A STUDY ON STRUCTURAL STABILITY OF FERRO CEMENT REPLACEMENT WITH RCC FOR LOW COST BUILDINGS

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ABSTRACT:

Concrete and steel are the basic construction materials, which are being used with different concepts for construction such as RCC, Pre stressed and Ferro cement. Ferro cement is an innovative technology and has several advantages. This project is an attempt to promote extensive use of Ferro cement components as an alternative to conventional concrete components for application in low-rise housing by doing a comparative study of cost analysis of Ferro cement and RCC. Ferro cement is a form of reinforced concrete that consists of closely spaced, multiple layers of mesh or fine rods completely embedded in cement mortar.The study was conducted in two phases. First phase involved the development of high workability and high performance slag-cement based mortar mix to cast proposed Ferro cement encasement. The developed mortar was aimed to replace the traditional manual method of plastering the wire mesh by a mechanized casting method. The performance of mortar was investigated in terms of compressive strength, strength development, unit weight, effect of curing regime, and partial replacement of cement by weight with 50% and 60% of slag. The second phase of the study embarked on the development and investigation of the characteristics of Ferro cement encased lightweight aerated concrete sandwich wall elements. To achieve the objective, about 600 specimens including large size wall elements were cast and tested. Ferro cement encasement was maintained at 12mm throughout the study. The parameters studied were compressive strength, flexural strength, failure mode, load-deflection behavior, load-deformation behavior, load-strain behavior, unit weight, water absorption, initial surface absorption uniformity, and role of type and layers of the wire meshes.

1. INTRODUCTION

The floors and roofs of most buildings are constructed with reinforced cement concrete (RCC). The various options available for flooring and roofing purposes are the beam-slab system, channel sections, T-sections, ribbed sections, flat slabs and box sections. The channel sections, T-sections and ribbed slabs can be used for short span flooring purposes. While the remaining sections can be used for medium traverses Shells can likewise be utilized for material purposes on account of their bended shape and furthermore as ground surface in the wake of filling the rump with light materials. However, this choice superfluously expands the self-weight. In ordinary strengthened solid development, if a zone more extensive than 4 meters is required to be secured then the shaft piece development is ordinarily received or one needs to trade off on the cost by embracing level section sort of development. The strengthened solid structures have a high self weight to live load proportion, which needs a more grounded and additionally costlier supporting structure. For longer traverses, the material utilized ought to have a low self weight to live load proportion bringing about little dead weight stresses. The floors/rooftop made with lighter materials likewise prompt a reduction in the cost of the formwork and the supporting.

Ferro cement:

Ferro cement is a versatile structural construction material having one of a kind properties of quality and serviceability. It is made with nearly sew wire work and gentle steel fortifying bars loaded with rich bond mortar. Welded work may likewise be utilized as a part of place of fortifying bars. The materials required for making it, in particular, concrete, sand, wire work, and gentle steel strengthening bars, are effectively accessible deepest spots. It is conceivable to create in ferro concrete an assortment of auxiliary components which are thin, light, and tough and having a high level of penetrability. Ferro bond consolidates the delicacy of steel and form capacity of cement and can be thrown to any shape structures.

Application of Ferro cement:

Components several applications of this material in housing includes the following

a. Small capacity water tanks
b. Cupboard slabs
c. Roof & wall elements
d. Shuttering for concrete construction
e. Service core units
f. Toilet component
g. Benches, Furnitures, Dining & other tables
h. Sofa sets, book store units etc.
i. Biogas holders
j. Boats and water troughs

In this paper a brief description has been about the method of production of ferro cement roofing channels, Door shutters water tanks have been described and their cost economics have been indicated for comparison purpose.

