Earthquake Resistant Design and Analysis of a Multistoreyed Building using STAAD *pro*

By

Arun Rajta 031609
Chakshu Joshi 031601
Krishan kumar 031603
Prafulla Mittal 031618
Sagar Gaur 031606

MAY-2007

Submitted in partial fulfillment of the Degree of Bachelor of Technology

DEPARTMENT OF CIVIL ENGINEERING
JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY-WAKNAGHAT

CERTIFICATE

This is to certify that the work entitled, **"Earthquake Resistant Analysis and Design of a Multistoreyed Building using STAAD Pro"** submitted by Arun Rajta 031609,Chakshu Joshi 031601,Krishan Kumar 031603,Prafulla Mittal 031618,Sagar Gaur 031606 in partial fulfillment for the award of degree of Bachelor of Technology in Civil Engineering of Jaypee University of Information Technology has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

Supervisor

Poonam 1. June. 2007

Mrs. Poonam Dhiman
Civil Engineering Department
Jaypee University of Information Technology

ACKNOWLEDGMENT

The Earthquake Engineering project comes near to the culmination of all the concepts assimilated while studying the subject. It has presented us with an opportunity to use the technical know-how imparted to us to a real life project.

Designing a Four Storey Office Building, involving all the concepts of Structural Engineering and Mechanics, under the guidance of our esteemed mentors Mrs. Poonam Dhiman, Mr. Anil Dhiman Department of Civil Engineering, Jaypee University of Information Technology, not only cleared all our ambiguities but also generated a high level of interest and gusto in the subject. We are truly grateful to them.

The prospect of working in a group with a high level of accountability fostered a spirit of teamwork and created a feeling of oneness which thus, expanded our range of vision, motivated us to perform to the best of our ability and create a report of the highest quality.

To do only the best quality work, with utmost sincerity and precision has been our constant endeavor.

CHAKSHU JOSHI (031601)
ARUN RAJTA (031609)
SAGAR GAUR (031606)
KRISHAN KUMAR SINGH (031603)
PRAFULLA MITTAL (031618)

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LIST OF ABBREVIATIONS

A_h	Design horizontal seismic coefficient
A_k	Design horizontal acceleration spectrum value for mode k of vibration
ABS	Maximum absolute response
Damp	Damping Ratio
D_L	Response quantity due to dead load
E	Modulus of elasticity
EQ1	Earthquake load in X direction
EQ2	Earthquake load in Z direction
FX	Force in X direction
G	Acceleration due to gravity
GY	Global Y
H	Height of structure in meters
H_i	Height measured from the base of building to floor i
I	Importance factor
LL	Live load (Imposed load)
N	Number of storey
Poisson	Poisson Ratio
Q_i	Lateral force at floor i
R	Response reduction factor
S_a/g	Average response acceleration coefficient for rock or soil sites as given by Fig.2 and Table 3 (IS 18920(part 1):2002) based on appropriate natural periods and damping of the structure
T_a	Approximate fundamental period (in seconds)
V_b	Design seismic base shear
W	Seismic weight of the structure
W_i	Seismic weight of floor i
Z	Zone factor

ABSTRACT

This project consists of earthquake resistant analysis and design of a four storey three-bay reinforced concrete commercial building. Height of each storey is three and a half meters and width of each bay is five meters. This building is assumed to be situated in seismic zone IV as per IS 1893 (Part I):2002. Calculations of loads (other than earthquake) have been done as per guidelines of IS 875. Earthquake load have been calculated according to IS 1893(Part I):2002 guidelines. Static analysis of building has been carried out using STAAD Pro which is an analysis and design software package for structural engineering. Design of various components of building such as beams, columns and slabs have been designed as per IS 456:2000. Reinforced detailing of structural members and foundation is given in the drawing attached with the report.

Chapter 1

INTRODUCTION

1.1 GENERAL

The design of multistoried building comprises of design of foundation and design of super structure that rests on foundation. The building chosen for the Earthquake analysis and design is a four storey RC building, which is assumed to be situated in zone IV as per IS 1893 part 1. Storey height is taken as 3.5 m and bay width is 5 m. Size of all beam are 0.3×0.45 m and that all ground floor columns 0.8×0.8 m. Size of rest of all columns is 0.75×0.75 m. Thickness of roof slab is 115mm and that of floor slab is 125mm. Calculations of loads are carried out as per Indian Standard guidelines. STAAD Pro is used for the Analysis and Design of the building. Isolated footings are provided below each column.

1.2 OBJECTIVE

Objective of present report is Earthquake resistant analysis and design of superstructure of a four storey building using STAAD Pro. Design of foundation is also included in the report. Reinforcement detailing of each component is given at the end of the report.

1.3 TOOL USED: STAAD PRO 2004

The software used for analysis and design of multistorey building is STAAD Pro. STAAD Pro is an analysis and design software package for structural engineering. This is the next generation of the STAAD Product line, the most powerful structural engineering software in the world. With over 150,000 installations, 15,000 clients, design codes for 30 countries and NRC/NUPIC certification, STAAD Pro is the choice of professional engineers around the world.

STAADpro features state of the art user interface, visualisation tools, powerful analysis and design engines with advanced finite element (FEM) and dynamic analysis capabilities. From model generation, analysis and design to visualisation and result verification, STAADpro is the professional's first choice. STAADpro has building codes for most countries including US, Britain, Canada, Australia, France, Germany, Spain, Norway, Finland, Sweden, **India**, China, Euro Zone, Japan, Denmark and Holland. STAAD-Pro, the world's most powerful and popular structural analysis and design software is in use across the globe since 1980. Now it is available in the form of STAAD.Pro which consists of STAAD + STARDYNE +FEMkit + VisualDraw. STAAD.Pro is comprehensive, general purpose software for integrated structural analysis and design. STAAD.Pro may be utilized for analyzing and designing practically all types of structures – buildings, bridges, towers, transportation, industrial and utility structures. STAAD.Pro implements the most modern technologies in today's Computer-Aided-Engineering. It unifies leading-edge graphics and visualization techniques with proven and time tested analysis and design. A live, unified database provides seamless integration across all mission critical application. Main features of STAAD Pro are:

- ✓ Dynamic / Seismic Analysis
  - o Mass modeling, Extraction of Frequency and Mode shapes
  - o Response Spectrum, Time History Analysis.
  - o Modal Damping Ratio for Individual Models
  - o Combination of Dynamic forces with Static loading for subsequent design

- ✓ Analysis & Design :
  - o 2D/3D Analysis based on state-of-the-art Matrix method to handle extremely large job
  - o Beam, Truss, Tapered Beam, Shell/Plate Bending/Plane Stress
  - o Full/Partial Moment Releases
  - o Member Offset Specification
  - o Fixed, Pinned and Spring Supports with Releases. Also inclined Supports
  - o Automatic Spring Support Generator
  - o Linear, P-Delta Analysis, Non-Linear Analysis with automatic load and stiffness correction. Multiple Analyses within same run

- ✓ Concrete Design :

- Design of Concrete Beam/Column/Slab/Footing as per all major international codes

- Numerical and Graphical Design Outputs with complete reinforcement details.
- IS 456-2000 for RCC design.
- RC detailer as per IS 456-2000 has been implemented which has given a new dimension to RCC design.

✓ Result Verification :

- Result verification and display.
- Deflected and Mode Shapes based on Joint/Section Displacement for user-specified loading.
- Bending Moment and Shear force diagrams of individual members as well as the entire structure.
- User-controlled Scale factors for Deflected or Mode shapes.
- Moment Envelope Plots as max/min for all loads.
- Animation of Deflected/Mode shapes, Stress Contours.

1.4 INDIAN STANDARD CODES

IS 1893 (PART 1) 2002

Indian Standard Criteria for Earthquake Resistant Design of Structures (5th Revision)

IS 875 (Part 1):1987

Code of practice for design loads (other than earthquake) for buildings and structures: Part 1 Dead loads – Unit weights of building material and stored materials (second revision)

IS 875 (Part 2):1987

Code of practice for design loads (other than earthquake) for buildings and structures: Part 2 imposed loads (second revision).

IS 456: 2000

Code of practice for general structural use of plain and reinforced concrete.

IS 13920: 1993

Ductile Detailing of RCS subjected to seismic forces – code of practices

SP 16

Design Aids to IS - 456: 1978.

1.5 METHODOLOGY

The approach for designing the proposed building consists of the following stages:

1. **Estimation of Loads (as per IS 875 part (I-II) :**

For the four-storey building, the analysis is carried out for the following loads and their combinations:

- Dead load
- Live load
- Earthquake load

The dead load has been worked out by assuming 115mm thickness for roof slab and 125mm for all floor slabs. The load due to the flooring – finishes, tiles etc. was given due consideration and an allowance was made for future erection of partitions. Unit weights for the material are taken from IS 875:1987 part I. The live loads considered are due to the imposed loads in case of commercial buildings, as per the specifications of IS 875:1987 part II. Due to increased emphasis being laid on the design of earthquake resistant structures, nowadays the earthquake forces are also estimated for Design of multistory buildings. For the present work, earthquake loads are taken from the revised Seismic Code (IS: 1893-2002(I)). The proposed building is in Zone IV. The load was initially applied to the slabs and through trapezoidal distribution it was transmitted to the columns via beams (longitudinal and transverse), and consequently to the foundations. The designing was done after analyzing the structure for the above-mentioned loads – individually and for different load combinations recommended in IS 1893:2002 part I.

2. Analysis of the Structure:

The building was divided into two frames: middle frame and end frame and these frames have been analyzed using the STAAD.Pro software. The four-storey portals were analyzed for dead load, live load, earthquake loads and their combinations.

The analysis gave the design forces arising in the members, namely – transverse beams and columns, due to the above loads and these members were designed for the severest of forces obtained due to the load combinations.

3. Concrete Design:

The members were designed using the Limit State method, according to the guidelines prescribed by IS: 456-2000. For the purpose of design, Design Aids to IS: 456 (SP: 16) was also be referred.

4. Drawing Details:

The drawings enabled the understanding of the layout of the building and gave the locations of the various members. The structural drawings were prepared after designing the individual members, showing the details of the reinforcement to be provided.

The analysis, designs, and the drawings were compiled in the end in the form of this project report.

Chapter 2

EARTHQUAKE RESISTANT ANALYSIS AND DESIGN

2.1 EARTHQUAKE RESISTANT DESIGN PHILOSOPHY

The philosophy of seismic design can be summarized as:

(a) The design philosophy adopted in the code is to ensure that structures possess at least a minimum strength to

   (i) Resist minor earthquake (<DBE), which may occur frequently, without change;

   (ii) Resist moderate earthquake (DBE) without significant damage through some non-structural damage;

   (iii) Resist major earthquake (MCE) without collapse.

"Design Basis Earthquake (DBE) is defined as the maximum earthquake that reasonably can be expected to experience at the site once during lifetime of the structure. The earthquake corresponding to the ultimate safety requirements is often called as Maximum Considered Earthquake (MCE). Generally, the DBE is half of MCE".

(b) Actual forces that appear on structures during earthquakes are much higher than the design forces specified in the code. It is recognized that the complete protection against earthquakes of all sizes is not economically feasible and design based alone on strength criteria is not justified. The basic criteria is of earthquake resistant design should be used on lateral strength as well as deformability and ductility capacity of structure with limited damage, but no collapse. Ductility in the structures will arise from inelastic material, behavior and detailing of reinforcement in such a manner that brittle failure is avoided and ductile behavior is induced by allowing steel to yield in controlled manner Therefore gap between the actual and design lateral forces is narrowed down by providing ductility in the structure and additional reserve strength in structures over and above the design strength.

(c) The design lateral forces specified in the code shall be considered in each of the two orthogonal directions of the structure. For structures, which have lateral force resisting elements in the two orthogonal directions only, the design lateral force shall be considered along one direction at a time, and not in both directions simultaneously. Structures having lateral force resisting elements in direction other than the two orthogonal directions, shall be analyzed considering the load combinations specified in clause 6.3 of IS 1893 (Part 1): 2002.

(d) Earthquake generated vertical inertia forces are to be considered in design unless it is not significant. Vertical acceleration should be considered in structures with large spans, those in which stability is a criterion for design, or for overall stability analysis of structures. Reduction in gravity force due to vertical component of ground motions can be particularly detrimental in case of pre stressed horizontal members and of cantilevered members. Hence, special attention should be paid to the effect of vertical component of the ground motion on pre-stressed or cantilevered beams, girders and slab. Where both horizontal and vertical seismic forces are taken into account, load combination specified in the code shall be considered.

(e) The response of a structure to ground vibrations is a function of the nature of foundation soil; materials, form, size and mode of construction structures; and the duration and characteristics of ground motion. This code specifies design forces for structures standing on rock or firm soils, which do not liquefy or slide due to loss of strength during ground vibrations.

2.2 DETERMINATION OF DESIGN LATERAL FORCES AS PER IS 1893 PART I

The procedures recommended for the determination of lateral force in the code are based on the approximation effects, yielding can be accounted for linear analysis of the building using the design spectrum. This analysis is carried out by either modal analysis procedure or dynamic analysis procedure (Clause 7.8 of IS 1893 (Part I): 2002).

A simplified method may also be adopted that will be referred as lateral force procedure (clause 7.5 of IS 1893 (Part I): 2002) also recognized as equivalent lateral force procedure or equivalent static procedure in the literature. The main difference between the equivalent lateral force procedure and dynamic analysis procedure lies in the magnitude and distribution of lateral forces over the height of the buildings. In the dynamic analysis procedure the lateral forces are based on the properties of the natural vibration modes of the building, which are determined by the distribution of mass and stiffness over height. In the equivalent lateral force procedures the magnitude of forces is based on an estimation of the fundamental period and on the distribution of forces, as given by simple formulas appropriate for regular buildings. Otherwise the two procedures have similar capabilities and are subjected to the same limitation.

2.2.1 Equivalent Lateral Force Procedure

As discussed in the previous section that the equivalent lateral force procedure is the simplest method of analysis and requires less computational effort because, the forces depend on the code based fundamental period of structures with some empirical modifier. The design base shear shall first be computed as a whole, than be distributed along the height of the buildings based on simple formulas appropriate for buildings with regular distribution of mass and stiffness. The design lateral force obtained at each floor level shall then be distributed to individual lateral load resisting elements depending upon floor diaphragm action. In case of rigid diaphragm (reinforced concrete monolithic slab-beam floors or those consisting of prefabricated/precast elements with topping reinforced screed can be taken as rigid diaphragm) action, the total shear in any horizontal plane shall be distributed to the various elements of lateral force resisting system on the basis of relative rigidity (Clause 7.7.2 of IS 1893 (Part I): 2002). The following are the major steps for determining the forces by equivalent static procedures.

2.2.2 Determination of base shear

The total design lateral force or design base shear along any principal direction shall be determined by the following expression, Clause 7.5 of IS 1893 (Part I): 2002.

$V_B = A_h W$

Where,

A_h = Design horizontal seismic coefficient for a structure

W = Seismic weight of building.

Ah shall be determined by the following expression:

$A_h = (Z/2)(I/R)(S_a/g)$

Note: The value of A_h will not be taken less than Z/2 whatever the value of (I/R).

In factor (Z/2), Z is the Zone factor given in table 2 of IS 1893 (Part I): 2002, for the Maximum Considered Earthquake (MCE) and service life of structure in a Zone. The factor 2 in the denominator of Z is used as to reduce the Maximum Considered Earthquake (MCE) zone factor to the factor for Design Basis Earthquake (DBE). Z can also be determined from the seismic zone map of India, shown in Figure 1 of IS 1893 (Part I): 2002, which segregates the country in various areas of similar probable maximum intensity ground motion. The maximum intensity is fixed in such a way that the lifeline/critical structures will remain functional and there is low probability of collapse for structures designed with the provisions provided in the code even for an event of occurrence earthquake with higher intensity. The value of Z ranges from 0.10 to 0.36 corresponding to Zone II to Zone V. This map has divided the whole country into four zones starting from Zone II to Zone V.

The intensity as per Comprehensive Intensity Scale (MSK 64) broadly associated with the various zones is VI (or less), VII, VIII and IX (and above) for Zones II, III, IV and V respectively. In Zone II, low seismic intensity zone where minor damage could occur has a Z value of 0.10. Zone III (Z = 0.16), moderate intensity zone where moderate damage could occur. Zone IV (Z = 0.24), severe intensity zone where major property damage could occur and Zone V (Z = 0.36), very severe intensity zone that lies in close proximity to certain prescribed major fault systems.

In factor (I/R), I is the importance factor, depending upon the functional use of the structures, characterized by hazardous consequences of its failure, post earthquake functional needs, historic value, or economic importance. The minimum values of importance factor are given in Table 6 o IS 1893 (Part I): 2002.According to table 6, buildings are classified in two categories: (i) important service and community buildings and (ii) all other buildings. Importance service buildings have an I factor 1.5, and all other buildings are assigned a value of 1.0. The value of I may be more than the assigned value as proposed in Table 6, depending upon economy, strategy considerations like multi storey buildings, hazardous consequences etc. Importance service buildings refers to those structures that must be safe and usable for emergency purpose after a major earthquake has occurred in order to preserve the peace, health and safety of general public.

R is the response reduction factor, depending on the perceived seismic damage performance of the structure, characterized by ductile or brittle deformations. This characteristic represents the structure's ductility, damping as well as the past seismic performance of structure with various structural framing systems. In actual, the need for incorporation of factor R in base shear formula in an attempt to consider the structure's inelastic characteristics in linear analysis method since it is undesirable as well as uneconomical that a structure will be designed on the basis that will remain in elastic range for all major earthquakes. A limited inelastic yielding must be allowed to the structure by considering that its vertical load carrying capacity and endangering life safety should not be impairing.

The inelastic characteristics include (i) inelastic deformation and its changing pattern as yielding progresses, (ii) the damping characteristics of the yielding elements, and (iii) the variation in stiffness and period of the structure as yielding progresses. In this way, the base shear equation produces force levels that are probably more nearly representative of those occurring in an actual structure. It is achieved by applying those base shears for linear design that are reduced by a factor I/R from those that would be obtained from fully elastic response. Experiments and performance of structure during earthquake have shown that the structure designed for reduced force levels perform adequately, if properly detailed. The value of R increases with the increase of structural ductility and its energy dissipation capacity and degree of redundancy. The factor R is assigned to different types of building structures generally on the basis of empirical or semi empirical judgment, experience with building performance in past earthquakes, on analytical and experimental studies and on calibration with force levels in codes. The values of R are prescribed in Table 7 of IS 1893 (Part I): 2002 for different types of building systems.

Table 7 of IS 1893 (Part I): 2002 shows a low value of R approaching 1.5 assigned to an extremely brittle building i.e. unreinforced masonry wall buildings and a high value of R (=5) is assigned o a more ductile structure like special moment resistant frame reinforced concrete or shear wall buildings. The response reduction factor R is also be known by the name response modification factor (ATC -3, UBC, and NEHRP) or behavior factor (q-factors) in EC8.

S_a/g is the Average response acceleration coefficient for rock and soil sites as given by Figure 2 of IS 1893 (Part I): 2002 and by the equations described in clause 6.0 for different soil condition based on appropriate natural periods of the structure. These values are given for 5% of damping of the structure; for other value of damping it is modified according to Table 3 of IS 1893 (Part I): 2002. These curves represent free field ground motion.

The fundamental natural period for buildings are given in Clause 7.6 of IS 1893 (Part I): 2002 and it is summarized as:

$T_a = 0.075h$ moment resisting RC frame building without brick infill walls

$T_a = 0.085h$ moment resisting steel frame building without brick infill walls

$T_a = .09h/d_{1/2}$ all other buildings including moment resisting RC frame building with brick infill walls

H is the height of building in m and d is the base dimension of building at plinth level in m, along the considered direction of lateral force.

W is the Seismic weight of building which is the sum of the seismic weight of floors.

The seismic weight at any floor level would be equal to the dead weight of the floor system plus weight of column and walls in inverse proportion to its distance from the floors plus appropriate amount of imposed load as specified in Clause 7.3 of IS 1893 (Part I): 2002. Imposed load on roof level not be considered. The basic reasons for considering the percentage of live load as specified in Table 8 of IS 1893 (Part I): 2002 are (i) only a part of the maximum live load will probably be existing at the time of earthquake, (ii) non-rigid mounting of the live load absorbs part of the earthquake energy and (iii) specified live load include as part of it, impact effect of loads which need not be considered since earthquake loads act on the mass only.

