Design and Comparision of High Rise Framed Structure by Varying Geometric Shapes of Columns

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ABSTRACT:

Static and dynamic loads affect High-rise buildings. The proposed paper suggests varying in geometric shapes for columns. We have developed model for studying different aspects and results with codes are listed. The constructed model was evaluated for different shapes of columns varied i.e; L Plus and Square give considerable differences in quantities and also give an indication in choosing L-columns as the priority. To study further we have extended this paper with limitation and future work.

Keywords: *high rise framed structure, geometric shapes, displacement*

[1] INTRODUCTION

The economic structural design of high-rise buildings is a complex technical challenge, with requirements for lateral stiffness, strength and deformation under wind and earthquakes compounding gravity and constructability issues. In general, as buildings grow taller and slenderer, wind loading effects become more significant in comparison to earthquake effects. Accordingly, in regions of moderate seismic hazard, a building structure designed to resist wind effects may require only modest (although vitally important) modifications to meet seismic performance targets. In contrast the design of the lateral force resisting system in a low-rise building at the same site would be entirely governed by seismic requirements. Reasons to use framed structures for high rise buildings

i. Quick to erect and support high loads from tall structures
ii. Flexible and economical structural form
iii. Large open floors plates that can be remodeled
iv. Up gradation of buildings

[2] RIGID FRAME STRUCTURE

This structure was firstly designed using L-shaped columns and further with square and Plus shapes. According to this the area of L-columns was used to calculate the equivalent area for square and plus columns.

For comparison three models were prepared with different column shapes with same loading & support conditions. The column sizes were revised according to the needs of the structure

Details of Preheater tower

The Preheater consists of a series of large cyclones and ductwork whose only purpose is to recover heat energy and transfer it to the kiln feed. The arrangement is made in such a way that the raw meal enters the Preheater from top and moves down against hot gases from the kiln.

- Design of Preheater Building of Cement Production Plant, which has 10 floors at different levels and 112 m height.
- The loads coming on thus structure vary from 150 KN to 2070 KN.
- The area of the Preheater structure is 434.66 m²
- The structure is located in Earthquake zone 3.
- Max. wind speed of 55 m/s is considered.

Consist of columns and girders joined by moment resistant connections. Lateral stiffness of a rigid frame bent depends on the bending stiffness of the columns, girders, and connection in the plane of the bents.

Ideally it is suited for reinforced concrete buildings because of the inherent rigidity of reinforced concrete joints.

rigid frame of a typical scale that serve alone to resist lateral loading have an economic height limit of about 25 stories, smaller scale rigid frames in the form of perimeter tube, or typically rigid frames in combination with shear walls or braced bents, can be economic up top much greater heights

Advantages:

May be place in or around the core, on the exterior, or throughout the interior of the building with minimal constraint on the planning module.

The frame may be architecturally exposed to express the grid like nature of the structure.

The spacing of the columns in a moment resisting frame can match that required for gravity framing. Only suitable for building up to 20 –30 stories only; member proportions and materials cost become unreasonable for building higher than that.

[3] DESIGN BASIS REPORTS

- Reference Codes
- For design of RCC elements – IS: 456
- For dead load – IS: 875 Part I
- For live load – IS: 875 Part II
- For wind load – IS: 875 Part III
- For earthquake loads – IS: 1893, IS: 13920
- For load combinations - IS: 875 Part V

