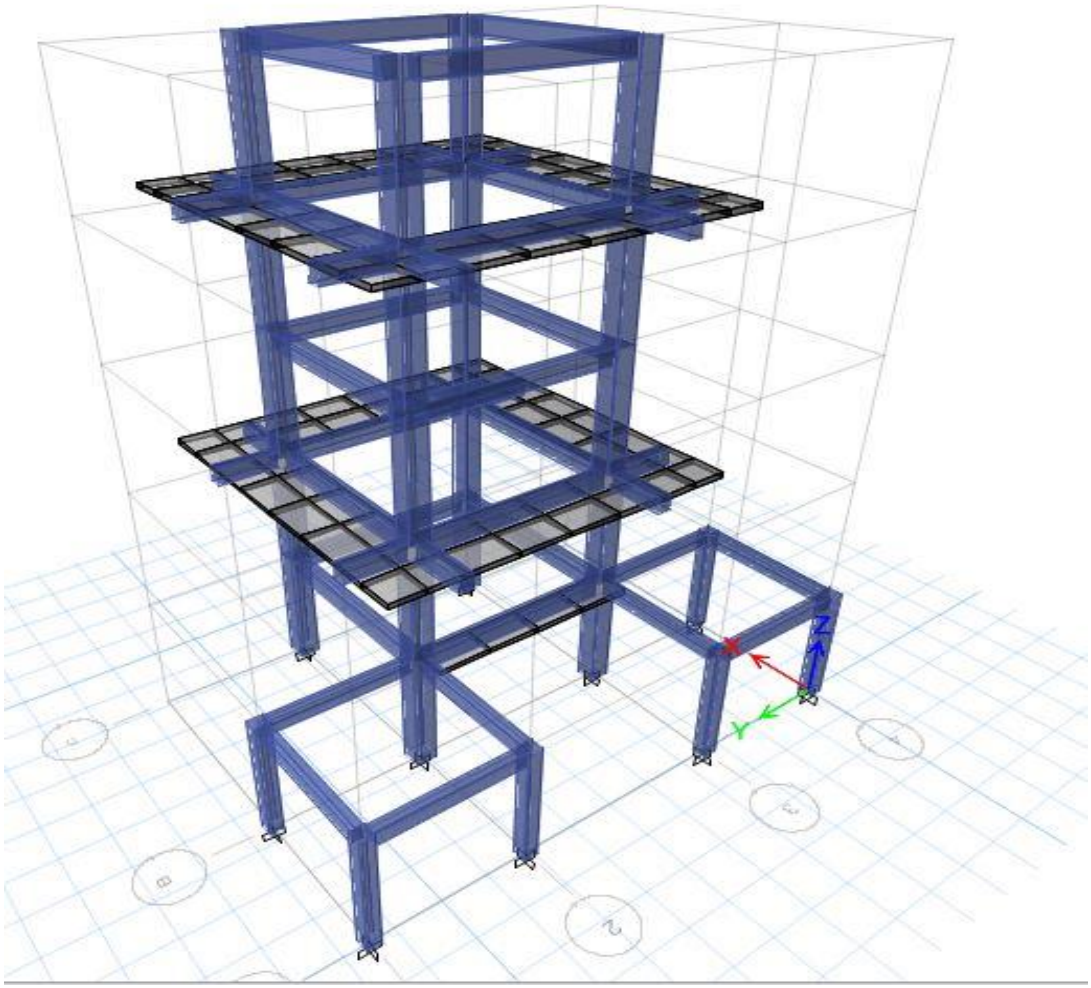
A

REPORT

ON

SEISMIC RESISTANT DESIGN OF BUILDING STRUCTURE



SEPTEMBER 2022

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1. Background

The principle aim of the structural design is to prepare necessary for construction of the structure, which should possess adequate strength and stability during the action of all possible loads in its life span. The process consists of integration of consideration of design regulations, local condition and the functional need. The behaviors of the structure in terms of stresses and strength have to be determined closer to the reality when subjected to the possible actions. The subject matter, such as, the properties and mechanics of the materials, analytical methods, design techniques and production of the construction documents, studied in isolation to address in an integral approach to arrive at the creation of the needful structure.

Earthquakes are defined as earth's surface vibrations caused by waves originating from a source of disturbance in the earth mass. Earthquake is caused by volcanic eruption, slipping of faults i.e. tectonic activities, big reservoirs, explosions etc.

Sindhuli lies in a very seismically vulnerable zone. The intensity of possible earthquake in the region is more prominent compare to that of wind. The soil deposit in the region is soft & mainly consists of clayey layers resulting into a substantial amplification of ground motion at the surface.

Thus the seismic structural design of structures is found to be very essential for countries like Nepal .The structures need to be designed and detailed so as to counteract, the internal forces induce due to the earth mass shaking in base of these structures. The design should ensure the structure against stability, strength and serviceability with acceptable levels of seismic safety.

The probable maximum earthquake occurrences are not so frequent; it would not be economically feasible to design the building so as to ensure that they remain elastic and damage-free. Thus it is reliable to design the ductile structure and not to design damage free structure but non-collapsible structure for minimum destruction in lives and properties. The design should ensure the structure against stability, strength and serviceability with acceptable levels of seismic safety.

2. Introduction

The Structural design of residential building has been carried out using ETABS 2019 by Limit State Method of design .

Earthquakes are defined as earth's surface vibrations caused by waves originating from a source of disturbance in the earth mass. Earthquake is caused by volcanic eruption, slipping of faults i.e. tectonic activities, big reservoirs, explosion etc.

In case of Nepal, slipping of faults i.e. tectonic activities cause earthquake because there are number of active faults and thrusts in Nepal. Nepal's geology is very young and hazardous. Also it lies in the boundary of two seismically very active tectonic plates of the world i.e. Indian plate and Tibetan Plate. It is also said that the Indian plate is moving toward the Tibetan Plate, which cause the slippage of the faults causing the big earthquake. Thus Nepal is very vulnerable with respect to seismic activities.

Though the time of shaking of earth mass is very small in fraction of seconds, it causes very severe damages of properties as well as the lives. Nepal has so many experiences about such destructive earthquakes. Out of them 1990 B.S and 2045 B.S are the recently known ones.

Thus the seismic structural design of structures id found to be very essential for countries like Nepal. The structures need to be designed and detailed so as to counteract, the internal forces induced due to the earth mass shaking in base of these structures. The design should ensure the structure against stability, strength and serviceability with acceptable levels of seismic safety.

However, it would not be economically feasible to design the building so as to ensure that they remain elastic and damage-free because the occurrence of maximum earthquakes is low say one 75 years. Thus it is reliable to design the ductile structure and not to design damage free structure but not-collapsible structure for minimum destruction in lives and properties. The design should ensure the structure against stability, strength and serviceability with acceptable levels of seismic safety.

The Literature review consists of standard literatures like national building code of India (IS code) and Nepal national building code (NBC), other standard books of RCC structures. The dead load and live loads are taken as per the recommendations of NBC and IS code. The seismic load i.e. base shear is calculated by static seismic coefficient method using the procedures and guidelines provided by the IS code and NBC.

The 3-D modeling of the building if built and the analysis is carried out using ETABS 2016 Design load combinations are given as per the IS code.

Design of the structural elements are done by limit state method with the application of ETABS 2016 software following IS code. As the soil test report is not available, the ground condition of the site is assumed to be medium with the deposited material at the top and clay of low plasticity at the bottom. The isolated and strap footing is designed.

The Floor slab and beam combination has made the building stiffer which help in resisting the distributed seismic load. The weak girder and strong column system has been adopted to facilitate more stability against the lateral load. The frames are designed for the total vertical load coming to individual column with ignoring the stiffness of the infill wall but the considering its load.

3. Assumption load

3.1 Loads

All the loads are extracted from the IS code and NBC as per recommendation.

3.1.1 Dead load

The Dead load on the frame is calculated floor wise and it comprises of the Self weight of beams, columns, slabs, foundations, and partition wall floor finishes etc. The dead load due to the self-weight is auto calculated by the software itself from material properties assigned and the size of the section. In case of the dead load of the wall the calculation is shown in the table.

As per IS 875 part I:

1. Self-weight of all the components of the building :
    - Columns
    - Beams
    - Slab with floor finishes and other
    - Finishing stairs
    - Foundation
    - Partition wall
    - Main wall and all components
2. Partition wall load:

   It comprises the unit load of partition wall of 115mm, 229mm thick wall including plaster.
3. Floor finishing load:

   It comprises marble/tile flooring and cement plaster on wall and ceiling, including screeding, punning, IPS flooring etc.
4. Partition load:

   In case the partition is not defined during the partition wall load of 1.2 KN/m^2 is applied on the floor for future partition wall to be made.

3.1.2 Live load:

The live load for the building is extracted from the IS 875 part II-1987 for different occupancies.

For residential building:

- 1.5 KN/m^2 for terrace
- 2.0 KN/m^2 for rooms
- 4.0 KN/m^2 for stair, passage, lobby, verandah etc.

3.1.3 Seismic load:

Seismic coefficient method is applied to calculate the seismic load on the components.

The seismic coefficient factors are calculated as per IS code 1893-2002. Seismic load on the building is calculated automatically and distributed to each floor diaphragm from the softwareand only seismic coefficient is inputted to the software as calculated before. The seismic coefficient is calculated as follows:

Seismic Coefficient Method:

Seismic coefficient method considered the calculation of base shear of the building considering different factors. It also realized each storey as a lumped mass system and distributes the base shear to all lump mass systems. The base shear, Vb is given by as per IS

1893 (Part I) : 2002:

Calculation of total base shear:

Total Horizontal Base Shear $V_B = A_h * W$

Where, $A_h =$

Where,Z= Zone factor = 0.36

Importance Factor = 1

For $T=0.075*H^{0.75}$

H=Height of Building

R=Response Reduction Factor

S_a/g = Spectral Acceleration

W = Total load

Seismic weight at any floor level = W_i = Total gravity loads due to Beam, slabs, column and walls for $^1/_2$ height above and $^1/_2$ height below the level +25% of live load

Total Weight of $W = \sum_{i=1}$ where n = total number of storey

Calculation of storey shear :

$F_i = V_B * W_i * h_i^2 / \sum$

Where, W_i = DL + 25% LL (if LL<3KN/m^2)

h_i = Height of floor level from base of building

3.2 Load Cases And Load Combinations Used

3.2.1 Static and lateral load cases:

The static load cases including lateral load assigned to the software are as follows:

S.no.	Load Type	Load Pattern in ETABS 2016	Remarks
1.	Dead load (DL)	DEAD	Self-weight of building components
2.	Wall load (WL)	DEAD	As per unit weight of wall material
3.	Floor Finishing Load (FF)	DEAD	Taken as 1.25 KN/m^2 as per weight of the finishing materials
4.	Live Load (LL)	LIVE	As per IS code 875 (part II) for building type
5.	Partition Wall (PW)	DEAD	Taken as 1.2KN/m^2 as and where required
6.	Earth quake load in X-X direction(EQx)	QUAKE	As per IS 1893
7.	Earth quake load in Y-Y direction(EQy)	QUAKE	As per IS 1893

3.2.2 Design Load Combinations:

Design Load combinations define the various factored combinations of thee load cases for which the structure is to be designed. The design loading combinations are obtained by multiplying the characteristic loads by appropriate partial factor of safety.

The Load Combinations used as per IS 456:2002 are as follows:

1. 1.5DL+1.5LL
2. 1.2DL +1.2LL+ 1.2 EQX
3. 1.2DL +1.2 LL+1.2 EQY

4. 1.2DL +1.2 LL-1.2 EQX
5. 1.2DL +1.2 LL-1.2 EQY
6. 1.5DL+1.5EQX
7. 1.5DL+1.5EQY
8. 1.5DL-1.5EQX
9. 1.5DL-1.5EQY
10. 0.9DL +1.5 EQX
11. 0.9DL +1.5 EQY
12. 0.9DL -1.5 EQX
13. 0.9DL -1.5 EQY

3.2.3 Assume unit weight of material

As per IS 875 Part-I:
Reinforced Cement Concrete=25 KN/m³
Local Brick Masonry = 19.2 KN/m³
Finishing Works:
Cement Plaster=20.40 KN/m³
Scree ding =22KN/m³
Marble Floor Finishing=27KN/m³

4. Design

The design for components like columns and beams are carried out with the help of ETABS 2016 using Indian Standard code.

4.1 Foundation Design

The Isolated footing is design using Limit state method using service DL and LL. The depth of foundation is checked against moment due to soil pressure, one way and two way shear.

4.1.1 Bearing Capacity of Soil

Allowable Bearing Capacity of the soil is taken as 100KN/m^2 assuming medium type soil.

4.2 Slab Design

The Slabs are Designed as two-way slab by bending moment coefficient method for different existing boundary conditions as per the code IS 456-2000.The boundary conditions considered are as follows:

1. One short edge discontinuous
2. Two adjacent edge discontinuous

The straight bars are used at bottom without any bent up. And the extra cut pieces are used for extra top bar.

4.3 Columns

Columns are designed with the help of ETABS 2016. Each Column was designed for the total vertical load coming on to the individual column. The percentage of steel is checked as per Limit governed by IS 456.The stirrup Area is checked for the spacing provided.

The spacing of stirrups is as per the requirement of seismic criteria given in seismic code and seismic detailing code. Also the lapping and any other detailing requirement of IS 13920 is followed.

4.4 Beams

Beams are designed with the software ETABS 2016 considering the reversible effect due to the seismic force. The most critical value of seismic force of all possible direction has been considered.

The Shear Stirrups are designed as per the requirements and instruction of code and area of the stirrups are checked for provided spacing. The spacing of the stirrups is governed by the seismic detailing requirements.

4.5 Staircase

Stair case is designed for the live load 3 KN/m^2 as per the code and standard RCC books.