Raw Materials of Ferro Cement:

Part The accompanying are the elements of a ferro bond item. Pozzolona bond from the perspective of long haul toughness River sand Clean water G I wire work or weld work Normally a blend extent of concrete sand mix in the range proportion of 1:5 to 1:3 is embraced in the generation of segments with water concrete proportion going from 0.45 to 0.5. Boundless states of ferro concrete segment can be delivered relying upon the prerequisites.

2. LITERATURE REVIEW

Achintya et al (1991) He exhibited the conduct for block in filled fortified solid edges subjected to horizontal load, through an exploratory approach. The quality of mortar is found to have significant effect on the parallel solidness and quality of the in filled outlines. Casings tried with fortified block board have demonstrated inconsequential change in disappointment quality. The solidness of the in filled outline diminishes quickly after the start of breaks.

Diptesh Das and Murthy (2004) He considered the impact of block stone work infill in seismic outline of strengthened solid edge structures. It was demonstrated that the block infill dividers exhibit in strengthened solid edge structures decrease the auxiliary float yet increment the quality and solidness. Likewise, the pliability of the structure is lessened due to the infill. Building composed by the proportional supported edge strategy demonstrated better general execution.

Moretti Marina and Tassios Theodosios (2006) He analyzed the conduct and malleability of strengthened solid short segments utilizing the Global Truss demonstrate. The fundamental after effects of an exploratory program in eight full-scale fortified solid short segments are introduced. The examples were subjected to pressure and turned around cyclic uniaxial shear relocations. The parameters explored were the estimation of shear proportion, the proportions of longitudinal and transverse fortification, and the standardized pivotal power proportion. The relative execution of the examples tried is assessed by different pliability criteria. A model for outlining short sections is additionally exhibited.

Santiago Pujal et al (2008) He analyzed the fortified solid structure was repaired and reinforced with strong block infill dividers. These dividers were compelling in expanding the quality (by 100%) and solidness (by 500%) of the first strengthened solid structure. The reinforced structure supported float inversions with amplitudes of up to 1.5% of the tallness of the structure without unnecessary solidness lessening. Results from numerical reproductions done utilizing models adjusted to coordinate test outcomes propose that it is likely that the reinforced structure would not achieve float proportion surpassing 1.5% amid ground movement.

Jigme - Dorji (2009) He inspected that the impact of in fills on the auxiliary execution is huge. The basic reaction, for example, major period, rooftop removal, entomb – story float proportion, worries in infill divider and basic part powers of bars and sections for the most part decrease with fuse of in filled dividers. The structure composed and built with or without seismic arrangement performs in a comparable way if in fills of high quality are utilized.

3. MATERIALS AND METHODS

3.1 DEAD LOADS:

All permanent constructions of the structure form the dead loads. The dead load comprises of the weights of walls, partitions floor finishes, false ceilings, false floors and the other permanent constructions in the buildings. The dead load loads may be calculated from the dimensions of various members and their unit weights. the unit weights of plain concrete and reinforced concrete made with s and gravel or crushed natural stone aggregate may be taken as 24 kN/m" and 25 kN/m" respectively.

3.2 WIND LOAD:

Wind is air in motion relative to the surface of the earth. The essential driver of wind is followed to earth's pivot and contrasts in earthbound radiation. The radiation impacts are fundamentally in charge of convection either upwards or downwards. The breeze by and large blows level to the ground at high breeze speeds. Since vertical parts of climatic movement are generally little, the term 'wind' means only the even breeze, vertical breezes are constantly recognized all things considered. The breeze speeds are evaluated with the guide of anemometers or anemographs which are introduced at meteorological observatories at statures for the most part shifting from 10 to 30 meters over the ground.

Design Wind Speed (V,)

The basic wind speed (V,) for any site shall be obtained from and shall be modified to include the following effects to get design wind velocity at any height (V,) for the chosen structure:

a) Risk level;

Terrain roughness, height and size of

structure; and Local topography.