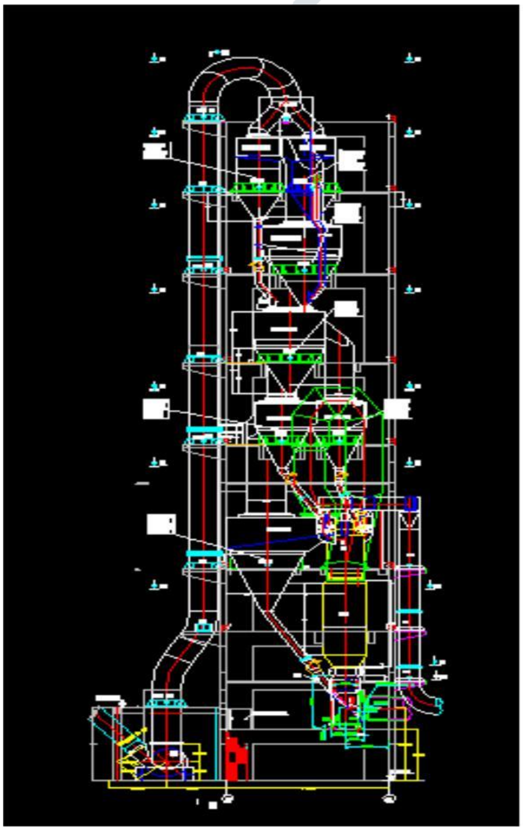

Figure 1 ELEVATION OF PREHEATER TOWER

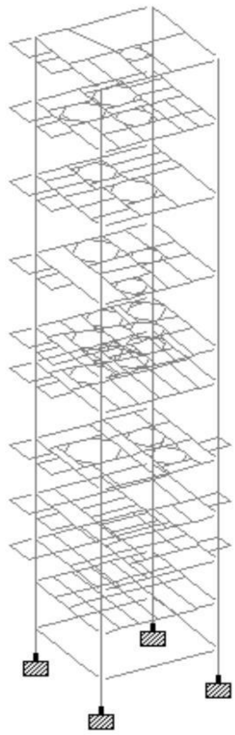

Figure 2 3D MODEL OF PREHEATER

Figure 3 GENERAL ARRANGEMENT OF 71.00M LVL.