NOTES

A. GENERAL

1. READ STRUCTURAL DRAWING IN CONJUCTION WITH ARCHITECTURAL DRAWING. REPORT ANY DESCREPANCIES TO THE SITE ENGINEER PRIOR TO FABRICATION OR CONSTRUCTION. ANY CONFLICT BETWEEN SPECIFIC ATION & DRAWING SHALL BE LIKEWISE REPORTED.
2. CONTRACTORS SHALL BE RESPONSIBLE FOR CHECKING FIELD DIMENSION & SITE CONDITIONS.
3. UNLESS OTHERWISE INDICATED ALL CONSTRUCTION JOINTS SHALL BE ROUGHENED JOINTS 5mm (AMPLITUDE MINIMUM 5mm.).
4. NO MEASUREMENT SHALL BE DIRECTLY TAKEN FROM THE PRINT, WRITTEN DIMENSION SHALL BE FOLLOWED.

B. FOUNDATION

1. FOUNDATION SHALL BE ON UNDISTURBED SOIL.
2. SOIL BEARING CAPACITIES SHALL BE VERIFIED IN THE FIELD NOTIFIED ENGINEER IMMEDIATELY OF ANY SOFT POCKETS OR OTHER ADVERSE SOIL CONDITIONS ENCOUNTERED.
3. THE LINE OF SLOPE BETWEEN ADJACENT EXCAVATIONS FOR FOOTING OR ALONG STEPPED FOOTING SHALL NOT EXCEED A RISE 1INARUNOF2.
4. PLACING OF FOUNDATION CONCRETE SHALL BE DONE AS SOON AS EXCAVATIONS HAVE BEEN COMPLETED & APPROVED BY THE SITE ENGIN EER.

C. CONCRETE & REINFORCING STEEL

1. CAST-IN-SITU CONCRETE SHALL HAVE A MINIMUM 28 DAYS COMPRESSIVE CUBE STRENGTH OF 20N/mm FOR COULMN AND 15 N/mm FOR OTHER STRUCTURAL MEMBER.
2. REINFORCING STEEL SHALL BE NEW TMT STEEL BARS HAVING A MINIMUM YIELD STRENGTH OF 500N/mm FOR COULMN, 500N/mm FOR OTHER STRUCTURE & CONFORMING TO IS 1786:1979 OR IS 1139:1963. MINIMUM REINFORCING LAPS SHALL BE IN ACCORDANCE WITH IS 1786:1979 & AS SPECIFIED ON STRUCTURAL DRAWING.
3. COVER TO MAIN REINFORCING STEEL BE IN ACCORDANCE WITH IS 456:1978 & AS SPECIFIED

ON STRUCTURAL DRAWING.

1. CLEAROVEROFCONCRETE

SLAB	= 20mm
STAIRCASE	= 20mm
BEAM	= 40mm
COLUMN	= 40mm

4. PLUMBING, SLOTS, HOLES, AROUND PIPES DUCTS OR OTHER ITEMS WHICH PASS THROUGH CONCRETE SLAB OR WALL SHALL BE FILLED & PATCHED TO THE SAME DEPTHS AS THE SLAB OR WALL.

REFERENCES:

1.0 IS code 456-2000: Plain and Reinforced Concrete code of Practice
2.0 IS code 1893 (part I)-2002: Criteria for earthquake Resistant Design of Structures
3.0 IS code 875-1987: Code Of Practice For Design Loads Part 1
Dead Loads
Part 2 Imposed Loads
Part 5 Special loads and Load combination
4.0 IS code 13920-1993: Ductile Detailing of RCC structures subjected to seismic force-Code of practice
5.0 Nepal National Building Code (NBC 105): Seismic Design of Buildings in Nepal
6.0 RCC structures by A.K. Jain
7.0 RCC structures by S.N. Sinha
8.0 Limit State Design by Vargees
9.0 Design of R.C.C. Structural Elements by S.S.Bhavikatti
9.0 Structural Design of Multistoried building by U.H. Varyani
10.0 IS code SP 16 Design guidelines for RCC Structures
11.0 IS code SP 34 for detailing of RCC structures

STATIC LOAD ON BUILDING

I) DEAD LOAD

Unit weight of Materials:

As per IS 875 Part-I:

Reinforced Cement Concrete =25 KN/m^3

Local Brick Masonry = 18.85 KN/m^3(1920 Kg/m^3)

Finishing Works:

Cement Plaster= 20.40 KN/m^3

Screeding= 20.40 KN/m^3

Marble Floor Finishing= 26.70 KN/m³

Dead Load due to the walls on the beam of the Building:

SN	Building component	Dimensions		Self-weight	Total Unit Weight	Units	Remarks
		Width (B)mm	Depth(D) or Height (H) mm				
a	9"outer wall without opening	229	2794	12.06	12.06	KN/m	
b	9" outer wall with opening	229	2515	9.64	9.64	KN/m	20% Opening
e	4" parapet wall	115	1000	2.2	2.2	KN/m	

ii) Live Load:

Imposed Floor load for residential Building:

As per IS 875 Part II:

Live Load Intensity for rooms without separate storage= 2 KN/m²

Live Load for Staircase, Corridors, Passages and Lobbies= 3 KN/m²

Live Load for Bath and Toilet Rooms = 2 KN/m² Live Load or

Balconies = 3 KN/m²

Live Load for flat, sloping or curved Roof with slope upto 10degree and Access Provided= 2.0 KN/m²

Live Load Intensity for overhead tank storage= 3.0 KN/m²

Floor Finishing for toilet 2.25 KN/m² Minimum loading for Floor Finishing

Floor Finising for Landing, passages, balconys= 1.25KN/m^2

Floor Finising for Staircase =1.25KN/m^2

Floor Finising for Rooms etc=1.25KN/m^2

Table: Base Shear Calculation

As per IS 456:2002

Height of the building (m)	16.02	m
Importance factor (I)	1.2	
Seismic Weight (T)	2859.5078	KN
Soil Type	II	Medium Soil
Time Period in both dir^{n} $(0.075*(H)^{3/4})$	0.6	Sec
Structural performance factor(K)	1	
Seismic Zone Factor (Z)	1	
a_h	0.09	
Base Shear	173.3602	KN

Storey Drift

Drift due to EQx

Story	Load Case/Combo	Direction	Drift
5F	EQX 1	X	0.001127
4F	EQX 1	X	0.002054
3F	EQX 1	X	0.002523
2F	EQX 1	X	0.00228
1F	EQX 1	X	0.000994
PL	EQX 1	X	0

Drift due to EQy

Story	Load Case/Combo	Direction	Drift
5F	EQY 1	Y	0.001109
4F	EQY 1	Y	0.002025
3F	EQY 1	Y	0.002509
2F	EQY 1	Y	0.002386
1F	EQY 1	Y	0.001218
PL	EQY 1	Y	0

Displacement due to EQx

Story	Load Case/Combo	Direction	Displacement
5F	EQX 1	X	28.731
4F	EQX 1	X	25.125
3F	EQX 1	X	18.552
2F	EQX 1	X	10.479
1F	EQX 1	X	3.18
PL	EQX 1	X	0

Displacement due to EQy

Story	Load Case/Combo	Direction	Displacement
5F	EQY 1	Y	29.596
4F	EQY 1	Y	26.638
3F	EQY 1	Y	19.564
2F	EQY 1	Y	12.083
1F	EQY 1	Y	3.899
PL	EQY 1	Y	0

ETABS 2019 output

TABLE: Joint Reactions

Story	Label	Unique Name	Output Case	Case Type	FX	FY	FZ	MX	MY	MZ
					kN	kN	kN	kN-m	kN-m	kN-m
GF	1	2	1.5(DL+LL)	Combination	1.4961	0.5798	21.0775	-0.6104	1.616	0.000006284
GF	2	4	1.5(DL+LL)	Combination	0.9145	-0.8179	20.1857	0.8611	1.0037	0.000006284
GF	3	6	1.5(DL+LL)	Combination	-0.6725	-1.2341	20.2108	1.2994	-0.6672	0.000006284
GF	4	8	1.5(DL+LL)	Combination	0.9146	0.8178	20.1857	-0.8611	1.0038	0.000006284
GF	5	10	1.5(DL+LL)	Combination	1.4961	-0.5798	21.0775	0.6105	1.6161	0.000006284
GF	6	12	1.5(DL+LL)	Combination	-0.6724	1.2341	20.2107	-1.2994	-0.6671	0.000006284
GF	7	14	1.5(DL+LL)	Combination	8.3388	10.7362	860.5647	-11.1168	8.8413	0.00003181
GF	8	16	1.5(DL+LL)	Combination	8.3381	-10.7358	860.5659	11.1163	8.8405	0.00003181
GF	9	18	1.5(DL+LL)	Combination	-10.0769	10.0415	838.4844	-10.3977	-10.2273	0.00003181
GF	10	20	1.5(DL+LL)	Combination	-10.0765	-10.0419	838.4834	10.3977	-10.2269	0.00003181

TABLE: Modal Participating Mass Ratios

Case	Mode	Period	UX	UY	SumUX	SumUY	RX	RY	RZ	SumRX	SumRY	SumRZ
		sec										
Modal	1	0.987	0	0.738	0	0.738	0.2599	0	0.0512	0.2599	0	0.0512
Modal	2	0.969	0.7597	0	0.7597	0.738	0	0.272	0	0.2599	0.272	0.0512
Modal	3	0.785	0	0.022	0.7597	0.76	0.0107	0	0.6324	0.2706	0.272	0.6837
Modal	4	0.3	0	0.1382	0.7597	0.8982	0.4981	0	0.0043	0.7688	0.272	0.688
Modal	5	0.296	0.1586	0	0.9183	0.8982	0	0.5335	0	0.7688	0.8056	0.688
Modal	6	0.255	0	0.018	0.9183	0.9162	0.035	0	0.1813	0.8037	0.8056	0.8693
Modal	7	0.142	0	0.0411	0.9183	0.9573	0.0586	0	0.0151	0.8623	0.8056	0.8844
Modal	8	0.142	0.0354	0	0.9537	0.9573	0	0.0481	0	0.8623	0.8537	0.8844
Modal	9	0.13	0	0.002	0.9537	0.9593	0.007	0	0.0744	0.8694	0.8537	0.9588
Modal	10	0.11	0	0.0141	0.9537	0.9734	0.044	0	0.0236	0.9133	0.8537	0.9824
Modal	11	0.104	0.0412	0	0.9949	0.9734	0	0.1344	0	0.9133	0.9881	0.9824
Modal	12	0.098	0	0.0207	0.9949	0.9941	0.072	0	0.0145	0.9853	0.9881	0.9969

TABLE: Load Pattern Definitions - Auto Seismic - IS 1893 2016													
Name	Is Auto Load	Ecc Ratio	Top Story	Bottom Story	Period Type	Z	Site Type	I	R	Period Used	Coeff Used	Weight Used	Base Shear
										sec		kN	kN
EQx	No	0.05	5F	GF	Program Calculated	0.36	II	1.2	5				
EQx(1/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.969	0.060626	2859.5078	173.3602
EQx(2/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.969	0.060626	2859.5078	173.3602
EQx(3/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.969	0.060626	2859.5078	173.3602
EQy	No	0.05	5F	GF	Program Calculated	0.36	II	1.2	5				
EQy(1/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.987	0.059542	2859.5078	170.2616
EQy(2/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.987	0.059542	2859.5078	170.2616
EQy(3/3)	Yes	0.05	5F	GF	Program Calculated	0.36	II	1.2	5	0.987	0.059542	2859.5078	170.2616

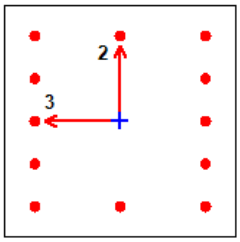
DESIGN OF COLUMN

Concrete Grade (fck): 20 | Steel Grade (fy): 500 | Effective Cover: 40 mm

Column Type	Storey/ Column ID	Column Size		Column Area (mm2)	Ast Required as per ETABS DESIGN (mm2)	Bars Provided				Total Nos. of Bars Provided	Ast Provided (mm2)	Percentage of Steel Provided (Pt%)	Lateral Ties (Fe500)		Result	Remarks
		Depth (X) mm	Width (Y) mm			No.	Bar (mm)	No.	Bar (mm)				Stirrup Legs	Shear Reinforcement Dia. (mm)		
C2	GF	304.8	304.8	92903.04	1457	8	16			8	1608.495	1.73137	4	10	OK	
C1	GF	457.2	457.2	209031.8	1742	4	25	8	20	12	4476.77	2.141669	4	10	OK	
C1	1F	457.2	457.2	209031.8	1862	12	20			12	3769.911	1.803511	4	10	OK	
C1	2F	457.2	457.2	209031.8	1952	4	20	8	16	12	2865.133	1.370668	4	10	OK	
C1	3F	457.2	457.2	209031.8	1716	12	16			12	2412.743	1.154247	4	10	OK	
C1	4F	457.2	457.2	209031.8	1768	12	16			12	2412.743	1.154247	4	10	OK	

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
3F	C7	60	C-18"X18"	UDCon11	0	3200.4	0.968

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
457.2	457.2	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
22360.68	20	1	500	500

Design Code Parameters

ɣc	ɣs
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²	Rebar % %
149.5787	-16.1956	149.9588	3.1154	3.1154	1952	0.93

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.909499	2794	30.5569	0	3.1154
Minor Bend(M2)	0.909499	2794	-6.4783	0	3.1154

Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	68.8778	98.9372	72.6403	68.8778	506.78
Minor, V_{u3}	68.6532	98.9372	72.6403	68.6532	506.78

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
2090.3	19.5	2613.2736	827.6693	149.5787	1

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	0.873	457.2	5.558	12	No	0
Minor Bending (M_2)	Yes	0.873	457.2	5.558	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