It can be mathematically expressed as follows: Where:

V = Vb * kl * k* ks

Vb = design wind speed at any height z in m/s; kl = probability factor (risk coefficient)

k = terrain, height and structure size factor and ks = topography factor

Risk Coefficient (kI Factor) gives basic wind speeds for terrain Category 2 as applicable at 10 m above ground level based on 50 years mean return period. In the design of all buildings and structures, a regional basic wind speed having a mean return period of 50 years shall be used.

Terrain, Height and Structure Size Factor (k, Factor)

Territory - Selection of landscape classifications should be made with due respect to the impact of obstacles which constitute the ground surface harshness. The territory class utilized as a part of the plan of a structure may change contingent upon the bearing of twist under thought. Wherever adequate meteorological data is accessible about the idea of wind course, the introduction of any building or structure might be reasonably arranged.

Geography (ks Factor) - The fundamental breeze speed Vb assesses the general level of site above ocean level. This does not consider nearby topographic highlights, for example, slopes, valleys, precipices, ledges, or edges which can essentially influence twist speed in their region. The impact of geology is to quicken twist close to the summits of slopes or peaks of bluffs, ledges or edges and decelerate the breeze in valleys or close to the foot of precipice, soak ledges, or edges.

4. RESULTS

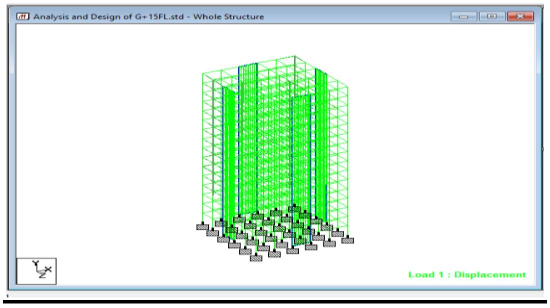


Figure shows the analysis simulation of high raised building at applied earthquake loading along X-axis

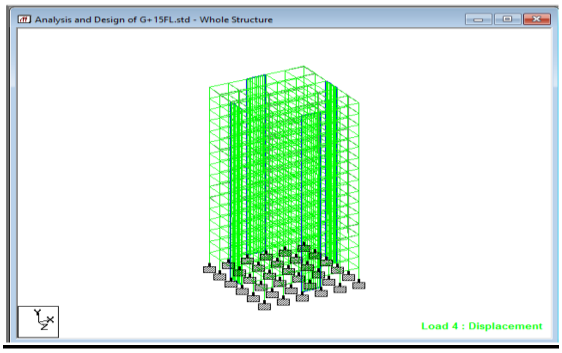
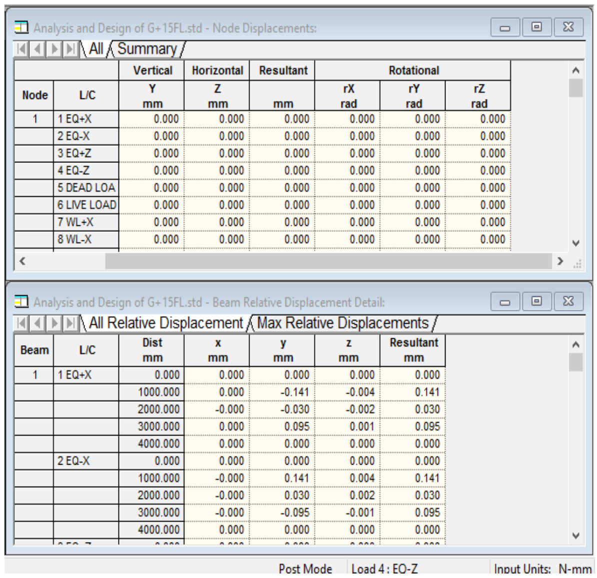


Figure shows the analysis simulation of high raised building at applied earthquake loading at different conditioning along Z-axis



Analysis and Design of G+15FL.std - Node Displacements:

All / Summary

Node	L/C	Vertical Y mm	Horizontal Z mm	Resultant mm	Rotational rX rad	rY rad	rZ rad
1	1 EQ+X	0.000	0.000	0.000	0.000	0.000	0.000
	2 EQ-X	0.000	0.000	0.000	0.000	0.000	0.000
	3 EQ+Z	0.000	0.000	0.000	0.000	0.000	0.000
	4 EQ-Z	0.000	0.000	0.000	0.000	0.000	0.000
	5 DEAD LOA	0.000	0.000	0.000	0.000	0.000	0.000
	6 LIVE LOAD	0.000	0.000	0.000	0.000	0.000	0.000
	7 WL+X	0.000	0.000	0.000	0.000	0.000	0.000
	8 WL-X	0.000	0.000	0.000	0.000	0.000	0.000

Analysis and Design of G+15FL.std - Beam Relative Displacement Detail:

All Relative Displacement / Max Relative Displacements

Beam	L/C	Dist mm	x mm	y mm	z mm	Resultant mm
1	1 EQ+X	0.000	0.000	0.000	0.000	0.000
		1000.000	0.000	-0.141	-0.004	0.141
		2000.000	-0.000	-0.030	-0.002	0.030
		3000.000	0.000	0.095	0.001	0.095
		4000.000	0.000	0.000	0.000	0.000
	2 EQ-X	0.000	0.000	0.000	0.000	0.000
		1000.000	-0.000	0.141	0.004	0.141
		2000.000	-0.000	0.030	0.002	0.030
		3000.000	-0.000	-0.095	-0.001	0.095
		4000.000	0.000	0.000	0.000	0.000

Post Mode | Load 4 : EQ-Z | Input Units: N-mm

Figure shows the results of earthquake loading analysis along Z-axis

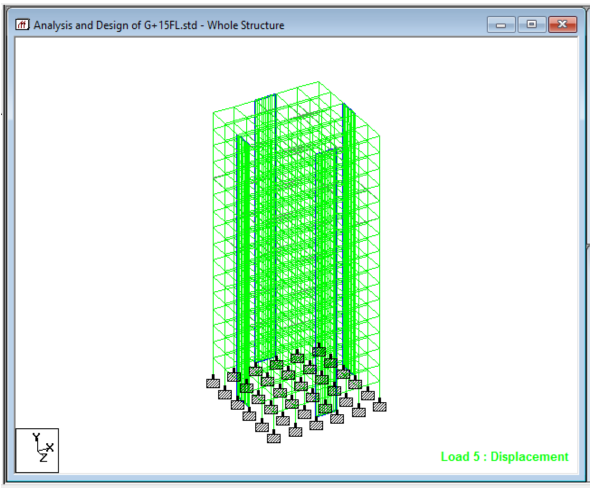
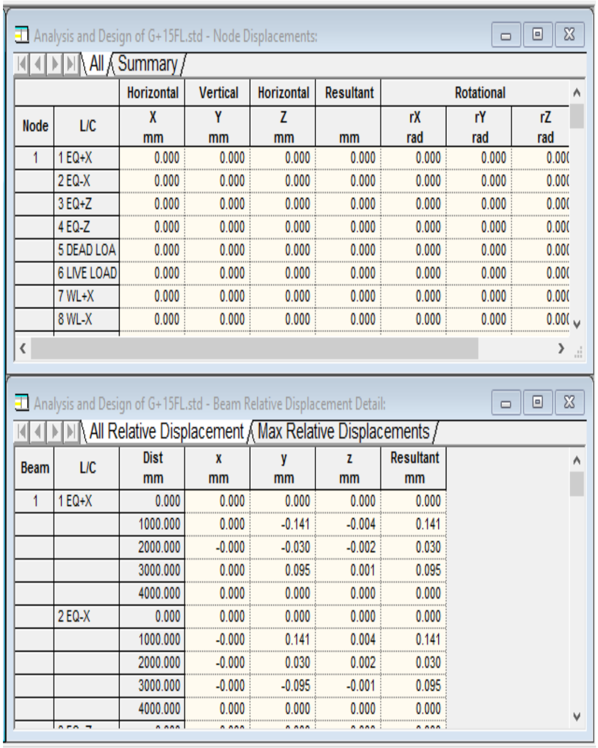