Lateral distribution of base shear

The computed base shear is now distributed along the height of the building. The shear force, at any level, depends on the mass at that level and deforms shape of the structure. Earthquake forces deflect a structure into number of shapes, known as the natural mode shapes. Number of natural modes shapes depends upon the degree-of-freedom of the system. Generally, a structure has a continuous system with infinite degree-of-freedom. From structural idealization we convert an infinite degree-of-freedom to finite degree of freedom system. For example, a multi-storeyed building has been idealized into lumped masses model by assuming the mass of the building lumped at each floor level (called node); with one degree of freedom in the direction of lateral displacement in which the structure is being analyzed per floor, resulting in as many degrees of freedom as the number of floors. Therefore, a multi-storeyed building has a multiple degree of freedom with many possible patterns of deformations. The magnitude of the lateral force at a particular floor (node) depends on the mass of that node, the distribution of stiffness over the height of structure, and the nodal displacements in a given mode. The actual distribution of base shear over the height of the building is obtained as the superposition of all the modes of vibration of the multiple-degree-of-freedom system.

In equivalent lateral force procedure, the magnitude of lateral forces is based on the fundamental period of vibration, the other periods and shapes of natural modes are not required. IS 1893 (Part I): 2002 uses a parabolic distribution (Paz, 1994) of lateral force along the height of building as per the following expression

$Q_i = V_b (W_i h_{i2})/$

Where,

Q_i = Design lateral force at floor i

Wi = Seismic weight of floor i,

Hi = Height of floor I measured from base, and

N = Number of stories in the building is the number of levels at which masses are located.

2.3 STAGES IN THE STRUCTURAL ANALYSIS AND DESIGN PROCESS

The approach for designing the proposed building consisted of the following stages:

2.3.1 Estimation of Loads:

For the Four-storey building, the analysis and design has been performed for the following loads as per IS 875(Part I, Part II) and IS 1893 part 1:

- Dead load
- Live load
- Earthquake load

Dead Load:

- Self weight -1 in Y direction
- Floor Finish .960 KN/m^2
- (Floor finish 40 mm thick, unit wt. 24 KN/m^3)

Live Load:

Roof Slab 1.5 KN/m^2

Floor Slab 2 KN/m^2

(a) Calculation for End Frame

- **Mass of Roof (M1)**
- ✓ Mass of column 0.75*.753.5/2)*24*4 = 94.5 kN
- ✓ Mass of Beams
- ✓ Lateral 0.3*.45*5*24*3 = 48.6 kN

- ✓ Transverse 0.3*.45*(5/2)*24*4 = 32.4 kN
- ✓ Mass of slab 5*(5/2)*.115*24*3 = 117.56 kN (25% of LL)
  Total = 293.06 kN

- **Mass of Floor (M2)**
- Mass of Columns .75*.75*3.5*24*4=189 kN
- Mass of Beams
- Lateral .3*.45*5*24*3=48.6 kN
- Transverse .3*.45*(5/2)*24*4=32.4 kN
- ✓ Mass of Slab 5*(5/2)*.125*24*3=150 kN (25% of LL)
- Total = 234.135 kN

Seismic wt. of a end frame, (M1+3*M2)

W = 1553.06 kN

Fundamental Natural Period

$$T_a = 0.075 * h^{0.75}$$ (For RC frame building)

Where, h = height of the building, in meters

h = 14 m

Fundamental natural period is **0.543 sec.**

Design Base Shear

Design seismic base shear,

$$V_B = A_h * W$$

Where,

$$A_h = \frac{Z}{2}\frac{I}{R}\frac{S_a}{g}$$

Where,

Z = Zone factor given in the IS 1893

(Part 1):2002 Table 2, for the Maximum Considered Earthquake (MCE).

I = Importance factor, depending upon the functional use of the structures.

R = Response reduction factor, depending on the perceived seismic damage performance of the structure.

$A_h = 0.1104$

$V_b = 171.46$ kN

S_a/g is Average response acceleration coefficient

Vertical Distribution of Base Shear

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$$

Q1 = 6.81 kN

Q2 = 27.25 kN

Q3 = 61.32 kN

Q4 = 76.07 kN

Total Shear , Q = Q1+Q2+Q3+Q4 = 171.45 kN

Where,

Q_i = Design lateral forces at floor i

W_i = Seismic weights of the floors i

h_i = Heights of the floors i

n = Number of stories

(b) Calculation for Middle Frame

☞ **Mass of Roof (M1)**

✓	Mass of column	94.5 kN
✓	Mass of Beams	
✓	Lateral	48.6 kN
✓	Transverse	64.8 kN
✓	Mass of slab	235.13 kN
	Total = 443.03 kN	

☞ **Mass of Floor (M2)**

✓	Mass of Columns	94.5	kN

✓ Mass of Beams

➢ Lateral	48.6	kN
➢ Transverse	64.8	kN
✓ Mass of Slab	300	kN

Total = 507.9 kN

Seismic wt. of a middle frame, (M1+3*M2)

W = 1966.73 kN

V_b = 171.46 kN

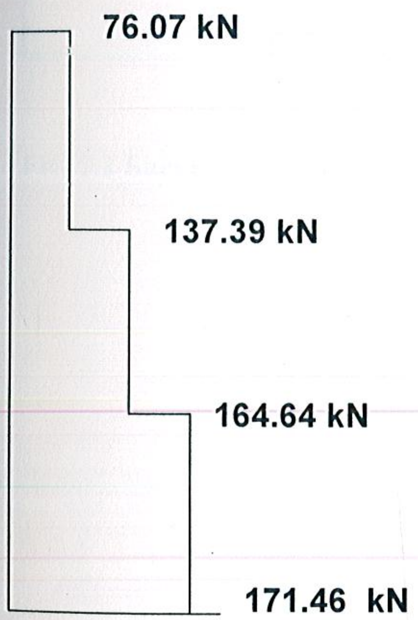
Q1 = 6.133 kN

Q2 = 24.53 kN

Q3 = 55.19 kN

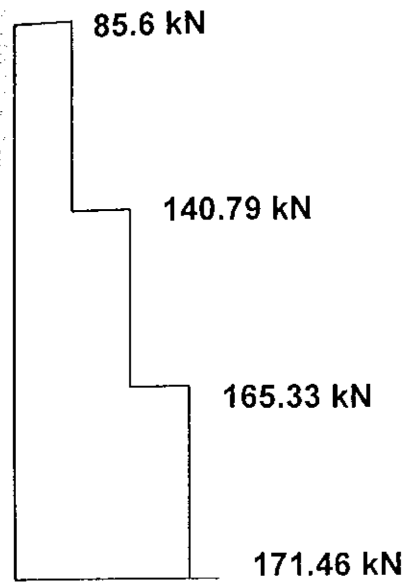
Q4 = 85.6 kN

Q = Q1 + Q2 + Q3+Q4 = 171.46 kN



Lateral force distribution at various floor levels

FIG 2.1 **Shear Diagram for End frame**



Lateral force distribution at various floor levels

FIG 2.2 **Shear Diagram for Middle frame**

2.4 PRIMARY LOADS AND LOAD COMBINATIONS

1. Primary Loads

LOAD 1: Dead Load (DL)

LOAD 2: Live Load (LL)

LOAD 3: SEISMIC Load in X direction (EQ1)

LOAD 4: SEISMIC Load in Z direction (EQ2)

2. Load combinations

LOAD COMB 5: 1.5*(DL+LL)

LOAD COMB 6:1.2*(DL+LL+EQ1)

LOAD COMB 7: 1.2*(DL+LL-EQ1)

LOAD COMB 8: 1.2*(DL+LL+EQ2)

LOAD COMB 9: 1.2*(DL+LL-EQ2)

LOAD COMB 10: 1.5*(DL+EQ1)

LOAD COMB 11: 1.5*(DL-EQ1)

LOAD COMB 12: 1.5*(DL+EQ2)

LOAD COMB 13: 1.5*(DL-EQ2)

LOAD COMB 14: .9*DL+1.5*EQ1

LOAD COMB 15: .9*DL-1.5EQ1

LOAD COMB 16: .9DL+1.5EQ2

LOAD COMB 17: .9DL-1.5EQ2

2.5 STAAD PRO MODELLING

2.5.1 SOURCE CODE

```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 15-Mar-07
END JOB INFORMATION
INPUT WIDTH 79
**********************************************
*       STAAD.Pro Generated Comment        *
**********************************************
*1 0 0 0 4 15 0 0
*REP 3 0 3.5 0
*REP ALL 3 0 0 -5
**********************************************
UNIT METER KN
JOINT COORDINATES
1 0 0 -15; 2 0 0 -10; 3 0 0 -5; 4 0 0 0; 5 0 3.5 -15; 6 0 3.5 -10; 7 0 3.5 -5;
8 0 3.5 0; 9 0 7 -15; 10 0 7 -10; 11 0 7 -5; 12 0 7 0; 13 0 10.5 -15;
14 0 10.5 -10; 15 0 10.5 -5; 16 0 10.5 0; 17 5 0 -15; 18 5 0 -10; 19 5 0 -5;
20 5 0 0; 21 5 3.5 -15; 22 5 3.5 -10; 23 5 3.5 -5; 24 5 3.5 0; 25 5 7 -15;
26 5 7 -10; 27 5 7 -5; 28 5 7 0; 29 5 10.5 -15; 30 5 10.5 -10; 31 5 10.5 -5;
32 5 10.5 0; 33 10 0 -15; 34 10 0 -10; 35 10 0 -5; 36 10 0 0; 37 10 3.5 -15;
38 10 3.5 -10; 39 10 3.5 -5; 40 10 3.5 0; 41 10 7 -15; 42 10 7 -10; 43 10 7 -5;
44 10 7 0; 45 10 10.5 -15; 46 10 10.5 -10; 47 10 10.5 -5; 48 10 10.5 0;
49 15 0 -15; 50 15 0 -10; 51 15 0 -5; 52 15 0 0; 53 15 3.5 -15; 54 15 3.5 -10;
55 15 3.5 -5; 56 15 3.5 0; 57 15 7 -15; 58 15 7 -10; 59 15 7 -5; 60 15 7 0;
```

61 15 10.5 -15; 62 15 10.5 -10; 63 15 10.5 -5; 64 15 10.5 0; 65 0 14 -15;
66 0 14 -10; 67 0 14 -5; 68 0 14 0; 69 5 14 -15; 70 5 14 -10; 71 5 14 -5;
72 5 14 0; 73 10 14 -15; 74 10 14 -10; 75 10 14 -5; 76 10 14 0; 77 15 14 -15;
78 15 14 -10; 79 15 14 -5; 80 15 14 0;

****

* STAAD.Pro Generated Comment *

****

*1 1 2 3 1 1

*REP 3 3 4

*REP ALL 4 16 12

****

MEMBER INCIDENCES

4 1 5; 5 2 6; 6 3 7; 7 4 8; 8 6 5; 9 7 6; 10 8 7; 11 5 9; 12 6 10; 13 7 11;
14 8 12; 15 10 9; 16 11 10; 17 12 11; 18 9 13; 19 10 14; 20 11 15; 21 12 16;
22 14 13; 23 15 14; 24 16 15; 29 5 21; 30 6 22; 31 7 23; 32 8 24; 33 9 25;
34 10 26; 35 11 27; 36 12 28; 37 13 29; 38 14 30; 39 15 31; 40 16 32; 44 17 21;
45 18 22; 46 19 23; 47 20 24; 48 22 21; 49 23 22; 50 24 23; 51 21 25; 52 22 26;
53 23 27; 54 24 28; 55 26 25; 56 27 26; 57 28 27; 58 25 29; 59 26 30; 60 27 31;
61 28 32; 62 30 29; 63 31 30; 64 32 31; 69 21 37; 70 22 38; 71 23 39; 72 24 40;
73 25 41; 74 26 42; 75 27 43; 76 28 44; 77 29 45; 78 30 46; 79 31 47; 80 32 48;
84 33 37; 85 34 38; 86 35 39; 87 36 40; 88 38 37; 89 39 38; 90 40 39; 91 37 41;
92 38 42; 93 39 43; 94 40 44; 95 42 41; 96 43 42; 97 44 43; 98 41 45; 99 42 46;
100 43 47; 101 44 48; 102 46 45; 103 47 46; 104 48 47; 109 37 53; 110 38 54;
111 39 55; 112 40 56; 113 41 57; 114 42 58; 115 43 59; 116 44 60; 117 45 61;
118 46 62; 119 47 63; 120 48 64; 124 49 53; 125 50 54; 126 51 55; 127 52 56;
128 54 53; 129 55 54; 130 56 55; 131 53 57; 132 54 58; 133 55 59; 134 56 60;
135 58 57; 136 59 58; 137 60 59; 138 57 61; 139 58 62; 140 59 63; 141 60 64;
142 62 61; 143 63 62; 144 64 63; 176 13 65; 177 14 66; 178 15 67; 179 16 68;
180 29 69; 181 30 70; 182 31 71; 183 32 72; 184 45 73; 185 46 74; 186 47 75;
187 48 76; 188 61 77; 189 62 78; 190 63 79; 191 64 80; 192 66 65; 193 67 66;
194 68 67; 195 65 69; 196 66 70; 197 67 71; 198 68 72; 199 70 69; 200 71 70;
201 72 71; 202 69 73; 203 70 74; 204 71 75; 205 72 76; 206 74 73; 207 75 74;
208 76 75; 209 73 77; 210 74 78; 211 75 79; 212 76 80; 213 78 77; 214 79 78;
215 80 79;

```
ELEMENT INCIDENCES SHELL
173 13 16 64 61; 174 9 12 60 57; 175 5 8 56 53; 216 65 68 80 77;
START GROUP DEFINITION
MEMBER
_EXTECOL 11 TO 14 131 TO 134
_EXTERCOL 18 TO 21 138 TO 141
_EXTERICOL 176 TO 179 188 TO 191
_IXTECOL 51 TO 54 91 TO 94
_IXTERCOL 58 TO 61 98 TO 101
_IXTERICOL 180 TO 187
_EXTEBEAM 192 TO 195 198 202 205 209 212 TO 214
_EXTERBEAM 15 TO 17 33 36 73 76 113 116 135 TO 137
_EXTERIBEAM 22 TO 24 37 40 77 80 117 120 142 TO 144
_IXTEBEAM 34 35 55 TO 57 74 75 95 TO 97 114 115
_IXTERBEAM 38 39 62 TO 64 78 79 102 TO 104 118 119
_IXTERIBEAM 196 197 199 TO 201 203 204 206 TO 208 210 211
END GROUP DEFINITION
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 2.17184e+007
POISSON 0.17
DENSITY 23.5615
ALPHA 5.5e-006
DAMP 0.05
END DEFINE MATERIAL
MEMBER PROPERTY INDIAN
8 TO 10 15 TO 17 22 TO 24 29 TO 40 48 TO 50 55 TO 57 62 TO 64 69 TO 80 88 -
89 TO 90 95 TO 97 102 TO 104 109 TO 120 128 TO 130 135 TO 137 142 TO 144 192 -
193 TO 215 PRIS YD 0.45 ZD 0.3
MEMBER PROPERTY INDIAN
11 TO 14 18 TO 21 51 TO 54 58 TO 61 91 TO 94 98 TO 101 131 TO 134 138 TO 141 -
176 TO 191 PRIS YD 0.75 ZD 0.75
MEMBER PROPERTY
4 TO 7 44 TO 47 84 TO 87 124 TO 127 PRIS YD 0.8 ZD 0.8
```

```
CONSTANTS
MATERIAL CONCRETE MEMB 4 TO 24 29 TO 40 44 TO 64 69 TO 80 84 TO 104 -
109 TO 120 124 TO 144 173 TO 216
ELEMENT PROPERTY
216 THICKNESS 0.115
173 TO 175 THICKNESS 0.125
SUPPORTS
1 TO 4 17 TO 20 33 TO 36 49 TO 52 FIXED
LOAD 1 DL
ELEMENT LOAD
173 TO 175 216 PR GY -0.96
SELFWEIGHT Y -1
LOAD 2 LL
ELEMENT LOAD
216 PR GY -1.5
173 TO 175 PR GY -2
LOAD 3 LOADTYPE SEISMIC  TITLE EQ1
JOINT LOAD
5 TO 8 53 TO 56 FX 171.458
9 TO 12 57 TO 60 FX 164.645
13 TO 16 61 TO 64 FX 137.39
65 TO 68 77 TO 80 FX 76.0684
21 TO 24 37 TO 40 FX 171.458
25 TO 28 41 TO 44 FX 165.325
29 TO 32 45 TO 48 FX 140.793
69 TO 76 FX 85.595
LOAD 4 LOADTYPE SEISMIC  TITLE EQ2
JOINT LOAD
5 8 21 24 37 40 53 56 FZ 171.458
9 12 25 28 41 44 57 60 FZ 164.645
13 16 29 32 45 48 61 64 FZ 137.39
65 68 69 72 73 76 77 80 FZ 76.0684
6 7 22 23 38 39 54 55 FZ 171.458
10 11 26 27 42 43 58 59 FZ 165.325
```

```
14 15 30 31 46 47 62 63 FZ 140.793
66 67 70 71 74 75 78 79 FZ 85.595
LOAD COMB ABS 5 1.5*(DL+LL)
1 1.5 2 1.5
LOAD COMB ABS 6 1.2*(DL+LL+EQ1)
1 1.2 2 1.2
LOAD COMB ABS 7 1.2*(DL+LL-EQ1)
1 1.2 2 1.2
LOAD COMB ABS 8 1.2*(DL+LL+EQ2)
1 1.2 2 1.2
LOAD COMB ABS 9 1.2*(DL+LL-EQ2)
1 1.2 2 1.2
LOAD COMB ABS 10 1.5*(DL+EQ1)
1 1.5
LOAD COMB ABS 11 1.5*(DL-EQ1)
1 1.5
LOAD COMB ABS 12 1.5*(DL+EQ2)
1 1.5
LOAD COMB ABS 13 1.5*(DL-EQ2)
1 1.5
LOAD COMB ABS 14 .9*DL+1.5*EQ1
1 0.9
LOAD COMB ABS 15 .9*DL-1.5EQ1
1 0.9
LOAD COMB ABS 16 .9DL+1.5EQ2
1 0.9
LOAD COMB ABS 17 .9DL-1.5EQ2
1 0.9
PERFORM ANALYSIS
PRINT SUPPORT REACTION
PRINT STORY DRIFT
START CONCRETE DESIGN
CODE INDIAN
CLEAR 0.03 MEMB 4 TO 7 44 47 84 87 124 TO 127
```

```
FC 25000 MEMB 4 TO 7 44 47 84 87 124 TO 127
DESIGN BEAM 8 TO 10 15 TO 17 22 TO 24 29 TO 40 48 TO 50 55 TO 57 62 TO 64 -
69 TO 80 88 TO 90 95 TO 97 102 TO 104 109 TO 120 128 TO 130 135 TO 137 142 -
143 TO 144 192 TO 215
DESIGN COLUMN 4 TO 7 11 TO 14 18 TO 21 44 TO 47 51 TO 54 58 TO 61 84 TO 87
-91 TO 94 98 TO 101 124 TO 127 131 TO 134 138 TO 141 176 TO 191
DESIGN ELEMENT 173 TO 175 216
CONCRETE TAKE
END CONCRETE DESIGN
PERFORM ANALYSIS
FINISH
```

