	-171.758	F_{270}	=	12.761	F_{298}	=	385.692	F_{326}	=	43.3961
F_{243}	=	164.378	F_{271}	=	-89.5113	F_{299}	=	-31.0734	F_{327}	=	-391.726
F_{244}	=	71.9263	F_{272}	=	-217.329	F_{300}	=	-31.5307	F_{328}	=	-421.102
F_{245}	=	-6.99404	F_{273}	=	626.22	F_{301}	=	31.3082	F_{329}	=	300.403
F_{246}	=	6.5372	F_{274}	=	465.125	F_{302}	=	32.6817	F_{330}	=	150.201
F_{247}	=	-71.3078	F_{275}	=	-116.615	F_{303}	=	-388.565	F_{331}	=	-33.3519
F_{248}	=	-162.684	F_{276}	=	-57.2662	F_{304}	=	-398.165	F_{332}	=	-16.676
F_{249}	=	165.813	F_{277}	=	116.613	F_{305}	=	354.981	F_{333}	=	33.3313
F_{250}	=	72.184	F_{278}	=	57.2445	F_{306}	=	371.345	F_{334}	=	16.6657
F_{251}	=	-6.6864	F_{279}	=	-626.199	F_{307}	=	-31.2817	F_{335}	=	-300.319
F_{252}	=	8.07224	F_{280}	=	-465.029	F_{308}	=	-34.5739	F_{336}	=	-150.159

GRID A&D

Note: All values are in kip-in.

F_{337}	=	577.445
F_{338}	=	151.397
F_{339}	=	-91.536
F_{340}	=	91.5853
F_{341}	=	-151.39
F_{342}	=	-577.48
F_{343}	=	265.772
F_{344}	=	157.309
F_{345}	=	16.2664
F_{346}	=	-16.314
F_{347}	=	-157.27
F_{348}	=	-265.65
F_{349}	=	327.891
F_{350}	=	148.336
F_{351}	=	-10.357
F_{352}	=	10.5056
F_{353}	=	-148.57
F_{354}	=	-328.51
F_{355}	=	315.374
F_{356}	=	151.788
F_{357}	=	-4.097
F_{358}	=	3.60411
F_{359}	=	-150.42
F_{360}	=	-312.15
F_{361}	=	318.043
F_{362}	=	151.223
F_{363}	=	-4.777
F_{364}	=	6.04321

F_{365}	=	-158.99
F_{366}	=	-334.84
F_{367}	=	361.794
F_{368}	=	170.023
F_{369}	=	-7.4157
F_{370}	=	6.91644
F_{371}	=	-168.72
F_{372}	=	-358.69
F_{373}	=	339.968
F_{374}	=	162.134
F_{375}	=	-5.1847
F_{376}	=	5.33114
F_{377}	=	-162.35
F_{378}	=	-340.55
F_{379}	=	418.328
F_{380}	=	194.353
F_{381}	=	-9.8863
F_{382}	=	9.85004
F_{383}	=	-194.32
F_{384}	=	-418.22
F_{385}	=	1183.97
F_{386}	=	871.092
F_{387}	=	-786.43
F_{388}	=	-278.08
F_{389}	=	786.499
F_{390}	=	278.001
F_{391}	=	-1183.9
F_{392}	=	-870.92

F_{393}	=	624.453
F_{394}	=	690.687
F_{395}	=	104.459
F_{396}	=	-21.358
F_{397}	=	-104.37
F_{398}	=	21.7521
F_{399}	=	-624.75
F_{400}	=	-691.59
F_{401}	=	742.758
F_{402}	=	728.594
F_{403}	=	-116.66
F_{404}	=	-86.138
F_{405}	=	116.35
F_{406}	=	84.823
F_{407}	=	-741.23
F_{408}	=	-724.04
F_{409}	=	717.365
F_{410}	=	720.3
F_{411}	=	-61.589
F_{412}	=	-67.559
F_{413}	=	62.0303
F_{414}	=	70.7645
F_{415}	=	-725.15
F_{416}	=	-743.45
F_{417}	=	662.721
F_{418}	=	692.61
F_{419}	=	-72.795
F_{420}	=	-81.253

F_{421}	=	75.5911
F_{422}	=	81.6207
F_{423}	=	-683.05
F_{424}	=	-699.57
F_{425}	=	706.941
F_{426}	=	691.382
F_{427}	=	-81.395
F_{428}	=	-73.08
F_{429}	=	80.2232
F_{430}	=	72.796
F_{431}	=	-703.08
F_{432}	=	-690.06
F_{433}	=	729.989
F_{434}	=	784.154
F_{435}	=	-83.908
F_{436}	=	-103.05
F_{437}	=	84.2605
F_{438}	=	103.152
F_{439}	=	-730.73
F_{440}	=	-784.41
F_{441}	=	558.88
F_{442}	=	279.44
F_{443}	=	-81.462
F_{444}	=	-40.731
F_{445}	=	81.3624
F_{446}	=	40.6812
F_{447}	=	-558.73
F_{448}	=	-279.36

GRID B&C

Note: All values are in kip-in.

$[F_o]$ MATRIX

ELEVATION 1

F_{o1}	=	-874.8
F_{o2}	=	874.8
F_{o3}	=	-874.8
F_{o4}	=	874.8
F_{o5}	=	-874.8
F_{o6}	=	874.8
F_{o7}	=	-874.8
F_{o8}	=	874.8
F_{o9}	=	-874.8
F_{o10}	=	874.8
F_{o11}	=	-874.8
F_{o12}	=	874.8
F_{o13}	=	-874.8
F_{o14}	=	874.8
F_{o15}	=	-874.8
F_{o16}	=	874.8
F_{o17}	=	-874.8
F_{o18}	=	874.8
F_{o19}	=	-874.8
F_{o20}	=	874.8
F_{o21}	=	-874.8
F_{o22}	=	874.8
F_{o23}	=	-874.8
F_{o24}	=	874.8
F_{o25}	=	-874.8
F_{o26}	=	874.8
F_{o27}	=	-874.8
F_{o28}	=	874.8

F_{o29}	=	-874.8
F_{o30}	=	874.8
F_{o31}	=	-874.8
F_{o32}	=	874.8
F_{o33}	=	-874.8
F_{o34}	=	874.8
F_{o35}	=	-874.8
F_{o36}	=	874.8
F_{o37}	=	-874.8
F_{o38}	=	874.8
F_{o39}	=	-874.8
F_{o40}	=	874.8
F_{o41}	=	-874.8
F_{o42}	=	874.8
F_{o43}	=	-874.8
F_{o44}	=	874.8
F_{o45}	=	-874.8
F_{o46}	=	874.8
F_{o47}	=	-874.8
F_{o48}	=	874.8
F_{o49}	=	0
F_{o50}	=	0
F_{o51}	=	0
F_{o52}	=	0
F_{o53}	=	0
F_{o54}	=	0
F_{o55}	=	0
F_{o56}	=	0

F_{o57}	=	0
F_{o58}	=	0
F_{o59}	=	0
F_{o60}	=	0
F_{o61}	=	0
F_{o62}	=	0
F_{o63}	=	0
F_{o64}	=	0
F_{o65}	=	0
F_{o66}	=	0
F_{o67}	=	0
F_{o68}	=	0
F_{o69}	=	0
F_{o70}	=	0
F_{o71}	=	0
F_{o72}	=	0
F_{o73}	=	0
F_{o74}	=	0
F_{o75}	=	0
F_{o76}	=	0
F_{o77}	=	0
F_{o78}	=	0
F_{o79}	=	0
F_{o80}	=	0
F_{o81}	=	0
F_{o82}	=	0
F_{o83}	=	0
F_{o84}	=	0

F_{o85}	=	0
F_{o86}	=	0
F_{o87}	=	0
F_{o88}	=	0
F_{o89}	=	0
F_{o90}	=	0
F_{o91}	=	0
F_{o92}	=	0
F_{o93}	=	0
F_{o94}	=	0
F_{o95}	=	0
F_{o96}	=	0
F_{o97}	=	0
F_{o98}	=	0
F_{o99}	=	0
F_{o100}	=	0
F_{o101}	=	0
F_{o102}	=	0
F_{o103}	=	0
F_{o104}	=	0
F_{o105}	=	0
F_{o106}	=	0
F_{o107}	=	0
F_{o108}	=	0
F_{o109}	=	0
F_{o110}	=	0
F_{o111}	=	0
F_{o112}	=	0

GRID 1&4

Note: All values are in kip-in.

F_{o113}	=	-1653.2	F_{o141}	=	-1653.2	F_{o169}	=	0	F_{o197}	=	0
F_{o114}	=	1653.204	F_{o142}	=	1653.204	F_{o170}	=	0	F_{o198}	=	0
F_{o115}	=	-1653.2	F_{o143}	=	-1653.2	F_{o171}	=	0	F_{o199}	=	0
F_{o116}	=	1653.204	F_{o144}	=	1653.204	F_{o172}	=	0	F_{o200}	=	0
F_{o117}	=	-1653.2	F_{o145}	=	-1653.2	F_{o173}	=	0	F_{o201}	=	0
F_{o118}	=	1653.204	F_{o146}	=	1653.204	F_{o174}	=	0	F_{o202}	=	0
F_{o119}	=	-1653.2	F_{o147}	=	-1653.2	F_{o175}	=	0	F_{o203}	=	0
F_{o120}	=	1653.204	F_{o148}	=	1653.204	F_{o176}	=	0	F_{o204}	=	0
F_{o121}	=	-1653.2	F_{o149}	=	-1653.2	F_{o177}	=	0	F_{o205}	=	0
F_{o122}	=	1653.204	F_{o150}	=	1653.204	F_{o178}	=	0	F_{o206}	=	0
F_{o123}	=	-1653.2	F_{o151}	=	-1653.2	F_{o179}	=	0	F_{o207}	=	0
F_{o124}	=	1653.204	F_{o152}	=	1653.204	F_{o180}	=	0	F_{o208}	=	0
F_{o125}	=	-1653.2	F_{o153}	=	-1653.2	F_{o181}	=	0	F_{o209}	=	0
F_{o126}	=	1653.204	F_{o154}	=	1653.204	F_{o182}	=	0	F_{o210}	=	0
F_{o127}	=	-1653.2	F_{o155}	=	-1653.2	F_{o183}	=	0	F_{o211}	=	0
F_{o128}	=	1653.204	F_{o156}	=	1653.204	F_{o184}	=	0	F_{o212}	=	0
F_{o129}	=	-1653.2	F_{o157}	=	-1653.2	F_{o185}	=	0	F_{o213}	=	0
F_{o130}	=	1653.204	F_{o158}	=	1653.204	F_{o186}	=	0	F_{o214}	=	0
F_{o131}	=	-1653.2	F_{o159}	=	-1653.2	F_{o187}	=	0	F_{o215}	=	0
F_{o132}	=	1653.204	F_{o160}	=	1653.204	F_{o188}	=	0	F_{o216}	=	0
F_{o133}	=	-1653.2	F_{o161}	=	0	F_{o189}	=	0	F_{o217}	=	0
F_{o134}	=	1653.204	F_{o162}	=	0	F_{o190}	=	0	F_{o218}	=	0
F_{o135}	=	-1653.2	F_{o163}	=	0	F_{o191}	=	0	F_{o219}	=	0
F_{o136}	=	1653.204	F_{o164}	=	0	F_{o192}	=	0	F_{o220}	=	0
F_{o137}	=	-1653.2	F_{o165}	=	0	F_{o193}	=	0	F_{o221}	=	0
F_{o138}	=	1653.204	F_{o166}	=	0	F_{o194}	=	0	F_{o222}	=	0
F_{o139}	=	-1653.2	F_{o167}	=	0	F_{o195}	=	0	F_{o223}	=	0
F_{o140}	=	1653.204	F_{o168}	=	0	F_{o196}	=	0	F_{o224}	=	0

GRID 2&3

Note: All values are in kip-in.

ELEVATION 2

F_{o225}	=	-938.96
F_{o226}	=	938.964
F_{o227}	=	-938.96
F_{o228}	=	938.964
F_{o229}	=	-938.96
F_{o230}	=	938.964
F_{o231}	=	-938.96
F_{o232}	=	938.964
F_{o233}	=	-938.96
F_{o234}	=	938.964
F_{o235}	=	-938.96
F_{o236}	=	938.964
F_{o237}	=	-938.96
F_{o238}	=	938.964
F_{o239}	=	-938.96
F_{o240}	=	938.964
F_{o241}	=	-938.96
F_{o242}	=	938.964
F_{o243}	=	-938.96
F_{o244}	=	938.964
F_{o245}	=	-938.96
F_{o246}	=	938.964
F_{o247}	=	-938.96
F_{o248}	=	938.964
F_{o249}	=	-938.96
F_{o250}	=	938.964
F_{o251}	=	-938.96
F_{o252}	=	938.964

F_{o253}	=	-938.96
F_{o254}	=	938.964
F_{o255}	=	-938.96
F_{o256}	=	938.964
F_{o257}	=	-938.96
F_{o258}	=	938.964
F_{o259}	=	-938.96
F_{o260}	=	938.964
F_{o261}	=	-938.96
F_{o262}	=	938.964
F_{o263}	=	-938.96
F_{o264}	=	938.964
F_{o265}	=	-938.96
F_{o266}	=	938.964
F_{o267}	=	-938.96
F_{o268}	=	938.964
F_{o269}	=	-938.96
F_{o270}	=	938.964
F_{o271}	=	-938.96
F_{o272}	=	938.964
F_{o273}	=	0
F_{o274}	=	0
F_{o275}	=	0
F_{o276}	=	0
F_{o277}	=	0
F_{o278}	=	0
F_{o279}	=	0
F_{o280}	=	0

F_{o281}	=	0
F_{o282}	=	0
F_{o283}	=	0
F_{o284}	=	0
F_{o285}	=	0
F_{o286}	=	0
F_{o287}	=	0
F_{o288}	=	0
F_{o289}	=	0
F_{o290}	=	0
F_{o291}	=	0
F_{o292}	=	0
F_{o293}	=	0
F_{o294}	=	0
F_{o295}	=	0
F_{o296}	=	0
F_{o297}	=	0
F_{o298}	=	0
F_{o299}	=	0
F_{o300}	=	0
F_{o301}	=	0
F_{o302}	=	0
F_{o303}	=	0
F_{o304}	=	0
F_{o305}	=	0
F_{o306}	=	0
F_{o307}	=	0
F_{o308}	=	0

F_{o309}	=	0
F_{o310}	=	0
F_{o311}	=	0
F_{o312}	=	0
F_{o313}	=	0
F_{o314}	=	0
F_{o315}	=	0
F_{o316}	=	0
F_{o317}	=	0
F_{o318}	=	0
F_{o319}	=	0
F_{o320}	=	0
F_{o321}	=	0
F_{o322}	=	0
F_{o323}	=	0
F_{o324}	=	0
F_{o325}	=	0
F_{o326}	=	0
F_{o327}	=	0
F_{o328}	=	0
F_{o329}	=	0
F_{o330}	=	0
F_{o331}	=	0
F_{o332}	=	0
F_{o333}	=	0
F_{o334}	=	0
F_{o335}	=	0
F_{o336}	=	0

GRID A&D

Note: All values are in kip-in.

