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"ADVANCE DYNAMICS STEEL STRUCTURE IN INDUSTRIAL SECTOR"

SUBMITTED BY

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GUIDE

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ABSTRACT

The construction industry in India suffers from over time and cst overruns in economy. Report from government and industry reports suggest that projects suffer from 30 to 35 percent time and cost overruns. Waste of materials & resources has been identified as a major source of weakness for construction industry. in spite of a substantial increment in the past few years, demand for professionals'

and contractors still exceeds supply by a large scale. The traditional methods adopted in the Indian construction industry may not be sufficient the needs of this dynamic environment, as they have produced large inefficiencies. New Innovative ways of procurement and project management can clearly satisfy the needs aspired to as well as bring added value. The objective of this paper is to discuss and analyse the strength & economic concern, inefficiencies and investigate a model that both explains the Indian construction industry structure and provides a framework to improve quality and efficiencies. The Best Value (BV) model is examined as an approach to be adopted in lieu of the traditional approach. This could result in efficient construction projects by minimizing cost overruns and delays with ultimate strength for structure, which until now have been a rarity.

Keywords: Construction Industry Structure in India.

CHAPTER 1

INTRODUCTION

1.1 General

India is a country which is rapidly flourishing in different sector. Out of which Infrastructure is one of the important sector. But when discussion is specifically about buildings it comprises of industrial, commercial and residential buildings.

Industrial buildings are mainly constructed in steel or PEB structures while residential and commercial are constructed in RCC. In surrounding locality most of the building structures lies under the category of low rise Structures.

For these structures, reinforced concrete members are used widely because the construction becomes quite convenient and economical. But since the population is growing exponentially and the land is limited, there is a need of vertical growth of buildings in coming future. Steel is one of the most widely used materials for building construction in the world.

Its inherent strength, toughness and high ductility are the factors which make it ideal to use it for Industrial construction. Analysis of Steel Structure should be done if any of load is any Dynamic or lateral forces are acting on it.

Project Work

The project consists of Structural and civil work of Rolling Mill (RMD Project) located in Sinnar Nashik. As the Client requirement was to make a 350*158 Mtr Shed with RMD Machine Foundation for Production of TMT Bar , a thorough inspection was to be carried out during the Structural Fabrication and construction work of the Rolling Mill Plant to check the feasibility and serviceability of the Construction, and checking the foundation with structure whether it can withstand the Lateral as well as Dynamic loads for Foundation and shed to carry the necessary strengthening measures if required; to be adopted to achieve stability and strength criteria.

The on-site photographs of Site during working period of Structural as well as machine foundation is herewith attached.

As the Structure was large and had heavy Dynamic/lateral forces acting on it the foundation as well as structural design is to be considered in priority for its structural as well as foundation strength.

All Structural as well as machine foundation plan as well as cross section drawings were provided by architect which was checked and confirmed by structural Engineer.

Figure : Actual Site Photographs of Rolling Mill Foundation which posses Dynamic forces acting on Structure.