2.5.2 3-D VIEW OF THE BUILDING

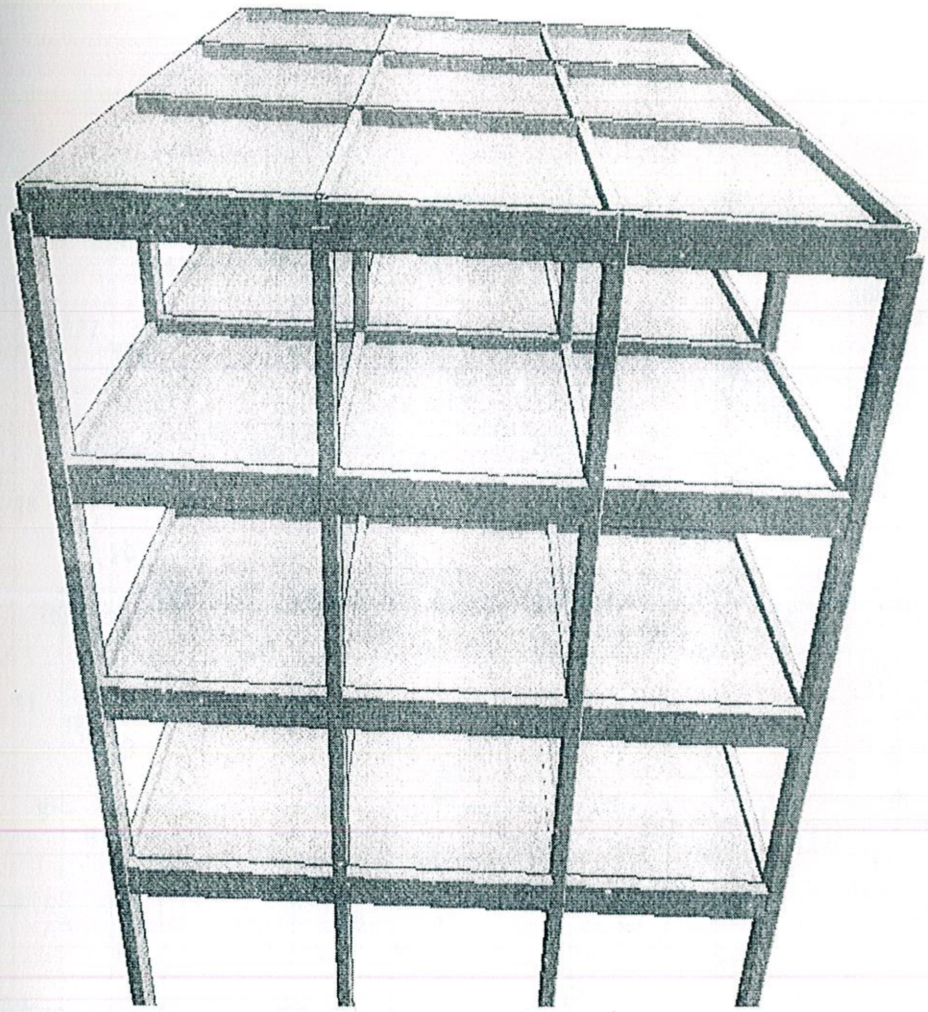


FIG 2.3: Final 3-D Model of the earthquake resistant multistorey building

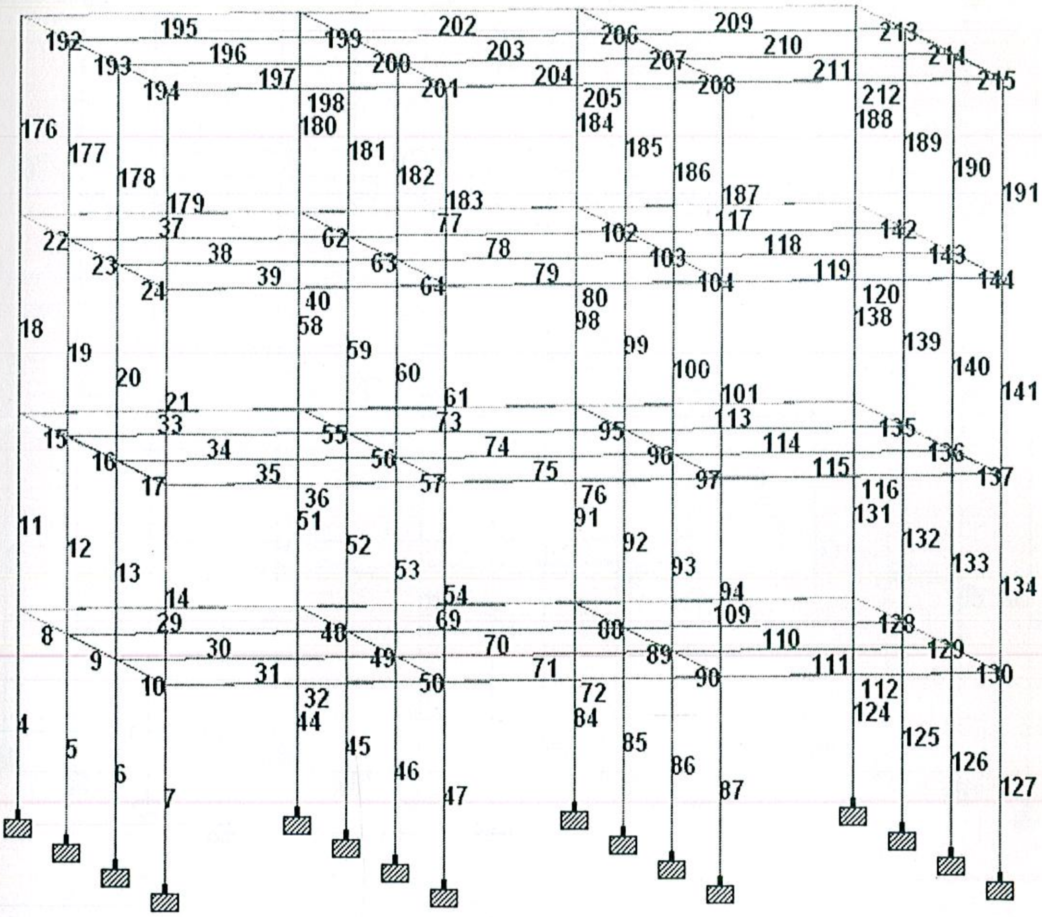


FIG 2.4: 3-D view of the structure showing beams and columns

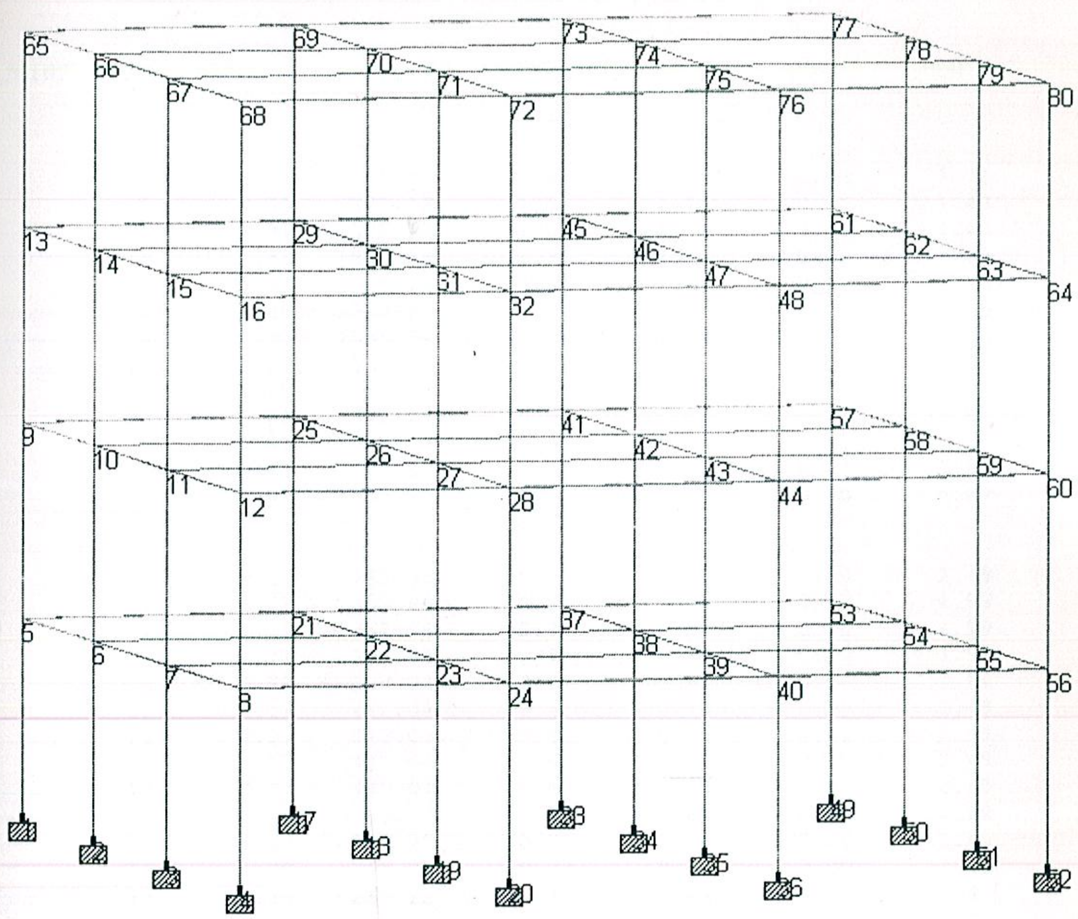


FIG 2.5: 3-D view of the structure showing nodes and their numbers

2.6 ANALYSIS RESULT

TABLE 1: SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT KN METE STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1							
	5	1.64	2281.41	1.64	1.79	0.00	1.79
	6	1.31	1825.13	1.31	1.43	0.00	1.43
	7	1.31	1825.13	1.31	1.43	0.00	1.43
	8	1.31	1825.13	1.31	1.43	0.00	1.43
	9	1.31	1825.13	1.31	1.43	0.00	1.43
	10	1.35	1659.28	1.35	1.45	0.00	1.45
	11	1.35	1659.28	1.35	1.45	0.00	1.45
	12	1.35	1659.28	1.35	1.45	0.00	1.45
	13	1.35	1659.28	1.35	1.45	0.00	1.45
	14	0.81	995.57	0.81	0.87	0.00	0.87
	15	0.81	995.57	0.81	0.87	0.00	0.87
	16	0.81	995.57	0.81	0.87	0.00	0.87
	17	0.81	995.57	0.81	0.87	0.00	0.87
2							
	5	2.13	447.33	0.93	1.10	0.00	2.49
	6	1.71	357.86	0.75	0.88	0.00	1.99
	7	1.71	357.86	0.75	0.88	0.00	1.99
	8	1.71	357.86	0.75	0.88	0.00	1.99
	9	1.71	357.86	0.75	0.88	0.00	1.99
	10	2.13	442.04	0.62	0.73	0.00	2.48
	11	2.13	442.04	0.62	0.73	0.00	2.48
	12	2.13	442.04	0.62	0.73	0.00	2.48
	13	2.13	442.04	0.62	0.73	0.00	2.48
	14	1.28	265.22	0.37	0.44	0.00	1.49
	15	1.28	265.22	0.37	0.44	0.00	1.49
	16	1.28	265.22	0.37	0.44	0.00	1.49
	17	1.28	265.22	0.37	0.44	0.00	1.49
3							
	5	2.13	447.33	0.93	1.10	0.00	2.49
	6	1.71	357.86	0.75	0.88	0.00	1.99
	7	1.71	357.86	0.75	0.88	0.00	1.99
	8	1.71	357.86	0.75	0.88	0.00	1.99
	9	1.71	357.86	0.75	0.88	0.00	1.99
	10	2.13	442.04	0.62	0.73	0.00	2.48
	11	2.13	442.04	0.62	0.73	0.00	2.48
	12	2.13	442.04	0.62	0.73	0.00	2.48
	13	2.13	442.04	0.62	0.73	0.00	2.48
	14	1.28	265.22	0.37	0.44	0.00	1.49
	15	1.28	265.22	0.37	0.44	0.00	1.49
	16	1.28	265.22	0.37	0.44	0.00	1.49

	17	1.28	265.22	0.37	0.44	0.00	1.49
4							
	5	1.64	2281.41	1.64	1.79	0.00	1.79
	6	1.31	1825.13	1.31	1.43	0.00	1.43
	7	1.31	1825.13	1.31	1.43	0.00	1.43
	8	1.31	1825.13	1.31	1.43	0.00	1.43
	9	1.31	1825.13	1.31	1.43	0.00	1.43
	10	1.35	1659.28	1.35	1.45	0.00	1.45
	11	1.35	1659.28	1.35	1.45	0.00	1.45
	12	1.35	1659.28	1.35	1.45	0.00	1.45
	13	1.35	1659.28	1.35	1.45	0.00	1.45
	14	0.81	995.57	0.81	0.87	0.00	0.87
	15	0.81	995.57	0.81	0.87	0.00	0.87
	16	0.81	995.57	0.81	0.87	0.00	0.87
	17	0.81	995.57	0.81	0.87	0.00	0.87
17							
	5	0.93	447.33	2.13	2.49	0.00	1.10
	6	0.75	357.86	1.71	1.99	0.00	0.88
	7	0.75	357.86	1.71	1.99	0.00	0.88
	8	0.75	357.86	1.71	1.99	0.00	0.88
	9	0.75	357.86	1.71	1.99	0.00	0.88
	10	0.62	442.04	2.13	2.48	0.00	0.73
	11	0.62	442.04	2.13	2.48	0.00	0.73
	12	0.62	442.04	2.13	2.48	0.00	0.73
	13	0.62	442.04	2.13	2.48	0.00	0.73
	14	0.37	265.22	1.28	1.49	0.00	0.44
	15	0.37	265.22	1.28	1.49	0.00	0.44
	16	0.37	265.22	1.28	1.49	0.00	0.44
	17	0.37	265.22	1.28	1.49	0.00	0.44
18							
	5	0.06	479.04	0.06	0.11	0.00	0.11
	6	0.05	383.23	0.05	0.09	0.00	0.09
	7	0.05	383.23	0.05	0.09	0.00	0.09
	8	0.05	383.23	0.05	0.09	0.00	0.09
	9	0.05	383.23	0.05	0.09	0.00	0.09
	10	0.05	478.94	0.05	0.11	0.00	0.11
	12	0.05	478.94	0.05	0.11	0.00	0.11
	13	0.05	478.94	0.05	0.11	0.00	0.11
	14	0.03	287.36	0.03	0.07	0.00	0.07
	15	0.03	287.36	0.03	0.07	0.00	0.07
	16	0.03	287.36	0.03	0.07	0.00	0.07
	17	0.03	287.36	0.03	0.07	0.00	0.07
19							
	5	0.06	479.04	0.06	0.11	0.00	0.11
	6	0.05	383.23	0.05	0.09	0.00	0.09
	7	0.05	383.23	0.05	0.09	0.00	0.09
	8	0.05	383.23	0.05	0.09	0.00	0.09
	9	0.05	383.23	0.05	0.09	0.00	0.09
	10	0.05	478.94	0.05	0.11	0.00	0.11
	11	0.05	478.94	0.05	0.11	0.00	0.11
	12	0.05	478.94	0.05	0.11	0.00	0.11
	13	0.05	478.94	0.05	0.11	0.00	0.11
	14	0.03	287.36	0.03	0.07	0.00	0.07
	15	0.03	287.36	0.03	0.07	0.00	0.07
	16	0.03	287.36	0.03	0.07	0.00	0.07
	17	0.03	287.36	0.03	0.07	0.00	0.07
20							
	5	0.93	447.33	2.13	2.49	0.00	1.10
	6	0.75	357.86	1.71	1.99	0.00	0.88
	7	0.75	357.86	1.71	1.99	0.00	0.88
	8	0.75	357.86	1.71	1.99	0.00	0.88
	9	0.75	357.86	1.71	1.99	0.00	0.88
	10	0.62	442.04	2.13	2.48	0.00	0.73
	11	0.62	442.04	2.13	2.48	0.00	0.73

	12	0.62	442.04	2.13	2.48	0.00	0.73
	13	0.62	442.04	2.13	2.48	0.00	0.73
	14	0.37	265.22	1.28	1.49	0.00	0.44
	15	0.37	265.22	1.28	1.49	0.00	0.44
	16	0.37	265.22	1.28	1.49	0.00	0.44
	17	0.37	265.22	1.28	1.49	0.00	0.44
33							
	5	0.93	447.33	2.13	2.49	0.00	1.10
	6	0.75	357.86	1.71	1.99	0.00	0.88
	7	0.75	357.86	1.71	1.99	0.00	0.88
	8	0.75	357.86	1.71	1.99	0.00	0.88
	9	0.75	357.86	1.71	1.99	0.00	0.88
	10	0.62	442.04	2.13	2.48	0.00	0.73
	11	0.62	442.04	2.13	2.48	0.00	0.73
	12	0.62	442.04	2.13	2.48	0.00	0.73
	13	0.62	442.04	2.13	2.48	0.00	0.73
	14	0.37	265.22	1.28	1.49	0.00	0.44
	15	0.37	265.22	1.28	1.49	0.00	0.44
	16	0.37	265.22	1.28	1.49	0.00	0.44
	17	0.37	265.22	1.28	1.49	0.00	0.44
34							
	5	0.06	479.04	0.06	0.11	0.00	0.11
	6	0.05	383.23	0.05	0.09	0.00	0.09
	7	0.05	383.23	0.05	0.09	0.00	0.09
	8	0.05	383.23	0.05	0.09	0.00	0.09
	9	0.05	383.23	0.05	0.09	0.00	0.09
	10	0.05	478.94	0.05	0.11	0.00	0.11
	11	0.05	478.94	0.05	0.11	0.00	0.11
	12	0.05	478.94	0.05	0.11	0.00	0.11
	13	0.05	478.94	0.05	0.11	0.00	0.11
	14	0.03	287.36	0.03	0.07	0.00	0.07
	15	0.03	287.36	0.03	0.07	0.00	0.07
	16	0.03	287.36	0.03	0.07	0.00	0.07
	17	0.03	287.36	0.03	0.07	0.00	0.07
35							
	5	0.06	479.04	0.06	0.11	0.00	0.11
	6	0.05	383.23	0.05	0.09	0.00	0.09
	7	0.05	383.23	0.05	0.09	0.00	0.09
	8	0.05	383.23	0.05	0.09	0.00	0.09
	9	0.05	383.23	0.05	0.09	0.00	0.09
	10	0.05	478.94	0.05	0.11	0.00	0.11
	11	0.05	478.94	0.05	0.11	0.00	0.11
	12	0.05	478.94	0.05	0.11	0.00	0.11
	13	0.05	478.94	0.05	0.11	0.00	0.11
	14	0.03	287.36	0.03	0.07	0.00	0.07
	15	0.03	287.36	0.03	0.07	0.00	0.07
	16	0.03	287.36	0.03	0.07	0.00	0.07
	17	0.03	287.36	0.03	0.07	0.00	0.07
36							
	5	0.93	447.33	2.13	2.49	0.00	1.10
	6	0.75	357.86	1.71	1.99	0.00	0.88
	7	0.75	357.86	1.71	1.99	0.00	0.88
	8	0.75	357.86	1.71	1.99	0.00	0.88
	9	0.75	357.86	1.71	1.99	0.00	0.88
	10	0.62	442.04	2.13	2.48	0.00	0.73
	11	0.62	442.04	2.13	2.48	0.00	0.73
	12	0.62	442.04	2.13	2.48	0.00	0.73
	13	0.62	442.04	2.13	2.48	0.00	0.73
	14	0.37	265.22	1.28	1.49	0.00	0.44
	15	0.37	265.22	1.28	1.49	0.00	0.44
	16	0.37	265.22	1.28	1.49	0.00	0.44
	17	0.37	265.22	1.28	1.49	0.00	0.44
49							
	5	1.64	2281.41	1.64	1.79	0.00	1.79