F_{o337}	=	-1761.76
F_{o338}	=	1761.76
F_{o339}	=	-1761.76
F_{o340}	=	1761.76
F_{o341}	=	-1761.76
F_{o342}	=	1761.76
F_{o343}	=	-1761.76
F_{o344}	=	1761.76
F_{o345}	=	-1761.76
F_{o346}	=	1761.76
F_{o347}	=	-1761.76
F_{o348}	=	1761.76
F_{o349}	=	-1761.76
F_{o350}	=	1761.76
F_{o351}	=	-1761.76
F_{o352}	=	1761.76
F_{o353}	=	-1761.76
F_{o354}	=	1761.76
F_{o355}	=	-1761.76
F_{o356}	=	1761.76
F_{o357}	=	-1761.76
F_{o358}	=	1761.76
F_{o359}	=	-1761.76
F_{o360}	=	1761.76
F_{o361}	=	-1761.76
F_{o362}	=	1761.76
F_{o363}	=	-1761.76
F_{o364}	=	1761.76

F_{o365}	=	-1761.76
F_{o366}	=	1761.76
F_{o367}	=	-1761.76
F_{o368}	=	1761.76
F_{o369}	=	-1761.76
F_{o370}	=	1761.76
F_{o371}	=	-1761.76
F_{o372}	=	1761.76
F_{o373}	=	-1761.76
F_{o374}	=	1761.76
F_{o375}	=	-1761.76
F_{o376}	=	1761.76
F_{o377}	=	-1761.76
F_{o378}	=	1761.76
F_{o379}	=	-1761.76
F_{o380}	=	1761.76
F_{o381}	=	-1761.76
F_{o382}	=	1761.76
F_{o383}	=	-1761.76
F_{o384}	=	1761.76
F_{o385}	=	0
F_{o386}	=	0
F_{o387}	=	0
F_{o388}	=	0
F_{o389}	=	0
F_{o390}	=	0
F_{o391}	=	0
F_{o392}	=	0

F_{o393}	=	0
F_{o394}	=	0
F_{o395}	=	0
F_{o396}	=	0
F_{o397}	=	0
F_{o398}	=	0
F_{o399}	=	0
F_{o400}	=	0
F_{o401}	=	0
F_{o402}	=	0
F_{o403}	=	0
F_{o404}	=	0
F_{o405}	=	0
F_{o406}	=	0
F_{o407}	=	0
F_{o408}	=	0
F_{o409}	=	0
F_{o410}	=	0
F_{o411}	=	0
F_{o412}	=	0
F_{o413}	=	0
F_{o414}	=	0
F_{o415}	=	0
F_{o416}	=	0
F_{o417}	=	0
F_{o418}	=	0
F_{o419}	=	0
F_{o420}	=	0

F_{o421}	=	0
F_{o422}	=	0
F_{o423}	=	0
F_{o424}	=	0
F_{o425}	=	0
F_{o426}	=	0
F_{o427}	=	0
F_{o428}	=	0
F_{o429}	=	0
F_{o430}	=	0
F_{o431}	=	0
F_{o432}	=	0
F_{o433}	=	0
F_{o434}	=	0
F_{o435}	=	0
F_{o436}	=	0
F_{o437}	=	0
F_{o438}	=	0
F_{o439}	=	0
F_{o440}	=	0
F_{o441}	=	0
F_{o442}	=	0
F_{o443}	=	0
F_{o444}	=	0
F_{o445}	=	0
F_{o446}	=	0
F_{o447}	=	0
F_{o448}	=	0

GRID B&C

Note: All values are in kip-in.

[F*] MATRIX

ELEVATION 1

F^*_{1}	=	-560.97	F^*_{29}	=	-949.3	F^*_{57}	=	313.196	F^*_{85}	=	32.5239
F^*_{2}	=	987.375	F^*_{30}	=	699.86	F^*_{58}	=	340.931	F^*_{86}	=	34.2602
F^*_{3}	=	-904.36	F^*_{31}	=	-687.73	F^*_{59}	=	-18.187	F^*_{87}	=	-334.82
F^*_{4}	=	904.361	F^*_{32}	=	953.168	F^*_{60}	=	-27.912	F^*_{88}	=	-342.88
F^*_{5}	=	-987.38	F^*_{33}	=	-884.91	F^*_{61}	=	18.1866	F^*_{89}	=	344.645
F^*_{6}	=	560.968	F^*_{34}	=	884.913	F^*_{62}	=	27.9119	F^*_{90}	=	338.34
F^*_{7}	=	-736.54	F^*_{35}	=	-953.17	F^*_{63}	=	-313.2	F^*_{91}	=	-33.975
F^*_{8}	=	940.811	F^*_{36}	=	687.726	F^*_{64}	=	-340.93	F^*_{92}	=	-31.954
F^*_{9}	=	-876.88	F^*_{37}	=	-696.65	F^*_{65}	=	361.668	F^*_{93}	=	33.9754
F^*_{10}	=	876.88	F^*_{38}	=	951.261	F^*_{66}	=	354.671	F^*_{94}	=	31.9543
F^*_{11}	=	-940.81	F^*_{39}	=	-883.21	F^*_{67}	=	-34.938	F^*_{95}	=	-344.64
F^*_{12}	=	736.538	F^*_{40}	=	883.209	F^*_{68}	=	-32.239	F^*_{96}	=	-338.34
F^*_{13}	=	-702.8	F^*_{41}	=	-951.26	F^*_{69}	=	34.9382	F^*_{97}	=	358.109
F^*_{14}	=	946.92	F^*_{42}	=	696.65	F^*_{70}	=	32.2391	F^*_{98}	=	384.183
F^*_{15}	=	-884.05	F^*_{43}	=	-657.88	F^*_{71}	=	-361.67	F^*_{99}	=	-36.078
F^*_{16}	=	884.052	F^*_{44}	=	962.878	F^*_{72}	=	-354.67	F^*_{100}	=	-42.223
F^*_{17}	=	-946.92	F^*_{45}	=	-888.39	F^*_{73}	=	356.258	F^*_{101}	=	36.0781
F^*_{18}	=	702.804	F^*_{46}	=	888.388	F^*_{74}	=	364.842	F^*_{102}	=	42.223
F^*_{19}	=	-711.13	F^*_{47}	=	-962.88	F^*_{75}	=	-31.422	F^*_{103}	=	-358.11
F^*_{20}	=	945.741	F^*_{48}	=	657.879	F^*_{76}	=	-33.304	F^*_{104}	=	-384.18
F^*_{21}	=	-882.06	F^*_{49}	=	560.803	F^*_{77}	=	31.4219	F^*_{105}	=	273.504
F^*_{22}	=	882.061	F^*_{50}	=	423.132	F^*_{78}	=	33.3039	F^*_{106}	=	136.752
F^*_{23}	=	-945.74	F^*_{51}	=	-82.99	F^*_{79}	=	-356.26	F^*_{107}	=	-32.245
F^*_{24}	=	711.134	F^*_{52}	=	-45.726	F^*_{80}	=	-364.84	F^*_{108}	=	-16.123
F^*_{25}	=	-699.86	F^*_{53}	=	82.9901	F^*_{81}	=	334.816	F^*_{109}	=	32.2452
F^*_{26}	=	949.296	F^*_{54}	=	45.7257	F^*_{82}	=	342.882	F^*_{110}	=	16.1226
F^*_{27}	=	-883.45	F^*_{55}	=	-560.8	F^*_{83}	=	-32.524	F^*_{111}	=	-273.5
F^*_{28}	=	883.449	F^*_{56}	=	-423.13	F^*_{84}	=	-34.26	F^*_{112}	=	-136.75

GRID 1&4

Note: All values are in kip-in.

F^*_{113}	=	-1044.41
F^*_{114}	=	1915.82
F^*_{115}	=	-1681.06
F^*_{116}	=	1681.058
F^*_{117}	=	-1915.82
F^*_{118}	=	1044.41
F^*_{119}	=	-1385.64
F^*_{120}	=	1788.359
F^*_{121}	=	-1652.29
F^*_{122}	=	1652.288
F^*_{123}	=	-1788.36
F^*_{124}	=	1385.642
F^*_{125}	=	-1320.91
F^*_{126}	=	1808.002
F^*_{127}	=	-1660.77
F^*_{128}	=	1660.771
F^*_{129}	=	-1808
F^*_{130}	=	1320.908
F^*_{131}	=	-1336.68
F^*_{132}	=	1803.95
F^*_{133}	=	-1658.22
F^*_{134}	=	1658.216
F^*_{135}	=	-1803.95
F^*_{136}	=	1336.678
F^*_{137}	=	-1314.73
F^*_{138}	=	1812.843
F^*_{139}	=	-1659.6
F^*_{140}	=	1659.604

F^*_{141}	=	-1812.84
F^*_{142}	=	1314.726
F^*_{143}	=	-1290.98
F^*_{144}	=	1822.742
F^*_{145}	=	-1660.92
F^*_{146}	=	1660.92
F^*_{147}	=	-1822.74
F^*_{148}	=	1290.979
F^*_{149}	=	-1308.3
F^*_{150}	=	1816.808
F^*_{151}	=	-1659.1
F^*_{152}	=	1659.101
F^*_{153}	=	-1816.81
F^*_{154}	=	1308.304
F^*_{155}	=	-1232.46
F^*_{156}	=	1847.436
F^*_{157}	=	-1663.96
F^*_{158}	=	1663.964
F^*_{159}	=	-1847.44
F^*_{160}	=	1232.459
F^*_{161}	=	1044.101
F^*_{162}	=	793.2354
F^*_{163}	=	-234.821
F^*_{164}	=	-111.524
F^*_{165}	=	234.8214
F^*_{166}	=	111.5244
F^*_{167}	=	-1044.1
F^*_{168}	=	-793.235

F^*_{169}	=	592.0115
F^*_{170}	=	641.6532
F^*_{171}	=	-24.5802
F^*_{172}	=	-60.933
F^*_{173}	=	24.58016
F^*_{174}	=	60.93301
F^*_{175}	=	-592.011
F^*_{176}	=	-641.653
F^*_{177}	=	678.8699
F^*_{178}	=	666.4449
F^*_{179}	=	-86.3353
F^*_{180}	=	-75.3847
F^*_{181}	=	86.33526
F^*_{182}	=	75.38468
F^*_{183}	=	-678.87
F^*_{184}	=	-666.445
F^*_{185}	=	669.8456
F^*_{186}	=	685.6713
F^*_{187}	=	-70.3859
F^*_{188}	=	-76.3378
F^*_{189}	=	70.38594
F^*_{190}	=	76.3378
F^*_{191}	=	-669.846
F^*_{192}	=	-685.671
F^*_{193}	=	628.6785
F^*_{194}	=	643.5472
F^*_{195}	=	-76.9387
F^*_{196}	=	-81.874

F^*_{197}	=	76.93874
F^*_{198}	=	81.87403
F^*_{199}	=	-628.679
F^*_{200}	=	-643.547
F^*_{201}	=	647.0586
F^*_{202}	=	635.7014
F^*_{203}	=	-79.9876
F^*_{204}	=	-73.1658
F^*_{205}	=	79.98756
F^*_{206}	=	73.16579
F^*_{207}	=	-647.059
F^*_{208}	=	-635.701
F^*_{209}	=	672.2253
F^*_{210}	=	720.1064
F^*_{211}	=	-84.5802
F^*_{212}	=	-102.816
F^*_{213}	=	84.58016
F^*_{214}	=	102.8163
F^*_{215}	=	-672.225
F^*_{216}	=	-720.106
F^*_{217}	=	511.9916
F^*_{218}	=	255.9958
F^*_{219}	=	-80.7016
F^*_{220}	=	-40.3508
F^*_{221}	=	80.70163
F^*_{222}	=	40.35081
F^*_{223}	=	-511.992
F^*_{224}	=	-255.996

GRID 2&3

Note: All values are in kip-in.

ELEVATION 2

F^*_{225}	=	-626.4
F^*_{226}	=	1036.3
F^*_{227}	=	-978.28
F^*_{228}	=	978.29
F^*_{229}	=	-1036.3
F^*_{230}	=	626.38
F^*_{231}	=	-802.62
F^*_{232}	=	1007.8
F^*_{233}	=	-938.51
F^*_{234}	=	938.48
F^*_{235}	=	-1007.8
F^*_{236}	=	802.68
F^*_{237}	=	-767.54
F^*_{238}	=	1011.2
F^*_{239}	=	-947.93
F^*_{240}	=	948.04
F^*_{241}	=	-1011.3
F^*_{242}	=	767.21
F^*_{243}	=	-774.59
F^*_{244}	=	1010.9
F^*_{245}	=	-945.96
F^*_{246}	=	945.5
F^*_{247}	=	-1010.3
F^*_{248}	=	776.28
F^*_{249}	=	-773.15
F^*_{250}	=	1011.1
F^*_{251}	=	-945.65
F^*_{252}	=	947.04

F^*_{253}	=	-1014.9
F^*_{254}	=	764.33
F^*_{255}	=	-750.6
F^*_{256}	=	1018.6
F^*_{257}	=	-948.79
F^*_{258}	=	948.33
F^*_{259}	=	-1018.1
F^*_{260}	=	752.23
F^*_{261}	=	-761.9
F^*_{262}	=	1016
F^*_{263}	=	-946.6
F^*_{264}	=	946.71
F^*_{265}	=	-1016.1
F^*_{266}	=	761.59
F^*_{267}	=	-721.58
F^*_{268}	=	1028.5
F^*_{269}	=	-951.75
F^*_{270}	=	951.73
F^*_{271}	=	-1028.5
F^*_{272}	=	721.63
F^*_{273}	=	626.22
F^*_{274}	=	465.12
F^*_{275}	=	-116.61
F^*_{276}	=	-57.266
F^*_{277}	=	116.61
F^*_{278}	=	57.244
F^*_{279}	=	-626.2
F^*_{280}	=	-465.03

F^*_{281}	=	337.25
F^*_{282}	=	370.48
F^*_{283}	=	-12.041
F^*_{284}	=	-26.164
F^*_{285}	=	12.071
F^*_{286}	=	26.266
F^*_{287}	=	-337.42
F^*_{288}	=	-370.97
F^*_{289}	=	396.83
F^*_{290}	=	389.96
F^*_{291}	=	-37.063
F^*_{292}	=	-33.84
F^*_{293}	=	36.952
F^*_{294}	=	33.443
F^*_{295}	=	-396.01
F^*_{296}	=	-387.49
F^*_{297}	=	384.39
F^*_{298}	=	385.69
F^*_{299}	=	-31.073
F^*_{300}	=	-31.531
F^*_{301}	=	31.308
F^*_{302}	=	32.682
F^*_{303}	=	-388.56
F^*_{304}	=	-398.17
F^*_{305}	=	354.98
F^*_{306}	=	371.34
F^*_{307}	=	-31.282
F^*_{308}	=	-34.574

F^*_{309}	=	32.291
F^*_{310}	=	34.783
F^*_{311}	=	-365.94
F^*_{312}	=	-375.08
F^*_{313}	=	379.03
F^*_{314}	=	370.35
F^*_{315}	=	-35.26
F^*_{316}	=	-32.655
F^*_{317}	=	34.915
F^*_{318}	=	32.555
F^*_{319}	=	-376.93
F^*_{320}	=	-369.64
F^*_{321}	=	391.32
F^*_{322}	=	420.96
F^*_{323}	=	-36.709
F^*_{324}	=	-43.368
F^*_{325}	=	36.795
F^*_{326}	=	43.396
F^*_{327}	=	-391.73
F^*_{328}	=	-421.1
F^*_{329}	=	300.4
F^*_{330}	=	150.2
F^*_{331}	=	-33.352
F^*_{332}	=	-16.676
F^*_{333}	=	33.331
F^*_{334}	=	16.666
F^*_{335}	=	-300.32
F^*_{336}	=	-150.16

GRID A&D

Note: All values are in kip-in.