Figure shows the analysis simulation of the building when an DEAD LOAD is applied



Analysis and Design of G+15FL.std - Node Displacements:

All / Summary

		Horizontal	Vertical	Horizontal	Resultant	Rotational		
Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
1	1 EQ+X	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	2 EQ-X	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	3 EQ+Z	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	4 EQ-Z	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	5 DEAD LOA	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	6 LIVE LOAD	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	7 WL+X	0.000	0.000	0.000	0.000	0.000	0.000	0.00
	8 WL-X	0.000	0.000	0.000	0.000	0.000	0.000	0.00

Analysis and Design of G+15FL.std - Beam Relative Displacement Detail:

All Relative Displacement / Max Relative Displacements

Beam	L/C	Dist mm	x mm	y mm	z mm	Resultant mm
1	1 EQ+X	0.000	0.000	0.000	0.000	0.000
		1000.000	0.000	-0.141	-0.004	0.141
		2000.000	-0.000	-0.030	-0.002	0.030
		3000.000	0.000	0.095	0.001	0.095
		4000.000	0.000	0.000	0.000	0.000
	2 EQ-X	0.000	0.000	0.000	0.000	0.000
		1000.000	-0.000	0.141	0.004	0.141
		2000.000	-0.000	0.030	0.002	0.030
		3000.000	-0.000	-0.095	-0.001	0.095
		4000.000	0.000	0.000	0.000	0.000

Figure shows the results of the analysis of building when DEAD LOAD is applied

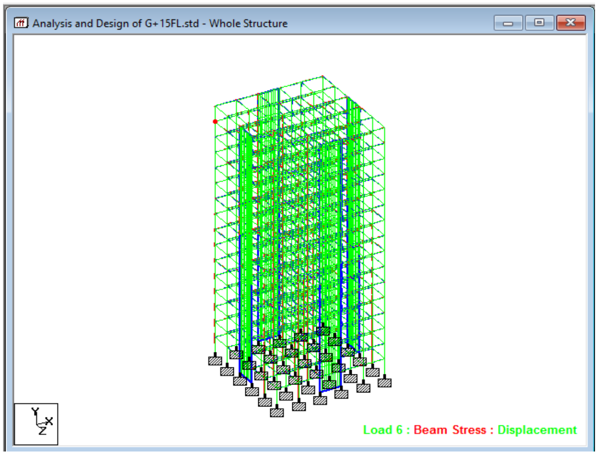
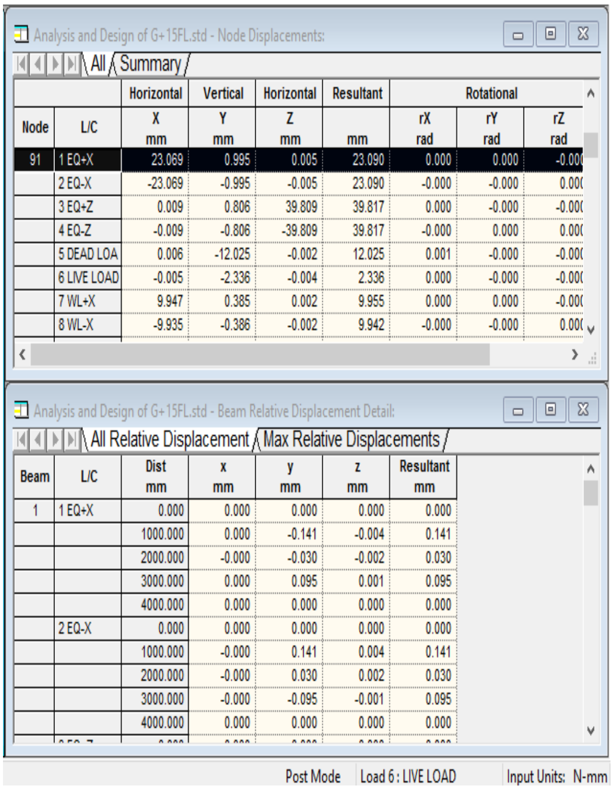