Figure 1.1: Actual photograph of Rolling Mill

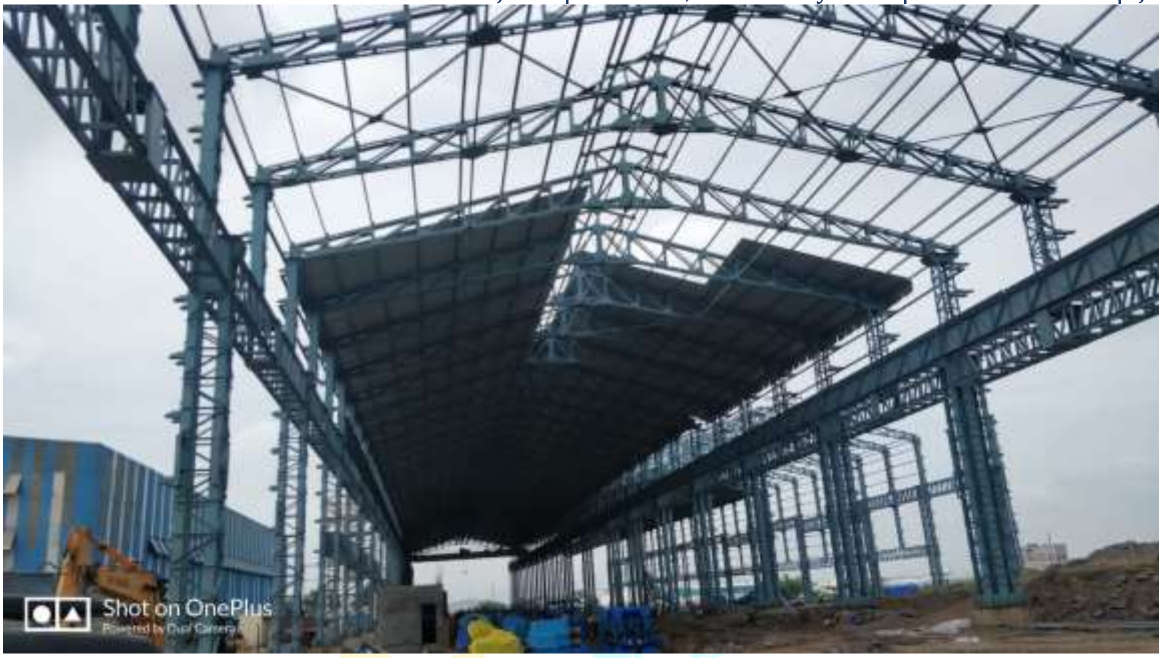


Figure 1.2: Actual site photographs of structural Work

Site Address: Bhagwati Ferro Metals Plot No:G7 & G8 Sinnar MIDC 422113

1.2 Analysis

In general, a Large Machine Foundation for rolling mill with Lateral loads acting on Structure were constructed with proper plan and design for lasting future.

Inspection of following Site were done with which had hard rock breaking by chiselling done by poclain for obtaining the level of the shed

Figure 1.3: Actual site photographs of structural work along with Breaking by Breaker

1.3 Aim of Project work

To carry out RMD Project with most economical Cost with strong structural Strength as well as Machine foundation Design to carry Dynamic and lateral forces on it.

1.4 Objectives of Project work

* Analysis and design of Steel Structure of rolling mill project (RMD Project)

* Comparative study in structural view point with most economical cost.

Structural design process

A Construction project are divided into three types:

- Plan
- Designing
- Execution.

Plan: The plan involves various requirement and elements affecting the Cross section and dimensions of the structure and ends in the choice of one or numerous various types of construction, which gives the best solutions in economical cost as well as structural strength of construction. The first look out is the function of the foundation and construction. Secondary look out such as aesthetics, as per government law, economic and the environment also be taken into account.
In observation there are structural and constructional engineering Needs and limitations, which may affect the type of structure to be designed.

Designing: This phase involves a detailed consideration of the alternative solutions defined in the planning phase and results in the determination of the most suitable proportions, dimensions and details of the structural
elements and connections for constructing each alternative structural arrangement being considered.

Construction: This Step involves mobilization of Equipment Materials and Personals with Engineers; procurement of materials, including their transportation to the site, and actual on-site execution. During this Stage, some redesign may be needed if unexpected problem happens, such as unavailability of specified materials or foundation problems as per the load capacity.

The I-section in which the large flanges were kept at a length from the neutral axis. In effect, the flanges carried the bending in the form of tension stress in one flange and compression stress in the other, while the shear was carried by the web.

For these situations where bending is high but shear is low, for example in roof design, material can be saved by raising a framework design. A truss is a pinpointed framework.

Rafters are normally divided into equal lengths and, ideally, the purlins are supported at the joints so that the rafters are only subjected to axial forces. This is not always practicable because purlin spacing is dependent on the type of roof covering. When the purlins are not supported at the panel joints, the rafter members must be designed for bending as well as axial force. The internal bracing members of a truss should be triangulated and, as far as possible, arranged so that long members are in tension and compression members are short to avoid buckling problems A truss concentrates the maximum amount of materials as far away as possible from the neutral axis. With the resulting greater moment arm *(h)*, much larger moments can be resisted.