F^*_{337}	=	-1184.3
F^*_{338}	=	1913.16
F^*_{339}	=	-1853.3
F^*_{340}	=	1853.35
F^*_{341}	=	-1913.2
F^*_{342}	=	1184.28
F^*_{343}	=	-1496
F^*_{344}	=	1919.07
F^*_{345}	=	-1745.5
F^*_{346}	=	1745.45
F^*_{347}	=	-1919
F^*_{348}	=	1496.11
F^*_{349}	=	-1433.9
F^*_{350}	=	1910.1
F^*_{351}	=	-1772.1
F^*_{352}	=	1772.27
F^*_{353}	=	-1910.3
F^*_{354}	=	1433.25
F^*_{355}	=	-1446.4
F^*_{356}	=	1913.55
F^*_{357}	=	-1765.9
F^*_{358}	=	1765.36
F^*_{359}	=	-1912.2
F^*_{360}	=	1449.61
F^*_{361}	=	-1443.7
F^*_{362}	=	1912.98
F^*_{363}	=	-1766.5
F^*_{364}	=	1767.8

F^*_{365}	=	-1920.7
F^*_{366}	=	1426.92
F^*_{367}	=	-1400
F^*_{368}	=	1931.78
F^*_{369}	=	-1769.2
F^*_{370}	=	1768.68
F^*_{371}	=	-1930.5
F^*_{372}	=	1403.07
F^*_{373}	=	-1421.8
F^*_{374}	=	1923.89
F^*_{375}	=	-1766.9
F^*_{376}	=	1767.09
F^*_{377}	=	-1924.1
F^*_{378}	=	1421.21
F^*_{379}	=	-1343.4
F^*_{380}	=	1956.11
F^*_{381}	=	-1771.6
F^*_{382}	=	1771.61
F^*_{383}	=	-1956.1
F^*_{384}	=	1343.54
F^*_{385}	=	1183.97
F^*_{386}	=	871.092
F^*_{387}	=	-786.43
F^*_{388}	=	-278.08
F^*_{389}	=	786.499
F^*_{390}	=	278.001
F^*_{391}	=	-1183.9
F^*_{392}	=	-870.92

F^*_{393}	=	624.453
F^*_{394}	=	690.687
F^*_{395}	=	104.459
F^*_{396}	=	-21.358
F^*_{397}	=	-104.37
F^*_{398}	=	21.7521
F^*_{399}	=	-624.75
F^*_{400}	=	-691.59
F^*_{401}	=	742.758
F^*_{402}	=	728.594
F^*_{403}	=	-116.66
F^*_{404}	=	-86.138
F^*_{405}	=	116.35
F^*_{406}	=	84.823
F^*_{407}	=	-741.23
F^*_{408}	=	-724.04
F^*_{409}	=	717.365
F^*_{410}	=	720.3
F^*_{411}	=	-61.589
F^*_{412}	=	-67.559
F^*_{413}	=	62.0303
F^*_{414}	=	70.7645
F^*_{415}	=	-725.15
F^*_{416}	=	-743.45
F^*_{417}	=	662.721
F^*_{418}	=	692.61
F^*_{419}	=	-72.795
F^*_{420}	=	-81.253

F^*_{421}	=	75.5911
F^*_{422}	=	81.6207
F^*_{423}	=	-683.05
F^*_{424}	=	-699.57
F^*_{425}	=	706.941
F^*_{426}	=	691.382
F^*_{427}	=	-81.395
F^*_{428}	=	-73.08
F^*_{429}	=	80.2232
F^*_{430}	=	72.796
F^*_{431}	=	-703.08
F^*_{432}	=	-690.06
F^*_{433}	=	729.989
F^*_{434}	=	784.154
F^*_{435}	=	-83.908
F^*_{436}	=	-103.05
F^*_{437}	=	84.2605
F^*_{438}	=	103.152
F^*_{439}	=	-730.73
F^*_{440}	=	-784.41
F^*_{441}	=	558.88
F^*_{442}	=	279.44
F^*_{443}	=	-81.462
F^*_{444}	=	-40.731
F^*_{445}	=	81.3624
F^*_{446}	=	40.6812
F^*_{447}	=	-558.73
F^*_{448}	=	-279.36

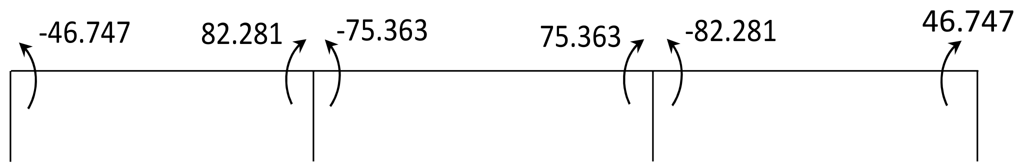
GRID B&C

Note: All values are in kip-in.

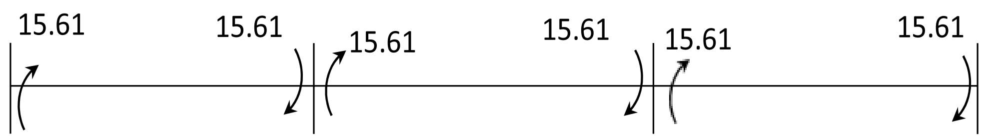
SUPERPOSITION

FRAME ON GRID 1 AND 4 (SUPERPOSITION)