Figure shows the simulation of the analysis of the building when LIVE LOAD is applied



Analysis and Design of G+15FL.std - Node Displacements:

All / Summary

		Horizontal	Vertical	Horizontal	Resultant	Rotational		
Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
91	1 EQ+X	23.069	0.995	0.005	23.090	0.000	0.000	-0.00
	2 EQ-X	-23.069	-0.995	-0.005	23.090	-0.000	-0.000	0.00
	3 EQ+Z	0.009	0.806	39.809	39.817	0.000	-0.000	-0.00
	4 EQ-Z	-0.009	-0.806	-39.809	39.817	-0.000	0.000	0.00
	5 DEAD LOA	0.006	-12.025	-0.002	12.025	0.001	-0.000	-0.00
	6 LIVE LOAD	-0.005	-2.336	-0.004	2.336	0.000	-0.000	-0.00
	7 WL+X	9.947	0.385	0.002	9.955	0.000	0.000	-0.00
	8 WL-X	-9.935	-0.386	-0.002	9.942	-0.000	-0.000	0.00

Analysis and Design of G+15FL.std - Beam Relative Displacement Detail:

All Relative Displacement / Max Relative Displacements

Beam	L/C	Dist mm	x mm	y mm	z mm	Resultant mm
1	1 EQ+X	0.000	0.000	0.000	0.000	0.000
		1000.000	0.000	-0.141	-0.004	0.141
		2000.000	-0.000	-0.030	-0.002	0.030
		3000.000	0.000	0.095	0.001	0.095
		4000.000	0.000	0.000	0.000	0.000
	2 EQ-X	0.000	0.000	0.000	0.000	0.000
		1000.000	-0.000	0.141	0.004	0.141
		2000.000	-0.000	0.030	0.002	0.030
		3000.000	-0.000	-0.095	-0.001	0.095
		4000.000	0.000	0.000	0.000	0.000

Post Mode | Load 6 : LIVE LOAD | Input Units: N-mm

Figure shows the Node Displacement and Beam Displacement analysis of LIVE LOAD

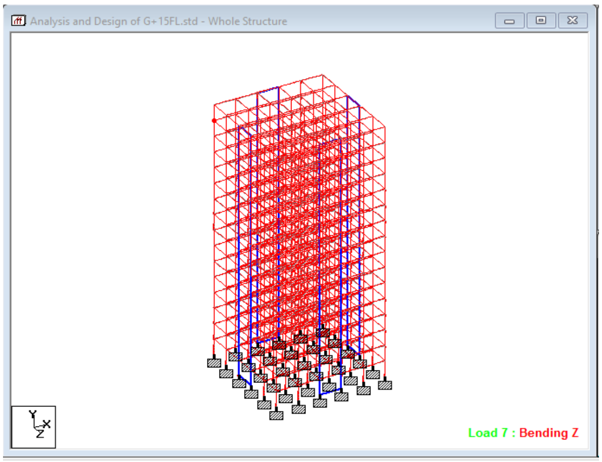
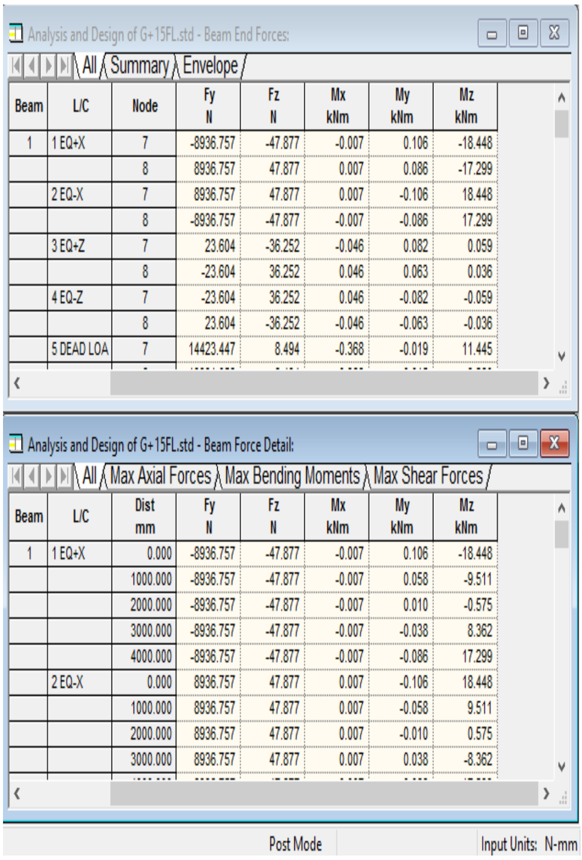