Beam Design Detail

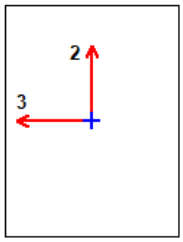
Beam size= 9"*14
Concrete Grade = M20
Steel Grade = Fe 500

Floor	Grid	Top				Bottom				Stirrups	
		Main Bars		Extra Bars		Main Bars		Extra Bars		End Ties	Mid Ties
		No.	ϕ	No.	ϕ	No.	ϕ	No.	ϕ		
First, Second	X-X direction	3	20	2	20	3	20			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c
	Y-Y direction	3	20	2	20	3	20			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c
Third, Fourth	X-X direction	3	16	2	20	2	20			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c
						1	16				
	Y-Y direction	3	16	2	20	2	20			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c
						1	16				
Top	X-X direction	3	16			3	16			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c
	Y-Y direction	3	16			3	16			10mm ϕ @ 100mm c/c	10mm ϕ @ 150mm c/c

Provide Plinth Tie beam of size = 9"*14"
Provide Plinth Tie beam bars = 6-nos. 16mmϕ

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
2F	B11	44	B-12"X16"	UDCon10	228.6	4724.4	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
304.8	406.4	304.8	0	40	40

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
22360.68	20	1	500	500

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-178.2175	6.4278	135.0348	0.3765

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-178.2175	8.8224	0	-187.04

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-187.04		1435	0	1435	359
Bottom (-2 Axis)		0	717	0	175	717

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
165.25	0	198.9916	94.1824	1504.97

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
6.4278	135.0348	244.8	346.4	704.46

FOOTING DESIGN SUMMARY									
Footing	Length (ft)	Breadth (ft)	Effective depth, d (in)	Overall Depth, D (in)	Bottom Bars		Top Bars		GRID ID
					X-dirn	Y-dirn	X-dirn	Y-dirn	
RAFT FOOTING	6	6.5	8	26	16mmØ @ 4" c/c	16mmØ @ 4" c/c	16mmØ @ 4" c/c	16mm Ø @ 4" c/c	ALL

Raft Foundation Design

1 Known Data:

Grade of concrete (fck) =	20	Mpa
Grade of steel (fy) =	500	Mpa
Bearing capacity of soil (q) =	120	kN/m^2
Length of foundation (L) =	4.489	m
Breadth of foundation (B) =	3.984	m
Gross area (A) =	27.662	m^2
Total vertical column load (Pu) =	2400	kN

4.489
3.984

2 Calculations :

1. Center of geometry[C.G.]

(X_g) =	2.840	m
(Y_g) =	2.435	m

2. Center of loads[C.L.]

(X_L) =	0.927	m
(Y_L) =	1.760	m

3. Eccentricity

Along x-direction,e_x =	-1.913	m
Along y-direction,e_y =	-0.675	m

4. Moment of inertia

Along x-direction,I_x=	30.032	m^4
Along y-direction,I_y=	23.655	m^4

5. Moment due to eccentricity

Along x-direction, $M_x=P^* e_y$ =	-1620.860	kN-m
Along y-direction ,$M_y=P^* e_x$ =	-4592.060	kN-m

6. Soil pressure at different points

Location (Grid)	X	Y	Pressure (q)		
C3	-0.927	-1.760	478.365	kN/m^2	318.91
C5	-0.927	1.742	-201.461	kN/m^2	-134.31
D3	2.199	-1.760	309.652	kN/m^2	206.435
E6	2.488	1.803	-397.612	kN/m^2	-265.07

In Y-direction, the raft is divided in 2 strips, that is,2equivalent beam:

i. Beam C-C with 2.54m width and soil pressure of	138.452	kN/m^2
ii. Beam D-D with 2.54 m width and soil pressure of	-43.980	kN/m^2

3 Calculation for maximum moment:

The bending moment is obtained by using a coefficient of 1/10 and 1/12 as per IS 456:2002 and L as center of column distance,

	Strip (Pressure)	Length (L)	+ve M	- ve M		
End pannel						
iv)	138.452	2.540	37.218	74.436	kN-m	Grid C-C
v)	-43.980	2.540	-11.823	-23.645	kN-m	Grid D-D

4 Calculation of Depth:

1. For maximum moments

The depth of raft will be governed by moment at middle portion.

Maximum +ve moments	37.218	kN-m
depth required (d)	118	mm
Maximum -ve moments	74.436	kN-m
depth required (d)	167	mm

2. For Punching Shear

The depth of raft will be governed by two way shear at the columns. In each case location of critical shear is at d/2 distance from the face of column.

Shear strength of concrete, $\tau_c' = \tau_c = 0.25*\sqrt{f_{ck}}$	1.118	Mpa
For corner column (having maximum load)		
Load (P)	498	kN
Column Size (BxD)	356	mm
Perimeter (b_o)	3*d/2 + 3*column	
For, $\tau_v = \tau_c$	1.118	Mpa
Required depth (d)	300	mm
For an edge column(having maximum load)		
Load (P)	416	kN
Column Size (BxD)	300	mm
Perimeter (b_o)	3*d/2+3* column	
For, $\tau_v = \tau_c$	1.118	Mpa
Required depth (d)	233	mm
Adopt, effective depth		
At middle, d =	450	mm
At column, d =	450	mm
Overall depth		
At middle, D =	500	mm
At column, D =	500	mm

5 Calculation of reinforcements

Maximum +ve moment (Mu) =	37.218	kN-m		
Maximum -ve moment (Mu) =	74.436	kN-m		
Top Reinforcement:				
Mim Ast =	600	mm^2		
Ast =	193	mm^2		
Ast required =	1345	mm^2		
Adopt ,	16	mm dia @	125	mm C/C
Ast provided=	1608	mm^2		
Hence, Ast Provided	>	Ast Required		
Bottom Reinforcement:				
Mim Ast =	540	mm^2		

Ast =	1258	mm^2		
Ast required =	1258	mm^2		
	16	mm dia	125	
Adopt ,		@		mm C/C
Ast provided=	1608	mm^2		
Hence, Ast Provided	>	Ast Required		

Design OF Cantilever Slab	Slab Id Number
Clear Span(m)	1.400
Wall/Beam Width (m)	0.3
fck (MPa) =	M20
Grade of Steel	Fe 500
FLOOR FINISH (kN/m2) =	1.00
IMPOSED LOAD (kN/m2) =	2.00
SLAB THKNESS, D (mm) =	125
EFF. COVER - X, d'x (mm) =	15
Effective Span Le (m)	1.55
fck (MPa) =	20
fy (MPa) =	500
w (kN/m^2) =	6.125
Eff. Depth - X, dx (mm) =	110
O.K	
Area of Steel Required (mm^2)	197
SELECT BAR DIA. (mm)	10
SPACING OF REBAR (mm)	300
Spacing of Rebar	
Area of Steel Provided (mm^2)	261
CALCULATIONS	
UNFACTORED BM (kN.m/m) =	6.0025
Factored Bending Moment,M(KN.m/m)=	9.0038
Ast (mm2/m) =	197
Ast,min (mm2/m) =	150
Coefficent for Slab type	7.00
Check For Deflection	OK
EFF. DEPTH, REQd.(mm)	58.18
EFF. DEPTH PROVIDED (mm)	110.00
O.K	

Design of staircase

	Finish (mm)	Riser (in.)	Thread (in.)
	25	7	12

Let thickness of waist slab be	150	mm	
Yield strength of steel =	500	N/mm^2	

Dead load of flight

Step section =	0.0271	m2
inclined slab =	0.05293	m2
Finish =	0.01207	m2
Total area =	0.09209	m2
Density of concrete =	25	KN/m3
DL of step section 1m in width=	2.30229829	KN/m
DL per m2 on plan =	7.55347	KN/m2
LL per m2 on plan =	3	KN/m2
Total load =	10.5535	KN/m2
Factored load =	15.8302	KN/m2
width of slab =	1.524	m
Total load /m =	24.13	KN/m

Load on landing

self weight of slab =	3.75	KN/m2
finish =	0.625	KN/m2
live load =	3	KN/m2
Total load =	7.375	KN/m2
Factored load =	11.063	KN/m2
width of slab =	1.524	m
load =	16.859	KN/m

Now

Design of stair flight

Length of landing A=	1.52	m
Length of flight =	1.52	m
Length of landing B=	1.524	m

Reaction at support B =	44.08	KN
Reaction at support A =	44.08	KN

Let point of zero shear force occurs at x distance from A

x = 2.29 m

Maximum bending moments occurs at x = 2.29 m from A

Maximum bending moment = 54.60 KN-m

Therefore,

Effective depth of slab d = 116.053381

Adopt

d = 125 mm

D = 150 mm = 5.90551181 in.

Now,

Area of tension steel (Ast) = 1219.18 mm2

Provide 12 mm dia bar @200mm 141.30 mm 5.56 in.

Provide 16 dia bar @ 5.56 inch. c/c as main bar 1722.7 mm2 **OK**

Temperature reinforcement

Provide 1-10 dia bar as temperature reinforcement in each riser.

In the waist slab provide 0.12 % steel = 180 mm2/m

i.e. provide 8 dia bar @ 200mm 279.11 mm c/c 10.99 inch.