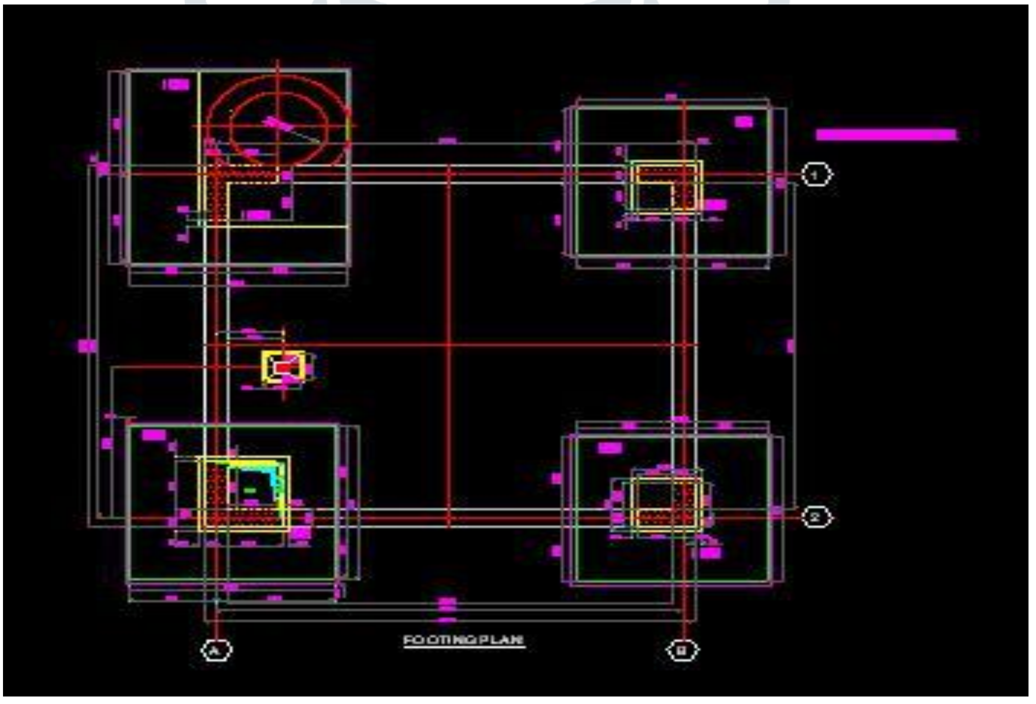

Figure 4 L-COLUMN FOOTING PLAN

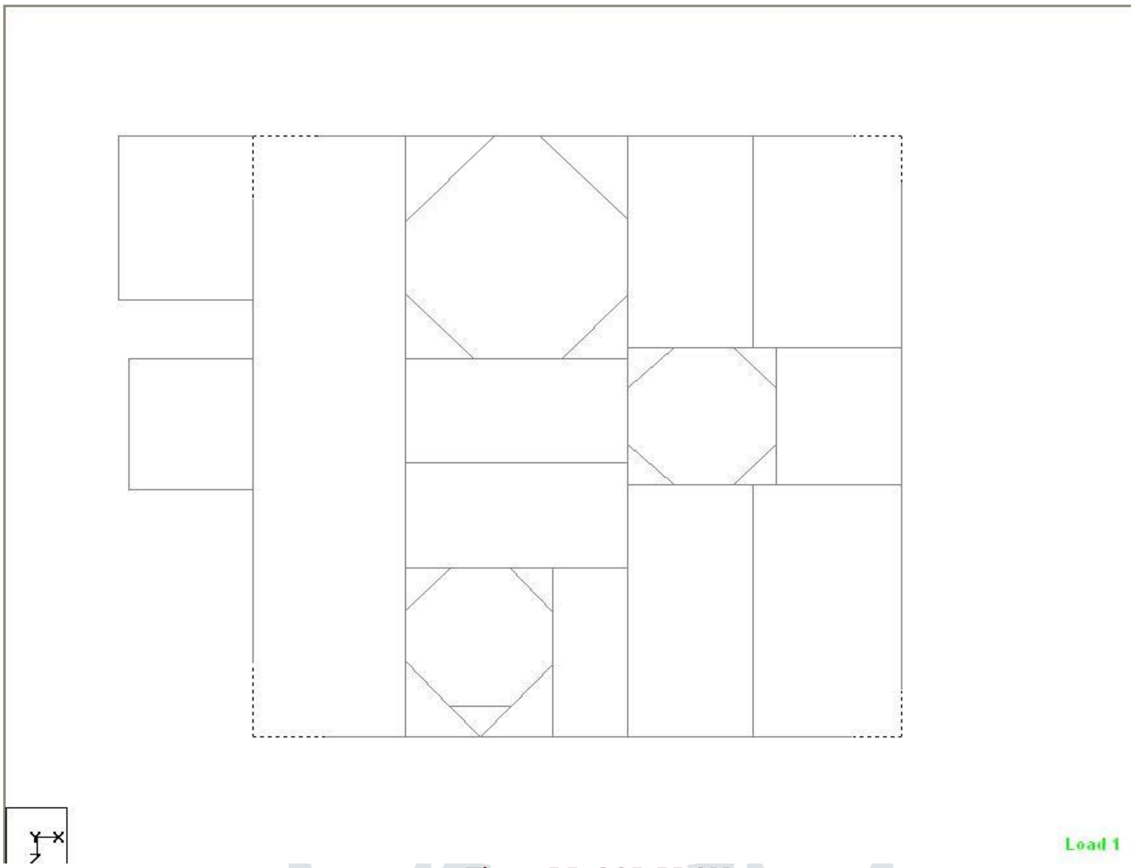