Figure shows the bending analysis of the high raised building at WIND LOAD applied



Analysis and Design of G+15FL.std - Beam End Forces:

All / Summary / Envelope

Beam	L/C	Node	Fy N	Fz N	Mx kNm	My kNm	Mz kNm
1	1 EQ+X	7	-8936.757	-47.877	-0.007	0.106	-18.448
		8	8936.757	47.877	0.007	0.086	-17.299
	2 EQ-X	7	8936.757	47.877	0.007	-0.106	18.448
		8	-8936.757	-47.877	-0.007	-0.086	17.299
	3 EQ+Z	7	23.604	-36.252	-0.046	0.082	0.059
		8	-23.604	36.252	0.046	0.063	0.036
	4 EQ-Z	7	-23.604	36.252	0.046	-0.082	-0.059
		8	23.604	-36.252	-0.046	-0.063	-0.036
	5 DEAD LOA	7	14423.447	8.494	-0.368	-0.019	11.445

Analysis and Design of G+15FL.std - Beam Force Detail:

All / Max Axial Forces / Max Bending Moments / Max Shear Forces

Beam	L/C	Dist mm	Fy N	Fz N	Mx kNm	My kNm	Mz kNm
1	1 EQ+X	0.000	-8936.757	-47.877	-0.007	0.106	-18.448
		1000.000	-8936.757	-47.877	-0.007	0.058	-9.511
		2000.000	-8936.757	-47.877	-0.007	0.010	-0.575
		3000.000	-8936.757	-47.877	-0.007	-0.038	8.362
		4000.000	-8936.757	-47.877	-0.007	-0.086	17.299
	2 EQ-X	0.000	8936.757	47.877	0.007	-0.106	18.448
		1000.000	8936.757	47.877	0.007	-0.058	9.511
		2000.000	8936.757	47.877	0.007	-0.010	0.575
		3000.000	8936.757	47.877	0.007	0.038	-8.362