	6	1.31	1825.13	1.31	1.43	0.00	1.43
	7	1.31	1825.13	1.31	1.43	0.00	1.43
	8	1.31	1825.13	1.31	1.43	0.00	1.43
	9	1.31	1825.13	1.31	1.43	0.00	1.43
	10	1.35	1659.28	1.35	1.45	0.00	1.45
	11	1.35	1659.28	1.35	1.45	0.00	1.45
	12	1.35	1659.28	1.35	1.45	0.00	1.45
	13	1.35	1659.28	1.35	1.45	0.00	1.45
	14	0.81	995.57	0.81	0.87	0.00	0.87
	15	0.81	995.57	0.81	0.87	0.00	0.87
	16	0.61	995.57	0.81	0.87	0.00	0.87
	17	0.81	995.57	0.81	0.87	0.00	0.87
50							
	5	2.13	447.33	0.93	1.10	0.00	2.49
	6	1.71	357.86	0.75	0.88	0.00	1.99
	7	1.71	357.86	0.75	0.88	0.00	1.99
	8	1.71	357.86	0.75	0.88	0.00	1.99
	9	1.71	357.86	0.75	0.88	0.00	1.99
	10	2.13	442.04	0.62	0.73	0.00	2.48
	11	2.13	442.04	0.62	0.73	0.00	2.48
	12	2.13	442.04	0.62	0.73	0.00	2.48
	13	2.13	442.04	0.62	0.73	0.00	2.48
	14	1.28	265.22	0.37	0.44	0.00	1.49
	15	1.28	265.22	0.37	0.44	0.00	1.49
	16	1.28	265.22	0.37	0.44	0.00	1.49
	17	1.28	265.22	0.37	0.44	0.00	1.49
51							
	5	2.13	447.33	0.93	1.10	0.00	2.49
	6	1.71	357.86	0.75	0.88	0.00	1.99
	7	1.71	357.86	0.75	0.88	0.00	1.99
	8	1.71	357.86	0.75	0.88	0.00	1.99
	9	1.71	357.86	0.75	0.88	0.00	1.99
	10	2.13	442.04	0.62	0.73	0.00	2.48
	11	2.13	442.04	0.62	0.73	0.00	2.48
	12	2.13	442.04	0.62	0.73	0.00	2.48
	13	2.13	442.04	0.62	0.73	0.00	2.48
	14	1.28	265.22	0.37	0.44	0.00	1.49
	15	1.28	265.22	0.37	0.44	0.00	1.49
	16	1.28	265.22	0.37	0.44	0.00	1.49
	17	1.28	265.22	0.37	0.44	0.00	1.49
52							
	5	1.64	2281.41	1.64	1.79	0.00	1.79
	6	1.31	1825.13	1.31	1.43	0.00	1.43
	7	1.31	1825.13	1.31	1.43	0.00	1.43
	8	1.31	1825.13	1.31	1.43	0.00	1.43
	9	1.31	1825.13	1.31	1.43	0.00	1.43
	10	1.35	1659.28	1.35	1.45	0.00	1.45
	11	1.35	1659.28	1.35	1.45	0.00	1.45
	12	1.35	1659.28	1.35	1.45	0.00	1.45
	13	1.35	1659.28	1.35	1.45	0.00	1.45
	14	0.81	995.57	0.81	0.87	0.00	0.87
	15	0.81	995.57	0.81	0.87	0.00	0.87
	16	0.81	995.57	0.81	0.87	0.00	0.87
	17	0.81	995.57	0.81	0.87	0.00	0.87

TABLE 2: STORY DRIFT

STORY	HEIGHT (METE)	LOAD	DRIFT(CM) X	Z	ECCENTRICITY (METE)	RATIO	
BASE=	0.00						
1	3.50	5	0.0001	0.0001	0.0000	L /	0
		6	0.0001	0.0001	0.0000	L /	0
		7	0.0001	0.0001	0.0000	L /	0
		8	0.0001	0.0001	0.0000	L /	0
		9	0.0001	0.0001	0.0000	L /	0
		10	0.0001	0.0001	0.0000	L /	0
		11	0.0001	0.0001	0.0000	L /	0
		12	0.0001	0.0001	0.0000	L /	0
		13	0.0001	0.0001	0.0000	L /	0
		14	0.0000	0.0000	0.0000	L /	0
		15	0.0000	0.0000	0.0000	L /	0
		16	0.0000	0.0000	0.0000	L /	0
		17	0.0000	0.0000	0.0000	L /	0
2	7.00	5	0.0001	0.0001	0.0000	L /	0
		6	0.0000	0.0000	0.0000	L /	0
		7	0.0000	0.0000	0.0000	L /	0
		8	0.0000	0.0000	0.0000	L /	0
		9	0.0000	0.0000	0.0000	L /	0
		10	0.0000	0.0000	0.0000	L /	0
		11	0.0000	0.0000	0.0000	L /	0
		12	0.0000	0.0000	0.0000	L /	0
		13	0.0000	0.0000	0.0000	L /	0
		14	0.0000	0.0000	0.0000	L /	0
		15	0.0000	0.0000	0.0000	L /	0
		16	0.0000	0.0000	0.0000	L /	0
		17	0.0000	0.0000	0.0000	L /	0
3	10.50	5	0.0001	0.0001	0.0000	L /	0
		6	0.0001	0.0001	0.0000	L /	0
		7	0.0001	0.0001	0.0000	L /	0
		8	0.0001	0.0001	0.0000	L /	0
		9	0.0001	0.0001	0.0000	L /	0
		10	0.0001	0.0001	0.0000	L /	0
		11	0.0001	0.0001	0.0000	L /	0
		12	0.0001	0.0001	0.0000	L /	0
		13	0.0001	0.0001	0.0000	L /	0
		14	0.0001	0.0001	0.0000	L /	0
		15	0.0001	0.0001	0.0000	L /	0
		16	0.0001	0.0001	0.0000	L /	0
		17	0.0001	0.0001	0.0000	L /	0
4	14.00	5	0.0005	0.0005	0.0000	L /	0
		6	0.0004	0.0004	0.0000	L /	0
		7	0.0004	0.0004	0.0000	L /	0
		8	0.0004	0.0004	0.0000	L /	0
		9	0.0004	0.0004	0.0000	L /	0
		10	0.0004	0.0004	0.0000	L /	0
		11	0.0004	0.0004	0.0000	L /	0
		12	0.0004	0.0004	0.0000	L /	0
		13	0.0004	0.0004	0.0000	L /	0
		14	0.0002	0.0002	0.0000	L /	0
		15	0.0002	0.0002	0.0000	L /	0
		16	0.0002	0.0002	0.0000	L /	0

17	0.0002	0.0002	0.0000	L / 0

TABLE 3: MEMBER END FORCES

ALL UNITS ARE -- KN METER

COLUMNS

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
4								
	5	1	2281.41	1.64	1.64	0.00	1.79	1.79
		5	2202.24	1.64	1.64	0.00	3.96	3.96
	6	1	1825.13	1.31	1.31	0.00	1.43	1.43
		5	1761.79	1.31	1.31	0.00	3.17	3.17
	7	1	1825.13	1.31	1.31	0.00	1.43	1.43
		5	1761.79	1.31	1.31	0.00	3.17	3.17
	8	1	1825.13	1.31	1.31	0.00	1.43	1.43
		5	1761.79	1.31	1.31	0.00	3.17	3.17
	9	1	1825.13	1.31	1.31	0.00	1.43	1.43
		5	1761.79	1.31	1.31	0.00	3.17	3.17
	10	1	1659.28	1.35	1.35	0.00	1.45	1.45
		5	1580.12	1.35	1.35	0.00	3.26	3.26
	11	1	1659.28	1.35	1.35	0.00	1.45	1.45
		5	1580.12	1.35	1.35	0.00	3.26	3.26
	12	1	1659.28	1.35	1.35	0.00	1.45	1.45
		5	1580.12	1.35	1.35	0.00	3.26	3.26
	13	1	1659.28	1.35	1.35	0.00	1.45	1.45
		5	1580.12	1.35	1.35	0.00	3.26	3.26
	14	1	995.57	0.81	0.81	0.00	0.87	0.87
		5	948.07	0.81	0.81	0.00	1.96	1.96
	15	1	995.57	0.81	0.81	0.00	0.87	0.87
		5	948.07	0.81	0.81	0.00	1.96	1.96
	16	1	995.57	0.81	0.81	0.00	0.87	0.87
		5	948.07	0.81	0.81	0.00	1.96	1.96
	17	1	995.57	0.81	0.81	0.00	0.87	0.87
		5	948.07	0.81	0.81	0.00	1.96	1.96
45								
	5	18	479.04	0.06	0.06	0.00	0.11	0.11
		22	399.87	0.06	0.06	0.00	0.09	0.09
	6	18	383.23	0.05	0.05	0.00	0.09	0.09
		22	319.90	0.05	0.05	0.00	0.07	0.07
	7	18	383.23	0.05	0.05	0.00	0.09	0.09
		22	319.90	0.05	0.05	0.00	0.07	0.07
	8	18	383.23	0.05	0.05	0.00	0.09	0.09
		22	319.90	0.05	0.05	0.00	0.07	0.07
	9	18	383.23	0.05	0.05	0.00	0.09	0.09
		22	319.90	0.05	0.05	0.00	0.07	0.07
	10	18	478.94	0.05	0.05	0.00	0.11	0.11
		22	399.77	0.05	0.05	0.00	0.08	0.08
	11	18	478.94	0.05	0.05	0.00	0.11	0.11
		22	399.77	0.05	0.05	0.00	0.08	0.08
	12	18	478.94	0.05	0.05	0.00	0.11	0.11
		22	399.77	0.05	0.05	0.00	0.08	0.08
	13	18	478.94	0.05	0.05	0.00	0.11	0.11
		22	399.77	0.05	0.05	0.00	0.08	0.08
	14	18	287.36	0.03	0.03	0.00	0.07	0.07
		22	239.86	0.03	0.03	0.00	0.05	0.05
	15	18	287.36	0.03	0.03	0.00	0.07	0.07
		22	239.86	0.03	0.03	0.00	0.05	0.05
	16	18	287.36	0.03	0.03	0.00	0.07	0.07
		22	239.86	0.03	0.03	0.00	0.05	0.05

	17	18	287.36	0.03	0.03	0.00	0.07	0.07
		22	239.86	0.03	0.03	0.00	0.05	0.05
11								
	5	5	1684.45	2.18	2.18	0.00	4.03	4.03
		9	1614.87	2.18	2.18	0.00	3.60	3.60
	6	5	1347.56	1.74	1.74	0.00	3.22	3.22
		9	1291.89	1.74	1.74	0.00	2.88	2.88
	7	5	1347.56	1.74	1.74	0.00	3.22	3.22
		9	1291.89	1.74	1.74	0.00	2.88	2.88
	8	5	1347.56	1.74	1.74	0.00	3.22	3.22
		9	1291.89	1.74	1.74	0.00	2.88	2.88
	9	5	1347.56	1.74	1.74	0.00	3.22	3.22
		9	1291.89	1.74	1.74	0.00	2.88	2.88
	10	5	1229.67	1.47	1.47	0.00	2.98	2.98
		9	1160.09	1.47	1.47	0.00	2.16	2.16
	11	5	1229.67	1.47	1.47	0.00	2.98	2.98
		9	1160.09	1.47	1.47	0.00	2.16	2.16
	12	5	1229.67	1.47	1.47	0.00	2.98	2.98
		9	1160.09	1.47	1.47	0.00	2.16	2.16
	13	5	1229.67	1.47	1.47	0.00	2.98	2.98
		9	1160.09	1.47	1.47	0.00	2.16	2.16
	14	5	737.80	0.88	0.88	0.00	1.79	1.79
		9	696.05	0.88	0.88	0.00	1.30	1.30
	15	5	737.80	0.88	0.88	0.00	1.79	1.79
		9	696.05	0.88	0.88	0.00	1.30	1.30
	16	5	737.80	0.88	0.88	0.00	1.79	1.79
		9	696.05	0.88	0.88	0.00	1.30	1.30
	17	5	737.80	0.88	0.88	0.00	1.79	1.79
		9	696.05	0.88	0.88	0.00	1.30	1.30
52								
	5	22	352.10	0.06	0.06	0.00	0.10	0.10
		26	282.52	0.06	0.06	0.00	0.12	0.12
	6	22	281.68	0.05	0.05	0.00	0.08	0.08
		26	226.01	0.05	0.05	0.00	0.10	0.10
	7	22	281.68	0.05	0.05	0.00	0.08	0.08
		26	226.01	0.05	0.05	0.00	0.10	0.10
	8	22	281.68	0.05	0.05	0.00	0.08	0.08
		26	226.01	0.05	0.05	0.00	0.10	0.10
	9	22	281.68	0.05	0.05	0.00	0.08	0.08
		26	226.01	0.05	0.05	0.00	0.10	0.10
	10	22	352.01	0.06	0.06	0.00	0.09	0.09
		26	282.43	0.06	0.06	0.00	0.11	0.11
	11	22	352.01	0.06	0.06	0.00	0.09	0.09
		26	282.43	0.06	0.06	0.00	0.11	0.11
	12	22	352.01	0.06	0.06	0.00	0.09	0.09
		26	282.43	0.06	0.06	0.00	0.11	0.11
	13	22	352.01	0.06	0.06	0.00	0.09	0.09
		26	282.43	0.06	0.06	0.00	0.11	0.11
	14	22	211.21	0.03	0.03	0.00	0.05	0.05
		26	169.46	0.03	0.03	0.00	0.06	0.06
	15	22	211.21	0.03	0.03	0.00	0.05	0.05
		26	169.46	0.03	0.03	0.00	0.06	0.06
	16	22	211.21	0.03	0.03	0.00	0.05	0.05
		26	169.46	0.03	0.03	0.00	0.06	0.06
	17	22	211.21	0.03	0.03	0.00	0.05	0.05
		26	169.46	0.03	0.03	0.00	0.06	0.06
18								
	5	9	1100.51	1.53	1.53	0.00	2.95	2.95
		13	1030.93	1.53	1.53	0.00	2.40	2.40
	6	9	880.41	1.22	1.22	0.00	2.36	2.36
		13	824.75	1.22	1.22	0.00	1.92	1.92
	7	9	880.41	1.22	1.22	0.00	2.36	2.36

		13	824.75	1.22	1.22	0.00	1.92	1.92
	8	9	880.41	1.22	1.22	0.00	2.36	2.36
		13	824.75	1.22	1.22	0.00	1.92	1.92
	9	9	880.41	1.22	1.22	0.00	2.36	2.36
		13	824.75	1.22	1.22	0.00	1.92	1.92
	10	9	811.93	0.58	0.58	0.00	1.22	1.22
		13	742.35	0.58	0.58	0.00	0.81	0.81
	11	9	811.93	0.58	0.58	0.00	1.22	1.22
		13	742.35	0.58	0.58	0.00	0.81	0.81
	12	9	811.93	0.58	0.58	0.00	1.22	1.22
		13	742.35	0.58	0.58	0.00	0.81	0.81
	13	9	811.93	0.58	0.58	0.00	1.22	1.22
		13	742.35	0.58	0.58	0.00	0.81	0.81
	14	9	487.16	0.35	0.35	0.00	0.73	0.73
		13	445.41	0.35	0.35	0.00	0.48	0.48
	15	9	487.16	0.35	0.35	0.00	0.73	0.73
		13	445.41	0.35	0.35	0.00	0.48	0.48
	16	9	487.16	0.35	0.35	0.00	0.73	0.73
		13	445.41	0.35	0.35	0.00	0.48	0.48
	17	9	487.16	0.35	0.35	0.00	0.73	0.73
		13	445.41	0.35	0.35	0.00	0.48	0.48
59								
	5	26	234.81	0.19	0.19	0.00	0.21	0.21
		30	165.23	0.19	0.19	0.00	0.46	0.46
	6	26	187.85	0.15	0.15	0.00	0.17	0.17
		30	132.19	0.15	0.15	0.00	0.36	0.36
	7	26	187.85	0.15	0.15	0.00	0.17	0.17
		30	132.19	0.15	0.15	0.00	0.36	0.36
	8	26	187.85	0.15	0.15	0.00	0.17	0.17
		30	132.19	0.15	0.15	0.00	0.36	0.36
	9	26	187.85	0.15	0.15	0.00	0.17	0.17
		30	132.19	0.15	0.15	0.00	0.36	0.36
	10	26	234.75	0.18	0.18	0.00	0.19	0.19
		30	165.17	0.18	0.18	0.00	0.44	0.44
	11	26	234.75	0.18	0.18	0.00	0.19	0.19
		30	165.17	0.18	0.18	0.00	0.44	0.44
	12	26	234.75	0.18	0.18	0.00	0.19	0.19
		30	165.17	0.18	0.18	0.00	0.44	0.44
	13	26	234.75	0.18	0.18	0.00	0.19	0.19
		30	165.17	0.18	0.18	0.00	0.44	0.44
	14	26	140.85	0.11	0.11	0.00	0.11	0.11
		30	99.10	0.11	0.11	0.00	0.26	0.26
	15	26	140.85	0.11	0.11	0.00	0.11	0.11
		30	99.10	0.11	0.11	0.00	0.26	0.26
	16	26	140.85	0.11	0.11	0.00	0.11	0.11
		30	99.10	0.11	0.11	0.00	0.26	0.26
	17	26	140.85	0.11	0.11	0.00	0.11	0.11
		30	99.10	0.11	0.11	0.00	0.26	0.26
176								
	5	13	518.92	2.33	2.33	0.00	3.19	3.19
		65	449.34	2.33	2.33	0.00	4.97	4.97
	6	13	415.14	1.87	1.87	0.00	2.55	2.55
		65	359.47	1.87	1.87	0.00	3.97	3.97
	7	13	415.14	1.87	1.87	0.00	2.55	2.55
		65	359.47	1.87	1.87	0.00	3.97	3.97
	8	13	415.14	1.87	1.87	0.00	2.55	2.55
		65	359.47	1.87	1.87	0.00	3.97	3.97
	9	13	415.14	1.87	1.87	0.00	2.55	2.55
		65	359.47	1.87	1.87	0.00	3.97	3.97
	10	13	395.77	0.40	0.40	0.00	0.65	0.65
		65	326.19	0.40	0.40	0.00	0.76	0.76
	11	13	395.77	0.40	0.40	0.00	0.65	0.65
		65	326.19	0.40	0.40	0.00	0.76	0.76
	12	13	395.77	0.40	0.40	0.00	0.65	0.65
		65	326.19	0.40	0.40	0.00	0.76	0.76
	13	13	395.77	0.40	0.40	0.00	0.65	0.65

		65	326.19	0.40	0.40	0.00	0.76	0.76
	14	13	237.46	0.24	0.24	0.00	0.39	0.39
		65	195.71	0.24	0.24	0.00	0.45	0.45
	15	13	237.46	0.24	0.24	0.00	0.39	0.39
		65	195.71	0.24	0.24	0.00	0.45	0.45
	16	13	237.46	0.24	0.24	0.00	0.39	0.39
		65	195.71	0.24	0.24	0.00	0.45	0.45
	17	13	237.46	0.24	0.24	0.00	0.39	0.39
		65	195.71	0.24	0.24	0.00	0.45	0.45
181								
	5	30	117.56	0.18	0.18	0.00	0.36	0.36
		70	47.98	0.18	0.18	0.00	0.27	0.27
	6	30	94.05	0.15	0.15	0.00	0.29	0.29
		70	38.38	0.15	0.15	0.00	0.22	0.22
	7	30	94.05	0.15	0.15	0.00	0.29	0.29
		70	38.38	0.15	0.15	0.00	0.22	0.22
	8	30	94.05	0.15	0.15	0.00	0.29	0.29
		70	38.38	0.15	0.15	0.00	0.22	0.22
	9	30	94.05	0.15	0.15	0.00	0.29	0.29
		70	38.38	0.15	0.15	0.00	0.22	0.22
	10	30	117.53	0.16	0.16	0.00	0.34	0.34
		70	47.95	0.16	0.16	0.00	0.21	0.21
	11	30	117.53	0.16	0.16	0.00	0.34	0.34
		70	47.95	0.16	0.16	0.00	0.21	0.21
	12	30	117.53	0.16	0.16	0.00	0.34	0.34
		70	47.95	0.16	0.16	0.00	0.21	0.21
	13	30	117.53	0.16	0.16	0.00	0.34	0.34
		70	47.95	0.16	0.16	0.00	0.21	0.21
	14	30	70.52	0.09	0.09	0.00	0.20	0.20
		70	28.77	0.09	0.09	0.00	0.12	0.12
	15	30	70.52	0.09	0.09	0.00	0.20	0.20
		70	28.77	0.09	0.09	0.00	0.12	0.12
	16	30	70.52	0.09	0.09	0.00	0.20	0.20
		70	28.77	0.09	0.09	0.00	0.12	0.12
	17	30	70.52	0.09	0.09	0.00	0.20	0.20
		70	28.77	0.09	0.09	0.00	0.12	0.12

BEAMS

30								
	5	6	0.60	11.91	0.00	0.01	0.01	9.83
		22	0.60	11.96	0.00	0.01	0.01	9.96
	6	6	0.48	9.53	0.00	0.01	0.00	7.87
		22	0.48	9.57	0.00	0.01	0.00	7.97
	7	6	0.48	9.53	0.00	0.01	0.00	7.87
		22	0.48	9.57	0.00	0.01	0.00	7.97
	8	6	0.48	9.53	0.00	0.01	0.00	7.87
		22	0.48	9.57	0.00	0.01	0.00	7.97
	9	6	0.48	9.53	0.00	0.01	0.00	7.87
		22	0.48	9.57	0.00	0.01	0.00	7.97
	10	6	0.60	11.90	0.00	0.01	0.00	9.82
		22	0.60	11.95	0.00	0.01	0.00	9.94
	11	6	0.60	11.90	0.00	0.01	0.00	9.82
		22	0.60	11.95	0.00	0.01	0.00	9.94
	12	6	0.60	11.90	0.00	0.01	0.00	9.82
		22	0.60	11.95	0.00	0.01	0.00	9.94
	13	6	0.60	11.90	0.00	0.01	0.00	9.82
		22	0.60	11.95	0.00	0.01	0.00	9.94
	14	6	0.36	7.14	0.00	0.00	0.00	5.89
		22	0.36	7.17	0.00	0.00	0.00	5.97
	15	6	0.36	7.14	0.00	0.00	0.00	5.89
		22	0.36	7.17	0.00	0.00	0.00	5.97
	16	6	0.36	7.14	0.00	0.00	0.00	5.89
		22	0.36	7.17	0.00	0.00	0.00	5.97
	17	6	0.36	7.14	0.00	0.00	0.00	5.89