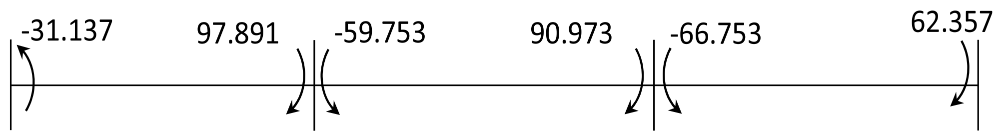
GRAVITY



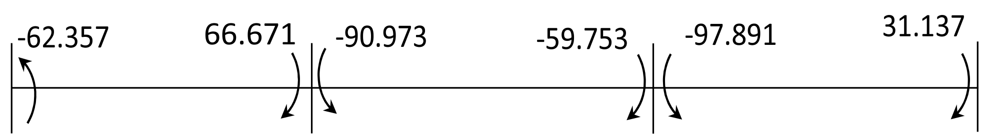
EARTHQUAKE



G + EQ

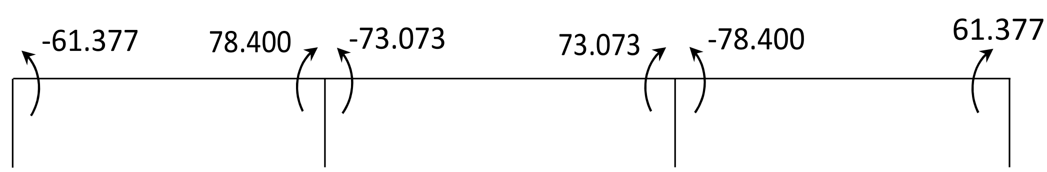


G - EQ

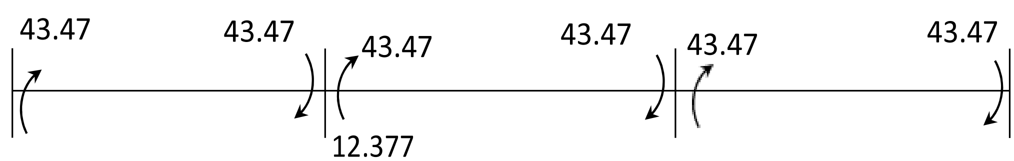


BEAM ON FLOOR 8

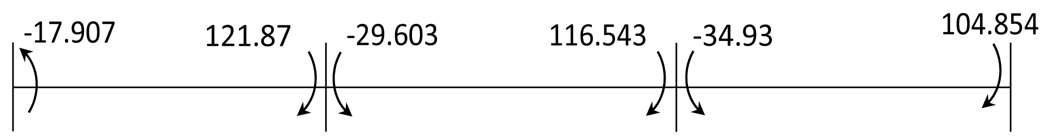
GRAVITY



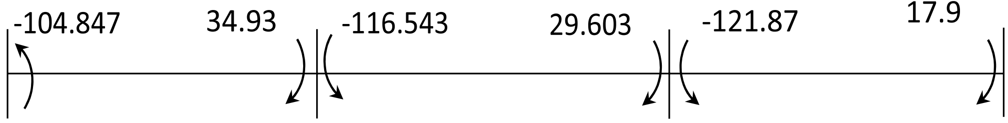
EARTHQUAKE



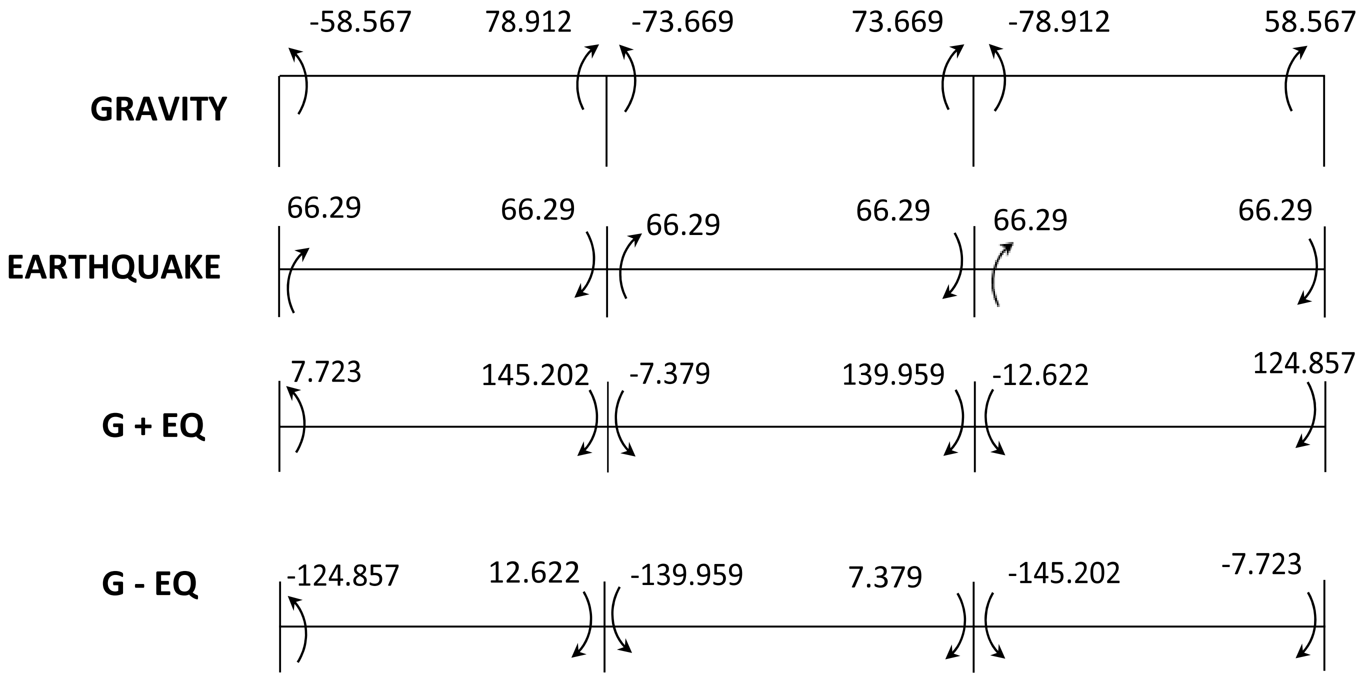
G + EQ



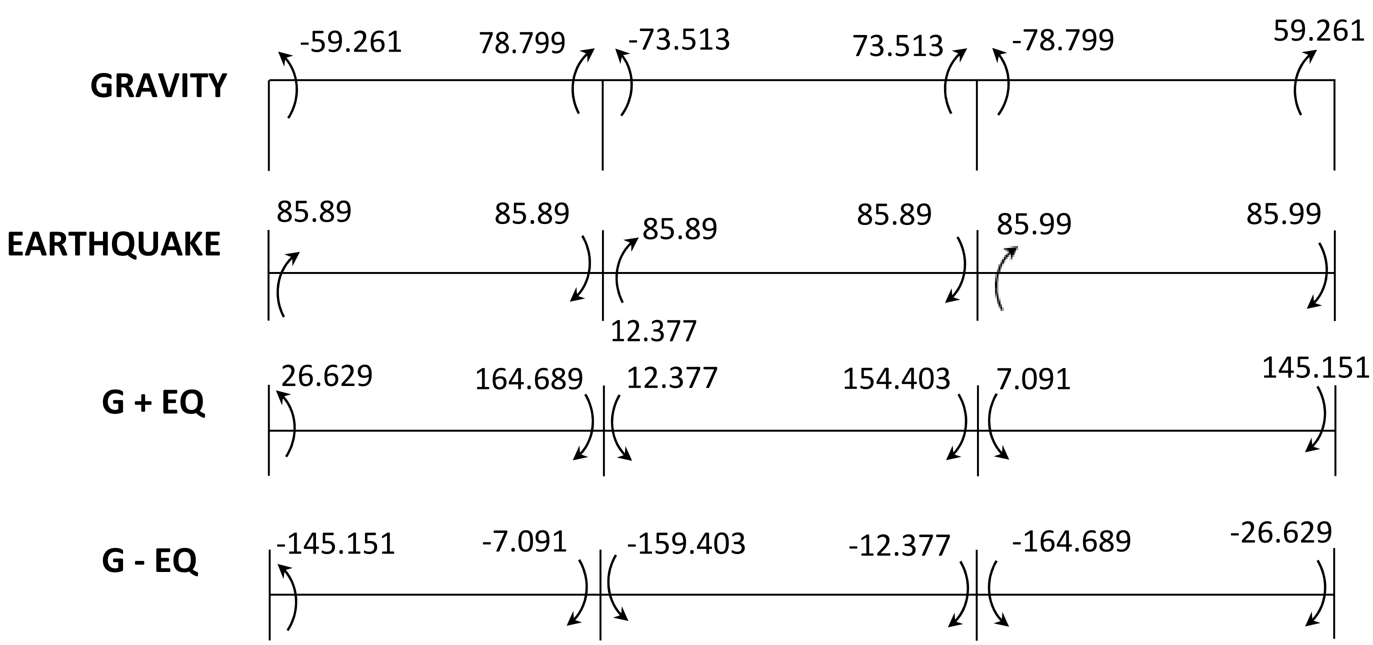
G - EQ



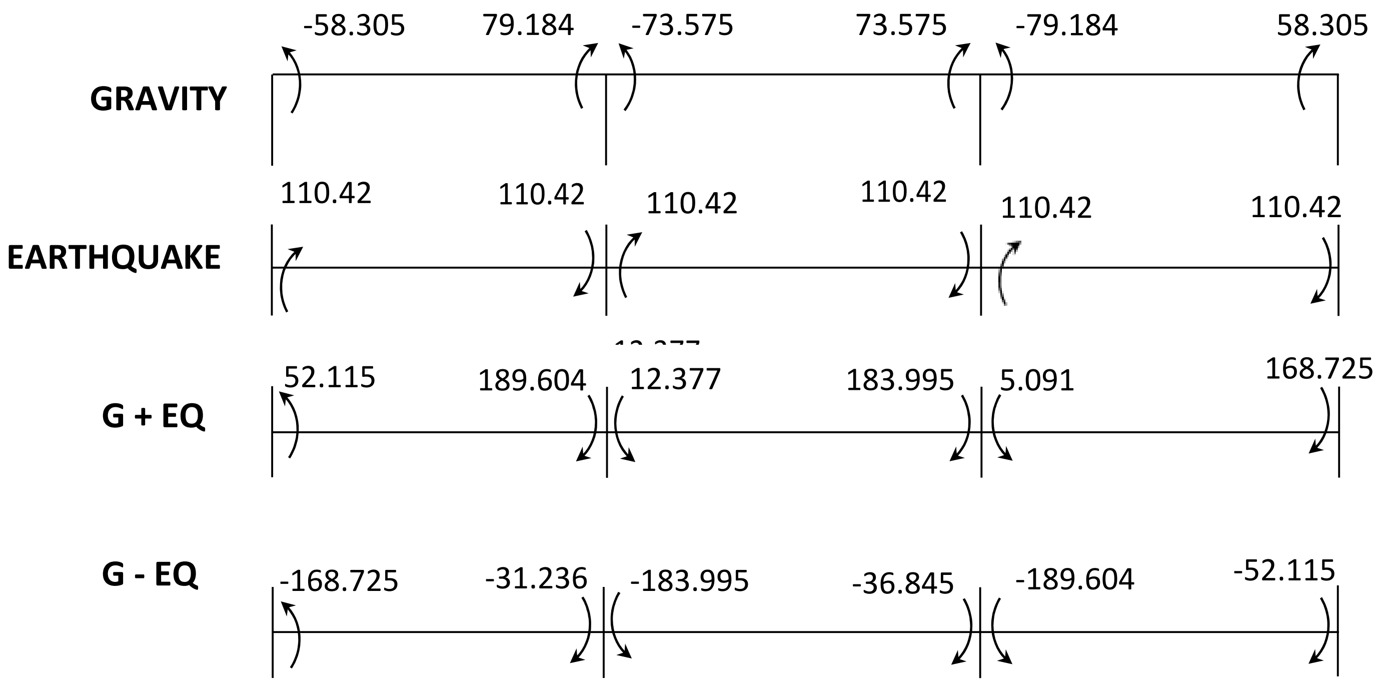
BEAM ON FLOOR 7



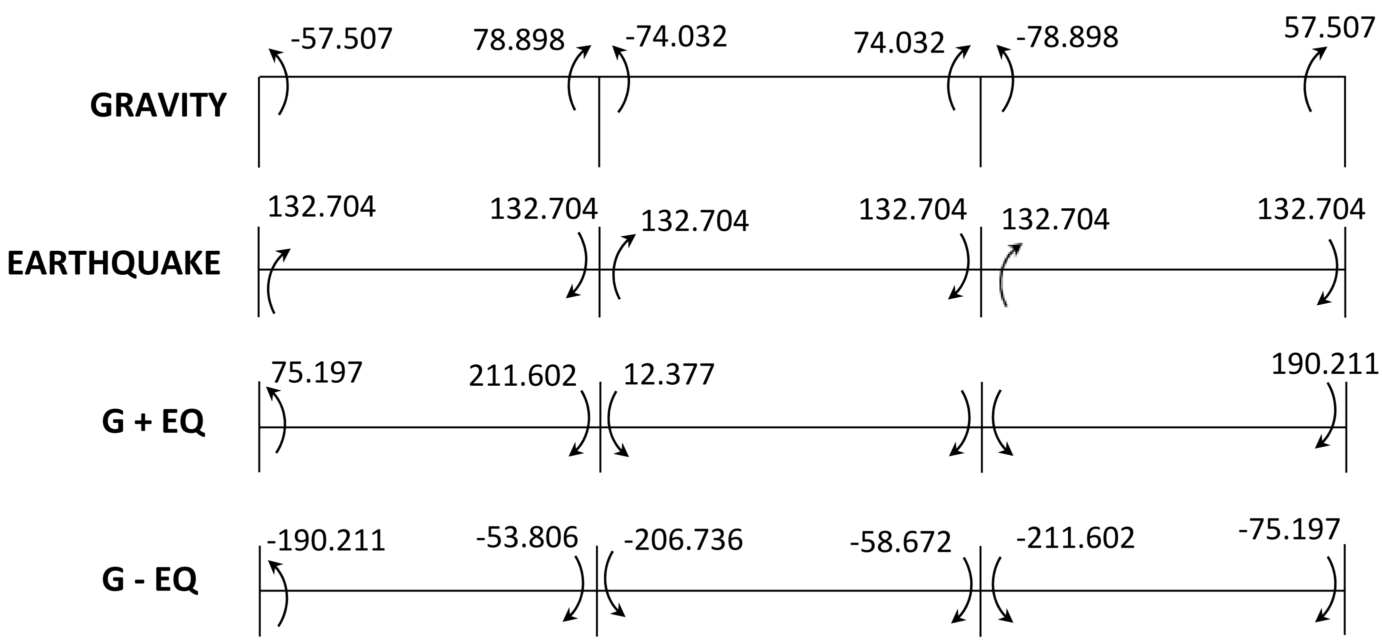
BEAM ON FLOOR 6



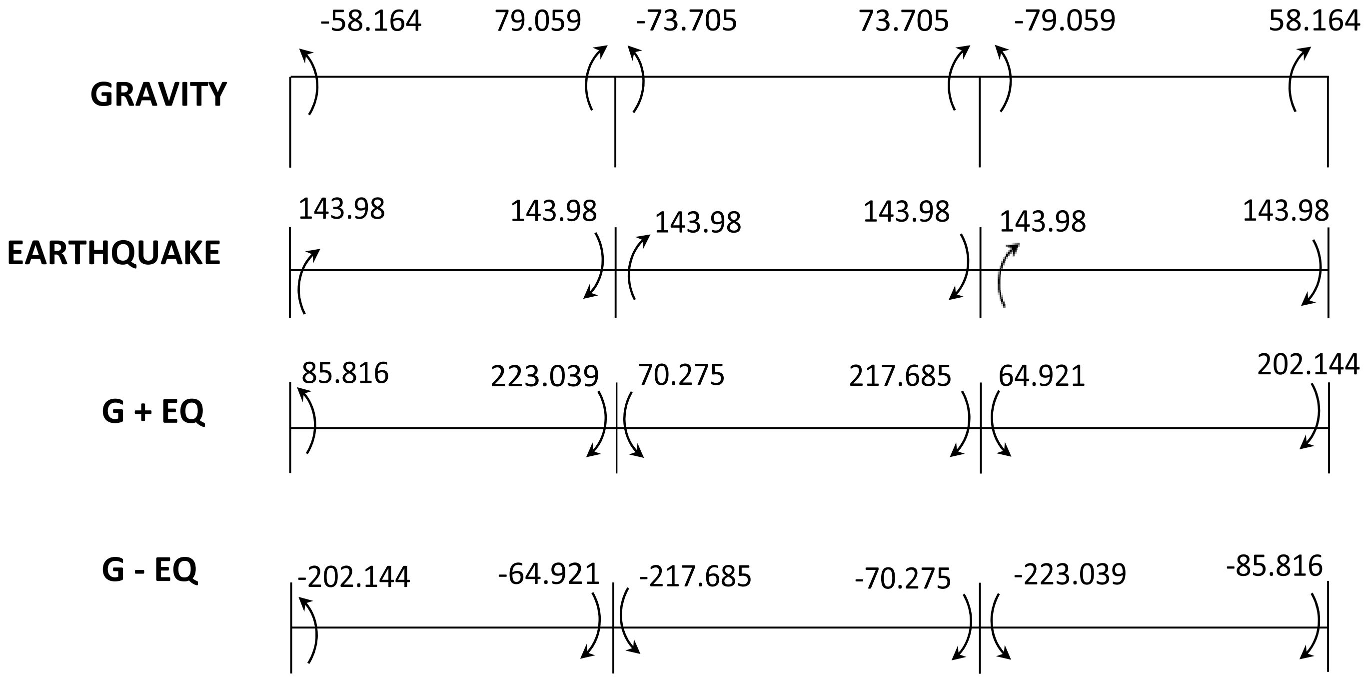
BEAM ON FLOOR 5



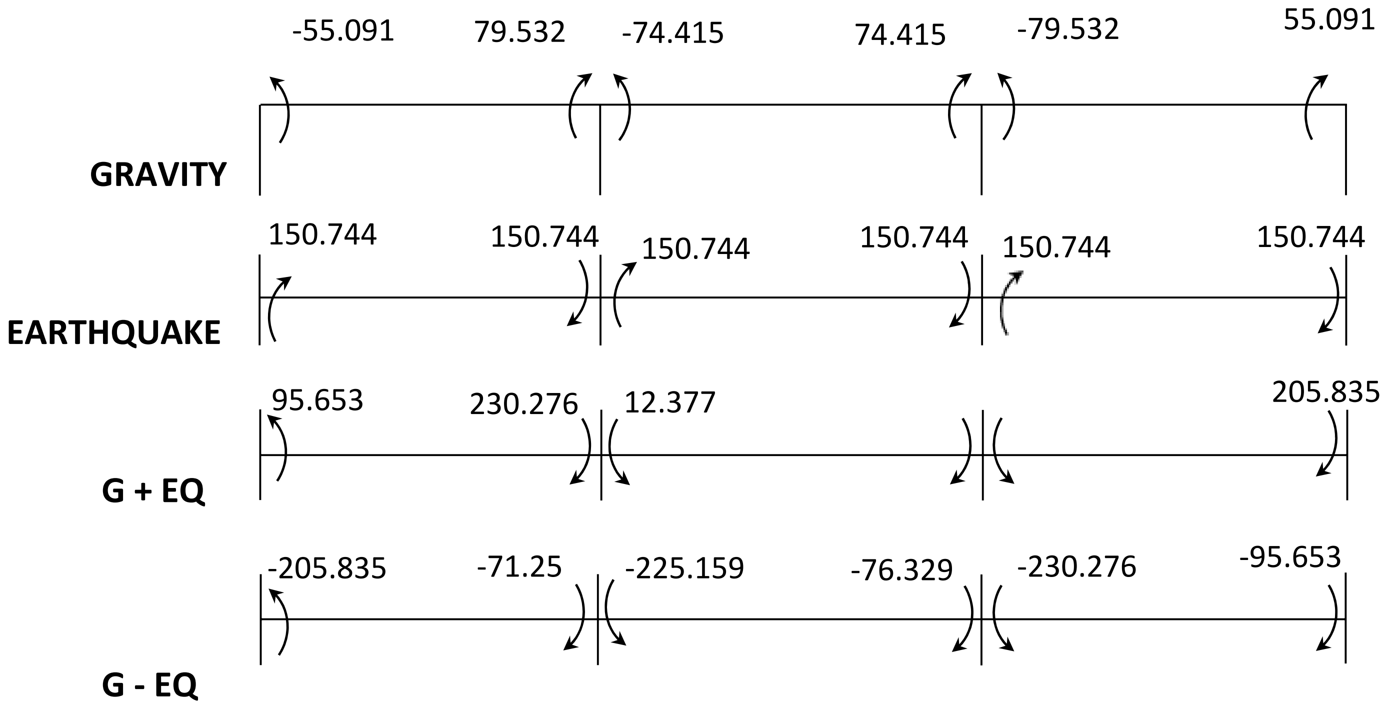
BEAM ON FLOOR 4



BEAM ON FLOOR 3



BEAM ON FLOOR 2



BEAM ON FLOOR 1

FINITE ELEMENT MODELLING
LOAD MATRIX

F1x	13.407
F1y	-21.87
M1	-874.8
F2x	0
F2y	-43.74
M2	0
F3x	0
F3y	-43.74
M3	0
F4x	0
F4y	-21.87
M4	874.8
F5x	10.47
F5y	-21.87
M5	-874.8
F6x	0
F6y	-43.74
M6	0
F7x	0
F7y	-43.74
M7	0
F8x	0
F8y	-21.87
M8	874.8
F9x	9.09
F9y	-21.87
M9	-874.8
F10x	0
F10y	-43.74
M10	0
F11x	0
F11y	-43.74

M11	0
F12x	0
F12y	-21.87
M12	874.8
F13x	7.7
F13y	-21.87
M13	-874.8
F14x	0
F14y	-43.74
M14	0
F15x	0
F15y	-43.74
M15	0
F16x	0
F16y	-21.87
M16	874.8
F17x	6.561
F17y	-21.87
M17	-874.8
F18x	0
F18y	-43.74
M18	0
F19x	0
F19y	-43.74
M19	0
F20x	0
F20y	-21.87
M20	874.8
F21x	5.08
F21y	-21.87
M21	-874.8
F22x	0

F22y	-43.74
M22	0
F23x	0
F23y	-43.74
M23	0
F24x	0
F24y	-21.87
M24	874.8
F25x	3.38
F25y	-21.87
M25	-874.8
F26x	0
F26y	-43.74
M26	0
F27x	0
F27y	-43.74
M27	0
F28x	0
F28y	-21.87
M28	874.8
F29x	1.69
F29y	-21.87
M29	-874.8
F30x	0
F30y	-43.74
M30	0
F31x	0
F31y	-43.74
M31	0
F32x	0
F32y	-21.87
M32	874.8

GRID 1&4

Note: All 'F' values are in kip and 'M' values are in kip-in.