Post Mode Input Units: N-mm

Figure shows the beam end forces and Beam Displacement analysis of WIND LOAD

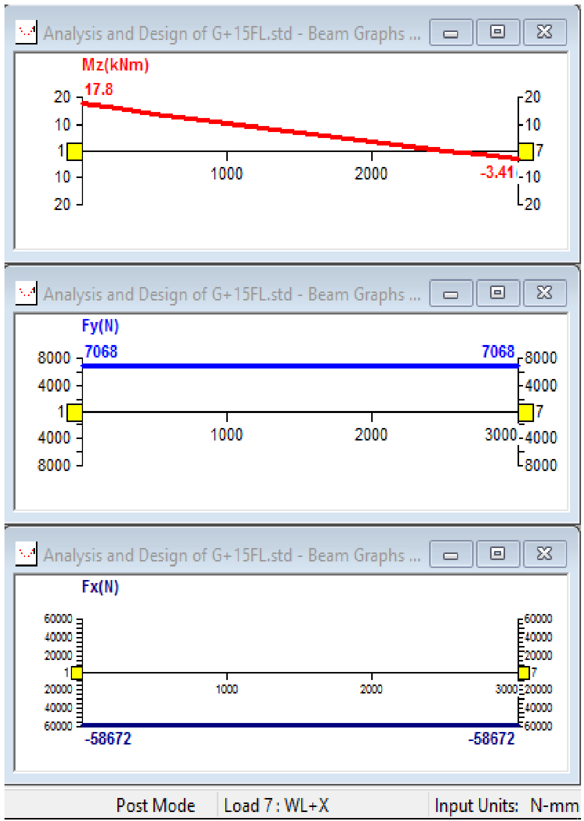


Figure shows the graph results of the high raised building at WIND LOAD along X-axis is applied

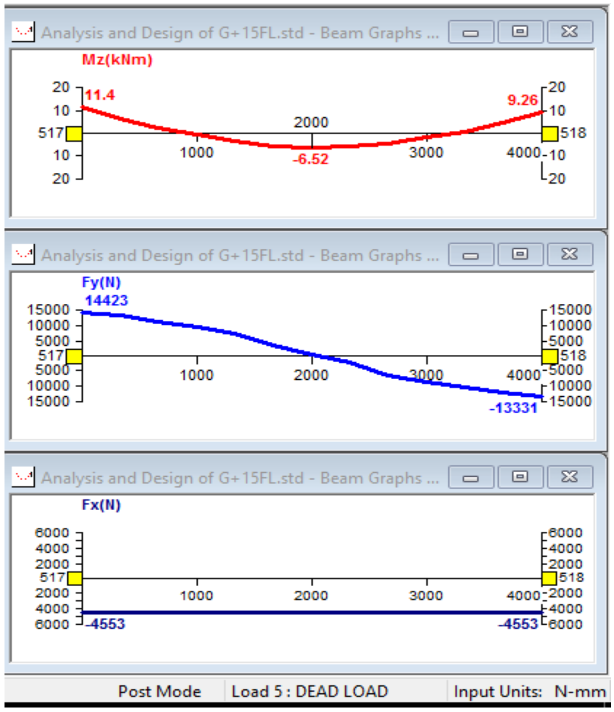


Figure shows the graph of the beam at LIVE LOAD

5. CONCLUSIONS:

The case study analysis puts forth that high rise residential structures are not popular due to user perception that they are expensive and the associated fear of safety during fire. STAAD PRO is a versatile software has the capability to calculate the reinforcement needed for any concrete section, to find lateral deflection due to earthquake load. The program contains a number of parameters which are designed as per IS: 456(2000), IS 1893:2002. Various structural action is consider on members such as axial, flexure, torsion etc according to their response.

Beam Design Output: The default design output of the beam contains flexural and shear reinforcement provided along the length of the beam. Column Design: Columns are designed for axial forces, uni axial and biaxial moments at the ends. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design. Base shear: Base shear plays an important role. Its gives the base shears for entire structures. Storey drift: High rise structures are subjected to excessive deflection. Deflection obtained by STAAD pro is checked by IS Codal limitation for serviceability.

FUTURE SCOPE:

As per analysis, it is concluded that displacement as well as its stress also at different level in multi-storied building with shear wall is comparatively lesser as compared to R.C.C. building Without Shear Wall. So now a day we can adopt with shear wall at analyzed and optimized location. Less obstruction will be there because of reduced size of column and provision of shear wall.

It is concluded that building with shear wall is constructed in lower cost as compared to structure without shear wall.

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