Figure 5 L COL PLAN

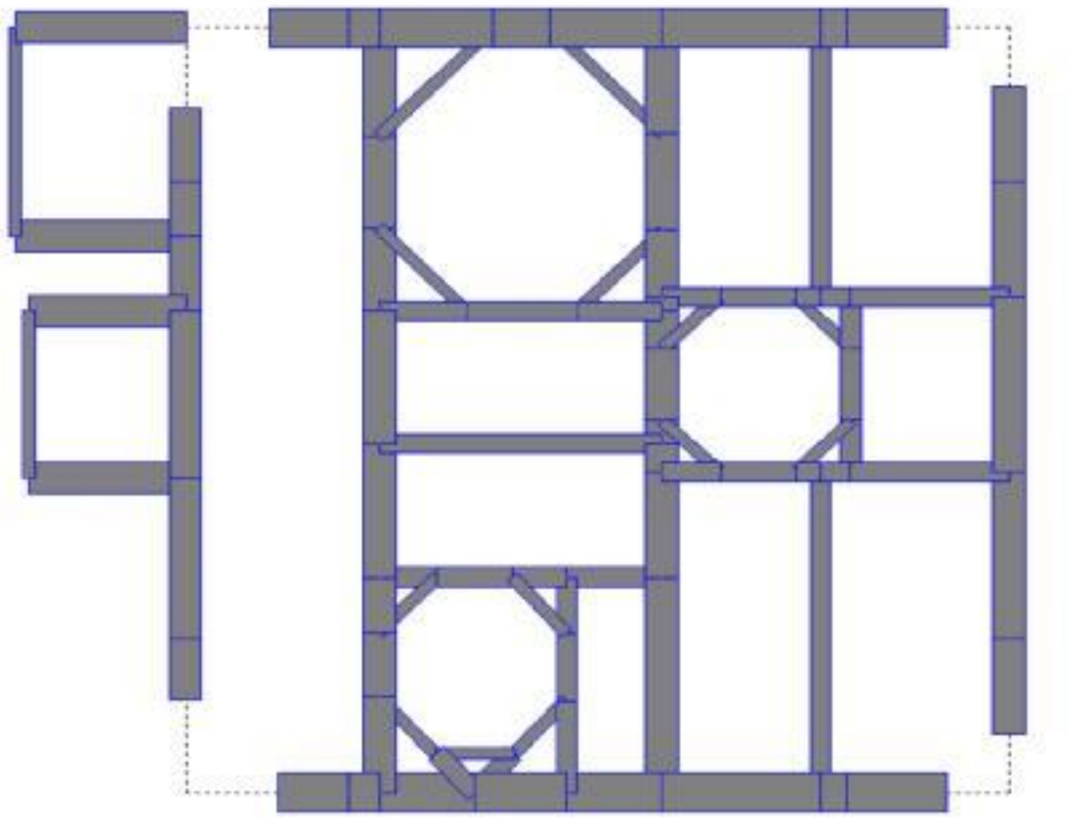

Figure 6 L COL PLAN (with offsets)