F1x	27.97	M11	0	F22y	-82.664
F1y	-41.332	F12x	0	M22	0
M1	-1653.28	F12y	-41.332	F23x	0
F2x	0	M12	1653.28	F23y	-82.664
F2y	-82.664	F13x	16.088	M23	0
M2	0	F13y	-41.332	F24x	0
F3x	0	M13	-1653.28	F24y	-41.332
F3y	-82.664	F14x	0	M24	1653.28
M3	0	F14y	-82.664	F25x	7.06
F4x	0	M14	0	F25y	-41.332
F4y	-41.332	F15x	0	M25	-1653.28
M4	1653.28	F15y	-82.664	F26x	0
F5x	21.86	M15	0	F26y	-82.664
F5y	-41.332	F16x	0	M26	0
M5	-1653.28	F16y	-41.332	F27x	0
F6x	0	M16	1653.28	F27y	-82.664
F6y	-82.664	F17x	13.689	M27	0
M6	0	F17y	-41.332	F28x	0
F7x	0	M17	-1653.28	F28y	-41.332
F7y	-82.664	F18x	0	M28	1653.28
M7	0	F18y	-82.664	F29x	3.53
F8x	0	M18	0	F29y	-41.332
F8y	-41.332	F19x	0	M29	-1653.28
M8	1653.28	F19y	-82.664	F30x	0
F9x	18.97	M19	0	F30y	-82.664
F9y	-41.332	F20x	0	M30	0
M9	-1653.28	F20y	-41.332	F31x	0
F10x	0	M20	1653.28	F31y	-82.664
F10y	-82.664	F21x	10.59	M31	0
M10	0	F21y	-41.332	F32x	0
F11x	0	M21	-1653.28	F32y	-41.332
F11y	-82.664	F22x	0	M32	1653.28

GRID 2&3

Note: All ‘F’ values are in kip and ‘M’ values are in kip-in.

F1x	13.407
F1y	-21.34
M1	-938.96
F2x	0
F2y	-42.68
M2	0
F3x	0
F3y	-42.68
M3	0
F4x	0
F4y	-21.34
M4	938.96
F5x	10.47
F5y	-21.34
M5	-938.96
F6x	0
F6y	-42.68
M6	0
F7x	0
F7y	-42.68
M7	0
F8x	0
F8y	-21.34
M8	938.96
F9x	9.09
F9y	-21.34
M9	-938.96
F10x	0
F10y	-42.68
M10	0
F11x	0
F11y	-42.68
M11	0
F12x	0
F12y	-21.34
M12	938.96
F13x	7.7
F13y	-21.34
M13	-938.96
F14x	0
F14y	-42.68
M14	0
F15x	0
F15y	-42.68
M15	0
F16x	0
F16y	-21.34
M16	938.96
F17x	6.561
F17y	-21.34
M17	-938.96
F18x	0
F18y	-42.68
M18	0
F19x	0
F19y	-42.68
M19	0
F20x	0
F20y	-21.34
M20	938.96
F21x	5.08
F21y	-21.34
M21	-938.96
F22x	0
F22y	-42.68
M22	0
F23x	0
F23y	-42.68
M23	0
F24x	0
F24y	-21.34
M24	938.96
F25x	3.38
F25y	-21.34
M25	-938.96
F26x	0
F26y	-42.68
M26	0
F27x	0
F27y	-42.68
M27	0
F28x	0
F28y	-21.34
M28	938.96
F29x	1.69
F29y	-21.34
M29	-938.96
F30x	0
F30y	-42.68
M30	0
F31x	0
F31y	-42.68
M31	0
F32x	0
F32y	-21.34
M32	938.96

GRID A&D

Note: All 'F' values are in kip and 'M' values are in kip-in.

F1x	27.97
F1y	-40.04
M1	-1761.72
F2x	0
F2y	-80.08
M2	0
F3x	0
F3y	-80.08
M3	0
F4x	0
F4y	-40.04
M4	1761.72
F5x	21.86
F5y	-40.04
M5	-1761.72
F6x	0
F6y	-80.08
M6	0
F7x	0
F7y	-80.08
M7	0
F8x	0
F8y	-40.04
M8	1761.72
F9x	18.97
F9y	-40.04
M9	-1761.72
F10x	0
F10y	-80.08
M10	0
F11x	0
F11y	-80.08

M11	0
F12x	0
F12y	-40.04
M12	1761.72
F13x	16.088
F13y	-40.04
M13	-1761.72
F14x	0
F14y	-80.08
M14	0
F15x	0
F15y	-80.08
M15	0
F16x	0
F16y	-40.04
M16	1761.72
F17x	13.689
F17y	-40.04
M17	-1761.72
F18x	0
F18y	-80.08
M18	0
F19x	0
F19y	-80.08
M19	0
F20x	0
F20y	-40.04
M20	1761.72
F21x	10.59
F21y	-40.04
M21	-1761.72
F22x	0

F22y	-80.08
M22	0
F23x	0
F23y	-80.08
M23	0
F24x	0
F24y	-40.04
M24	1761.72
F25x	7.06
F25y	-40.04
M25	-1761.72
F26x	0
F26y	-80.08
M26	0
F27x	0
F27y	-80.08
M27	0
F28x	0
F28y	-40.04
M28	1761.72
F29x	3.53
F29y	-40.04
M29	-1761.72
F30x	0
F30y	-80.08
M30	0
F31x	0
F31y	-80.08
M31	0
F32x	0
F32y	-40.04
M32	1761.72

GRID B&C

Note: All 'F' values are in kip and 'M' values are in kip-in.

DISPLACEMENT MATRIX

d1x	2.55580345
d1y	-0.090748312
ϕ1	-0.001145881
d2x	2.55052029
d2y	-0.243499063
ϕ2	-0.000307817
d3x	2.546076335
d3y	-0.242953435
ϕ3	-6.24532E-05
d4x	2.54335797
d4y	-0.172541151
ϕ4	0.000420574
d5x	2.446478491
d5y	-0.087778377
ϕ5	-0.000996537
d6x	2.444672981
d6y	-0.237396348
ϕ6	-0.000501019
d7x	2.443684912
d7y	-0.236519973
ϕ7	-0.000228631
d8x	2.443564058
d8y	-0.169173183
ϕ8	-0.000146919
d9x	2.278195429
d9y	-0.081906528
ϕ9	-0.00125685
d10x	2.276154726
d10y	-0.225474961
ϕ10	-0.000614354
d11x	2.274950112
d11y	-0.223989412

ϕ11	-0.000385947
d12x	2.274458414
d12y	-0.16174882
ϕ12	-0.000339576
d13x	2.052429957
d13y	-0.073545029
ϕ13	-0.001422247
d14x	2.050714475
d14y	-0.207590696
ϕ14	-0.000729091
d15x	2.049742262
d15y	-0.205392566
ϕ15	-0.000517587
d16x	2.049413325
d16y	-0.149969192
ϕ16	-0.000548472
d17x	1.77340523
d17y	-0.063043369
ϕ17	-0.001664749
d18x	1.772435426
d18y	-0.18363936
ϕ18	-0.000843725
d19x	1.772034175
d19y	-0.180759971
ϕ19	-0.000665055
d20x	1.771926464
d20y	-0.133558464
ϕ20	-0.000787008
d21x	1.34672618
d21y	-0.049112641
ϕ21	-0.001875808
d22x	1.3456614

d22y	-0.149098219
ϕ22	-0.000929022
d23x	1.345116225
d23y	-0.145754946
ϕ23	-0.000801502
d24x	1.344937588
d24y	-0.109150436
ϕ24	-0.001013964
d25x	0.873555927
d25y	-0.033777018
ϕ25	-0.001907044
d26x	0.872870361
d26y	-0.107127761
ϕ26	-0.000958032
d27x	0.872581589
d27y	-0.103960055
ϕ27	-0.000882724
d28x	0.872460136
d28y	-0.078789591
ϕ28	-0.001135348
d29x	0.381172883
d29y	-0.017350141
ϕ29	-0.001898854
d30x	0.38176968
d30y	-0.057535232
ϕ30	-0.000840991
d31x	0.382109085
d31y	-0.055373689
ϕ31	-0.000870808
d32x	0.38209825
d32y	-0.042356625
ϕ32	-0.001114936

GRID 1&4

Note: All‘d’ values are in inches and ‘ϕ’ values are in radians.

d1x	3.640832
d1y	-0.14571
ϕ1	-0.00152
d2x	3.631405
d2y	-0.26117
ϕ2	-0.00047
d3x	3.625074
d3y	-0.284
ϕ3	-0.00057
d4x	3.621244
d4y	-0.3017
ϕ4	0.000496
d5x	3.473981
d5y	-0.14076
ϕ5	-0.00136
d6x	3.469485
d6y	-0.25438
ϕ6	-0.00093
d7x	3.466703
d7y	-0.2768
ϕ7	-0.00089
d8x	3.466395
d8y	-0.29583
ϕ8	-0.00028
d9x	3.220196
d9y	-0.13118
ϕ9	-0.00171
d10x	3.215699
d10y	-0.24106
ϕ10	-0.00127
d11x	3.21315
d11y	-0.26258

ϕ11	-0.00128
d12x	3.212281
d12y	-0.28302
ϕ12	-0.00052
d13x	2.881694
d13y	-0.11767
ϕ13	-0.00196
d14x	2.877987
d14y	-0.22123
ϕ14	-0.0016
d15x	2.875791
d15y	-0.24127
ϕ15	-0.0016
d16x	2.875049
d16y	-0.26268
ϕ16	-0.00081
d17x	2.463313
d17y	-0.10085
ϕ17	-0.00226
d18x	2.460449
d18y	-0.19489
ϕ18	-0.00197
d19x	2.459022
d19y	-0.21282
ϕ19	-0.00198
d20x	2.458957
d20y	-0.23423
ϕ20	-0.00106
d21x	1.847698
d21y	-0.07865
ϕ21	-0.00251
d22x	1.845294

d22y	-0.15736
ϕ22	-0.00229
d23x	1.843903
d23y	-0.17209
ϕ23	-0.00233
d24x	1.843428
d24y	-0.19174
ϕ24	-0.00128
d25x	1.166654
d25y	-0.05426
ϕ25	-0.00257
d26x	1.164985
d26y	-0.11241
ϕ26	-0.00242
d27x	1.164098
d27y	-0.12305
ϕ27	-0.00245
d28x	1.163733
d28y	-0.13862
ϕ28	-0.0014
d29x	0.474668
d29y	-0.02809
ϕ29	-0.00242
d30x	0.474132
d30y	-0.05999
ϕ30	-0.00223
d31x	0.474336
d31y	-0.0657
ϕ31	-0.00232
d32x	0.475492
d32y	-0.07457
ϕ32	-0.00111

GRID 2&3

Note: All‘d’ values are in inches and ‘ϕ’ values are in radians.

d1x	2.64298
d1y	-0.08881
θ1	-0.00117
d1x	2.637113
d1y	-0.24509
θ2	-0.00028
d1x	2.63224
d1y	-0.2424
θ3	-8.5E-05
d1x	2.629171
d1y	-0.16426
θ4	0.000464
d1x	2.532248
d1y	-0.08596
θ5	-0.00101
d1x	2.530292
d1y	-0.23904
θ6	-0.0005
d1x	2.529218
d1y	-0.23612
θ7	-0.00026
d1x	2.529126
d1y	-0.16102
θ8	-0.00016
d1x	2.360027
d1y	-0.08033
θ9	-0.0013
d1x	2.357766
d1y	-0.22702
θ10	-0.00063
d1x	2.356431
d1y	-0.22369

θ11	-0.00043
d1x	2.355885
d1y	-0.15392
θ12	-0.00036
d1x	2.127096
d1y	-0.07228
θ13	-0.00148
d1x	2.125197
d1y	-0.20892
θ14	-0.00076
d1x	2.124117
d1y	-0.20514
θ15	-0.00058
d1x	2.123755
	-0.14268
θ16	-0.00059
d1x	1.83765
d1y	-0.06214
θ17	-0.00175
d1x	1.836572
d1y	-0.18464
θ18	-0.0009
d1x	1.836111
d1y	-0.18051
θ19	-0.00074
d1x	1.835999
d1y	-0.12707
θ20	-0.00084
d1x	1.395208
d1y	-0.04857
θ21	-0.00199
d1x	1.394022

d1y	-0.1497
θ22	-0.001
d1x	1.393406
d1y	-0.14551
θ23	-0.0009
d1x	1.393206
d1y	-0.10378
θ24	-0.00109
d1x	0.903251
d1y	-0.03353
θ25	-0.00203
d1x	0.902473
d1y	-0.10739
θ26	-0.00104
d1x	0.902129
d1y	-0.10374
θ27	-0.00099
d1x	0.901981
d1y	-0.07487
θ28	-0.00122
d1x	0.391056
d1y	-0.0173
θ29	-0.00204
d1x	0.391749
d1y	-0.05756
θ30	-0.00092
d1x	0.392135
d1y	-0.05523
θ31	-0.00097
d1x	0.392142
d1y	-0.04023
θ32	-0.00119

GRID A&D

Note: All'd' values are in inches and 'θ' values are in radians.

d1x	3.81983082
d1y	-0.144146394
ϕ1	-0.001597147
d2x	3.809292339
d2y	-0.255266852
ϕ2	-0.000461792
d3x	3.802242376
d3y	-0.273597155
ϕ3	-0.000590537
d4x	3.797786262
d4y	-0.28795769
ϕ4	0.000590832
d5x	3.648795975
d5y	-0.139365258
ϕ5	-0.00141854
d6x	3.643918277
d6y	-0.248650646
ϕ6	-0.000967334
d7x	3.640866107
d7y	-0.266656036
ϕ7	-0.000929377
d8x	3.640607202
d8y	-0.28228626
ϕ8	-0.000283647
d9x	3.385916571
d9y	-0.130076844
ϕ9	-0.001814272
d10x	3.380961765
d10y	-0.23564693
ϕ10	-0.001341109
d11x	3.378157157
d11y	-0.252935084