Provide 12 dia bar @ 10.99 inch. c/c

Check for shear

Nominal shear stress = 0.23 N/mm2

percent of tension steel = 0.90 %

Shear strength of M20 concrete for 0.90 % steel = 0.48 N/mm2

Shear strength for slab = K*τc

K = 1.3

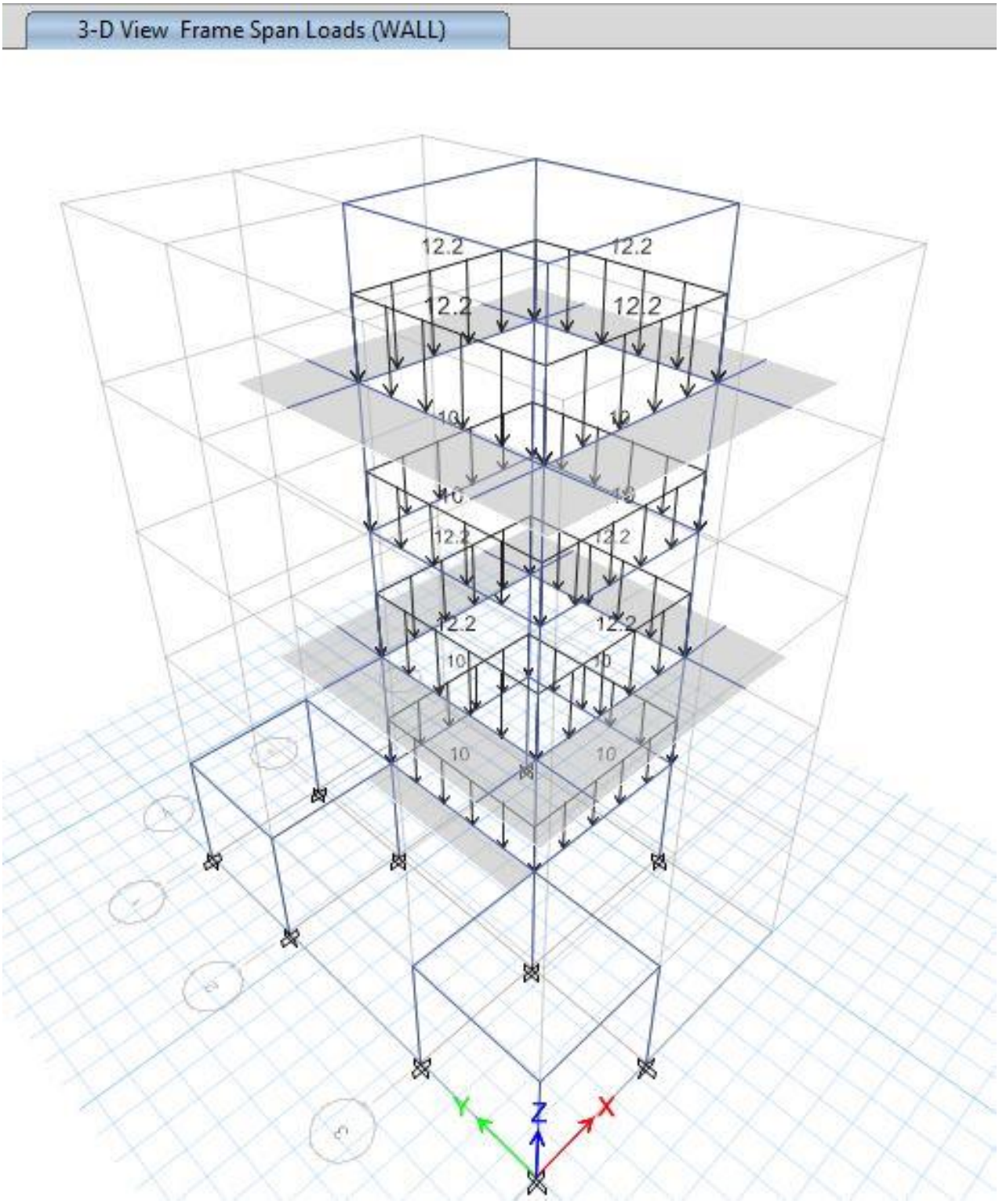
1.3 for depth of slab < 150mm

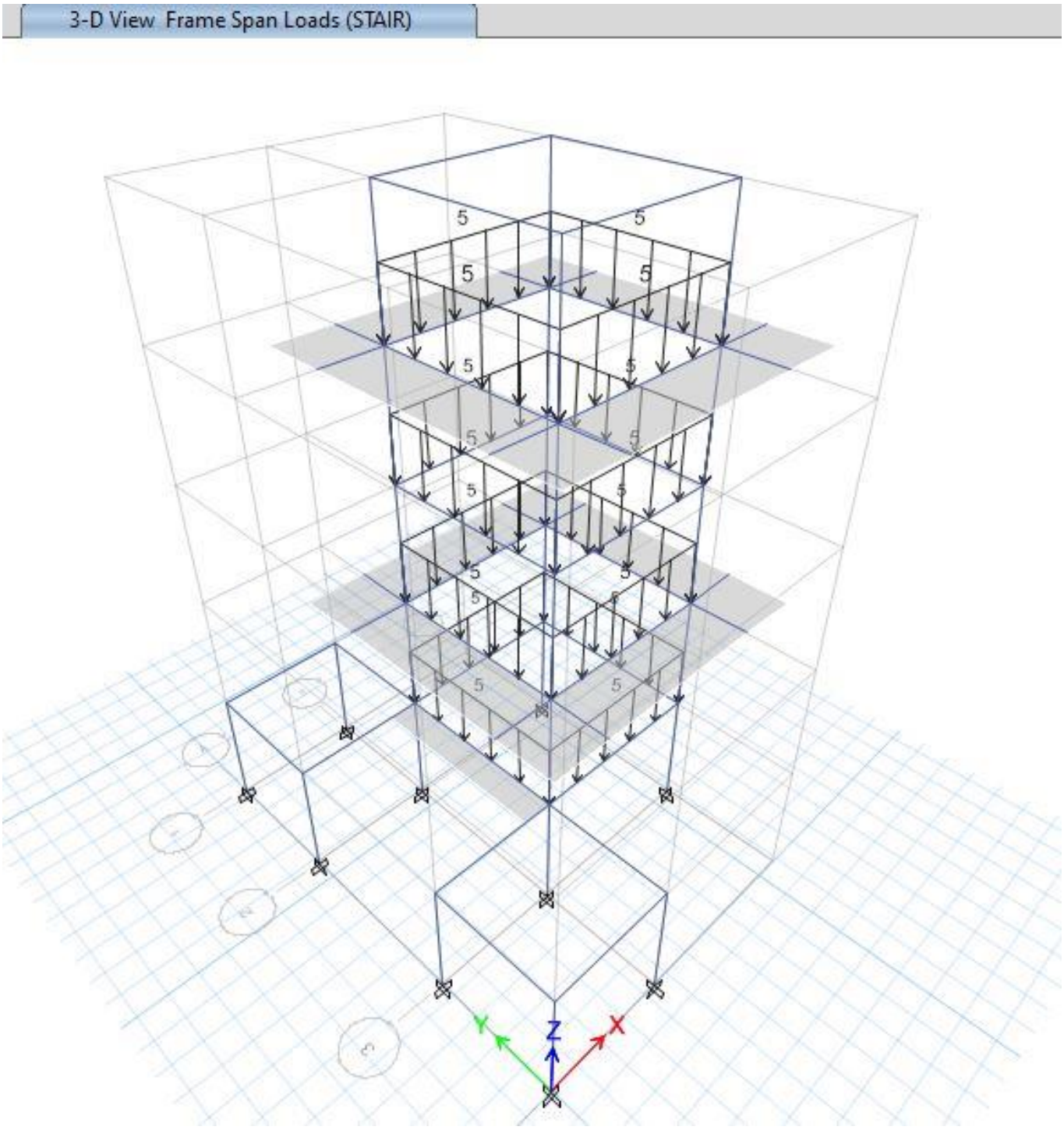
1.25 for depth of slab =175 mm

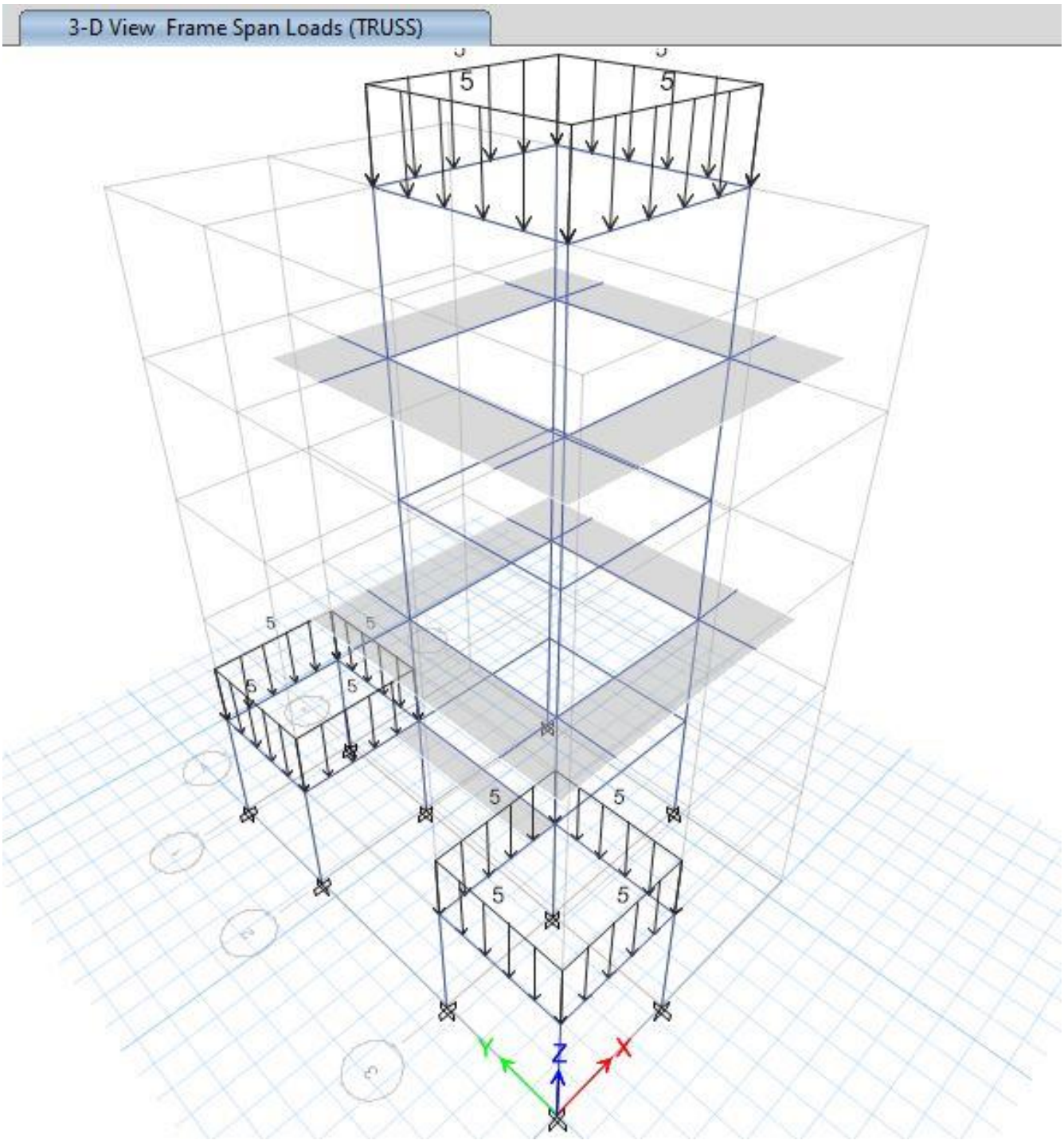
1.2 for depth of slab =200 mm

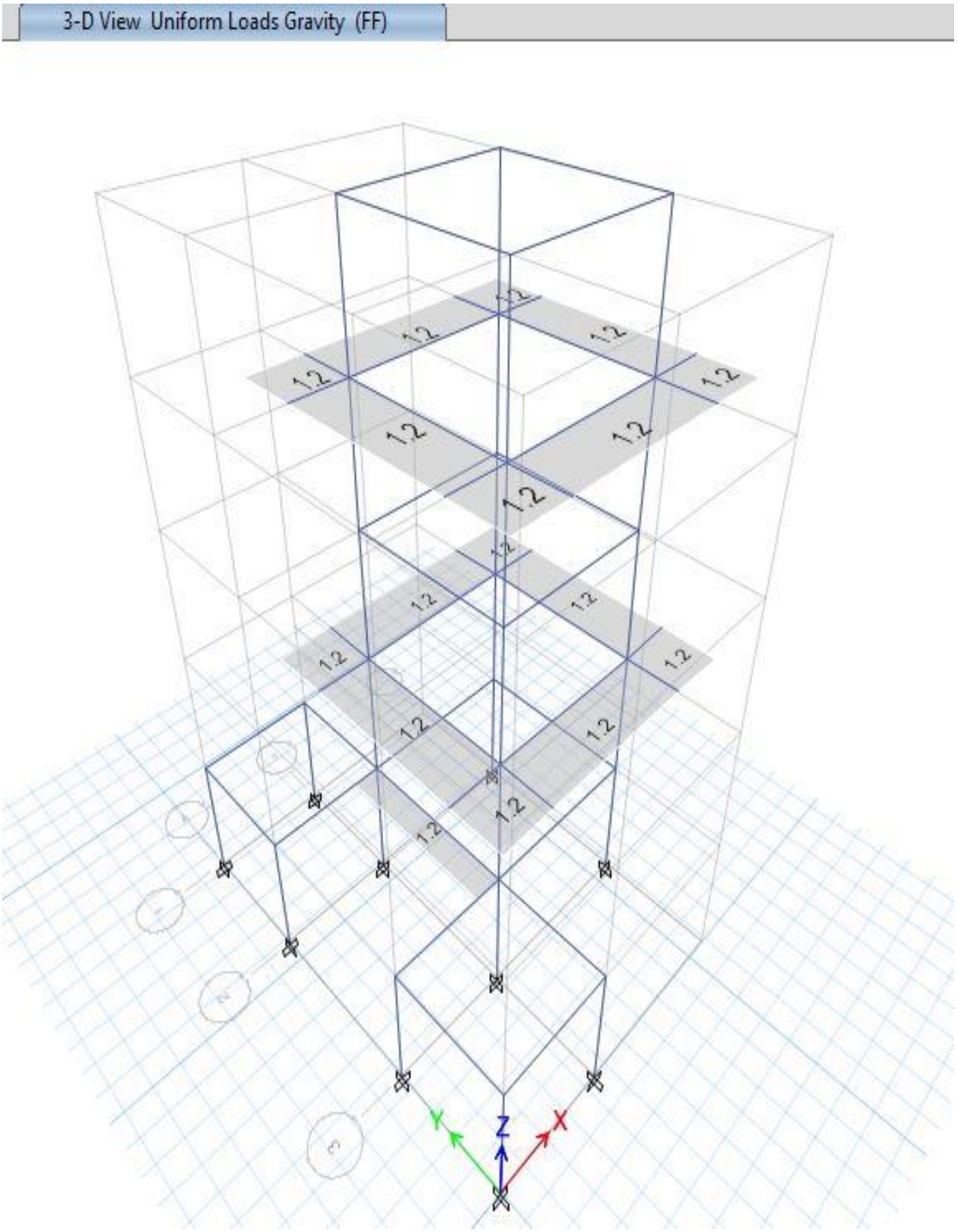
Shear strength for slab = 0.624 N/mm2 > 0.23 OK SAFE

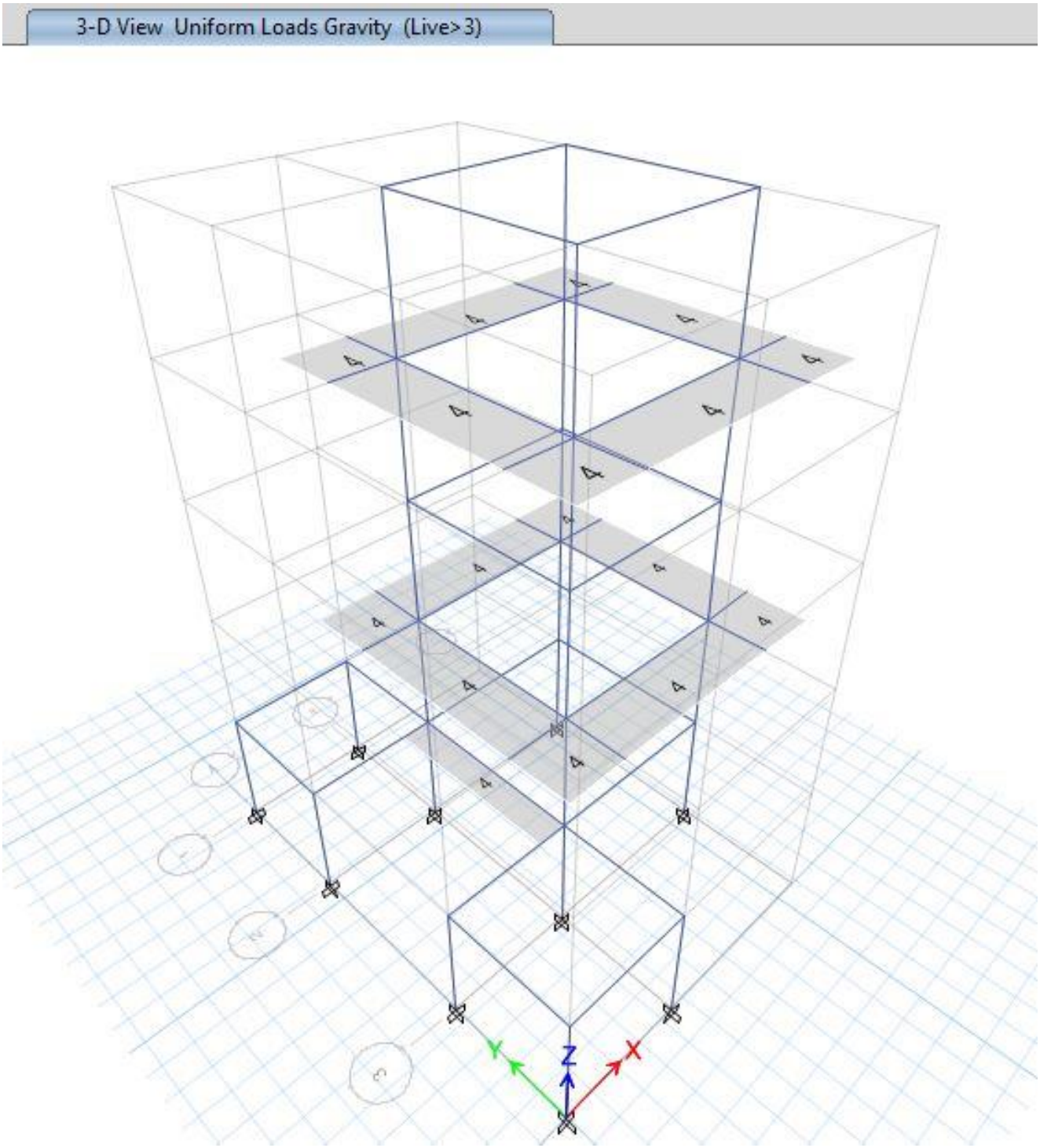
Etabs Output:

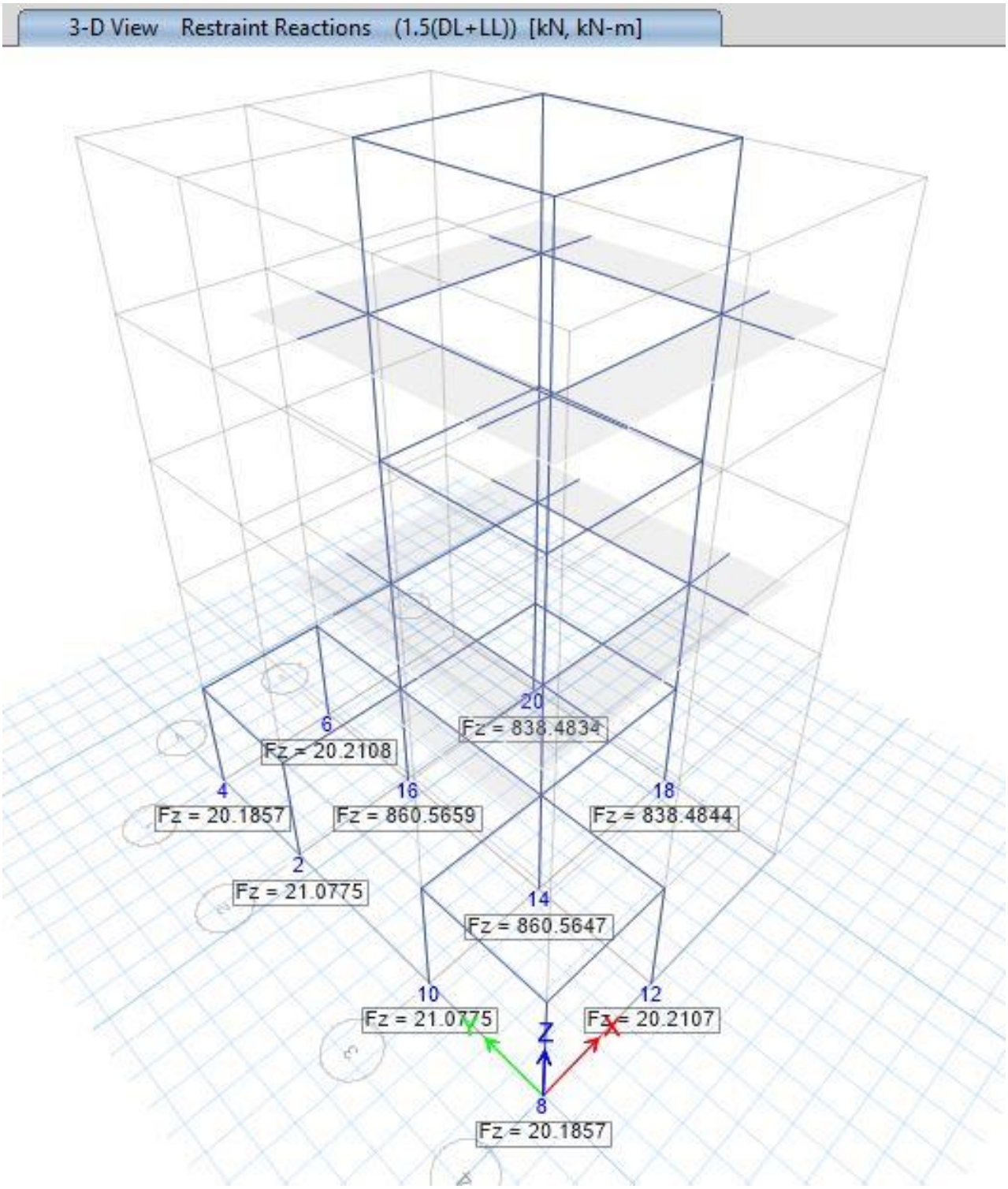


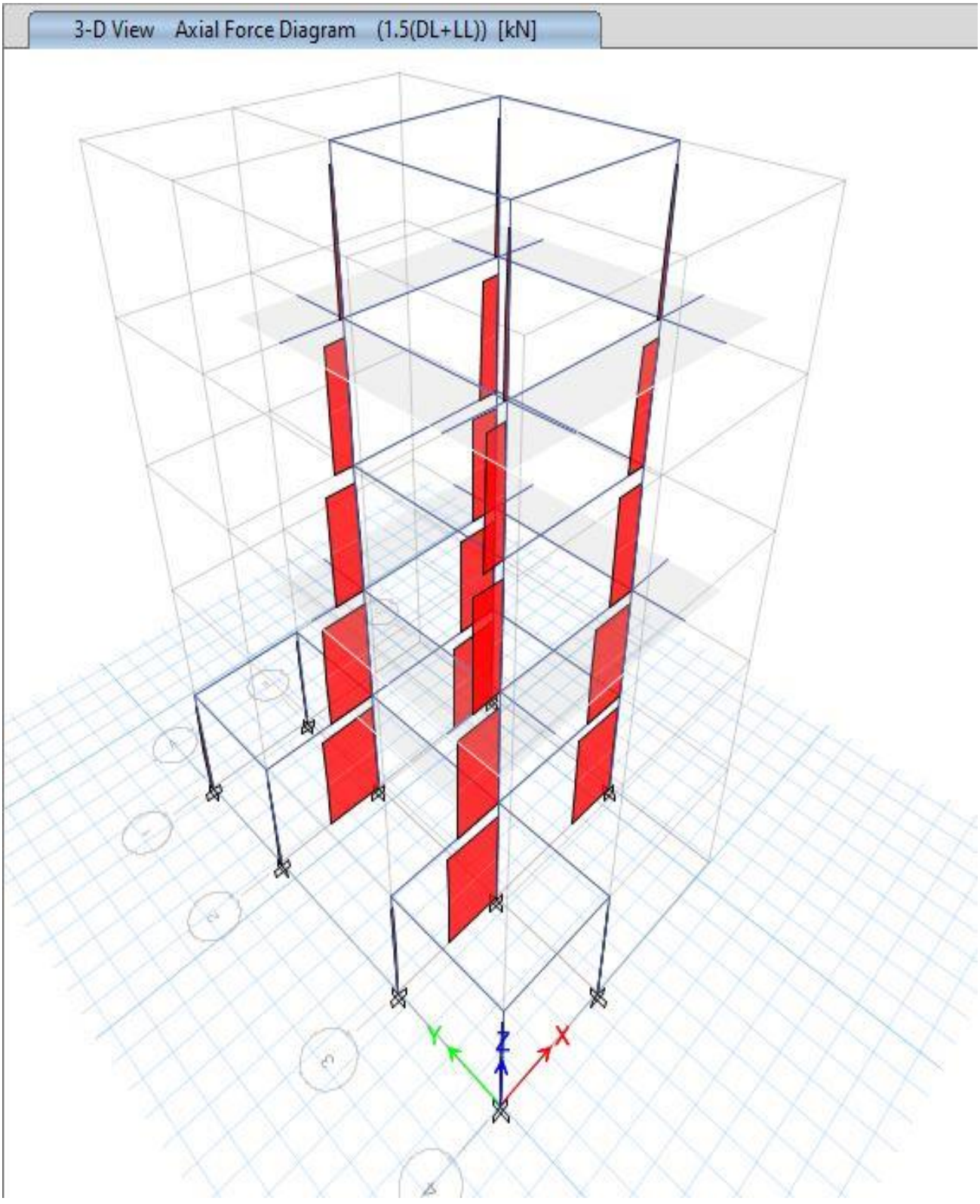

3-D View Frame Span Loads (STAIR)
5
Y
Z
X

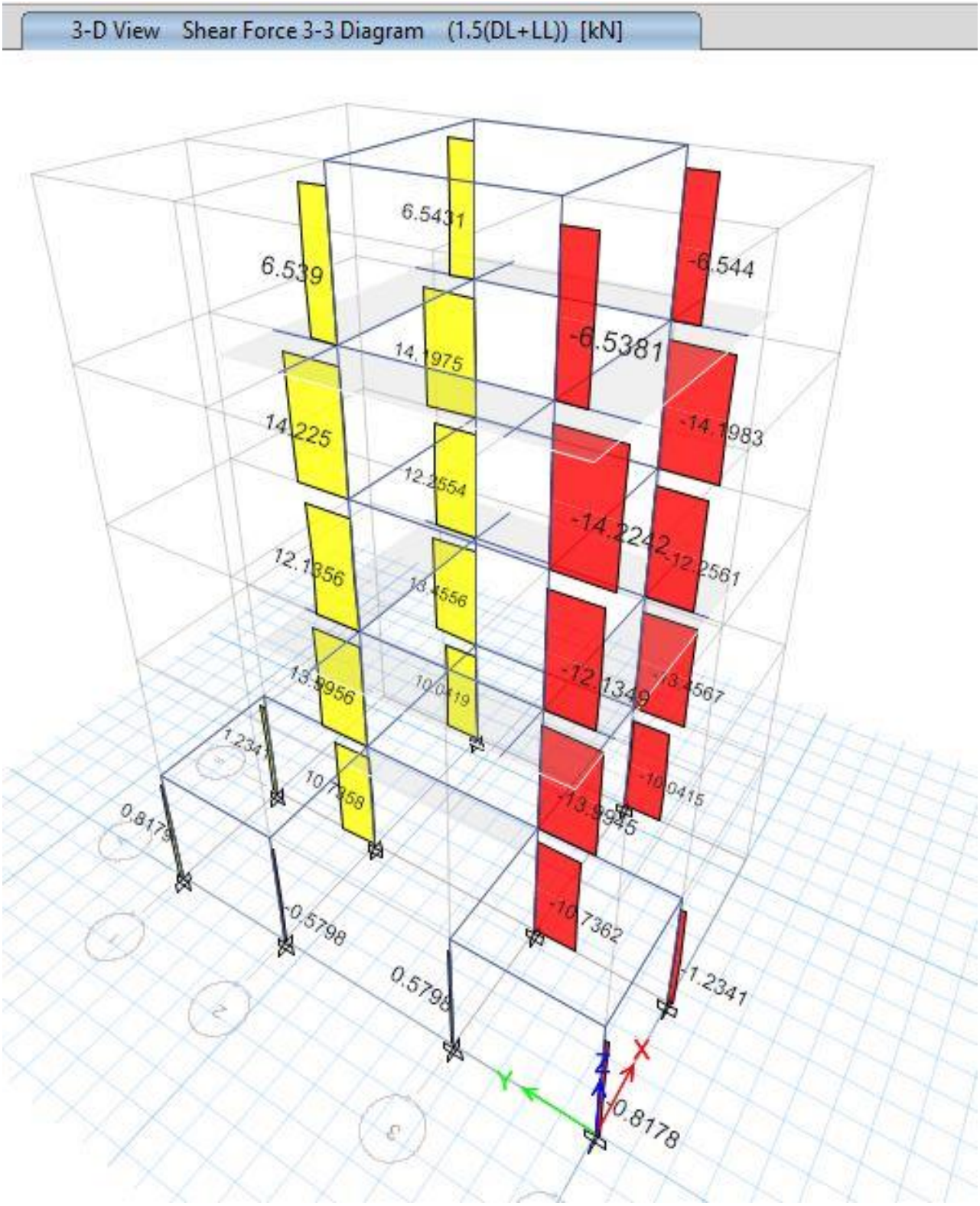

3-D View Frame Span Loads (TRUSS)
5
5
5
5
5
5
5
5
5
5
Z
Y
X

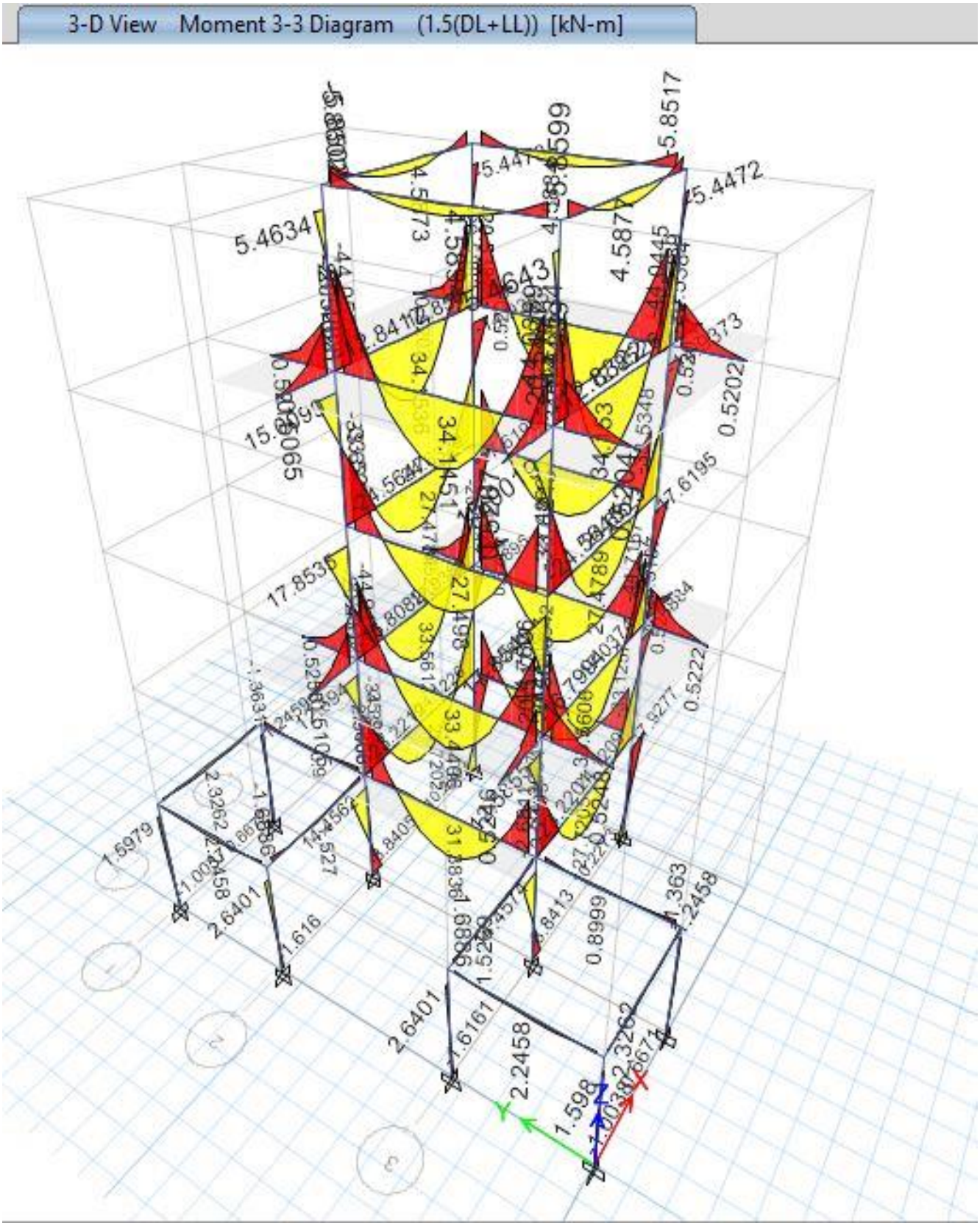

3-D View Uniform Loads Gravity (FF)
1.2
Y
Z
X