		22	0.36	7.17	0.00	0.00	0.00	5.97
29								
	5	5	0.31	11.18	0.00	0.01	0.01	8.00
		21	0.31	14.08	0.00	0.01	0.01	15.27
	6	5	0.25	8.94	0.00	0.01	0.01	6.40
		21	0.25	11.27	0.00	0.01	0.01	12.22
	7	5	0.25	8.94	0.00	0.01	0.01	6.40
		21	0.25	11.27	0.00	0.01	0.01	12.22
	8	5	0.25	8.94	0.00	0.01	0.01	6.40
		21	0.25	11.27	0.00	0.01	0.01	12.22
	9	5	0.25	8.94	0.00	0.01	0.01	6.40
		21	0.25	11.27	0.00	0.01	0.01	12.22
	10	5	0.25	10.47	0.00	0.01	0.01	6.25
		21	0.25	13.38	0.00	0.01	0.01	13.52
	11	5	0.25	10.47	0.00	0.01	0.01	6.25
		21	0.25	13.38	0.00	0.01	0.01	13.52
	12	5	0.25	10.47	0.00	0.01	0.01	6.25
		21	0.25	13.38	0.00	0.01	0.01	13.52
	13	5	0.25	10.47	0.00	0.01	0.01	6.25
		21	0.25	13.38	0.00	0.01	0.01	13.52
	14	5	0.15	6.28	0.00	0.00	0.00	3.75
		21	0.15	8.03	0.00	0.00	0.00	8.11
	15	5	0.15	6.28	0.00	0.00	0.00	3.75
		21	0.15	8.03	0.00	0.00	0.00	8.11
	16	5	0.15	6.28	0.00	0.00	0.00	3.75
		21	0.15	8.03	0.00	0.00	0.00	8.11
	17	5	0.15	6.28	0.00	0.00	0.00	3.75
		21	0.15	8.03	0.00	0.00	0.00	8.11
34								
	5	10	0.20	11.96	0.00	0.03	0.00	9.95
		26	0.20	11.92	0.00	0.03	0.00	9.87
	6	10	0.16	9.56	0.00	0.02	0.00	7.96
		26	0.16	9.54	0.00	0.02	0.00	7.90
	7	10	0.16	9.56	0.00	0.02	0.00	7.96
		26	0.16	9.54	0.00	0.02	0.00	7.90
	8	10	0.16	9.56	0.00	0.02	0.00	7.96
		26	0.16	9.54	0.00	0.02	0.00	7.90
	9	10	0.16	9.56	0.00	0.02	0.00	7.96
		26	0.16	9.54	0.00	0.02	0.00	7.90
	10	10	0.19	11.94	0.00	0.02	0.00	9.92
		26	0.19	11.91	0.00	0.02	0.00	9.85
	11	10	0.19	11.94	0.00	0.02	0.00	9.92
		26	0.19	11.91	0.00	0.02	0.00	9.85
	12	10	0.19	11.94	0.00	0.02	0.00	9.92
		26	0.19	11.91	0.00	0.02	0.00	9.85
	13	10	0.19	11.94	0.00	0.02	0.00	9.92
		26	0.19	11.91	0.00	0.02	0.00	9.85
	14	10	0.11	7.17	0.00	0.01	0.00	5.95
		26	0.11	7.15	0.00	0.01	0.00	5.91
	15	10	0.11	7.17	0.00	0.01	0.00	5.95
		26	0.11	7.15	0.00	0.01	0.00	5.91
	16	10	0.11	7.17	0.00	0.01	0.00	5.95
		26	0.11	7.15	0.00	0.01	0.00	5.91
	17	10	0.11	7.17	0.00	0.01	0.00	5.95
		26	0.11	7.15	0.00	0.01	0.00	5.91
33								
	5	9	0.13	10.60	0.00	0.03	0.01	6.56
		25	0.13	15.80	0.00	0.03	0.01	19.57
	6	9	0.10	8.48	0.00	0.02	0.00	5.25
		25	0.10	12.64	0.00	0.02	0.00	15.66
	7	9	0.10	8.48	0.00	0.02	0.00	5.25
		25	0.10	12.64	0.00	0.02	0.00	15.66

	8	9	0.10	8.48	0.00	0.02	0.00	5.25
		25	0.10	12.64	0.00	0.02	0.00	15.66
	9	9	0.10	8.48	0.00	0.02	0.00	5.25
		25	0.10	12.64	0.00	0.02	0.00	15.66
	10	9	0.06	9.33	0.00	0.02	0.01	3.38
		25	0.06	14.53	0.00	0.02	0.01	16.39
	11	9	0.06	9.33	0.00	0.02	0.01	3.38
		25	0.06	14.53	0.00	0.02	0.01	16.39
	12	9	0.06	9.33	0.00	0.02	0.01	3.38
		25	0.06	14.53	0.00	0.02	0.01	16.39
	13	9	0.06	9.33	0.00	0.02	0.01	3.38
		25	0.06	14.53	0.00	0.02	0.01	16.39
	14	9	0.04	5.60	0.00	0.01	0.00	2.03
		25	0.04	8.72	0.00	0.01	0.00	9.83
	15	9	0.04	5.60	0.00	0.01	0.00	2.03
		25	0.04	8.72	0.00	0.01	0.00	9.83
	16	9	0.04	5.60	0.00	0.01	0.00	2.03
		25	0.04	8.72	0.00	0.01	0.00	9.83
	17	9	0.04	5.60	0.00	0.01	0.00	2.03
		25	0.04	8.72	0.00	0.01	0.00	9.83
38								
	5	14	1.17	11.98	0.00	0.03	0.01	10.02
		30	1.17	11.91	0.00	0.03	0.01	9.85
	6	14	0.94	9.58	0.00	0.02	0.01	8.02
		30	0.94	9.53	0.00	0.02	0.01	7.88
	7	14	0.94	9.58	0.00	0.02	0.01	8.02
		30	0.94	9.53	0.00	0.02	0.01	7.88
	8	14	0.94	9.58	0.00	0.02	0.01	8.02
		30	0.94	9.53	0.00	0.02	0.01	7.88
	9	14	0.94	9.58	0.00	0.02	0.01	8.02
		30	0.94	9.53	0.00	0.02	0.01	7.88
	10	14	1.16	11.96	0.00	0.02	0.01	9.98
		30	1.16	11.89	0.00	0.02	0.01	9.81
	11	14	1.16	11.96	0.00	0.02	0.01	9.98
		30	1.16	11.89	0.00	0.02	0.01	9.81
	12	14	1.16	11.96	0.00	0.02	0.01	9.98
		30	1.16	11.89	0.00	0.02	0.01	9.81
	13	14	1.16	11.96	0.00	0.02	0.01	9.98
		30	1.16	11.89	0.00	0.02	0.01	9.81
	14	14	0.70	7.18	0.00	0.01	0.00	5.99
		30	0.70	7.14	0.00	0.01	0.01	5.89
	15	14	0.70	7.18	0.00	0.01	0.00	5.99
		30	0.70	7.14	0.00	0.01	0.01	5.89
	16	14	0.70	7.18	0.00	0.01	0.00	5.99
		30	0.70	7.14	0.00	0.01	0.01	5.89
	17	14	0.70	7.18	0.00	0.01	0.00	5.99
		30	0.70	7.14	0.00	0.01	0.01	5.89
37								
	5	13	0.72	10.20	0.01	0.03	0.02	5.59
		29	0.72	16.97	0.01	0.03	0.02	22.52
	6	13	0.58	8.16	0.01	0.02	0.01	4.47
		29	0.58	13.58	0.01	0.02	0.01	18.01
	7	13	0.58	8.16	0.01	0.02	0.01	4.47
		29	0.58	13.58	0.01	0.02	0.01	18.01
	8	13	0.58	8.16	0.01	0.02	0.01	4.47
		29	0.58	13.58	0.01	0.02	0.01	18.01
	9	13	0.58	8.16	0.01	0.02	0.01	4.47
		29	0.58	13.58	0.01	0.02	0.01	18.01
	10	13	0.56	8.54	0.01	0.02	0.02	1.44
		29	0.56	15.31	0.01	0.02	0.02	18.36
	11	13	0.56	8.54	0.01	0.02	0.02	1.44
		29	0.56	15.31	0.01	0.02	0.02	18.36
	12	13	0.56	8.54	0.01	0.02	0.02	1.44
		29	0.56	15.31	0.01	0.02	0.02	18.36
	13	13	0.56	8.54	0.01	0.02	0.02	1.44
		29	0.56	15.31	0.01	0.02	0.02	18.36

	14	13	0.34	5.13	0.00	0.01	0.01	0.86
		29	0.34	9.19	0.00	0.01	0.01	11.02
	15	13	0.34	5.13	0.00	0.01	0.01	0.86
		29	0.34	9.19	0.00	0.01	0.01	11.02
	16	13	0.34	5.13	0.00	0.01	0.01	0.86
		29	0.34	9.19	0.00	0.01	0.01	11.02
	17	13	0.34	5.13	0.00	0.01	0.01	0.86
		29	0.34	9.19	0.00	0.01	0.01	11.02
195								
	5	65	1.52	9.99	0.02	0.11	0.06	4.94
		69	1.52	17.28	0.02	0.11	0.05	23.16
	6	65	1.22	7.99	0.02	0.09	0.05	3.95
		69	1.22	13.82	0.02	0.09	0.04	18.53
	7	65	1.22	7.99	0.02	0.09	0.05	3.95
		69	1.22	13.82	0.02	0.09	0.04	18.53
	8	65	1.22	7.99	0.02	0.09	0.05	3.95
		69	1.22	13.82	0.02	0.09	0.04	18.53
	9	65	1.22	7.99	0.02	0.09	0.05	3.95
		69	1.22	13.82	0.02	0.09	0.04	18.53
	10	65	1.20	8.28	0.02	0.08	0.05	0.68
		69	1.20	15.57	0.02	0.08	0.05	18.90
	11	65	1.20	8.28	0.02	0.08	0.05	0.68
		69	1.20	15.57	0.02	0.08	0.05	18.90
	12	65	1.20	8.28	0.02	0.08	0.05	0.68
		69	1.20	15.57	0.02	0.08	0.05	18.90
	13	65	1.20	8.28	0.02	0.08	0.05	0.68
		69	1.20	15.57	0.02	0.08	0.05	18.90
	14	65	0.72	4.97	0.01	0.05	0.03	0.41
		69	0.72	9.34	0.01	0.05	0.03	11.34
	15	65	0.72	4.97	0.01	0.05	0.03	0.41
		69	0.72	9.34	0.01	0.05	0.03	11.34
	16	65	0.72	4.97	0.01	0.05	0.03	0.41
		69	0.72	9.34	0.01	0.05	0.03	11.34
	17	65	0.72	4.97	0.01	0.05	0.03	0.41
		69	0.72	9.34	0.01	0.05	0.03	11.34
196								
	5	66	4.10	11.83	0.02	0.10	0.04	9.51
		70	4.10	12.06	0.02	0.10	0.04	10.10
	6	66	3.28	9.46	0.01	0.08	0.03	7.61
		70	3.28	9.65	0.01	0.08	0.03	8.08
	7	66	3.28	9.46	0.01	0.08	0.03	7.61
		70	3.28	9.65	0.01	0.08	0.03	8.08
	8	66	3.28	9.46	0.01	0.08	0.03	7.61
		70	3.28	9.65	0.01	0.08	0.03	8.08
	9	66	3.28	9.46	0.01	0.08	0.03	7.61
		70	3.28	9.65	0.01	0.08	0.03	8.08
	10	66	4.07	11.81	0.01	0.07	0.03	9.47
		70	4.07	12.05	0.01	0.07	0.03	10.06
	11	66	4.07	11.81	0.01	0.07	0.03	9.47
		70	4.07	12.05	0.01	0.07	0.03	10.06
	12	66	4.07	11.81	0.01	0.07	0.03	9.47
		70	4.07	12.05	0.01	0.07	0.03	10.06
	13	66	4.07	11.81	0.01	0.07	0.03	9.47
		70	4.07	12.05	0.01	0.07	0.03	10.06
	14	66	2.44	7.09	0.01	0.04	0.02	5.68
		70	2.44	7.23	0.01	0.04	0.02	6.03
	15	66	2.44	7.09	0.01	0.04	0.02	5.68
		70	2.44	7.23	0.01	0.04	0.02	6.03
	16	66	2.44	7.09	0.01	0.04	0.02	5.68
		70	2.44	7.23	0.01	0.04	0.02	6.03
	17	66	2.44	7.09	0.01	0.04	0.02	5.68

70	2.44	7.23	0.01	0.04	0.02	6.03

SLABS

JOINT	FX	FY	FZ	MX	MY	MZ

SLAB 173

ELE.NO. 173 FOR LOAD CASE 5

13	-8.4550E-15	1.5071E-17	4.1864E-15	1.7522E-02	-4.5855E-14	1.7522E-02
16	-2.1184E-15	8.8349E-03	-4.2482E-15	4.8740E-02	-1.0407E-14	4.8740E-02
64	1.8098E-15	-1.7483E-18	-6.0475E-15	1.7522E-02	-6.8188E-15	1.7522E-02
61	8.3316E-15	-8.8349E-03	6.2327E-15	4.8740E-02	6.2680E-14	4.8740E-02

ELE.NO. 173 FOR LOAD CASE 6

13	-6.5912E-15	-1.8085E-18	3.3322E-15	1.4017E-02	-3.6363E-14	1.4017E-02
16	-1.6577E-15	7.0679E-03	-3.2627E-15	3.8992E-02	-8.2256E-15	3.8992E-02
64	1.5497E-15	1.2509E-17	-4.8627E-15	1.4017E-02	-5.5554E-15	1.4017E-02
61	6.7147E-15	-7.0679E-03	4.9862E-15	3.8992E-02	5.0144E-14	3.8992E-02

ELE.NO. 173 FOR LOAD CASE 7

13	-6.5912E-15	-1.8085E-18	3.3322E-15	1.4017E-02	-3.6363E-14	1.4017E-02
16	-1.6577E-15	7.0679E-03	-3.2627E-15	3.8992E-02	-8.2256E-15	3.8992E-02
64	1.5497E-15	1.2509E-17	-4.8627E-15	1.4017E-02	-5.5554E-15	1.4017E-02
61	6.7147E-15	-7.0679E-03	4.9862E-15	3.8992E-02	5.0144E-14	3.8992E-02

ELE.NO. 173 FOR LOAD CASE 8

13	-6.5912E-15	-1.8085E-18	3.3322E-15	1.4017E-02	-3.6363E-14	1.4017E-02
16	-1.6577E-15	7.0679E-03	-3.2627E-15	3.8992E-02	-8.2256E-15	3.8992E-02
64	1.5497E-15	1.2509E-17	-4.8627E-15	1.4017E-02	-5.5554E-15	1.4017E-02
61	6.7147E-15	-7.0679E-03	4.9862E-15	3.8992E-02	5.0144E-14	3.8992E-02

ELE.NO. 173 FOR LOAD CASE 9

13	-6.5912E-15	-1.8085E-18	3.3322E-15	1.4017E-02	-3.6363E-14	1.4017E-02
16	-1.6577E-15	7.0679E-03	-3.2627E-15	3.8992E-02	-8.2256E-15	3.8992E-02
64	1.5497E-15	1.2509E-17	-4.8627E-15	1.4017E-02	-5.5554E-15	1.4017E-02
61	6.7147E-15	-7.0679E-03	4.9862E-15	3.8992E-02	5.0144E-14	3.8992E-02

ELE.NO. 173 FOR LOAD CASE 10

13	-5.6154E-15	1.1906E-17	2.6736E-15	4.1503E-03	-3.2242E-14	4.1503E-03
16	-9.4509E-16	2.0927E-03	-2.6581E-15	1.1545E-02	-9.2014E-15	1.1545E-02
64	8.9879E-16	3.8733E-18	-3.7557E-15	4.1503E-03	-5.8117E-16	4.1503E-03
61	5.5305E-15	-2.0927E-03	3.7866E-15	1.1545E-02	4.1723E-14	1.1545E-02

ELE.NO. 173 FOR LOAD CASE 11

13	-5.6154E-15	1.1906E-17	2.6736E-15	4.1503E-03	-3.2242E-14	4.1503E-03
16	-9.4509E-16	2.0927E-03	-2.6581E-15	1.1545E-02	-9.2014E-15	1.1545E-02
64	8.9879E-16	3.8733E-18	-3.7557E-15	4.1503E-03	-5.8117E-16	4.1503E-03
61	5.5305E-15	-2.0927E-03	3.7866E-15	1.1545E-02	4.1723E-14	1.1545E-02

ELE.NO. 173 FOR LOAD CASE 12

13	-5.6154E-15	1.1906E-17	2.6736E-15	4.1503E-03	-3.2242E-14	4.1503E-03
16	-9.4509E-16	2.0927E-03	-2.6581E-15	1.1545E-02	-9.2014E-15	1.1545E-02
64	8.9879E-16	3.8733E-18	-3.7557E-15	4.1503E-03	-5.8117E-16	4.1503E-03
61	5.5305E-15	-2.0927E-03	3.7866E-15	1.1545E-02	4.1723E-14	1.1545E-02

ELE.NO. 173 FOR LOAD CASE 13

13	-5.6154E-15	1.1906E-17	2.6736E-15	4.1503E-03	-3.2242E-14	4.1503E-03
16	-9.4509E-16	2.0927E-03	-2.6581E-15	1.1545E-02	-9.2014E-15	1.1545E-02
64	8.9879E-16	3.8733E-18	-3.7557E-15	4.1503E-03	-5.8117E-16	4.1503E-03
61	5.5305E-15	-2.0927E-03	3.7866E-15	1.1545E-02	4.1723E-14	1.1545E-02

ELE.NO. 173 FOR LOAD CASE 14

13	-3.3260E-15	1.9155E-17	1.6018E-15	2.4902E-03	-1.9260E-14	2.4902E-03
16	-6.1798E-16	1.2556E-03	-1.6288E-15	6.9271E-03	-5.5158E-15	6.9271E-03
64	5.3696E-16	7.3849E-18	-2.3152E-15	2.4902E-03	-3.1860E-16	2.4902E-03

61	3.3260E-15	-1.2556E-03	2.2534E-15	6.9271E-03	2.5195E-14	6.9271E-03

ELE.NO. 173 FOR LOAD CASE 15

13	-3.3260E-15	1.9155E-17	1.6018E-15	2.4902E-03	-1.9260E-14	2.4902E-03
16	-6.1798E-16	1.2556E-03	-1.6288E-15	6.9271E-03	-5.5158E-15	6.9271E-03
64	5.3696E-16	7.3849E-18	-2.3152E-15	2.4902E-03	-3.1860E-16	2.4902E-03
61	3.3260E-15	-1.2556E-03	2.2534E-15	6.9271E-03	2.5195E-14	6.9271E-03

ELE.NO. 173 FOR LOAD CASE 16

13	-3.3260E-15	1.9155E-17	1.6018E-15	2.4902E-03	-1.9260E-14	2.4902E-03
16	-6.1798E-16	1.2556E-03	-1.6288E-15	6.9271E-03	-5.5158E-15	6.9271E-03
64	5.3696E-16	7.3849E-18	-2.3152E-15	2.4902E-03	-3.1860E-16	2.4902E-03
61	3.3260E-15	-1.2556E-03	2.2534E-15	6.9271E-03	2.5195E-14	6.9271E-03