ϕ11	-0.001364816
d12x	3.377179068
d12y	-0.269976241
ϕ12	-0.000547446
d13x	3.0319732
d13y	-0.116922059
ϕ13	-0.00209514
d14x	3.02789555
d14y	-0.216263386
ϕ14	-0.001707473
d15x	3.025467101
d15y	-0.232377307
ϕ15	-0.00171805
d16x	3.024639891
d16y	-0.250474389
ϕ16	-0.000866341
d17x	2.591724574
d17y	-0.100458861
ϕ17	-0.002435314
d18x	2.588584878
d18y	-0.190515412
ϕ18	-0.002112724
d19x	2.587015515
d19y	-0.204953616
ϕ19	-0.002138101
d20x	2.586967624
d20y	-0.223247085
ϕ20	-0.00115654
d21x	1.943480323
d21y	-0.078611801
ϕ21	-0.002726008
d22x	1.940825452

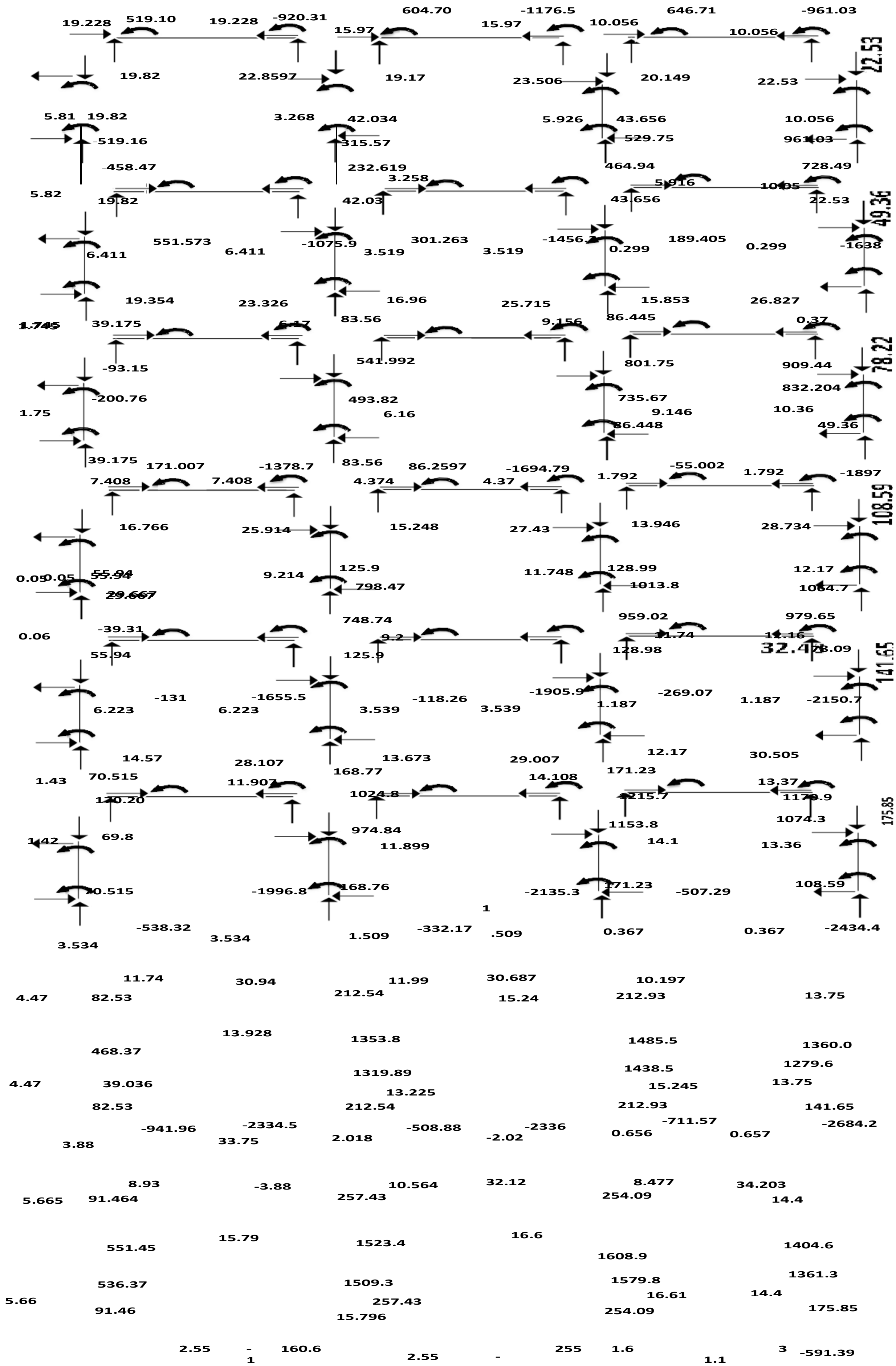
d22y	-0.153827008
ϕ22	-0.002476258
d23x	1.939279148
d23y	-0.165698741
ϕ23	-0.00252083
d24x	1.938751962
d24y	-0.182650189
ϕ24	-0.001401042
d25x	1.223962702
d25y	-0.054436796
ϕ25	-0.002809566
d26x	1.222095923
d26y	-0.10987596
ϕ26	-0.002628024
d27x	1.221094714
d27y	-0.118464077
ϕ27	-0.002666033
d28x	1.220681607
d28y	-0.131988049
ϕ28	-0.001547489
d29x	0.493375298
d29y	-0.028287511
ϕ29	-0.002657768
d30x	0.49282907
d30y	-0.058629575
ϕ30	-0.002411157
d31x	0.493100555
d31y	-0.063247441
ϕ31	-0.002504203
d32x	0.494457518
d32y	-0.070969006
ϕ32	-0.001222202

GRID B&C

Note: All'd' values are in inches and 'ϕ' values are in radians.

FREE BODY DIAGRAM

Note: All 'F' values are in kips and 'M' values are in kip-in.



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19.82
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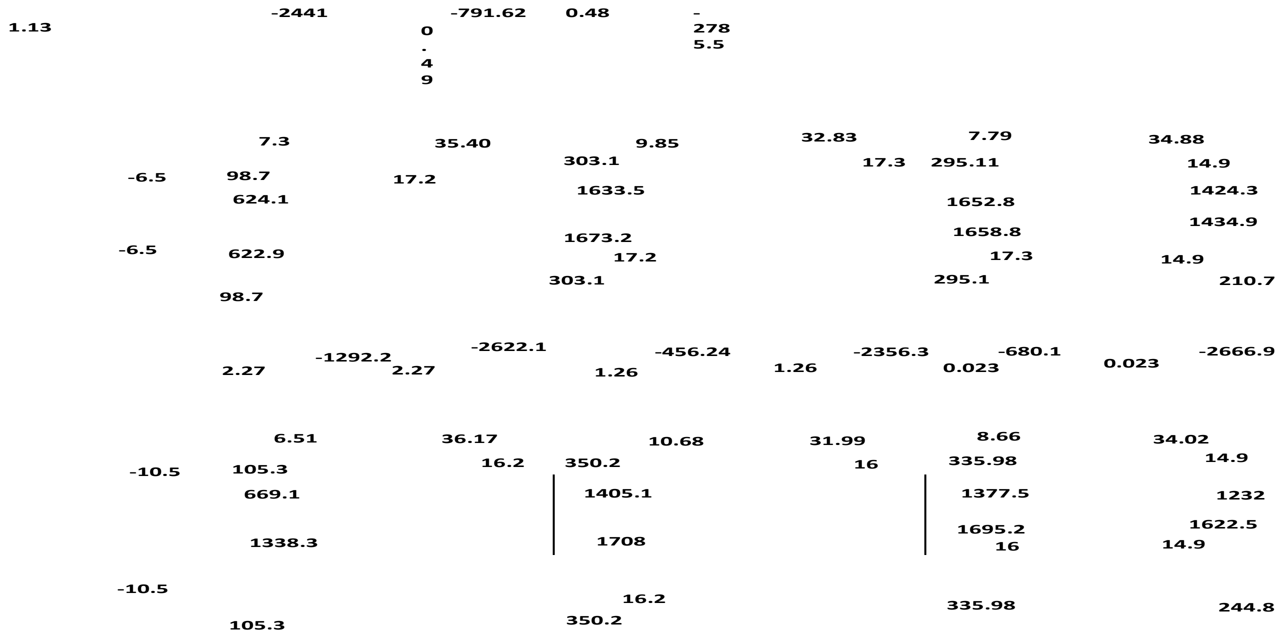

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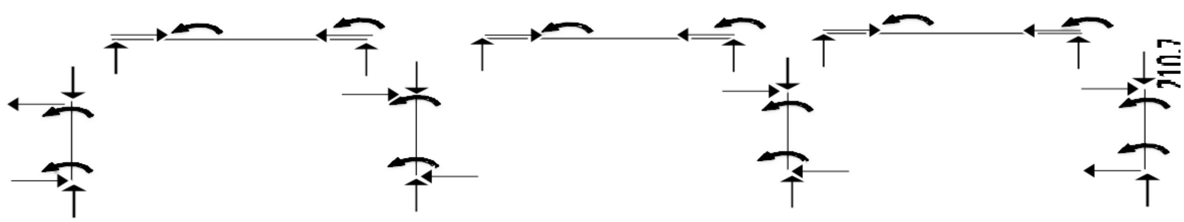
GRID A&D



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6.51 33.24 11.43 81.78 8.50 85.79 14.6

-585.4 1260.1 915.12 1390.6

-518.1 660.5 513.1 14.6 1062.6
11.43 8.50
6.51 85.79

33.24 502.1 -2779.6 81.78 454.4 -3050.4 745.85 -2410.1
15.99 15.99 10 10 0.85 0.85

31.34 48.7 30.21 49.8 33.93 46.15

0.69 64.56 17.42 160.73 17.66 169.6
15.86 1407.0 1389.2 15.45 1228.7

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26.88 53.2 25.66 54.42 30.08 50
2.04 91.46 24.5 239.6 23.64 254.1 18.66

223.6 2272.6 2195.5 1626.9

118.6 1837.5 24.5 1776.3 23.64 18.66 1507.4
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31.34 48.7 30.21 49.8 33.93 46.15

4.76 114.5 29.87 318.24 28.89 338.96
463.82 2749.4 2675.9 21.37 1849.3

336.32 2268.5 29.87 2177.2 28.89 1740.6
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831.8 3550.3 3450.5 2107.1

736.3 3172.9 35.02 3053.6 33.88 21.53 2026.8
8.16 424.5

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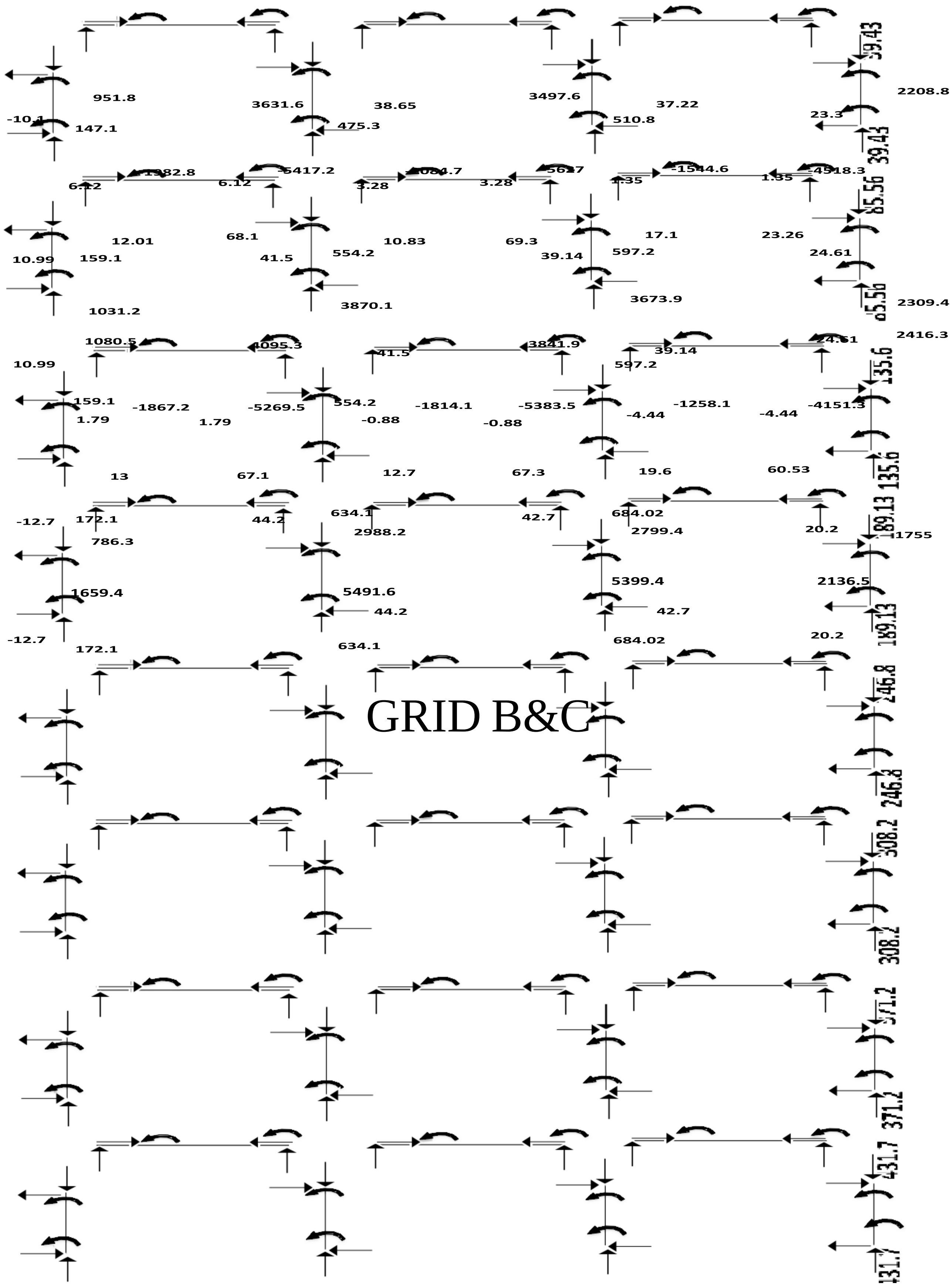