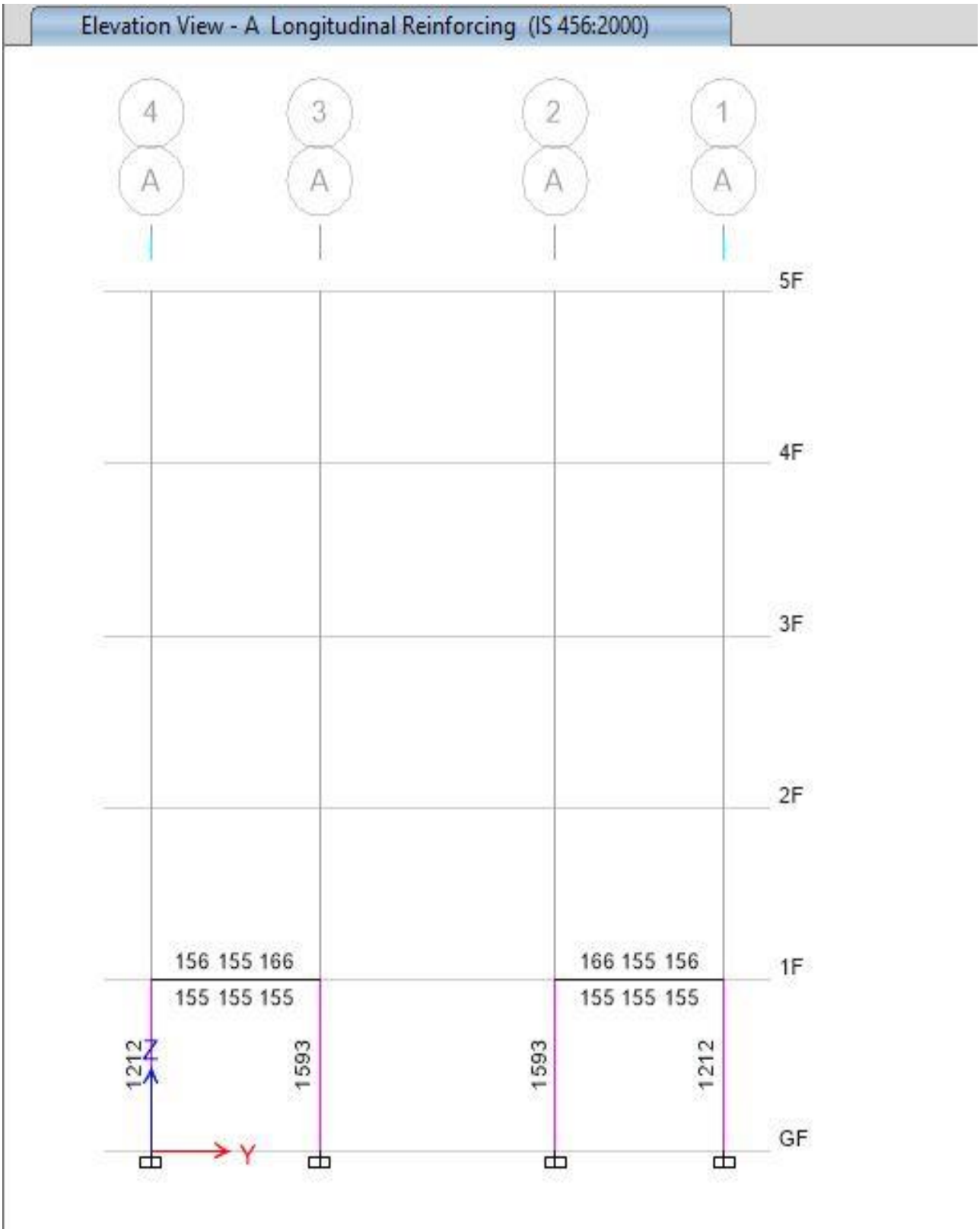

3-D View Uniform Loads Gravity (Live>3)
Y
Z
X

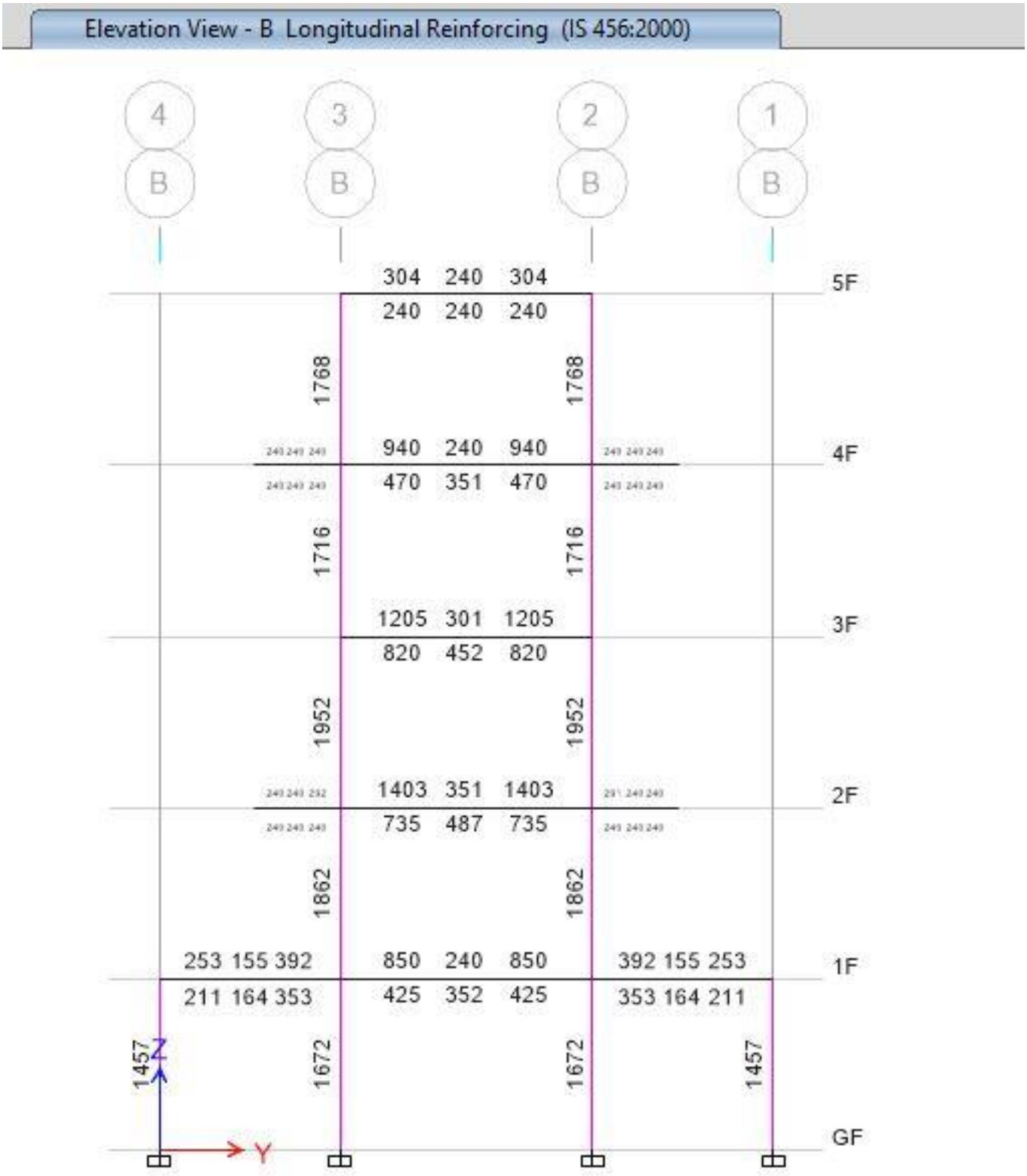

3-D View Restraint Reactions (1.5(DL+LL)) [kN, kN-m]
20
Fz = 838.4834
6
Fz = 20.2108
4
Fz = 20.1857
16
Fz = 860.5659
18
Fz = 838.4844
2
Fz = 21.0775
14
Fz = 860.5647
10
Fz = 21.0775
12
Fz = 20.2107
8
Fz = 20.1857
Z
X