ELE.NO. 173 FOR LOAD CASE 17

13	-3.3260E-15	1.9155E-17	1.6018E-15	2.4902E-03	-1.9260E-14	2.4902E-03
16	-6.1798E-16	1.2556E-03	-1.6288E-15	6.9271E-03	-5.5158E-15	6.9271E-03
64	5.3696E-16	7.3849E-18	-2.3152E-15	2.4902E-03	-3.1860E-16	2.4902E-03
61	3.3260E-15	-1.2556E-03	2.2534E-15	6.9271E-03	2.5195E-14	6.9271E-03

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ELE.NO. 174 FOR LOAD CASE 5

9	-2.6960E-14	3.1348E-18	1.4311E-14	3.1197E-02	-1.0150E-13	3.1197E-02
12	-1.4681E-14	1.5731E-02	-1.4373E-14	8.6783E-02	-9.5781E-15	8.6783E-02
60	1.4566E-14	8.3193E-18	-2.7322E-14	3.1197E-02	-1.0722E-13	3.1197E-02
57	2.6983E-14	-1.5731E-02	2.7291E-14	8.6783E-02	2.1800E-13	8.6783E-02

ELE.NO. 174 FOR LOAD CASE 6

9	-2.1628E-14	-1.2057E-18	1.1460E-14	2.4958E-02	-8.1042E-14	2.4958E-02
12	-1.1745E-14	1.2585E-02	-1.1529E-14	6.9426E-02	-7.6625E-15	6.9426E-02
60	1.1676E-14	6.0285E-19	-2.1852E-14	2.4958E-02	-8.5758E-14	2.4958E-02
57	2.1605E-14	-1.2585E-02	2.1821E-14	6.9426E-02	1.7446E-13	6.9426E-02

ELE.NO. 174 FOR LOAD CASE 7

9	-2.1628E-14	-1.2057E-18	1.1460E-14	2.4958E-02	-8.1042E-14	2.4958E-02
12	-1.1745E-14	1.2585E-02	-1.1529E-14	6.9426E-02	-7.6625E-15	6.9426E-02
60	1.1676E-14	6.0285E-19	-2.1852E-14	2.4958E-02	-8.5758E-14	2.4958E-02
57	2.1605E-14	-1.2585E-02	2.1821E-14	6.9426E-02	1.7446E-13	6.9426E-02

ELE.NO. 174 FOR LOAD CASE 8

9	-2.1628E-14	-1.2057E-18	1.1460E-14	2.4958E-02	-8.1042E-14	2.4958E-02
12	-1.1745E-14	1.2585E-02	-1.1529E-14	6.9426E-02	-7.6625E-15	6.9426E-02
60	1.1676E-14	6.0285E-19	-2.1852E-14	2.4958E-02	-8.5758E-14	2.4958E-02
57	2.1605E-14	-1.2585E-02	2.1821E-14	6.9426E-02	1.7446E-13	6.9426E-02

ELE.NO. 174 FOR LOAD CASE 9

9	-2.1628E-14	-1.2057E-18	1.1460E-14	2.4958E-02	-8.1042E-14	2.4958E-02
12	-1.1745E-14	1.2585E-02	-1.1529E-14	6.9426E-02	-7.6625E-15	6.9426E-02
60	1.1676E-14	6.0285E-19	-2.1852E-14	2.4958E-02	-8.5758E-14	2.4958E-02
57	2.1605E-14	-1.2585E-02	2.1821E-14	6.9426E-02	1.7446E-13	6.9426E-02

ELE.NO. 174 FOR LOAD CASE 10

9	-1.9897E-14	-9.4044E-18	1.0605E-14	1.4557E-02	-7.4053E-14	1.4557E-02
12	-1.0890E-14	7.3400E-03	-1.0551E-14	4.0493E-02	-7.1332E-15	4.0493E-02
60	1.0937E-14	9.6455E-19	-2.0128E-14	1.4557E-02	-8.0023E-14	1.4557E-02
57	1.9912E-14	-7.3400E-03	2.0283E-14	4.0493E-02	1.6146E-13	4.0493E-02

ELE.NO. 174 FOR LOAD CASE 11

9	-1.9897E-14	-9.4044E-18	1.0605E-14	1.4557E-02	-7.4053E-14	1.4557E-02
12	-1.0890E-14	7.3400E-03	-1.0551E-14	4.0493E-02	-7.1332E-15	4.0493E-02
60	1.0937E-14	9.6455E-19	-2.0128E-14	1.4557E-02	-8.0023E-14	1.4557E-02
57	1.9912E-14	-7.3400E-03	2.0283E-14	4.0493E-02	1.6146E-13	4.0493E-02

ELE.NO. 174 FOR LOAD CASE 12

9	-1.9897E-14	-9.4044E-18	1.0605E-14	1.4557E-02	-7.4053E-14	1.4557E-02
12	-1.0890E-14	7.3400E-03	-1.0551E-14	4.0493E-02	-7.1332E-15	4.0493E-02
60	1.0937E-14	9.6455E-19	-2.0128E-14	1.4557E-02	-8.0023E-14	1.4557E-02

57	1.9912E-14	-7.3400E-03	2.0283E-14	4.0493E-02	1.6146E-13	4.0493E-02

ELE.NO. 174 FOR LOAD CASE 13

9	-1.9897E-14	-9.4044E-18	1.0605E-14	1.4557E-02	-7.4053E-14	1.4557E-02
12	-1.0890E-14	7.3400E-03	-1.0551E-14	4.0493E-02	-7.1332E-15	4.0493E-02
60	1.0937E-14	9.6455E-19	-2.0128E-14	1.4557E-02	-8.0023E-14	1.4557E-02
57	1.9912E-14	-7.3400E-03	2.0283E-14	4.0493E-02	1.6146E-13	4.0493E-02

ELE.NO. 174 FOR LOAD CASE 14

9	-1.1910E-14	5.1845E-18	6.2834E-15	8.7341E-03	-4.4356E-14	8.7341E-03
12	-6.5496E-15	4.4040E-03	-6.3181E-15	2.4296E-02	-4.3000E-15	2.4296E-02
60	6.4724E-15	4.4611E-18	-1.2126E-14	8.7341E-03	-4.7894E-14	8.7341E-03
57	1.1910E-14	-4.4040E-03	1.2126E-14	2.4296E-02	9.6876E-14	2.4296E-02

ELE.NO. 174 FOR LOAD CASE 15

9	-1.1910E-14	5.1845E-18	6.2834E-15	8.7341E-03	-4.4356E-14	8.7341E-03
12	-6.5496E-15	4.4040E-03	-6.3181E-15	2.4296E-02	-4.3000E-15	2.4296E-02
60	6.4724E-15	4.4611E-18	-1.2126E-14	8.7341E-03	-4.7894E-14	8.7341E-03
57	1.1910E-14	-4.4040E-03	1.2126E-14	2.4296E-02	9.6876E-14	2.4296E-02

ELE.NO. 174 FOR LOAD CASE 16

9	-1.1910E-14	5.1845E-18	6.2834E-15	8.7341E-03	-4.4356E-14	8.7341E-03
12	-6.5496E-15	4.4040E-03	-6.3181E-15	2.4296E-02	-4.3000E-15	2.4296E-02
60	6.4724E-15	4.4611E-18	-1.2126E-14	8.7341E-03	-4.7894E-14	8.7341E-03
57	1.1910E-14	-4.4040E-03	1.2126E-14	2.4296E-02	9.6876E-14	2.4296E-02

ELE.NO. 174 FOR LOAD CASE 17

9	-1.1910E-14	5.1845E-18	6.2834E-15	8.7341E-03	-4.4356E-14	8.7341E-03
12	-6.5496E-15	4.4040E-03	-6.3181E-15	2.4296E-02	-4.3000E-15	2.4296E-02
60	6.4724E-15	4.4611E-18	-1.2126E-14	8.7341E-03	-4.7894E-14	8.7341E-03
57	1.1910E-14	-4.4040E-03	1.2126E-14	2.4296E-02	9.6876E-14	2.4296E-02

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ELE.NO. 175 FOR LOAD CASE 5

5	-1.5864E-14	3.3759E-18	8.3650E-15	4.1761E-02	-5.8263E-14	4.1761E-02
8	-8.6813E-15	2.1057E-02	-8.3264E-15	1.1617E-01	-6.2156E-15	1.1617E-01
56	8.7238E-15	3.8582E-18	-1.6146E-14	4.1761E-02	-6.4560E-14	4.1761E-02
53	1.5915E-14	-2.1057E-02	1.6223E-14	1.1617E-01	1.2939E-13	1.1617E-01

ELE.NO. 175 FOR LOAD CASE 6

5	-1.2657E-14	1.0851E-17	6.6827E-15	3.3409E-02	-4.6625E-14	3.3409E-02
8	-6.9451E-15	1.6846E-02	-6.6518E-15	9.2935E-02	-5.0728E-15	9.2935E-02
56	6.8988E-15	2.5320E-18	-1.2923E-14	3.3409E-02	-5.1718E-14	3.3409E-02
53	1.2722E-14	-1.6846E-02	1.2954E-14	9.2935E-02	1.0344E-13	9.2935E-02

ELE.NO. 175 FOR LOAD CASE 7

5	-1.2657E-14	1.0851E-17	6.6827E-15	3.3409E-02	-4.6625E-14	3.3409E-02
8	-6.9451E-15	1.6846E-02	-6.6518E-15	9.2935E-02	-5.0728E-15	9.2935E-02
56	6.8988E-15	2.5320E-18	-1.2923E-14	3.3409E-02	-5.1718E-14	3.3409E-02
53	1.2722E-14	-1.6846E-02	1.2954E-14	9.2935E-02	1.0344E-13	9.2935E-02

ELE.NO. 175 FOR LOAD CASE 8

5	-1.2657E-14	1.0851E-17	6.6827E-15	3.3409E-02	-4.6625E-14	3.3409E-02
8	-6.9451E-15	1.6846E-02	-6.6518E-15	9.2935E-02	-5.0728E-15	9.2935E-02
56	6.8988E-15	2.5320E-18	-1.2923E-14	3.3409E-02	-5.1718E-14	3.3409E-02
53	1.2722E-14	-1.6846E-02	1.2954E-14	9.2935E-02	1.0344E-13	9.2935E-02

ELE.NO. 175 FOR LOAD CASE 9

5	-1.2657E-14	1.0851E-17	6.6827E-15	3.3409E-02	-4.6625E-14	3.3409E-02
8	-6.9451E-15	1.6846E-02	-6.6518E-15	9.2935E-02	-5.0728E-15	9.2935E-02
56	6.8988E-15	2.5320E-18	-1.2923E-14	3.3409E-02	-5.1718E-14	3.3409E-02
53	1.2722E-14	-1.6846E-02	1.2954E-14	9.2935E-02	1.0344E-13	9.2935E-02

ELE.NO. 175 FOR LOAD CASE 10

5	-1.0491E-14	1.4227E-17	5.2840E-15	3.4824E-02	-3.7021E-14	3.4824E-02
8	-5.6361E-15	1.7559E-02	-5.2696E-15	9.6871E-02	-6.7934E-15	9.6871E-02
56	5.6361E-15	1.3263E-17	-1.0864E-14	3.4824E-02	-4.3751E-14	3.4824E-02

53	1.0517E-14	-1.7559E-02	1.0884E-14	9.6871E-02	8.7603E-14	9.6871E-02

ELE.NO. 175 FOR LOAD CASE 11

5	-1.0491E-14	1.4227E-17	5.2840E-15	3.4824E-02	-3.7021E-14	3.4824E-02
8	-5.6361E-15	1.7559E-02	-5.2696E-15	9.6871E-02	-6.7934E-15	9.6871E-02
56	5.6361E-15	1.3263E-17	-1.0864E-14	3.4824E-02	-4.3751E-14	3.4824E-02
53	1.0517E-14	-1.7559E-02	1.0884E-14	9.6871E-02	8.7603E-14	9.6871E-02

ELE.NO. 175 FOR LOAD CASE 12

5	-1.0491E-14	1.4227E-17	5.2840E-15	3.4824E-02	-3.7021E-14	3.4824E-02
8	-5.6361E-15	1.7559E-02	-5.2696E-15	9.6871E-02	-6.7934E-15	9.6871E-02
56	5.6361E-15	1.3263E-17	-1.0864E-14	3.4824E-02	-4.3751E-14	3.4824E-02
53	1.0517E-14	-1.7559E-02	1.0884E-14	9.6871E-02	8.7603E-14	9.6871E-02

ELE.NO. 175 FOR LOAD CASE 13

5	-1.0491E-14	1.4227E-17	5.2840E-15	3.4824E-02	-3.7021E-14	3.4824E-02
8	-5.6361E-15	1.7559E-02	-5.2696E-15	9.6871E-02	-6.7934E-15	9.6871E-02
56	5.6361E-15	1.3263E-17	-1.0864E-14	3.4824E-02	-4.3751E-14	3.4824E-02
53	1.0517E-14	-1.7559E-02	1.0884E-14	9.6871E-02	8.7603E-14	9.6871E-02

ELE.NO. 175 FOR LOAD CASE 14

5	-6.3050E-15	7.3547E-18	3.1674E-15	2.0894E-02	-2.2204E-14	2.0894E-02
8	-3.3859E-15	1.0536E-02	-3.1621E-15	5.8123E-02	-4.0836E-15	5.8123E-02
56	3.3883E-15	-6.7519E-18	-6.5283E-15	2.0894E-02	-2.6249E-14	2.0894E-02
53	6.3045E-15	-1.0536E-02	6.5302E-15	5.8123E-02	5.2562E-14	5.8123E-02

ELE.NO. 175 FOR LOAD CASE 15

5	-6.3050E-15	7.3547E-18	3.1674E-15	2.0894E-02	-2.2204E-14	2.0894E-02
8	-3.3859E-15	1.0536E-02	-3.1621E-15	5.8123E-02	-4.0836E-15	5.8123E-02
56	3.3883E-15	-6.7519E-18	-6.5283E-15	2.0894E-02	-2.6249E-14	2.0894E-02
53	6.3045E-15	-1.0536E-02	6.5302E-15	5.8123E-02	5.2562E-14	5.8123E-02

ELE.NO. 175 FOR LOAD CASE 16

5	-6.3050E-15	7.3547E-18	3.1674E-15	2.0894E-02	-2.2204E-14	2.0894E-02
8	-3.3859E-15	1.0536E-02	-3.1621E-15	5.8123E-02	-4.0836E-15	5.8123E-02
56	3.3883E-15	-6.7519E-18	-6.5283E-15	2.0894E-02	-2.6249E-14	2.0894E-02
53	6.3045E-15	-1.0536E-02	6.5302E-15	5.8123E-02	5.2562E-14	5.8123E-02

ELE.NO. 175 FOR LOAD CASE 17

5	-6.3050E-15	7.3547E-18	3.1674E-15	2.0894E-02	-2.2204E-14	2.0894E-02
8	-3.3859E-15	1.0536E-02	-3.1621E-15	5.8123E-02	-4.0836E-15	5.8123E-02
56	3.3883E-15	-6.7519E-18	-6.5283E-15	2.0894E-02	-2.6249E-14	2.0894E-02
53	6.3045E-15	-1.0536E-02	6.5302E-15	5.8123E-02	5.2562E-14	5.8123E-02

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ELE.NO. 216 FOR LOAD CASE 5

65	-2.0014E-15	-1.3021E-17	2.7158E-16	4.8160E-02	-1.1529E-14	4.8160E-02
68	2.8400E-16	2.4284E-02	-5.8024E-16	1.3397E-01	-1.0170E-14	1.3397E-01
80	-6.8526E-16	-1.2057E-17	-1.1989E-15	4.8160E-02	3.3232E-15	4.8160E-02
77	1.8162E-15	-2.4284E-02	9.5196E-16	1.3397E-01	1.8175E-14	1.3397E-01

ELE.NO. 216 FOR LOAD CASE 6

65	-1.3758E-15	1.1575E-17	4.7654E-16	3.8528E-02	-8.9420E-15	3.8528E-02
68	2.6424E-16	1.9427E-02	-2.9134E-16	1.0718E-01	-7.9354E-15	1.0718E-01
80	-1.8810E-18	2.0135E-17	-1.1443E-15	3.8528E-02	2.2973E-15	3.8528E-02
77	1.5147E-15	-1.9427E-02	8.3564E-16	1.0718E-01	1.4380E-14	1.0718E-01

ELE.NO. 216 FOR LOAD CASE 7

65	-1.3758E-15	1.1575E-17	4.7654E-16	3.8528E-02	-8.9420E-15	3.8528E-02
68	2.6424E-16	1.9427E-02	-2.9134E-16	1.0718E-01	-7.9354E-15	1.0718E-01
80	-1.8810E-18	2.0135E-17	-1.1443E-15	3.8528E-02	2.2973E-15	3.8528E-02
77	1.5147E-15	-1.9427E-02	8.3564E-16	1.0718E-01	1.4380E-14	1.0718E-01

ELE.NO. 216 FOR LOAD CASE 8

65	-1.3758E-15	1.1575E-17	4.7654E-16	3.8528E-02	-8.9420E-15	3.8528E-02
68	2.6424E-16	1.9427E-02	-2.9134E-16	1.0718E-01	-7.9354E-15	1.0718E-01

80	-1.8810E-18	2.0135E-17	-1.1443E-15	3.8528E-02	2.2973E-15	3.8528E-02
77	1.5147E-15	-1.9427E-02	8.3564E-16	1.0718E-01	1.4380E-14	1.0718E-01

ELE.NO. 216 FOR LOAD CASE 9

65	-1.3758E-15	1.1575E-17	4.7654E-16	3.8528E-02	-8.9420E-15	3.8528E-02
68	2.6424E-16	1.9427E-02	-2.9134E-16	1.0718E-01	-7.9354E-15	1.0718E-01
80	-1.8810E-18	2.0135E-17	-1.1443E-15	3.8528E-02	2.2973E-15	3.8528E-02
77	1.5147E-15	-1.9427E-02	8.3564E-16	1.0718E-01	1.4380E-14	1.0718E-01

ELE.NO. 216 FOR LOAD CASE 10

65	-2.1357E-15	1.7784E-17	7.2386E-16	5.2910E-03	-1.2202E-14	5.2910E-03
68	-6.7966E-17	2.6679E-03	-8.2418E-16	1.4718E-02	-6.4382E-15	1.4718E-02
80	1.3951E-17	2.9434E-17	-1.3641E-15	5.2910E-03	1.4963E-15	5.2910E-03
77	2.0740E-15	-2.6679E-03	1.3024E-15	1.4718E-02	1.7394E-14	1.4718E-02

ELE.NO. 216 FOR LOAD CASE 11

65	-2.1357E-15	1.7784E-17	7.2386E-16	5.2910E-03	-1.2202E-14	5.2910E-03
68	-6.7966E-17	2.6679E-03	-8.2418E-16	1.4718E-02	-6.4382E-15	1.4718E-02
80	1.3951E-17	2.9434E-17	-1.3641E-15	5.2910E-03	1.4963E-15	5.2910E-03
77	2.0740E-15	-2.6679E-03	1.3024E-15	1.4718E-02	1.7394E-14	1.4718E-02

ELE.NO. 216 FOR LOAD CASE 12

65	-2.1357E-15	1.7784E-17	7.2386E-16	5.2910E-03	-1.2202E-14	5.2910E-03
68	-6.7966E-17	2.6679E-03	-8.2418E-16	1.4718E-02	-6.4382E-15	1.4718E-02
80	1.3951E-17	2.9434E-17	-1.3641E-15	5.2910E-03	1.4963E-15	5.2910E-03
77	2.0740E-15	-2.6679E-03	1.3024E-15	1.4718E-02	1.7394E-14	1.4718E-02

ELE.NO. 216 FOR LOAD CASE 13

65	-2.1357E-15	1.7784E-17	7.2386E-16	5.2910E-03	-1.2202E-14	5.2910E-03
68	-6.7966E-17	2.6679E-03	-8.2418E-16	1.4718E-02	-6.4382E-15	1.4718E-02
80	1.3951E-17	2.9434E-17	-1.3641E-15	5.2910E-03	1.4963E-15	5.2910E-03
77	2.0740E-15	-2.6679E-03	1.3024E-15	1.4718E-02	1.7394E-14	1.4718E-02

ELE.NO. 216 FOR LOAD CASE 14

65	-1.3370E-15	-8.8016E-18	4.7059E-16	3.1746E-03	-7.4464E-15	3.1746E-03
68	-2.6890E-17	1.6007E-03	-4.9759E-16	8.8310E-03	-3.8228E-15	8.8310E-03
80	-3.0983E-17	2.8484E-18	-8.5859E-16	3.1746E-03	8.0749E-16	3.1746E-03
77	1.2907E-15	-1.6007E-03	7.8142E-16	8.8310E-03	1.0386E-14	8.8310E-03