Figure 7 L COL LEFT END

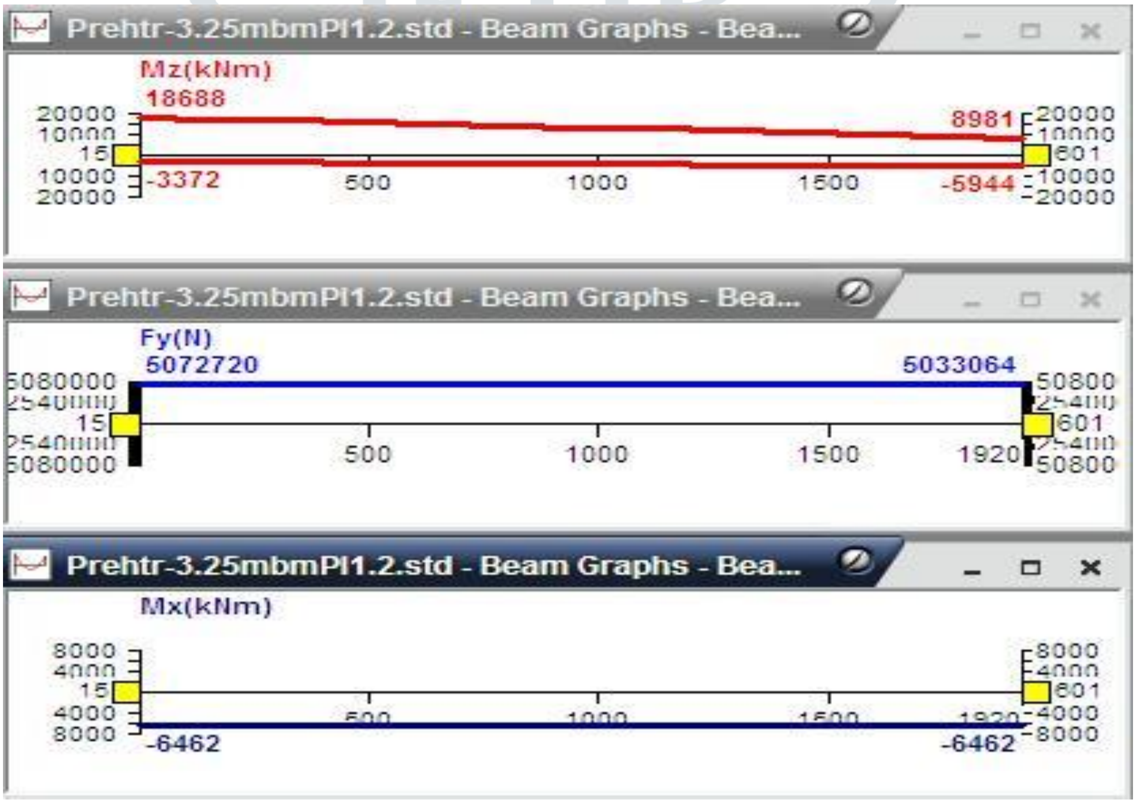

Figure 8 L COL LEFT END B.M, S.F, TORSION

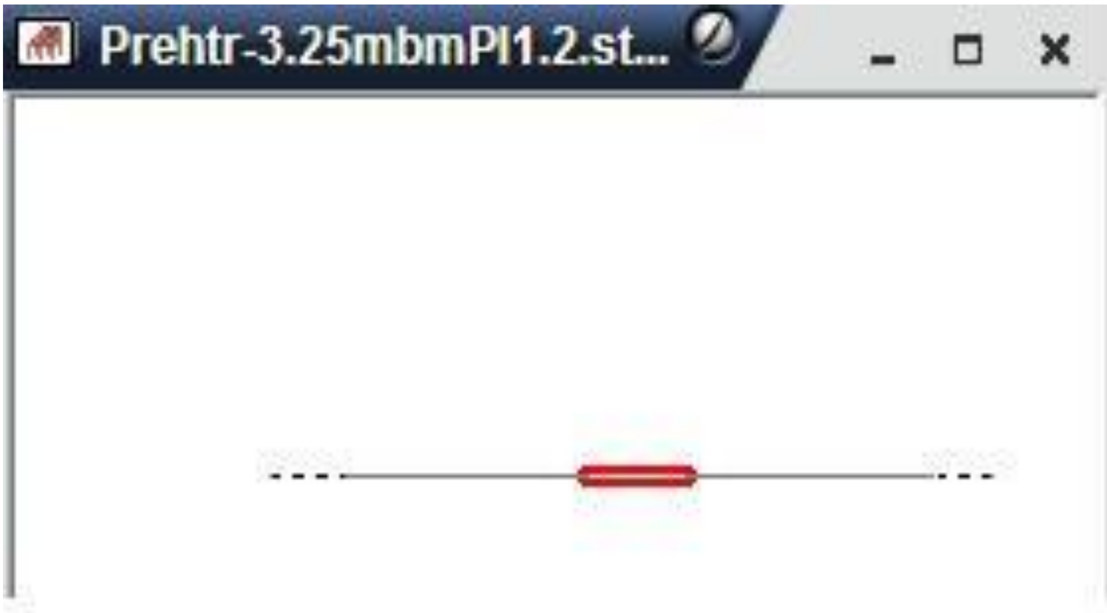

Figure 9 L COL CENTRE

Figure 11 L COL RIGHT END

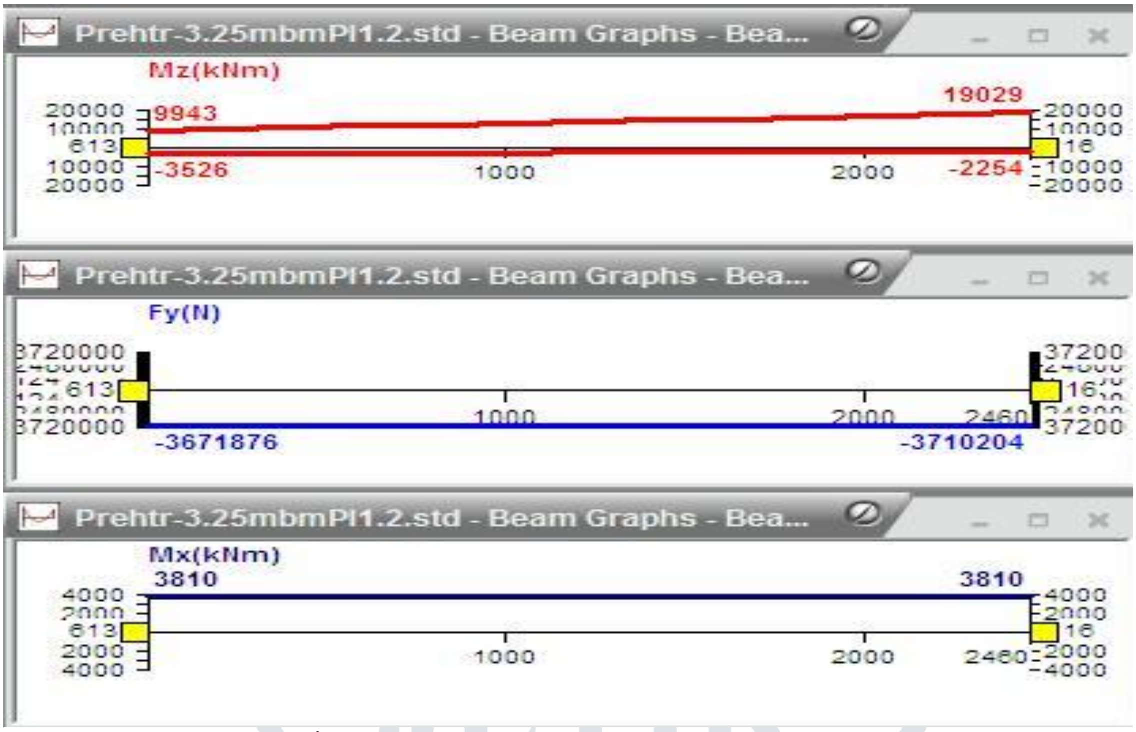

Figure 12 L COL RIGHT END B.M, S.F, TORSION

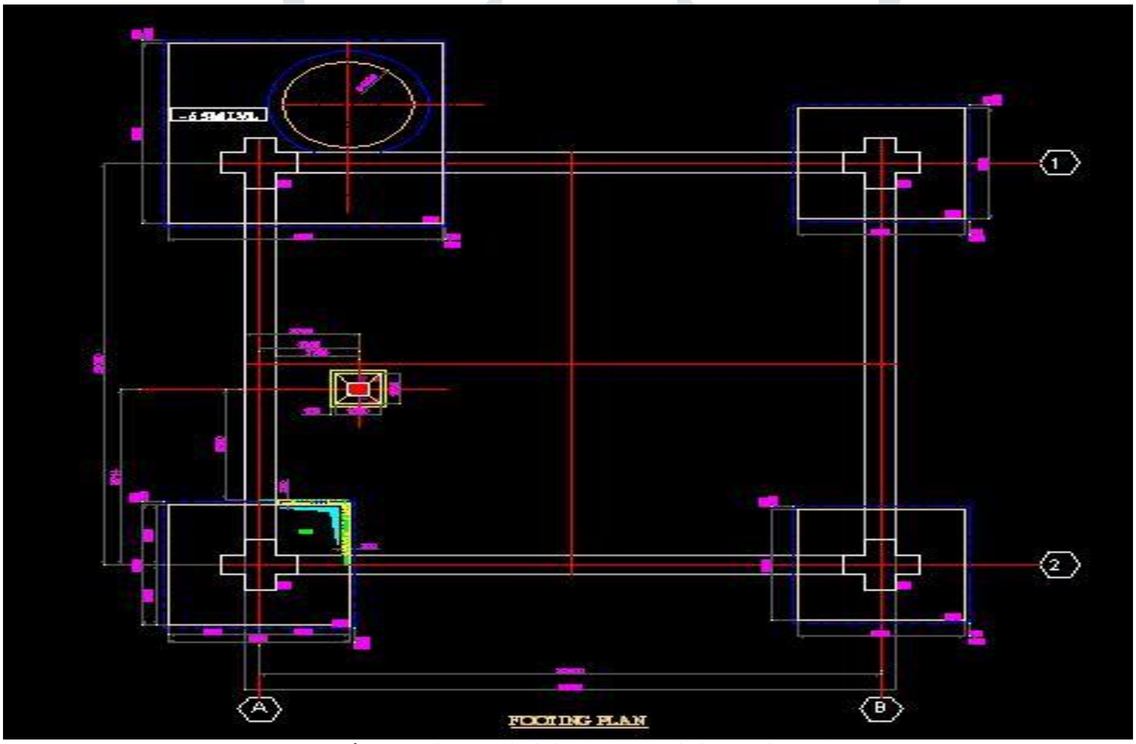

Figure 13 PLUS COLUMN FOOTING PLAN

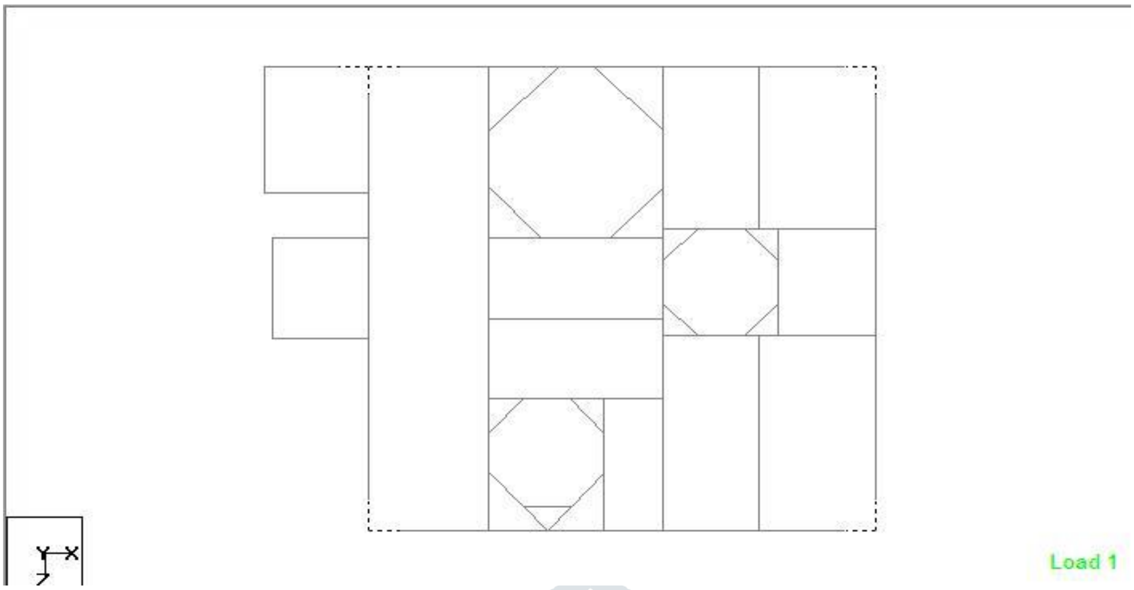

Figure 14 PLUS COL PLAN

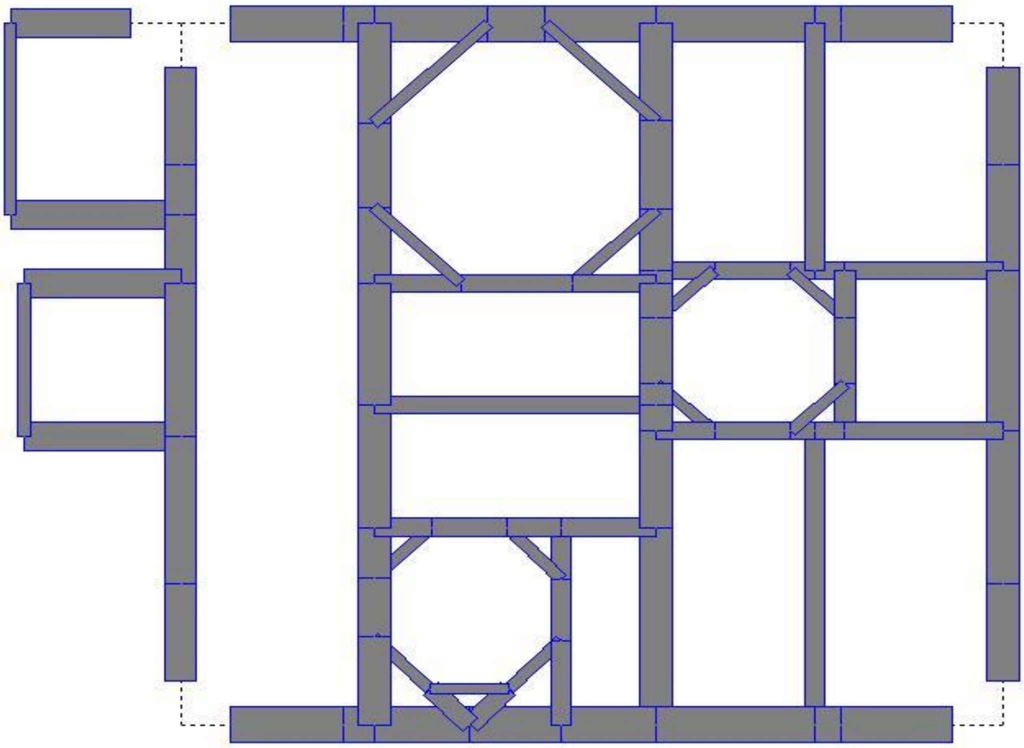

Figure 15 PLUS COL PLAN (with offsets)

[4] CONCLUSION

The shape of columns varied i.e; L Plus and Square give considerable differences in quantities and also give an indication in choosing L-columns as the priority as shown in sheet. Due to this typical shape the congestion at beam-column joint is avoided. The economy is achieved in steel as the lengths of beams are also reduced. The overall steel quantity is also less than other two in case L-column.