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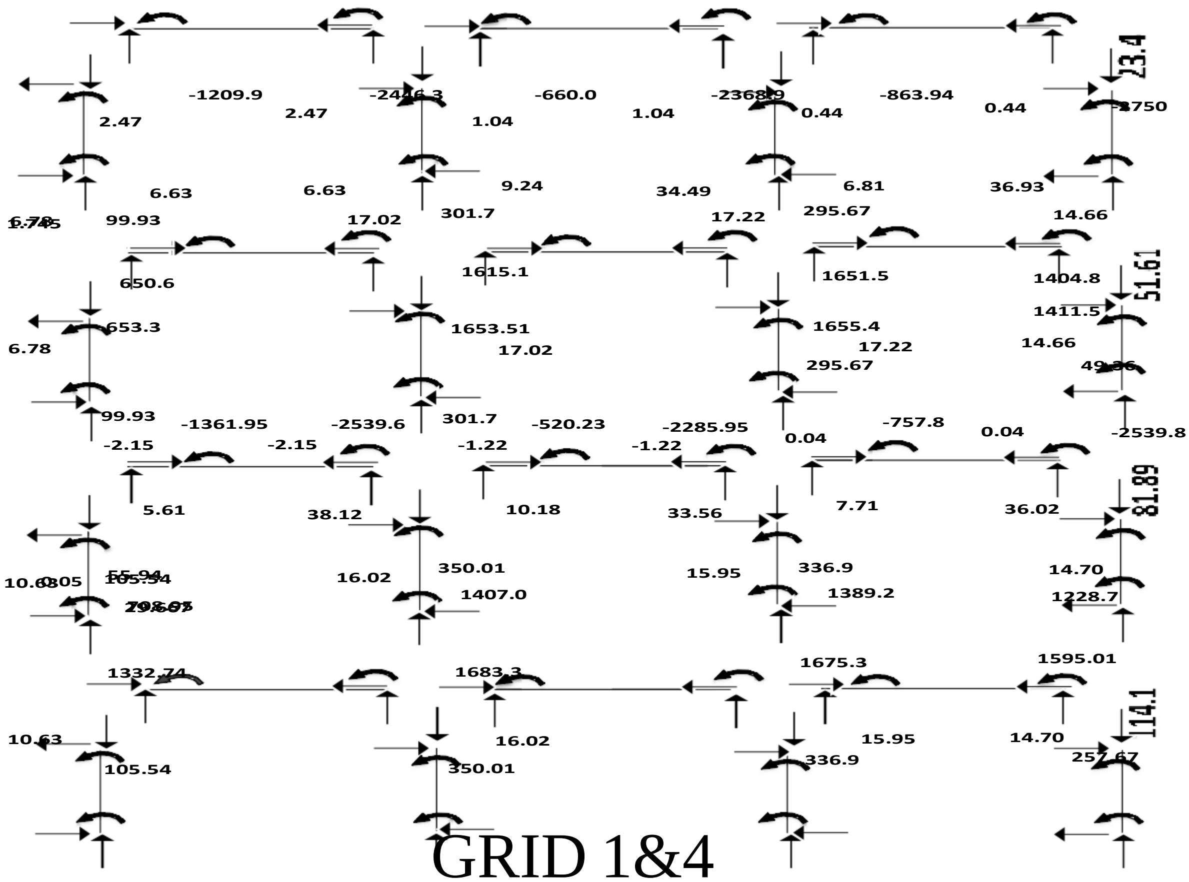
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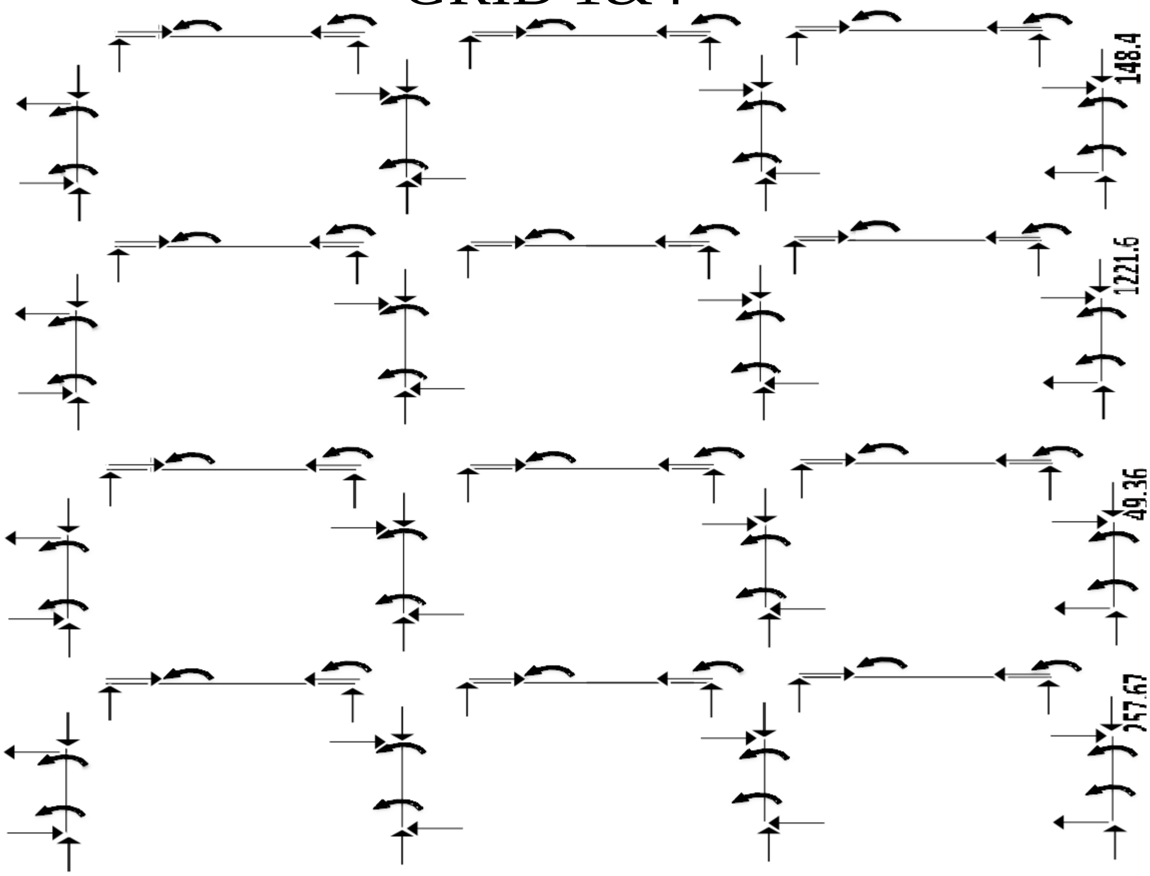
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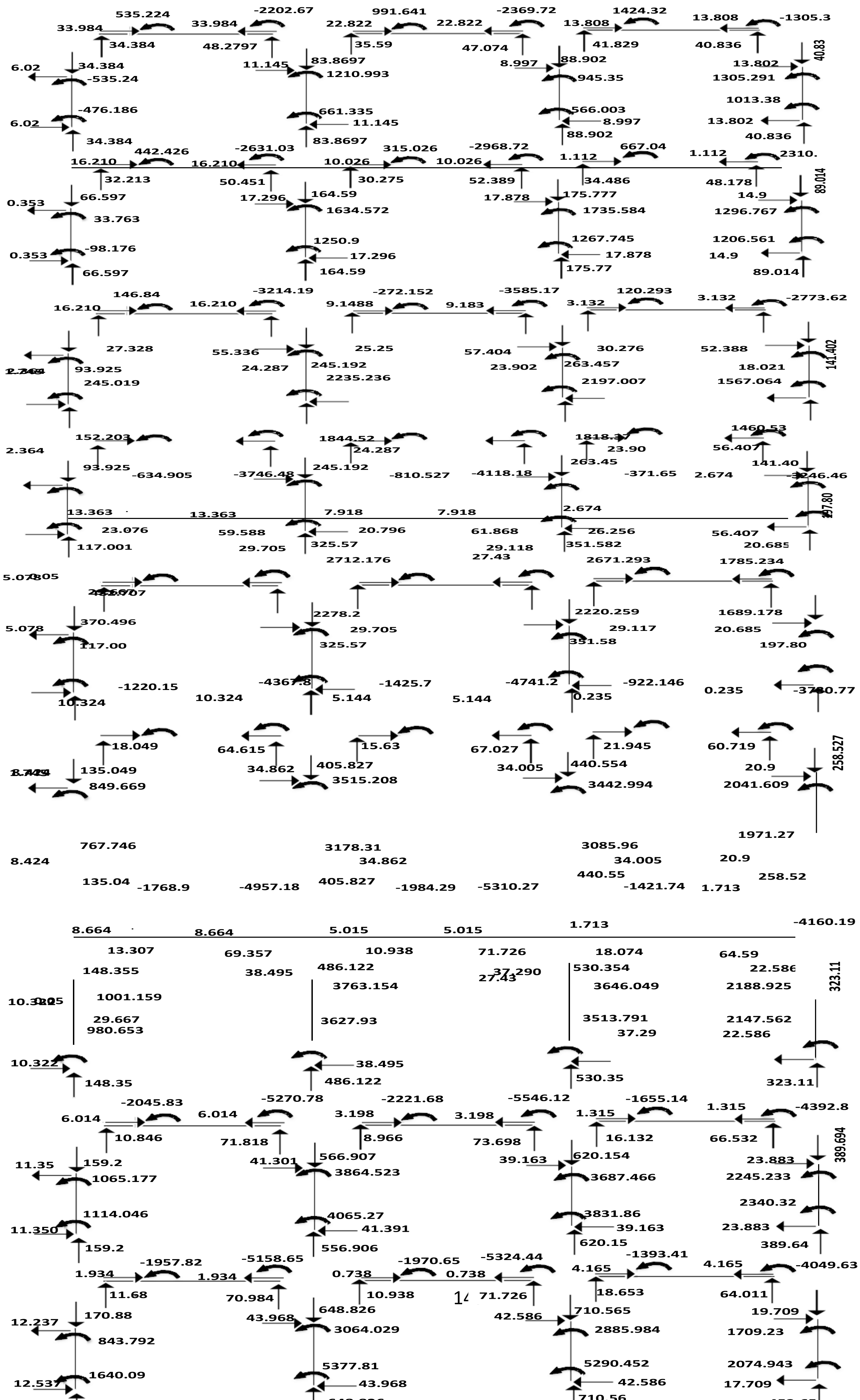
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APPENDIX D

CHARTS AND TABLES

Table 1:

Zone	1	2A	2B	3	4
Z	0.075	0.15	0.2	0.3	0.4

(From Table 16-I, UBC 1997.)

Table 2: Structural Systems[a]

Basic structural system[b]	Lateral-force-resisting system description	*R*	Ω_o	Height limit for seismic zones 3 and 4
1. Bearing wall System	1. Shear walls			
	a. Concrete	4.5	2.8	160
	b. Masonry	4.5	2.8	160
	2. Braced frames where bracing carries gravity load			
	a. Steel	4.4	2.2	160
	b. Concrete[e]	2.8	2.2	N.P.
2. Building frame system	1. Steel eccentrically braced frame (EBF)	7.0	2.8	240
	2. Shear walls			
	a. Concrete	5.5	2.8	240
	b. Masonry	5.5	2.8	160
	3. Ordinary braced frames			
	a. Steel	5.6	2.2	160
	b. Concrete[c]	5.6	2.2	N.P.
	4. Special concentrically braced frames			
	a. Steel	6.4	2.2	240
3. Moment-resisting frame system	1. Special moment-resisting frame (SMRF)			
	a. Steel	8.5	2.8	N.L.
	b. Concrete[d]	8.5	2.8	N.L.
	2. Masonry moment-resisting wall frame (MMRWF)	6.5	2.8	160
	3. Concrete intermediate moment-resisting frame (IMRF)[e]	5.5	2.8	N.P.
	4. Ordinary moment-resisting frame (OMRF)			
	a. Steel[f]	4.5	2.8	160

	b. Concrete[h]	3.5	2.8	N.P.
	5. Special truss moment frames of steel (STMF)	6.5	2.8	240
4. Dual systems (frame resists at least 25% of seismic shear)	1. Shear walls			
	a. Concrete with SMRF	8.5	2.8	N.L.
	b. Concrete with steel OMRF	4.2	2.8	160
	c. Concrete with concrete IMRF[e]	6.5	2.8	160
	d. Masonry with SMRF	5.5	2.8	160
	e. Masonry with steel OMRF	4.2	2.8	160
	f. Masonry with concrete IMRF[c]	4.2	2.8	N.P.
	g. Masonry with masonry MMRWF	6.0	2.8	160
	2. Steel EBF			
	a. With steel SMRF	8.5	2.8	N.L.
	b. With steel OMRF	4.2	2.8	160
	3. Ordinary braced frames			
	a. Steel with steel SMRF	6.5	2.8	N.L.
	b. Steel with steel OMRF	4.2	2.8	160
	c. Concrete with concrete SMRF[c]	6.5	2.8	N.P.
	d. Concrete with concrete IMRF[e]	4.2	2.8	N.P.
	4. Special concentrically braced frames			
	a. Steel with steel SMRF	7.5	2.8	N.L.
	b. Steel with steel OMRF	4.2	2.8	160
5. Cantilevered column building systems	1. Cantilevered column elements[g]	2.2	2.0	357
6. Shear wall-frame interaction systems	1. Concrete[h]	5.5	2.8	160
7. Undefined systems	See Sections 1629.6.7 and 1629.9.2 (UBC 1997)	—	—	—

N.L.—no limit N.P.—not permitted.

[a] See Section 1630.4 for combination of structural systems.

[b] Basic structural systems are defined in Section 1629.6, 1997 UBC.

[c] Prohibited in seismic zones 3 and 4.

[d] Includes precast concrete conforming to Section 1921.2.7, 1997 UBC.

[e] Prohibited in seismic zones 3 and 4, except as permitted in Section 1634.2, 1997 UBC.

[f] Ordinary moment-resisting frames in seismic zone 1 meeting the requirements of Section 2211.6 may use an *R* value of 8. See UBC 1997.

[g] Total height of the building including cantilevered columns.

[h] Prohibited in seismic zones 2A, 2B, 3, and 4. See Section 1633.2.7, 1997 UBC. (From UBC 1997, Table 16-N.)

Table 3: Seismic Coefficient C_v

Soil profile type	Seismic zone factor, Z				
	$Z = 0.075$	$Z = 0.15$	$Z = 0.2$	$Z = 0.3$	$Z = 0.4$
S_A	0.06	0.12	0.16	0.24	$0.32N_v$
S_B	0.08	0.15	0.20	0.30	$0.40N_v$
S_C	0.13	0.25	0.32	0.45	$0.56N_v$
S_D	0.18	0.32	0.40	0.54	$0.64N_v$
S_E	0.26	0.50	0.64	0.84	$0.96N_v$
S_F	Site-specific geotechnical investigation and dynamic site response analysis Shall be performed for soil type S_F .				