ELE.NO. 216 FOR LOAD CASE 15

65	-1.3370E-15	-8.8016E-18	4.7059E-16	3.1746E-03	-7.4464E-15	3.1746E-03
68	-2.6890E-17	1.6007E-03	-4.9759E-16	8.8310E-03	-3.8228E-15	8.8310E-03
80	-3.0983E-17	2.8484E-18	-8.5859E-16	3.1746E-03	8.0749E-16	3.1746E-03
77	1.2907E-15	-1.6007E-03	7.8142E-16	8.8310E-03	1.0386E-14	8.8310E-03

ELE.NO. 216 FOR LOAD CASE 16

65	-1.3370E-15	-8.8016E-18	4.7059E-16	3.1746E-03	-7.4464E-15	3.1746E-03
68	-2.6890E-17	1.6007E-03	-4.9759E-16	8.8310E-03	-3.8228E-15	8.8310E-03
80	-3.0983E-17	2.8484E-18	-8.5859E-16	3.1746E-03	8.0749E-16	3.1746E-03
77	1.2907E-15	-1.6007E-03	7.8142E-16	8.8310E-03	1.0386E-14	8.8310E-03

ELE.NO. 216 FOR LOAD CASE 17

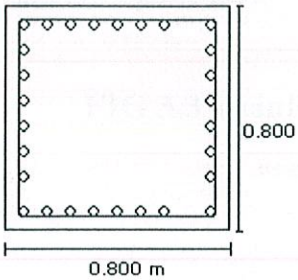
65	-1.3370E-15	-8.8016E-18	4.7059E-16	3.1746E-03	-7.4464E-15	3.1746E-03
68	-2.6890E-17	1.6007E-03	-4.9759E-16	8.8310E-03	-3.8228E-15	8.8310E-03
80	-3.0983E-17	2.8484E-18	-8.5859E-16	3.1746E-03	8.0749E-16	3.1746E-03
77	1.2907E-15	-1.6007E-03	7.8142E-16	8.8310E-03	1.0386E-14	8.8310E-03

Chapter 3

REINFORCED DETAILING

- **Columns**

Beam no. = 4 Design code : IS-456

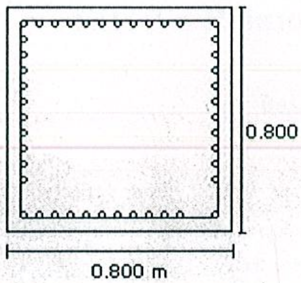


Design Load	
Load	4
Location	End 1
Pu(Kns)	-573.32
Mz(Kns-Mt)	9.75
My(Kns-Mt)	2227.42

Design Parameter	
Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	22016
As (%)	3.519
Bar Size	32
Bar No	28

FIG 3.1 Reinforced detailing for column no. 4

Beam no. = 45 Design code : IS-456

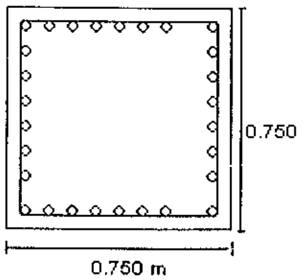


Design Load	
Load	4
Location	End 1
Pu(Kns)	6.3
Mz(Kns-Mt)	0
My(Kns-Mt)	2296.28

Design Parameter	
Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	20717
As (%)	3.375
Bar Size	25
Bar No	44

FIG 3.2 Reinforced detailing for column no. 45

Beam no. = 11 Design code : IS-456



Design Load

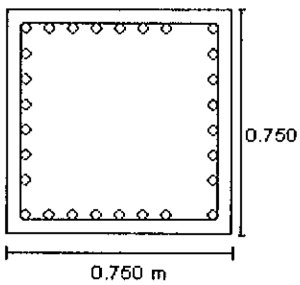
Load	4
Location	End 1
Pu(Kns)	-422.13
Mz(Kns-Mt)	22.69
My(Kns-Mt)	792.68

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	8550
As (%)	1.564
Bar Size	20
Bar No	28

FIG 3.3 Reinforced detailing for column no. 11

Beam no. = 52 Design code : IS-456



Design Load

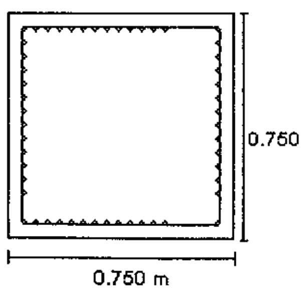
Load	4
Location	End 1
Pu(Kns)	4.67
Mz(Kns-Mt)	0.01
My(Kns-Mt)	944.51

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	8325
As (%)	1.564
Bar Size	20
Bar No	28

FIG 3.4 Reinforced detailing for column no. 52

Beam no. = 18 Design code : IS-456



Design Load

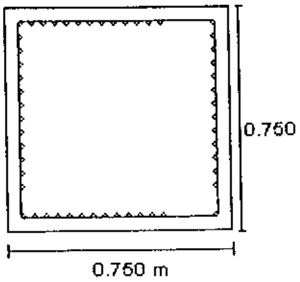
Load	4
Location	End 2
Pu(Kns)	-244.38
Mz(Kns-Mt)	21.14
My(Kns-Mt)	565.4

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm²)	5850
As (%)	1.046
Bar Size	12
Bar No	52

FIG 3.5 Reinforced detailing for column no. 18

Beam no. = 59 Design code : IS-456



Design Load

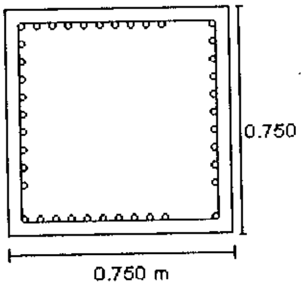
Load	4
Location	End 2
Pu(Kns)	2.8
Mz(Kns-Mt)	0
My(Kns-Mt)	689.27

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm^2)	5867
As (%)	1.046
Bar Size	12
Bar No	52

FIG 3.6 Reinforced detailing for column no. 59

Beam no. = 176 Design code : IS-456



Design Load

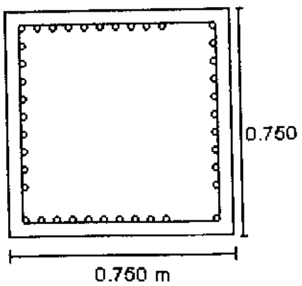
Load	17
Location	End 2
Pu(Kns)	-195.71
Mz(Kns-Mt)	0.45
My(Kns-Mt)	0.45

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm^2)	4500
As (%)	0.804
Bar Size	12
Bar No	40

FIG 3.7 Reinforced detailing for column no. 176

Beam no. = 181 Design code : IS-456



Design Load

Load	17
Location	End 2
Pu(Kns)	-28.77
Mz(Kns-Mt)	0.12
My(Kns-Mt)	0.12

Design Parameter

Fy(Mpa)	415
Fc(Mpa)	30
As Reqd(mm^2)	4500
As (%)	0.804
Bar Size	12
Bar No	40

FIG 3.8 Reinforced detailing for column no. 181

- **BEAMS**

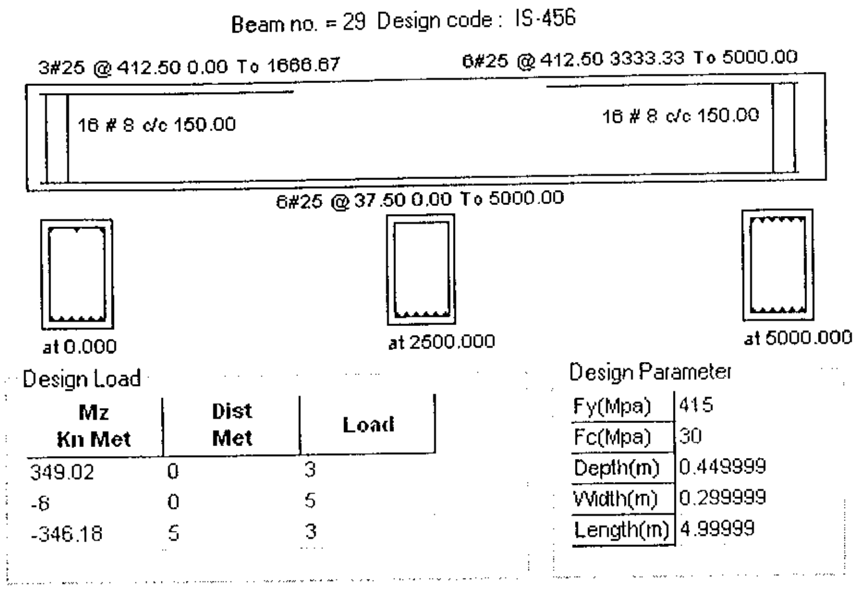


FIG 3.9 Reinforced detailing for beam no. 29

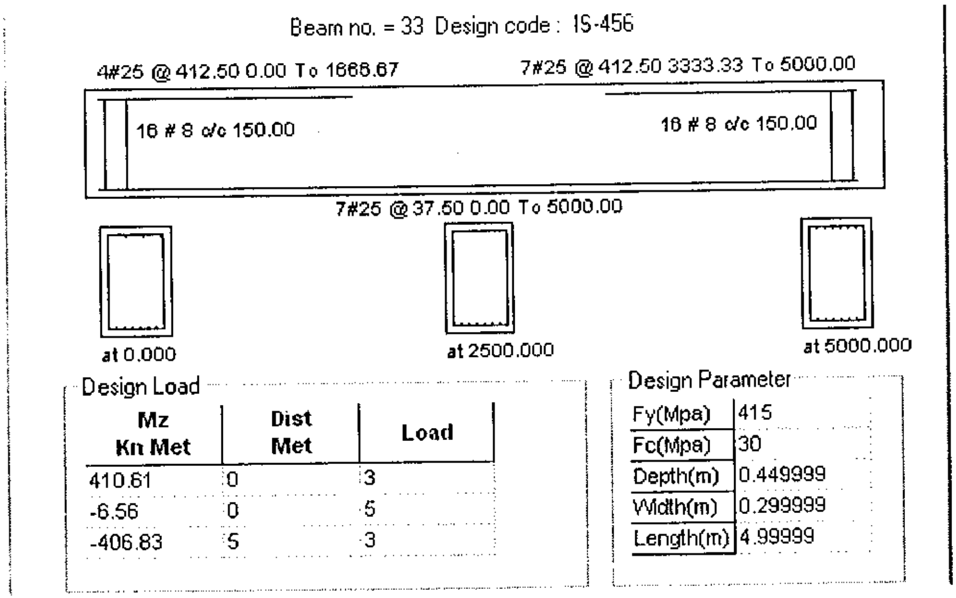


FIG 3.10 Reinforced detailing for beam no. 33

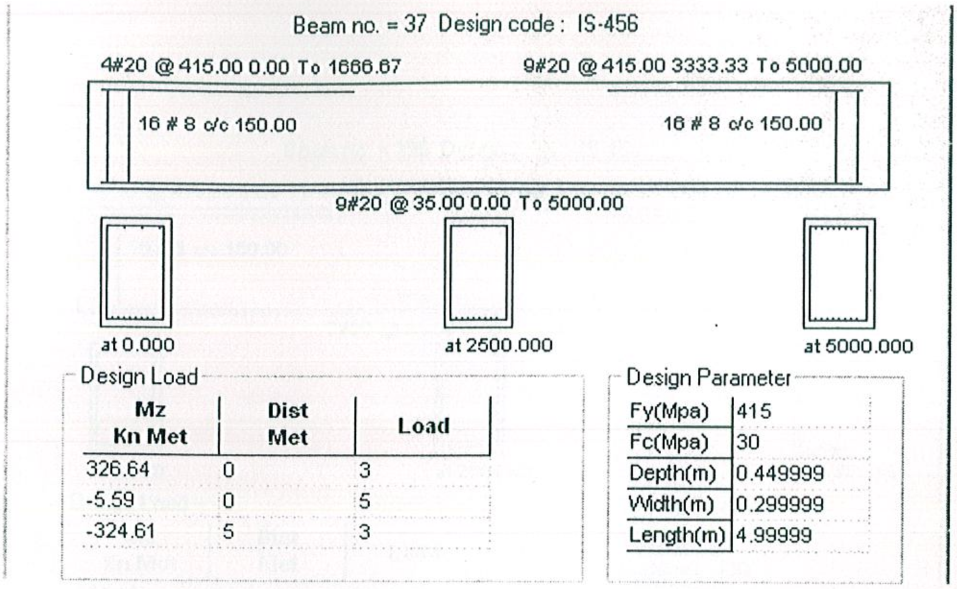


FIG 3.11 Reinforced detailing for beam no. 37

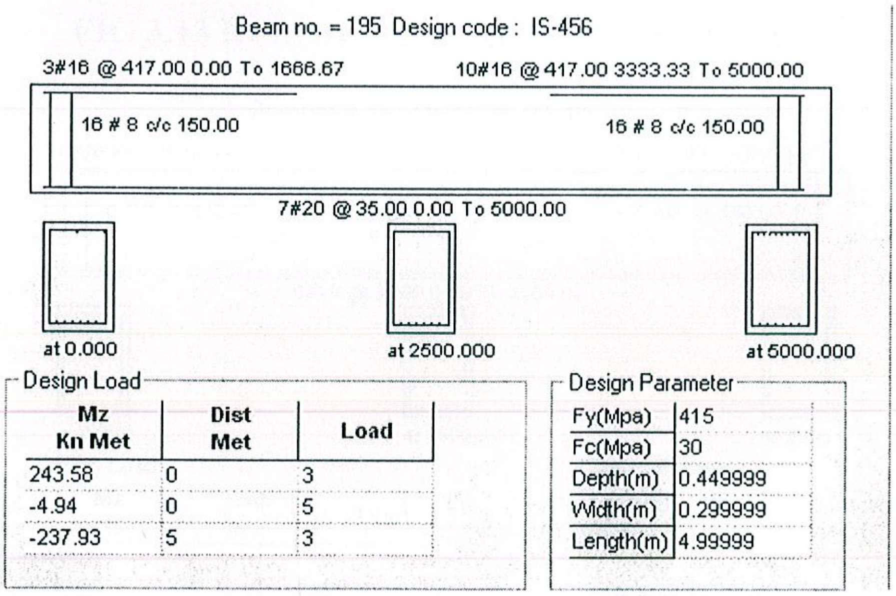


FIG 3.12 Reinforced detailing for beam no. 195

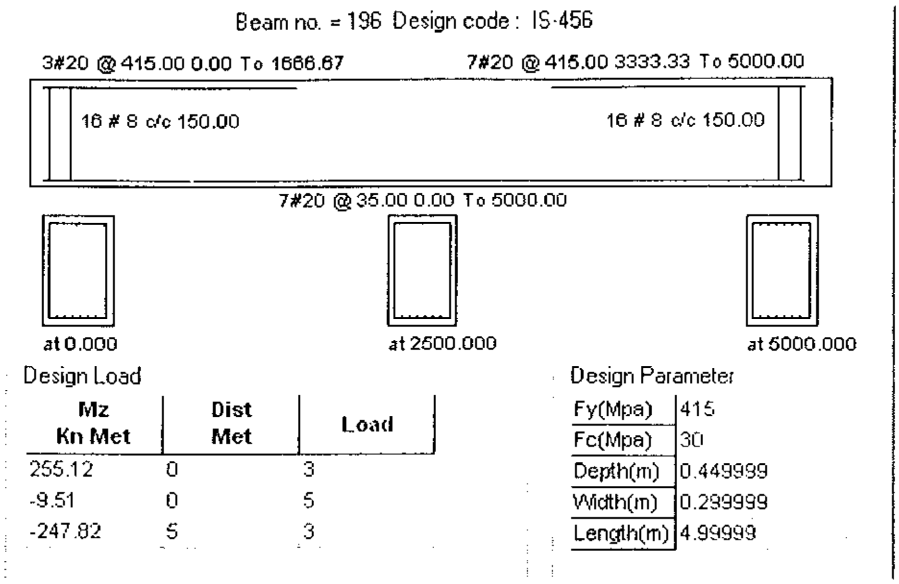


FIG 3.13 Reinforced detailing for beam no. 196

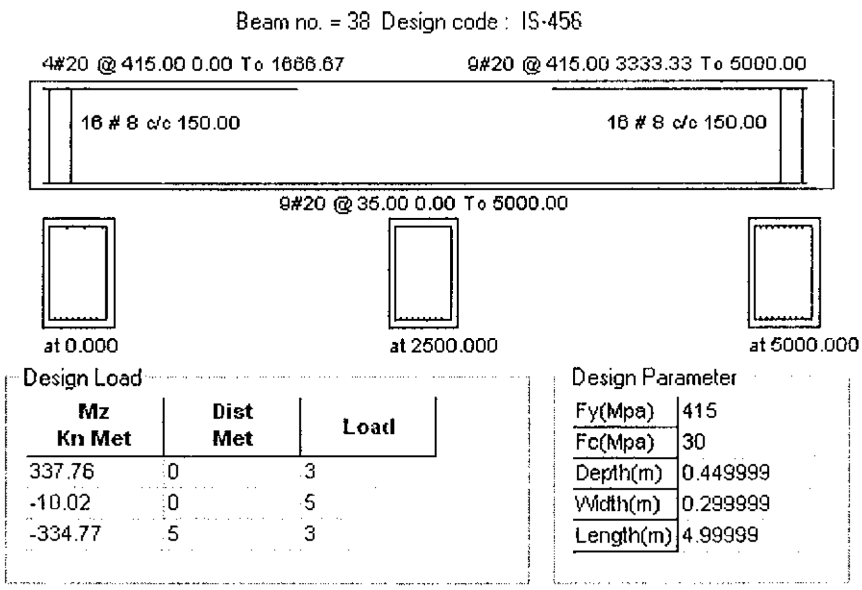


FIG 3.14 Reinforced detailing for beam no. 38

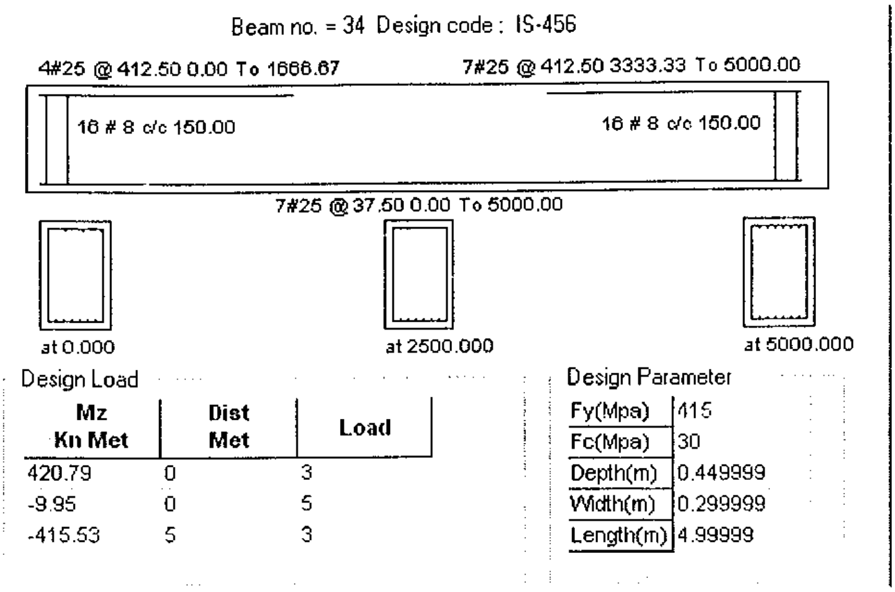


FIG 3.15 Reinforced detailing for beam no. 34

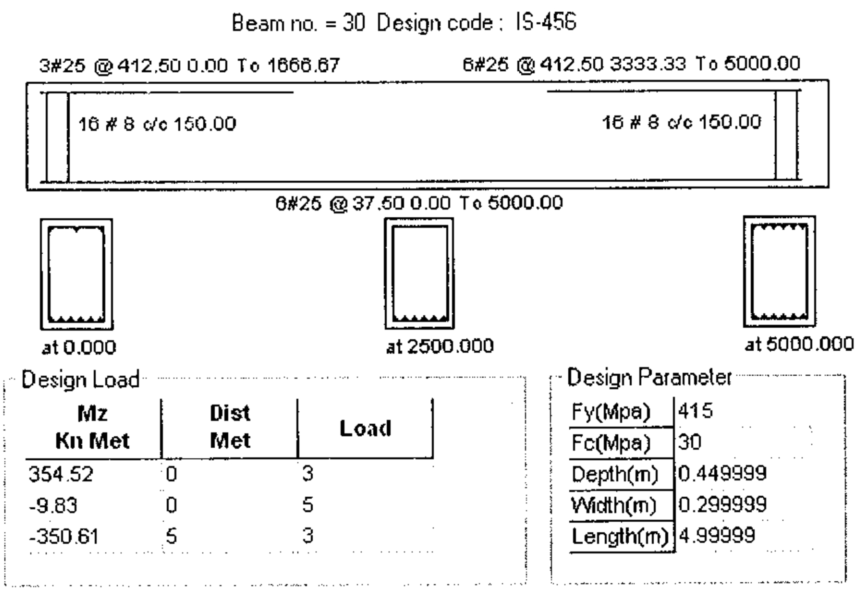


FIG 3.16 Reinforced detailing for beam no. 30

- **SLABS**

All slabs are safe with minimum area of steel. so in both directions 8 mm diameter bars @ 300 c/c are provided.