Advantages

1. The Preheater is the most important component of the cement plant; it helps in pre-calcination of the clinker before it enters the kiln.
2. The Preheater is predominant structure of cement plant it gives all possible advantage of being a tall structure.
3. The height of Preheater is kept large as compared to other structures in the cement plan because it has a long passage with various cyclones in order to preheat the material by means of hot gases.
4. The Preheater also helps utilize the energy of hot gases in order to heat the raw meal and avoid the wastage due to loss of heat energy.
5. The Preheater also helps reduce the overall cost of the project by reducing the length of the kiln as it needs the immediate temperature variations for heating, Preheater does it efficiently and economically.
6. The Preheater improves the efficiency of the structure as it imparts maximum benefit of its shape for equipment placing, servicing and maintenance.

[5] LIMITATIONS AND REMEDIES

1. The Preheater is meant to heavy loading so it needs to be strong, cost wise it is cheaper to use R.C.C. structure as steel needs more finance.
2. The Preheater requires a bucket elevator or a conveyor in order to place the raw meal at its top this is an extra need but can be economized by proper planning.
3. Preheater alignment is very unusual so the requirements for the platforms, staircases etc are more in this case.
4. Wind load is very high so provision of infill walls is not possible, it has to be applied carefully.
5. The absence of infill walls produces no damping condition so it is more prone To earthquake so it is also applied carefully.
6. The height of structure is enormous which also makes it prone to earthquake.

[6] FUTURE SCOPE

The entire structure will be analysed by STAAD.Pro while the design will be done manually using moments& shears given by STAAD.Pro. The 4 columns located at the corners will be changed in their geometrical shapes. In first case we have modeled by L-Columns, then we have modeled them as + Columns, Square Columns. Finally compare & select the most economical & durable structure.

This may lead us to a solution for using appropriate structural elements in order to reduce the overall cost of construction as well as to avoid the constructional difficulties such as the reinforcement congestion at beam column joints, since these beams are generally doubly reinforced the depth can also be reduced by deciding the appropriate column shape & size.

In case of high rise framed structures it is very important that the structure achieves economy in its shape as well to improve its purpose of being open from all sides. So also columns varying geometrically in shape will propose a new aspect to achieve the same.

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