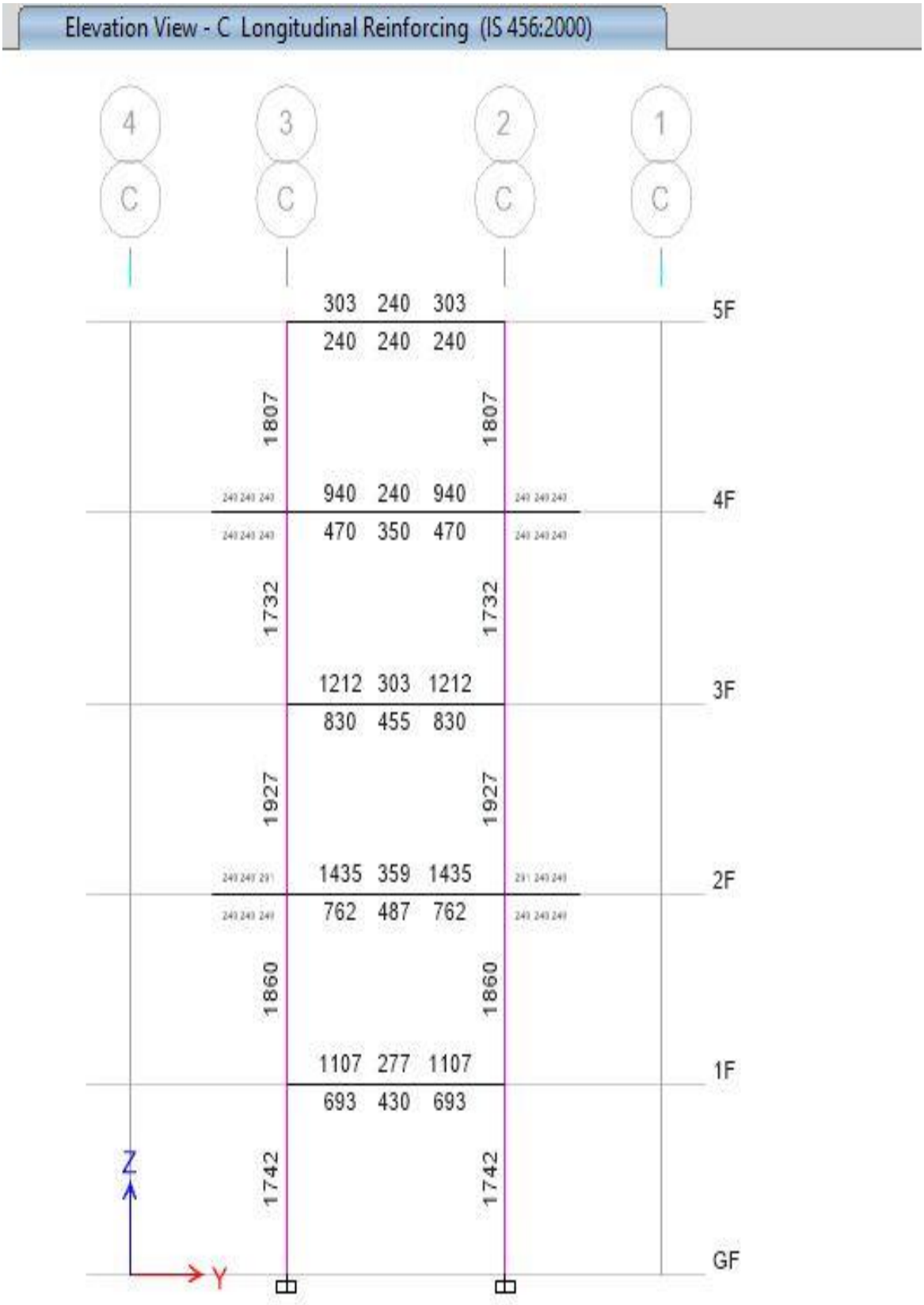

3-D View Axial Force Diagram (1.5(DL+LL)) [kN]
Y
Z
X

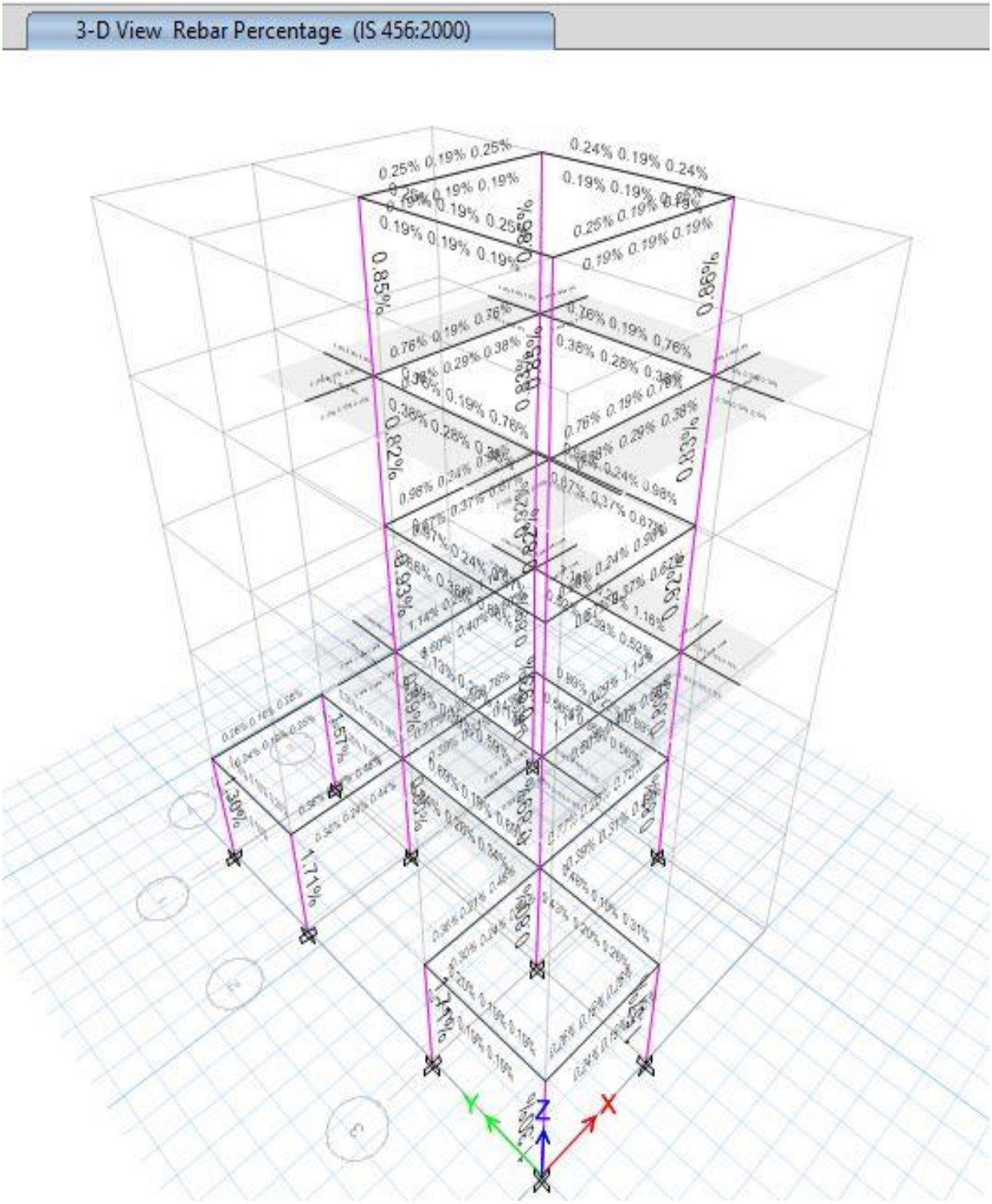

3-D View Shear Force 3-3 Diagram (1.5(DL+LL)) [kN]
6.5431
6.539
-6.544
-6.5381
14.1975
-14.1983
14.225
12.2554
-14.2242
-12.2561
12.1856
13.1556
-12.1349
-13.4567
13.9956
10.0419
-10.0415
-13.9945
1.2341
10.7358
0.8179
-0.5798
-10.7362
-1.2341
0.5798
0.8178

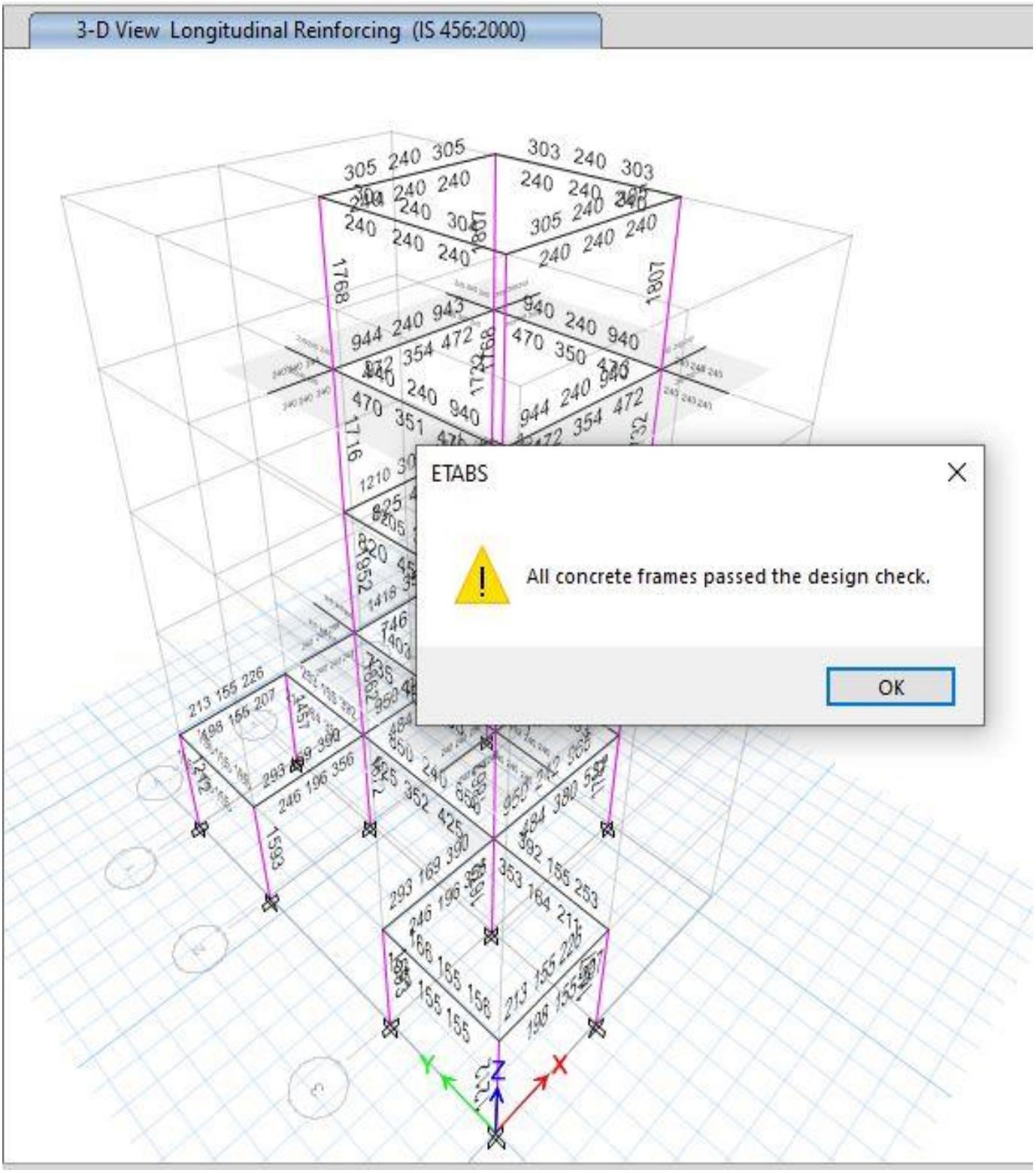

3-D View Moment 3-3 Diagram (1.5(DL+LL)) [kN-m]


Elevation View - A Longitudinal Reinforcing (IS 456:2000)
4
3
2
1
A
A
A
A
5F
4F
3F
2F
1F
GF
156 155 166
155 155 155
166 155 156
155 155 155
1212
1593
1593
1212
Z
Y


Elevation View - B Longitudinal Reinforcing (IS 456:2000)
4
3
2
1
B
B
B
B
304 240 304
240 240 240
5F
1768
1768
940 240 940
4F
470 351 470
1716
1716
1205 301 1205
3F
820 452 820
1952
1952
1403 351 1403
2F
735 487 735
1862
1862
253 155 392
850 240 850
392 155 253
1F
211 164 353
425 352 425
353 164 211
1457
1672
1672
1457
GF
Z
Y


Elevation View - C Longitudinal Reinforcing (IS 456:2000)
4
3
2
1
C
C
C
C
303 240 303
240 240 240
1807
1807
940 240 940
470 350 470
1732
1732
1212 303 1212
830 455 830
1927
1927
1435 359 1435
762 487 762
1860
1860
1107 277 1107
693 430 693
1742
1742
5F
4F
3F
2F
1F
GF
Z
Y


3-D View Rebar Percentage (IS 456:2000)
0.25% 0.19% 0.25%
0.24% 0.19% 0.24%
0.19% 0.19% 0.19%
0.85%
0.89%
0.76% 0.19% 0.76%
0.38% 0.29% 0.38%
0.38% 0.28% 0.38%
0.82%
0.83%
0.98% 0.24% 0.98%
0.87% 0.37% 0.87%
0.88% 0.24% 0.88%
0.53%
0.52%
1.14% 0.40% 1.14%
1.18% 0.24% 0.99%
1.30%
1.57%
1.71%
1.71%
Y
Z
X


3-D View Longitudinal Reinforcing (IS 456:2000)
ETABS
All concrete frames passed the design check.
OK

Ghyanglekh Rural Municipality

Office of Rural Municipal Executive

Hayutar, Sindhuli

FINAL REPORT

ON

REVISION OF DESIGN ESTIMATE OF PHAPARCHULI VIEW TOWER

Submitted By:

Abney Engineering Solution and Construction Pvt. Ltd.

Kathmandu

abney.engineering66@gmail.com

ACKNOWLEDGEMENTS

Abney Engineering Solution and Construction Pvt. Ltd. would like to express our deepest appreciation to all those who provided the possibility to complete this study "Revision of Design Estimate of Phaparchuli View Tower, Ghyanglekh RM, Sindhuli".

Abney Engineering Solution group expresses its gratitude to Ghyanglekh Rural Municipality, office of rural municipal executive to having entrusted this important task. It also expresses gratitude to Chairperson, Vice Chairperson Chief Executive Officer and engineering team for expert guidance and for providing suggestions throughout the study period. Abney Engineering Group is also thankful to Municipality team for their valuable, constructive comments and suggestions which were provided during entire report preparation period and presentation.

_____

Managing Director

Abney Engineering Solution and Construction Pvt Ltd.

Kathmandu, Nepal

Annex: Site Photographs

Fig: Progress on Site

Fig: Consultant and Municipality Engineers at Site Visit

Annex: 3D Photographs

Annex: Analysis Report

Annex: Detailed Cost Estimation

Ghyanglekh Rural Municipality

Office of Rural Municipal Executives

Hayutar, Sindhuli

Project: Revision of Design Estimate of Phaparchuli View Tower

Location: Ghyanglekh Rural Municipality Ward 1 Amale Sindhuli

Summary of Cost

S.N	Description of Works	Amount	Remarks
1	Civil Works	9,299,649.46	
2	Electrical Works	150000	
3	Insurance	107472	
4	Laboratory Tests	20000	
5	Information Board	7000	
	Total	9,584,121.46	
	Vat @13%	1,245,935.79	
	Contingencies (@2.5% of Total)	239,603.04	
	Grand Total	**11,069,660.29**	

In Words: One Crore Eleven Lakhs Eighty Five Thousand One Hundred Sixty Rupees Twenty Nine Paisa Only

Ghyanglekh Rural Municipality
Office of Rural Municipal Executives
Hayutar, Sindhuli
Abstract of Cost of View Tower

Project: Revision of Design Estimate of Phaparchuli View Tower
Location: Ghyanglekh Rural Municipality Ward 1 Amale Sindhuli