Chapter 4

DESIGN OF FOUNDATION

4.1 Design calculations for the footing

NOTE: The foundation is same for all the columns i.e. isolated rectangular footing.

Design Module = Isolated Rectangular Footing
Country Code = Indian
Job Name = Footing

Input Pages Report

Geometry Data

Item	Value	Unit
Footing Sizing Option	User Defined Sizing	
Length of Footing(X-Dirn)	2.2	m
Length of Footing(Y-Dirn)	2.2	m
Min. Width (Y-dirn)	0.5	m
Max. Width (Y-dirn)	5	m
Min. Length (X-dirn)	0.5	m
Max. Length (X-dirn)	5	m
Ratio (Length/Width)	1	
Thickness at Edge	0.5	m
Thickness at Column Face or Pedestal Face	0.8	m
Depth of Foundation	2	m
Type of Column	Rectangular	
Col. Dia.	0.3	m
Col. Length(X-dirn)	0.75	m
Col. Width (Y-dirn)	0.75	m
Consider Pedestal	No	
Height of Pedestal	0.2	m
Length of Pedestal(X-Dirn)	0.5	m
Width of Pedestal(Y-Dirn)	0.5	m
ex	0	m
ey	0	m
Allowable Gross Bearing Capacity of Soil	2000	kN/m2
Consider Water Table	No	
Depth of Water Table	0.6	m
Load Combination	Input Load Factors	
Numbers of Primary Load	1	
Number of Service Load Combinations	1	
Number of Strength Load	1	

Combinations

Number of Combined Load Cases for Serviceability	5
Number of Combined Load Cases for Strength	5

Modification Factors for Serviceabilty check

Load Combination	Combination 1
Bearing Capacity Factor	1.5
FOS Overturning	1.5
FOS Sliding	1.5
Contact Area Percentage	100

Primary Load Cases

Loads	Load Case 1	Unit
Surcharge Load	0	kN/m2
Vertical Load	2281.4	kN
Horiz. Load Along X-dirn	1.643	kN
Horiz. Load Along Y-dirn	1.643	kN
Moment Along X-dirn	1.792	kNm
Moment Along Y-dirn	1.792	kNm

Load Combination Factors for Serviceability

Load Combination	Combination 1
Selfweightfactor	1
Primary Load 1	1

Load Combination Factors for Strength Design

Load Combination	Combination 1
Selfweightfactor	1.5
Primary Load 1	1.5

Combined Loads for Serviceability

Loads	Combination 1	Unit
SelfWeightFactor	1	
Surcharge Load	0	kN/m2
Vertical Load	400	kN
Horiz. Load Along X-dirn	0	kN
Horiz. Load Along Y-dirn	0	kN
Moment Along X-dirn	0	kNm
Moment Along Y-dirn	0	kNm

Combined Loads for Strength

Loads	Combination 1	Unit
SelfWeightFactor	1	
Surcharge Load	0	kN/m2
Vertical Load	600	kN
Horiz. Load Along X-dirn	0	kN
Horiz. Load Along Y-dirn	0	kN
Moment Along X-dirn	0	kNm
Moment Along Y-dirn	0	kNm

Materials Data

Item	Value	Unit
Unit Wt. of Soil	17.671	kN/m3
Coefficient of Friction between Soil & Foundation	0.5	
Unit Weight of Water	1000	kg/m3
Grade of Concrete	M25	
Grade of Steel	Fe 415	
Grade of Steel for shear reinforcement of Pedestal	Fe 250	
Unit Wt. of Concrete.	24	kN/m3

Reinforcement Data

Item	Value	Unit
Dia of bar at bot.along X (mm)	16	
Dia of bar at bot.along Y (mm)	16	
Dia of bar at top along X (mm)	12	
Dia of bar at top along Y (mm)	12	
Dia of Main Reinforcement Bar for Pedestal	12	
Dia of Shear Reinforcement Bar for Pedestal	12	
Min. Bar Spacing of Foundation	0.04	m
Max. Bar Spacing of Foundation	0.3	m
Consider Clause 34.4 of IS-456-2000	Yes	
Percentage of Reinforcement in Column	0.8	

Shear Consideration for Foundation Slab	Increase depth of footing	
Clear Cover for Foundation Slab	0.06	m
Clear Cover for Pedestal	0.04	m
Consider curtailment of reinforcement	Yes	
Development Check Criteria	Do not Check	
Steel % along X-dirn at Bot.	0.12	
Steel % along Y-dirn at Bot.	0.12	
Steel % along X-dirn at Top	0.12	
Steel % along Y-dirn at Top	0.12	

Calculation Sheet Report

Footing Size Calculations

Foundation Dimension in X-Direction(L_x) = 2.200 m
Foundation Dimension in Y-Direction(L_y) = 2.200 m

Stability Calculation of Foundation against Serviceability Criteria

Weight of Foundation (Wfdn) = 70.146 kN
Weight of Backfill (Wbkfl) = 106.971 kN
Vertical load on Column in Load Case 1 (P) = 2281.400 kN
Load on foundation due to surcharge in Load Case 1 (P) = 0.000 kN
Total Vertical load in Load Case 1 (P) = 2458.516 kN
Total Moment in X-direction in Load Case 1 (Mx) = 3.106 kNm
Total Moment in Y-direction in Load Case 1 (My) = 3.106 kNm
Maximum Bearing Pressure developed in Load Case 1 (Prmax) = 511.459 kN/sq.m
Minimum Bearing Pressure developed in Load Case 1 (Prmin) = 504.457 kN/sq.m
Allowable Gross Bearing Pressure in Load Case 1 (Q_{All}) = 3000.000 kN/sq.m
Total Restoring Moment about Y-axis in Load Case 1 = 2704.368 kN-m
Total Overturning Moment about Y-axis in Load Case 1 = 3.106 kN-m
FOS against overturning about Y-axis in Load Case 1 (FOS_{ovrX}) = 870.579
Total Restoring Moment about X-axis in Load Case 1 = 2704.368 kN-m
Total Overturning Moment about X-axis in Load Case 1 = 3.106 kN-m
FOS against overturning about X-axis in Load Case 1 (FOS_{ovrY}) = 870.579
Allowable FOS against overturing in Load Case 1($Fos_{over\text{-}turn}$) = 1.500
$FOS_{ovrX\ in\ Load\ Case\ 1}$ > $Fos_{over\text{-}turn\ in\ Load\ Case\ 1}$ Hence OK.
$FOS_{ovrY\ in\ Load\ Case\ 1}$ > $Fos_{over\text{-}turn\ in\ Load\ Case\ 1}$ Hence OK.
Total Sliding Force Along X-Direction in Load Case 1 = 1643.000 kN
Total Resisting Force against sliding in Load Case 1 = 1229258.244 kN
FOS against sliding along X-axis in Load Case 1 ($FOS_{slidingX}$) = 748.179
Allowable FOS against sliding in Load Case 1 ($FOS_{sliding}$) = 1.500

$FOS_{slidingX\ in\ Load\ Case\ 1}$ > $Fos_{sliding\ in\ Load\ Case\ 1}$ Hence OK.

Total Sliding Force Along Y-Direction in Load Case 1 = 1643.000 kN

Total Resisting Force against sliding in Load Case 1 = 1229258.244 kN
FOS against sliding along Y-axis in Load Case 1 ($FOS_{slidingX}$) = 748.179
Allowable FOS against sliding in Load Case 1 ($FOS_{sliding}$) = 1.500

$FOS_{slidingY\ in\ Load\ Case\ 1}$ > $FOS_{sliding\ in\ Load\ Case\ 1}$ Hence OK.

Contact Area in Load Case 1 ($A_{contact}$) = 4.840 sq. m
Percentage of Contact Area in Load Case 1 ($A_{percentage\ contact}$) = 100.000
Allowable percentage of contact area in Load Case 1($A_{contPerc}$) = 100.000
Tension does not occur
Hence,the foundation is safe against all serviceability criteria
Transfer of Load at the Base of Column as per clause 34.4 of IS:456-2000
Maximum Actual Bearing Stress on the Loaded Area = 4106.795 kN/sq.m
Supporting Area for Bearing of Footing (A_1)= 4.840 m2
Loaded area at the column base (A_2)= 0.563 m2
Permissible Bearing Stress = $0.45*F_{ck}*sqrt(A_1/ A_2)$ = 22500.000 kN/sq.m

Calculation of Bottom Reinforcement of the footing

Design soil pressure under the foundation

Pressure on Foundation in Load Case 1 (PrDesign) = 712.297 kN/sq.m
Maximum upward soil pressure under the foundation(Pr_{Design}) = 712.297 kN/sq.m
Moment along X-direction on foundation at critcal section on right side of Column($Mx_{designRt}$) = $Pr_{design}* (((L_x- BCritical_x) / 2)- E_x)^2/2$ = 0.187 kNm per mm length
Moment along X-direction on foundation at critcal section on left side of Column($Mx_{designLt}$) = $Pr_{design}* (((L_x- BCritical_x) / 2)+ E_x)^2/2$ = 0.187 kNm per mm length
Moment along Y-direction on foundation at critcal section on right side of Column($My_{designRt}$) = $Pr_{design}* (((L_y- BCritical_y) / 2)- E_y)^2/2$ = 0.187 kNm per mm length
Moment along Y-direction on foundation at critcal section on left side of Column($My_{designLt}$) = $Pr_{design}* (((L_y- BCritical_y) / 2)+ E_y)^2/2$ = 0.187 kNm per mm length
Characteristic strength of concrete (f_{ck}) = 25.000 N/sq.mm
Yeild strength of reinforcing steel (f_y) = 415.000 N/sq.mm
Limiting MU/BD^2 of the footing section = 3.449 N/sq.mm

Calculated MU/BD^2 in X direction at bottom (Right of Column) = 0.349 N/sq.mm
Calculated MU/BD^2 in X direction at bottom (Left of Column) = 0.349 N/sq.mm
Calculated MU/BD^2 in Y direction at bottom (Right of Column) = 0.365 N/sq.mm
Calculated MU/BD^2 in Y direction at bottom (Left of Column) = 0.365 N/sq.mm

Calculated MU/BD^2 in X direction at bottom (Right of Column) < Limiting MU/BD^2
Hence OK.
Calculated MU/BD^2 in X direction at bottom (Left of Column) < Limiting MU/BD^2
Hence OK.
Calculated MU/BD^2 in Y direction at bottom (Right of Column) < Limiting MU/BD^2
Hence OK.
Calculated MU/BD^2 in Y direction at bottom (Left of Column) < Limiting MU/BD^2
Hence OK.

Required Reinforcement along X-direction at Bottom on right side of Column($Ast_{bxRight}$) = 878.40 mm ^{2}/m length
Required Reinforcement along X-direction at Bottom on left side of Column(Ast_{bxLeft}) = 878.40 mm ^{2}/m length
Required Reinforcement along Y-direction at Bottom on right side of Column($Ast_{byRight}$) = 859.20 mm ^{2}/m length
Required Reinforcement along Y-direction at Bottom on left side of Column(Ast_{byLeft}) = 859.20 mm ^{2}/m length
Spacing Provided for Reinforcement along X-direction at Bottom on right side of Column($S_{bxRightprov}$) = 225.00 mm
Spacing Provided for Reinforcement along X-direction at Bottom on left side of Column($S_{bxLeftprov}$) = 225.00 mm
Spacing Provided for Reinforcement along Y-direction at Bottom on right side of Column($S_{byRightprov}$) = 230.00 mm
Spacing Provided for Reinforcement along Y-direction at Bottom on left side of Column($S_{byLeftprov}$) = 230.00 mm
Provided Reinforcement along X-direction at Bottom on right side of Column($Ast_{bxRightprov}$) = 893.61 mm ^{2}/m length
Provided Reinforcement along X-direction at Bottom on left side of Column($Ast_{bxLeftprov}$) = 893.61 mm ^{2}/m length
Provided Reinforcement along Y-direction at Bottom on right side of Column($Ast_{byRightprov}$) = 874.18 mm ^{2}/m length
Provided Reinforcement along Y-direction at Bottom on left side of Column($Ast_{byLeftprov}$) = 874.18 mm ^{2}/m length

One way shear calculation for bottom Reinforcement

Maximum permissible shear stress of concrete ($\square_{cmax}$) = 3.100 N/sq.mm
Effective thickness of footing at the critical section (parallel to X-axis) of failure against one way shear (D_{sfx}) = 429.103 mm
Effective thickness of footing at the critical section (parallel to Y-axis) of failure against one way shear (D_{sfy}) = 419.724 mm
Upward shear force on footing at the critical section on right side of column parallel to Y-axis (SF_{xRight}) = 0.000 kN per m length
Upward shear force on footing at the critical section on left side of column parallel to Y-axis (SF_{xLeft}) = 0.000 kN per m length
Upward shear force on footing at the critical section on right side of column parallel to X-axis (SF_{yRight}) = 6.411 kN per m length
Upward shear force on footing at the critical section on left side of column parallel to X-axis (SF_{yLeft}) = 6.411 kN per m length
Shear stress at the critical section parallel to Y-axis on right side of column($\square_{vxRight}$) = 0.000 N/sq.mm
Shear stress at the critical section parallel to Y-axis on left side of column($\square_{vxLeft}$) = 0.000 N/sq.mm
Shear stress at the critical section parallel to X-axis on right side of column($\square_{vyRight}$) = 0.015 N/sq.mm
Shear stress at the critical section parallel to X-axis on left side of column($\square_{vyLeft}$) = 0.015 N/sq.mm
Permissible shear stress at the section parallel to Y-axis on right side of column($\square_{cxRight}$) = 0.337 N/sq.mm

Permissible shear stress at the section parallel to Y-axis on left side of column($\square_{cxLeft}$) = 0.337 N/sq.mm
Permissible shear stress at the section parallel to X-axis on right side of column($\square_{cyRight}$) = 0.337 N/sq.mm
Permissible shear stress at the section parallel to X-axis on left side of column($\square_{cyLeft}$) = 0.337 N/sq.mm

Punching Shear Calculation

Ratio of minimum to maximum dimension of column ($\square_c$) = 1.000
Value of K_s= 1.000
Minimum thickness of footing at critical section of punching shear (D_{Punch}) = 567.862 mm
Perimeter of the punching shear zone ($Peri_{Punch}$) = 5896.000 mm
Area of the punching shear zone ($Area_{Punch}$) = 2172612.000 sq. mm
Shear force for punching (SF_{punch}) = Pr_{design}* (B_x* B_y- $Area_{Punch}$) = 1899.972 kN
Actual punching shear stress ($\square_{vPunch}$) = SF_{punch}/ ($Peri_{Punch}$* D_{Punch}) = 0.567 N/sq.mm
Allowable punching shear stress ($\square_{AllPunch}$) = K_s* 0.25 * SQRT(f_{ck}) = 1.250 N/sq.mm

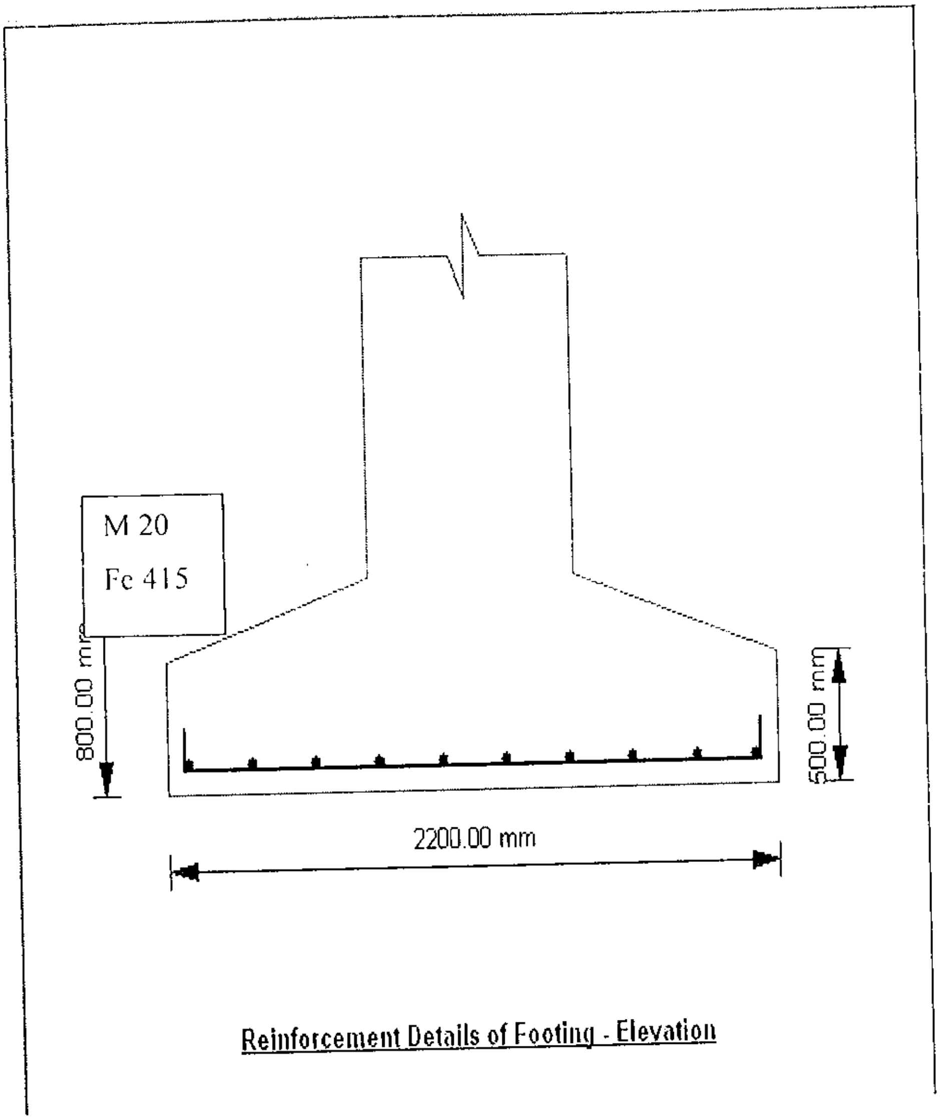


FIG 4.1: Reinforced detailing of footing

CONCLUSIONS

This project helped us in understanding the concept of analysis and design of earthquake resistant structure using STAAD Pro. The earthquake load on a building lying in the seismic zone IV has been calculated. The seismic load calculated gives step by step determination of all the lateral forces which in return helps us in determining the various moments and shear forces for the safe design of the building against the earthquake.

The complete analysis of the structure resulted in the safe design of the building. It also determined the exact amount of concrete and steel to be used in the building which makes our structure economic. The procedure which had been used in this project for seismic analysis of a real frame as per IS 1893 (Part 1):2002 does not consider the effect of infill walls.

After the continuous iterative method of the required parameters for the design of both superstructure and foundation, the building is safe from earthquake according to the guidelines given in IS 1893(Part I):2002.

Thus, the project helped in gaining the knowledge of how to analyze and design of any structure using STAAD Pro considering the earthquake forces.

APPENDIX A

TOTAL VOLUME OF CONCRETE = 195.03 CU.METER

BAR DIA (in mm)	WEIGHT (in N)
8	26098.67
10	203.20
12	44858.18
16	2773.82
20	81497.68
25	136277.97
32	18211.14
40	5418.64
TOTAL =	315339.31 N

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