Table 4: Soil Profile Types

Soil profile type	Soil profile name/generic description	Average soil properties for top 100 feet (30,480 mm) of soil profile		
		Shear wave velocity, fsseet/second (m/s)	Standard penetration test (blows/foot)	Undrained shear strength, psf (kPa)
S_A	Hard rock	>5,000 (1,500)	—	—
S_B	Rock	2,500 to 5,000 (760 to 1,500)		
S_C	Very dense soil and soft rock	1,200 to 2,500 (360 to 760)	>50	>2,000 (100)
S_D	Stiff soil profile	600 to 1,200 (180 to 360)	15 to 50	1,000 to 2,000 (50 to 100)
S_E	Soft soil profile	<600 (180)	<15	<1,000 (50)
S_F	Soil requiring site-specific evaluation.			

USE OR OCCUPANCY		UNIFORM LOAD[1] (psf)	CONCENTRATED LOAD (pounds)
Category	Description	× 0.0479 for kN/m²	× 0.004 48 for kN
1. Access floor systems	Office use	50	2,000[2]
	Computer use	100	2,000[2]
2. Armories		150	0
3. **Assembly areas[3] and auditoriums and balconies therewith**	Fixed seating areas	50	0
	Movable seating and other areas	100	0
	Stage areas and enclosed platforms	125	0
4. Cornices and marquees		60[4]	0
5. Exit facilities[5]		100	0[6]
6. Garages	General storage and/or repair	100	[7]
	Private or pleasure-type motor vehicle storage	50	[7]
7. Hospitals	Wards and rooms	40	1,000[2]
8. Libraries	Reading rooms	60	1,000[2]
	Stack rooms	125	1,500[2]
9. Manufacturing	Light	75	2,000[2]
	Heavy	125	3,000[2]
10. Offices		50	2,000[2]
11. Printing plants	Press rooms	150	2,500[2]
	Composing and linotype rooms	100	2,000[2]
12. Residential[8]	Basic floor area	40	0[6]
	Exterior balconies	60[4]	0
	Decks	40[4]	0
	Storage	40	0
13. Restrooms[9]			
14. Reviewing stands, grandstands, bleachers, and folding and telescoping seating		100	0
15. Roof decks	Same as area served or for the type of occupancy accommodated		
16. Schools	Classrooms	40	1,000[2]
17. Sidewalks and driveways	Public access	250	[7]
18. Storage	Light	125	
	Heavy	250	
19. Stores		100	3,000[2]
20. Pedestrian bridges and walkways		100	

Table 1: Uniform and Concentrated Loads

APPENDIX E

WEIGHT OF BUILDING

LOAD OF EIGHTH FLOOR																				
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 8				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	8.13	9.75	1.603	1.924	32.873	39.442	8.84	14.144	32.873	39.454	8.84	14.14
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	11.94	14.32	1.603	1.924	54.993	65.984	16.45	26.32	54.993	65.984	16.45	26.32
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	11.94	14.32	1.603	1.924	54.993	65.984	16.45	26.32	54.993	65.984	16.45	26.32
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	8.13	9.75	1.603	1.924	32.873	39.442	8.84	14.144	32.873	39.454	8.84	14.14
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	12.35	14.82	1.603	1.924	55.853	67.024	16.56	26.496	55.853	66.994	16.56	26.49
2-B	440	66	79.2	30.8	49.28	8.4	10.08	16.37	19.63	2.85	3.42	93.62	112.33	30.8	49.28	93.62	112.33	30.8	49.28
2-C	440	66	79.2	30.8	49.28	8.4	10.08	16.37	19.63	2.85	3.42	93.62	112.33	30.8	49.28	93.62	112.33	30.8	49.28
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	12.35	14.82	1.603	1.924	55.853	67.024	16.56	26.496	55.853	66.994	16.56	26.49
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	12.35	14.82	1.603	1.924	55.853	67.024	16.56	26.496	55.853	66.994	16.56	26.49
3-B	440	66	79.2	30.8	49.28	8.4	10.08	16.37	19.63	2.85	3.42	93.62	112.33	30.8	49.28	93.62	112.33	30.8	49.28
3-C	440	66	79.2	30.8	49.28	8.4	10.08	16.37	19.63	2.85	3.42	93.62	112.33	30.8	49.28	93.62	112.33	30.8	49.28
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	12.35	14.82	1.603	1.924	55.853	67.024	16.56	26.496	55.853	66.994	16.56	26.49
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	8.13	9.75	1.603	1.924	32.873	39.442	8.84	14.144	32.873	39.454	8.84	14.14
4-B	235	35.25	42.3	16.45	26.32	6.2	7.4	11.94	14.32	1.603	1.924	54.993	65.944	16.45	26.32	54.993	65.944	16.45	26.32
4-C	235	35.25	42.3	16.45	26.32	6.2	7.4	11.94	14.32	1.603	1.924	54.993	65.944	16.45	26.32	54.993	65.944	16.45	26.32
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	8.13	9.75	1.603	1.924	32.873	39.442	8.84	14.144	32.873	39.454	8.84	14.14
∑		622.76	747.312	290.6	464.96	100.8	120.88	195.16	234.08	30.636	36.768	949.356	1139.04	290.6	464.96	949.356	1138.968	290.6	464.92

LOAD OF SEVENTH FLOOR																			
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 7				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	76.293	91.392	17.68	28.28
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	124.223	149.024	32.9	52.64
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	124.223	149.024	32.9	52.64
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	76.293	91.392	17.68	28.28
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	126.373	151.574	33.12	52.98
2-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	207.65	249.16	61.6	98.56
2-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	207.65	249.16	61.6	98.56
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	126.373	151.574	33.12	52.98
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	126.373	151.574	33.12	52.98
3-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	207.65	249.16	61.6	98.56
3-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	207.65	249.16	61.6	98.56
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	126.373	151.574	33.12	52.98
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	76.293	91.392	17.68	28.28
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	124.223	148.984	32.9	52.64
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	124.223	148.984	32.9	52.64
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	76.293	91.392	17.68	28.28
∑		622.76	747.312	290.6	464.96	100.8	120.96	390.72	468.24	74.52	89.04	1188.8	1425.552	290.6	464.92	2138.156	2564.52	581.2	929.84

LOAD OF SIXTH FLOOR																					
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 6				Commulative Load					
		D.L		L.L								D.L		L.L		D.L		L.L			
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)		
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	119.713	143.33	26.52	42.42		
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	193.453	232.064	49.35	78.96		
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	193.453	232.064	49.35	78.96		
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	119.713	143.33	26.52	42.42		
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	196.893	236.154	49.68	79.47		
2-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	321.68	385.99	92.4	147.84		
2-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	321.68	385.99	92.4	147.84		
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	196.893	236.154	49.68	79.47		
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	196.893	236.154	49.68	79.47		
3-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	321.68	385.99	92.4	147.84		
3-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	321.68	385.99	92.4	147.84		
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	196.893	236.154	49.68	79.47		
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	119.713	143.33	26.52	42.42		
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	193.453	232.024	49.35	78.96		
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	193.453	232.024	49.35	78.96		
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	119.713	143.33	26.52	42.42		
∑		622.76	747.312	290.6	464.96	100.8	120.96	390.72	468.24	74.52	89.04	1188.8	1425.552	290.6	464.92	3326.956	3990.072	871.8	1394.76		

LOAD OF FIFTH FLOOR																					
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 5				Commulative Load					
		D.L		L.L								D.L		L.L		D.L		L.L			
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)		
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	163.133	195.268	35.36	56.56		
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	262.683	315.104	65.8	105.28		
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	262.683	315.104	65.8	105.28		
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	163.133	195.268	35.36	56.56		
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	267.413	320.734	66.24	105.96		
2-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	435.71	522.82	123.2	197.12		
2-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	435.71	522.82	123.2	197.12		
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	267.413	320.734	66.24	105.96		
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	267.413	320.734	66.24	105.96		
3-B	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	435.71	522.82	123.2	197.12		
3-C	440	66	79.2	30.8	49.28	8.4	10.08	32.73	39.27	6.9	8.28	114.03	136.83	30.8	49.28	435.71	522.82	123.2	197.12		
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	24.71	29.64	3.91	4.66	70.52	84.58	16.56	26.49	267.413	320.734	66.24	105.96		
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	163.133	195.268	35.36	56.56		
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	262.683	315.064	65.8	105.28		
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	23.87	28.64	3.91	4.66	69.23	83.04	16.45	26.32	262.683	315.064	65.8	105.28		
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	16.37	19.51	3.91	4.66	43.42	51.938	8.84	14.14	163.133	195.268	35.36	56.56		
∑		622.76	747.312	290.6	464.96	100.8	120.96	390.72	468.24	74.52	89.04	1188.8	1425.552	290.6	464.92	4515.756	5415.624	1162.4	1859.68		

LOAD OF FOURTH FLOOR

Column No.	Tributy Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 4				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	17.79	21.35	4.215	5.061	45.145	54.179	8.84	14.14	208.278	249.447	44.2	70.7
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	26.12	31.34	4.215	5.061	71.785	86.141	16.45	26.32	334.468	401.245	82.25	131.6
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	26.12	31.34	4.215	5.061	71.785	86.141	16.45	26.32	334.468	401.245	82.25	131.6
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	17.79	21.35	4.215	5.061	45.145	54.179	8.84	14.14	208.278	249.447	44.2	70.7
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	27.03	32.44	4.215	5.061	73.145	87.781	16.56	26.49	340.558	408.515	82.8	132.45
2-B	440	66	79.2	30.8	49.28	8.4	10.08	35.82	42.97	7.5	9	117.72	141.25	30.8	49.28	553.43	664.07	154	246.4
2-C	440	66	79.2	30.8	49.28	8.4	10.08	35.82	42.97	7.5	9	117.72	141.25	30.8	49.28	553.43	664.07	154	246.4
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	27.03	32.44	4.215	5.061	73.145	87.781	16.56	26.49	340.558	408.515	82.8	132.45
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	27.03	32.44	4.215	5.061	73.145	87.781	16.56	26.49	340.558	408.515	82.8	132.45
3-B	440	66	79.2	30.8	49.28	8.4	10.08	35.82	42.97	7.5	9	117.72	141.25	30.8	49.28	553.43	664.07	154	246.4
3-C	440	66	79.2	30.8	49.28	8.4	10.08	35.82	42.97	7.5	9	117.72	141.25	30.8	49.28	553.43	664.07	154	246.4
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	27.03	32.44	4.215	5.061	73.145	87.781	16.56	26.49	340.558	408.515	82.8	132.45
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	17.79	21.35	4.215	5.061	45.145	54.179	8.84	14.14	208.278	249.447	44.2	70.7
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	26.12	31.34	4.215	5.061	71.785	86.141	16.45	26.32	334.468	401.205	82.25	131.6
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	26.12	31.34	4.215	5.061	71.785	86.141	16.45	26.32	334.468	401.205	82.25	131.6
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	17.79	21.35	4.215	5.061	45.145	54.179	8.84	14.14	208.278	249.447	44.2	70.7
∑		622.76	747.312	290.6	464.96	100.8	120.96	427.04	512.4	80.58	96.732	1231.18	1477.404	290.6	464.92	5746.936	6893.028	1453	2324.6

LOAD OF THIRD FLOOR

Column No.	Tributy Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 3				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	255.205	305.7594	53.04	84.844
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	408.698	490.321	98.7	157.92
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	408.698	490.321	98.7	157.92
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	255.205	305.7594	53.04	84.844
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	416.228	499.319	99.36	158.946
2-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	674.63	809.51	184.8	295.68
2-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	674.63	809.51	184.8	295.68
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	416.228	499.319	99.36	158.946
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	416.228	499.319	99.36	158.946
3-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	674.63	809.51	184.8	295.68
3-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	674.63	809.51	184.8	295.68
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	416.228	499.319	99.36	158.946
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	255.205	305.7594	53.04	84.844
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	408.698	490.281	98.7	157.92
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	408.698	490.281	98.7	157.92
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	255.205	305.7594	53.04	84.844
∑		622.76	747.312	290.6	464.96	100.8	120.96	461.428	553.7136	87.12	104.544	1272.108	1526.5296	290.6	464.96	7019.044	8419.5576	1743.6	2789.56

LOAD OF SECOND FLOOR																			
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 2				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	302.132	362.0718	61.88	98.988
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	482.928	579.397	115.15	184.24
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	482.928	579.397	115.15	184.24
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	302.132	362.0718	61.88	98.988
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	491.898	590.123	115.92	185.442
2-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	795.83	954.95	215.6	344.96
2-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	795.83	954.95	215.6	344.96
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	491.898	590.123	115.92	185.442
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	491.898	590.123	115.92	185.442
3-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	795.83	954.95	215.6	344.96
3-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	795.83	954.95	215.6	344.96
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	491.898	590.123	115.92	185.442
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	302.132	362.0718	61.88	98.988
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	482.928	579.357	115.15	184.24
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	482.928	579.357	115.15	184.24
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	302.132	362.0718	61.88	98.988
∑		622.76	747.312	290.6	464.96	100.8	120.96	461.428	553.7136	87.12	104.544	1272.108	1526.5296	290.6	464.96	8291.152	9946.0872	2034.2	3254.52

LOAD OF FIRST FLOOR																			
Column No.	Tributry Area	Slab Load				Beam Load		Masonary Load		Column Load		Total Load For Floor 1				Commulative Load			
		D.L		L.L								D.L		L.L		D.L		L.L	
		Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)	Service (Kips)	Factored (kips)
1-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
1-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	557.158	668.473	131.6	210.56
1-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	557.158	668.473	131.6	210.56
1-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
2-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
2-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
2-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
2-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
3-A	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
3-B	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
3-C	440	66	79.2	30.8	49.28	8.4	10.08	38.7	46.44	8.1	9.72	121.2	145.44	30.8	49.28	917.03	1100.39	246.4	394.24
3-D	236.5	35.5	42.6	16.56	26.496	6.4	7.68	29.21	35.052	4.56	5.472	75.67	90.804	16.56	26.496	567.568	680.927	132.48	211.938
4-A	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
4-B	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	557.158	668.433	131.6	210.56
4-C	235	35.25	42.3	16.45	26.32	6.2	7.44	28.22	33.864	4.56	5.472	74.23	89.076	16.45	26.32	557.158	668.433	131.6	210.56
4-D	126.31	18.94	22.728	8.84	14.144	4.2	5.04	19.227	23.0724	4.56	5.472	46.927	56.3124	8.84	14.144	349.059	418.3842	70.72	113.132
∑		622.76	747.312	290.6	464.96	100.8	120.96	461.428	553.7136	87.12	104.544	1272.108	1526.5296	290.6	464.96	9563.26	11472.6168	2324.8	3719.48

REFERENCES

- Intermediate Structural Analysis by C.K. Wang
- A First Course in the Finite Element Method by Daryl L. Logan
- Uniform Building Code-1997 (UBC 97)
- ACI (318-05)
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