ABSTRACT OF COST

SN.	Description of Works	Unit	Quantity	Rate	Amount	Remarks
A	**Constructuin work till now**					
1	Site clearance (excavation in all kind of soil including dressing of sides, ramming of bottom (gravelled/boulder mixed) and refilling the trench in layers, lift upro 3m and a lead upto 50m including watering, ramming, consolidation and dressing, with all necesasry shoring and dewatering all complete as per drawing, specification and approval of engineer all complete)	sq ft	2,025.00	25.00	50,625.00	
2	Earthwork in excavation in all kinds of soil including dressing of sides, ramming of bottom (gravelled/boulder mixed) and refilling the trench in layers, lift upto 3m and a lead upto 50m. Including watering, ramming, consolidation and dressing, with all necessary shoring and dewatering all complete as per drawing, specificcation and approval of engineer all complete	Cu ft	7,122.43	15.00	106,836.45	
3	Earthwork in filling under floor with earth/gravel/mixed soil from associated excavation including machine compaction in 15cm layers with sprinking water reqyured to obtain 90% density as per the specification and approval of engineer all complete	Cu ft	4,748.29	25.00	118,707.25	
4	Dry Brick Soling in foundation with first class chimney made brick in true line and label including watering, sand blending and ramming all complete as per drawing and specification and approval of engineer all complete	sq ft	1,241.57	170.00	211,066.90	
5	Providing and laying brick masonry including lead and lift using stones with 1:4 cement sand mortar including scaffoldinh, curing, cleaning and racking out mortar joints and marking ducts, recesses where required as per specification, different test and approval of engineer	cuft	601.27	500.00	300,635.00	
6	Supplying, mixing, placing compacting and curing different mizes of plain cement concrete for foundation bases and flooring excluding the cost of formwork and reinforcement as per specification 1:3:6	cuft	310.39	250.00	77,597.50	
7	Supplying, mixing, placing compacting and curing different mizes of plain cement concrete for foundation bases and flooring excluding the cost of formwork and reinforcement as per specification 1:1.5:3	cuft	2,384.70	350.00	834,645.00	
8	Providing, placing, fixing, centering of plywood or steel formwork in slabs, walls, column , lintels, beams and other RCC works including nails, propping supports, bracing lead and lift at any height and removal and disposal all complete as per specification and approval of engineer.	sqft	1,113.83	40.00	44,553.24	

Abstract of Cost of View Tower

Project: Revision of Design Estimate of Phaparchuli View Tower
Location: Ghyanglekh Rural Municipality Ward 1 Amale Sindhuli

ABSTRACT OF COST

SN.	Description of Works	Unit	Quantity	Rate	Amount	Remarks
9	Supplying, fixing, cutting, bending and placing in position including the cost of 18 gauge black annealed binding wire all complete as per drawing, specification, different tests and approval of engineer.	Kg	8,425.44	135.00	1,137,434.40	
B	**New Construction**					
1	**Earthwork in filling**				-	
	Earthwork in filling under floor with earth/gravel/mixed soil from associated excavation including machine compaction in 15cm layers with sprinking water reqyured to obtain 90% density as per the specification and approval of engineer all complete	cuft	1,113.60	25.00	27,840.00	
2	**Dry Brick Soling**					
	Dry Brick Soling in foundation with first class chimney made brick in true line and label including watering, sand blending and ramming all complete as per drawing and specification and approval of engineer all complete	sqft	240.25	170.00	40,842.50	
3	**PCC (1:3:6)**					
	Supplying, mixing, placing compacting and curing different mizes of plain cement concrete for foundation bases and flooring excluding the cost of formwork and reinforcement as per specification 1:3:6	cuft	80.08	250.00	20,020.83	
4	**RCC (1:1.5:3)**					
	Supplying, mixing, placing compacting and curing different mizes of plain cement concrete for foundation bases and flooring excluding the cost of formwork and reinforcement as per specification 1:1.5:3	cuft	2,438.83	350.00	853,592.13	

Abstract of Cost of View Tower

Project: Revision of Design Estimate of Phaparchuli View Tower
Location: Ghyanglekh Rural Municipality Ward 1 Amale Sindhuli

ABSTRACT OF COST

SN.	Description of Works	Unit	Quantity	Rate	Amount	Remarks
5	**Formwork**					
	Providing, placing, fixing, centering of plywood or steel formwork in slabs, walls, column , lintels, beams and other RCC works including nails, propping supports, bracing lead and lift at any height and removal and disposal all complete as per specification and approval of engineer.	sqft	5,885.81	40.00	235,432.50	
6	**Reinforcement**					
	Plain cement Concrete (PCC)(38mm) in 1:2:4ratio for foundations and flooring with approved quality of cement, sand and machine crushed stone aggregate including supply of materials,mixing, laying, curing the work at least 7 days etc all complete as per approved drawing, Specification and instruction of site engineer.	kg	13,563.46	135.00	1,831,067.11	
7	**Brick Masonary Work (1:4) CM**					
	Providing and laying brick masonry including lead and lift using stones with 1:4 cement sand mortar including scaffoldinh, curing, cleaning and racking out mortar joints and marking ducts, recesses where required as per specification, different test and approval of engineer	cuft	1,825.31	500.00	912,656.25	
8	**12.5mm Plaster Work**	sqft	6,229.50	41.99	261,576.71	
9	**Tiling work in floow (1:4) CM**	sq ft	492.69	431.84	212,765.17	
10	**Iron Railing with sq. pipe and 2" hand rail**	rft	295.00	1,477.52	435,868.40	
11	**Wood Work**	cuft	41.67	7,127.69	296,997.48	
12	**Glazed Shutter**	sq ft	546.25	975.65	532,948.81	
13	**Sal wood panel shutter**	sq ft	77.00	1,505.57	115,928.89	
14	**2 coat of enamel with primer**	sq ft	1,308.04	34.19	44,721.72	
15	**Painting Works**					
	Supplying & applying **2 coats of weather paint** at outside of Building of approved colour with one coat of primer Painting over porperly cleaned surface at outside of building all complete as per approved drawing, Specification and instruction of site engineer.	sq ft	3,114.75	36.22	112,816.25	
16	**Supplying & applying 0.5mm thick CGI sheets all complete as per approved drawing, Specification and instruction of site engineer.**	sq ft	608.00	148.44	90,252.83	
17	**Iron Pipe Works**					
18	**Supplying & applying black steel pipe truss all complete as per approved drawing, Specification and instruction of site engineer.**	kg	1,087.16	126.22	137,221.15	
19	**Gajur from online source**	nos	3.00		240,000.00	
20	**Additional Cost for Scaffolding and tools**	ls			15,000.00	
				Total Cost=	**9,299,649.46**	

Ghyanglekh Rural Municipality
Office of Rural Municipal Executives
Hayutar, Sindhuli
Detail Estimate of View Tower

Project: Revision of Design Estimate of Phaparchuli View Tower
Location: Ghyanglekh Rural Municipality Ward 1 Amale Sindhuli

MEASUREMENT SHEET (VIEW TOWER)

Item No.	Description	No.	Length (ft)	Breadth (ft)	Height (ft)	Quantity	Unit
1.00	**Earthwork in filling**						
		1.00				1,113.60	cu.ft.
2.00	**Dry Brick Soling**						
		1.00	15.500	15.500		240.25	sqft
3.00	**PCC (1:3:6)**						
		1.00	15.50	15.50		240.25	sqft
4.00	**RCC (1:1.5:3)**						
a	**All columns in 5 floor**	20.00	1.500	1.500	10.500	472.50	cuft
b	**Beam**						
	First Floor						
	Ticket Counter						
	Grid 1-1,2-2,3-3,4-4 (9"x14")	4.00	10.083	0.750	1.167	35.29	cuft
	Grid A-A, B-B (9"x14")	4.00	10.083	0.750	1.167	35.29	cuft
	Main Tower						
	Grid 2-2, 3-3	2.00	14.000	1.000	1.333	37.33	cuft
	Grid B-B, C-C	2.00	14.000	1.000	1.333	37.33	cuft
	Second, Fourth and Roof Floor						
	Grid 2-2, 3-3	6.00	23.000	1.000	1.333	184.00	cuft
	Grid B-B, C-C	6.00	23.000	1.000	1.333	184.00	cuft
	Third Floor						
	Grid 2-2, 3-3	2.00	14.000	1.000	1.333	37.33	cuft
	Grid B-B, C-C	2.00	14.000	1.000	1.333	37.33	cuft
c	**Slab (5" Thickness)**						
	First Floor	1.00	Area=	101.25	0.417	42.19	cuft
	Second, Fourth and Roof Floor	3.00	Area=	462.00	0.417	577.50	cuft
	Third Floor	1.00	Area=	128.25	0.417	53.44	cuft
	Sill Band	20.00	14.000	0.750	0.333	70.00	cuft
	Lintel Band	20.00	14.000	0.750	0.333	70.00	cuft
	For ticket Counter						
	Sill Band	8.00	10.083	0.750	0.333	20.15	cuft
	Lintel Band	8.00	10.083	0.750	0.333	20.15	cuft
	Staircase for all floors						
	Landing Slab (5")	8	5.25	5.25	0.417	91.88	cuft
	Waist Slab	12	6.75	5.25	0.5	212.63	cuft
	Steps	72	5.25	0.58	1	220.50	cuft
			Total RCC quantity			2,438.83	cuft

5.00	**Formwork**						
a	**Column**	80.00	2.00		10.50	1,680.00	sqft
b	**Beam**						
	First Floor						
	Ticket Counter						
	Grid 1-1,2-2,3-3,4-4 (9"x14")	12.00	10.500		1.500	189.00	sq.ft
	Grid A-A, B-B (9"x14")	12.00	10.500		1.500	189.00	sq.ft
	Main Tower						
	Grid 2-2, 3-3	6.00	14.500		1.500	130.50	sq.ft
	Grid B-B, C-C	6.00	14.500		1.500	130.50	sq.ft
	Second, Fourth and Roof Floor						
	Grid 2-2, 3-3	18.00	23.500		1.500	634.50	sq.ft
	Grid B-B, C-C	18.00	23.500		1.500	634.50	sq.ft
	Third Floor						
	Grid 2-2, 3-3	6.00	14.500		1.500	130.50	sq.ft
	Grid B-B, C-C	6.00	14.500		1.500	130.50	sq.ft
c	**Slab**						
	First Floor	1.00	Area=	101.25		101.25	sqft
	Second, Fourth and Roof Floor	3.00	Area=	462.00		1,386.00	sqft
	Third Floor	1.00	Area=	128.25		128.25	sqft
d	**Staircase**						
	Landing Slab	8	5.25	5.25		220.50	sqft
	Waist Slab	3	6.75	5.25		106.31	sqft
	Steps	18	5.25		1	94.50	sqft
			Total Formwork			5,885.81	sq.ft
6.00	**Reinforcement**						
	TMT steel reinforcement bar of Fe 500 grade including supplying,straightening,cleaning,cutting,binding and fixing in position with annealed tying binding wire including 30m haulage all complete as per approved drawing specification and instruction of site engineer.						
					Total=	13,563.46	kg
7.00	**Brick Masonary Work (1:4) CM**						
i	Ticket Counter	8	10.08	0.750	9.000	544.50	cuft
	Deduction						
	Window	-6	5.000	0.750	4.750	(106.88)	cuft
	Door	-2	3.5	0.75	7	(36.75)	cuft
ii	Main Tower	20	14	0.75	9.17	1,925.00	cuft
	Deduction						
	Window	-17	5.000	0.750	4.750	(302.81)	cuft
	Door	-2	3.5	0.75	7	(36.75)	cuft
	Main Door	-1	4.000	0.75	7	(21.00)	cuft
	Sill and Lintel	(40.00)	14.000	0.750	0.333	(140.00)	cuft
			Total Brick Masonry			1,825.31	cu ft

8.00	**12.5mm Plaster Work**						
	Internal Wall						
i	Ticket Counter	8	10.08		10.500	847.00	sq. ft
	Deduction						
	Window	-6	5.000		4.750	(142.50)	sq. ft
	Door	-2	3.5		7	(49.00)	sq. ft
ii	Main Tower	20	14		10.50	2,940.00	sq. ft
	Deduction						
	Window	-17	5.000		4.750	(403.75)	sq. ft
	Door	-2	3.5		7	(49.00)	sq. ft
	Main Door	-1	4.000		7	(28.00)	sq. ft
	External Wall						
i	Ticket Counter	8	10.08		10.500	847.00	sq. ft
	Deduction						
	Window	-6	5.000		4.750	(142.50)	sq. ft
	Door	-2	3.5		7	(49.00)	sq. ft
ii	Main Tower	20	14		10.50	2,940.00	sq. ft
	Deduction						
	Window	-17	5.000		4.750	(403.75)	sq. ft
	Door	-2	3.5		7	(49.00)	sq. ft
	Main Door	-1	4.000		7	(28.00)	sq. ft
		Total Plaster works Internal and External				6,229.50	sq. ft
9.00	**Tiling Work**						
	Tiling work in floow (1:4) CM						
		2	11.000	11.000		242.00	sq.ft
		1	15.833	15.833		250.69	sq.ft
			Total Tiling work			492.69	sq.ft
10.00	**Iron Railing with sq. pipe and 2" hand rail**						
	Staircase	12	7.25			87.00	ft
	Balcony	2	104.0			208.00	ft
			Total Railing work			295.00	ft
11.00	**Wood Work**						
	Sal wood for door and window frame	1	18.000	0.333	0.250	1.50	cuft
	Door	2	17.000	0.333	0.250	2.83	cuft
	Window	23	19.500	0.333	0.250	37.34	cuft
			Total Wood Work			41.67	cuft
12.00	Glazed Shutter	23	5.000		4.750	546.25	sq ft
13.00	Sal wood panel shutter						
	MD	1	4.000		7.000	28.00	sq.ft
	D	2	3.500		7.000	49.00	sq.ft
			Total Wood Panel			77.00	sq.ft

14.00	2 coat of enamel with primer					1,308.04	sq ft
15.00	**Painting Works**						
	Supplying & applying **2 coats of weather paint** at outside of Building of approved colour with one coat of primer Painting over porperly cleaned surface at outside of building all complete as per approved drawing, Specification and instruction of site engineer.						
	same as plastering					3,114.75	sq.ft
16.00	Supplying & applying 0.5mm thick CGI sheets all complete as per approved drawing, Specification and instruction of site engineer.						
	For ticket Counter	2	88.000			176.00	sq.ft
	For tower	1	432.000			432.00	sqft
17.00	Supplying & applying black steel pipe truss all complete as per approved drawing, Specification and instruction of site engineer.	1	956.000	ft	0.52 kg/ft	1,087.159	kg