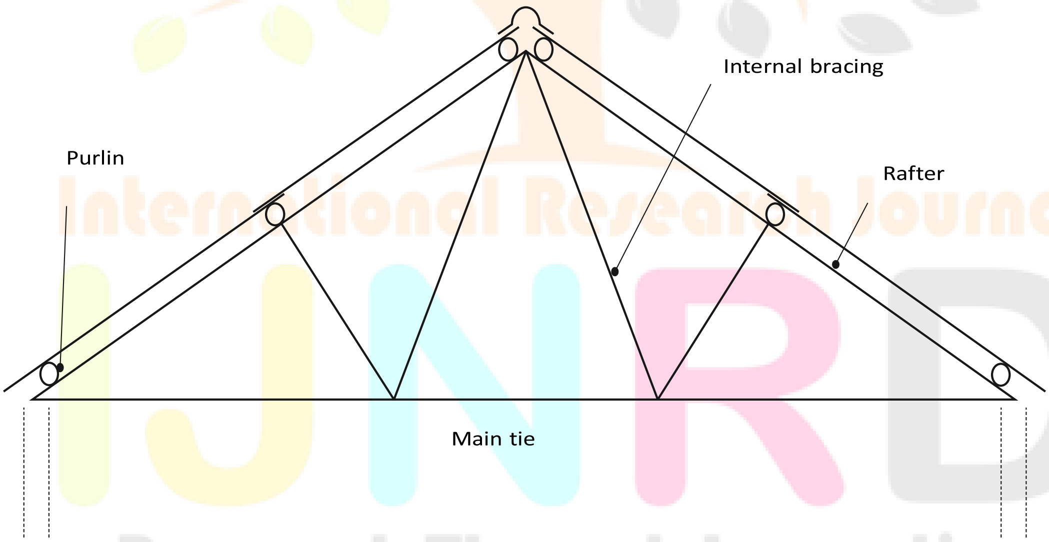


Figure 1.4: **Structural Fabrication of beam column framing of Industrial Work**

Resistance of a truss at a section is provided by:

$M = C \times h = T \times h$

where:

$C = T$ in parallel chords and:

C = compression in the top chord of the truss. T = tension in bottom chord of a simply supported truss. h = vertical height of truss section.

If either C or T or h can be increased, then the truss will be capable of resisting heavier loads. The value of h can be increased by making a deeper truss.

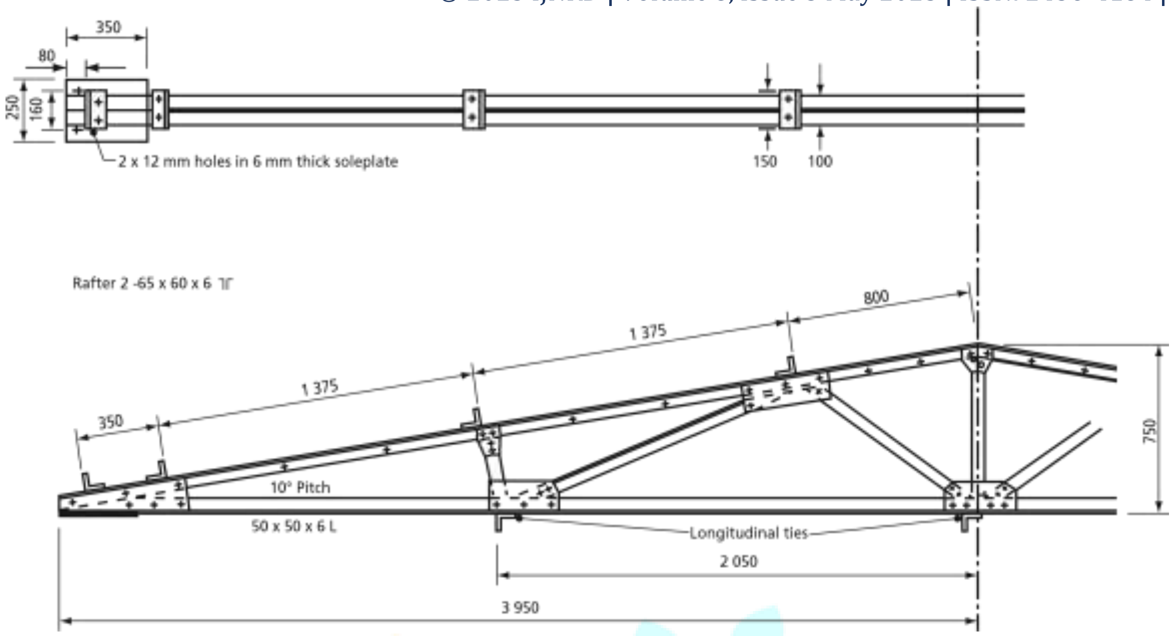
Allowable C- or T-stresses can be increased by choosing a larger cross-section for the chords of the truss, or by changing to a stronger material.

A framework or truss can be considered as a beam with the major part of the web removed. This is possible where bending stresses are more significant than shear stresses. The simple beam has a constant section along its length, yet the bending and shear stresses vary. The truss, comprising a number of simple members, can be fabricated to take into account this change in stress along its length.

The pitched-roof truss is the best example of this, although the original shape was probably designed to shed rainwater. Roof trusses consist of sloping rafters that meet at the ridge, a main tie connecting the feet of the rafters and internal bracing members. They are used to support a roof covering in conjunction with purlins, which are laid longitudinally across the rafters, with the roof cover attached to the purlin. The arrangement of the internal bracing depends on the span.

when designing a truss:

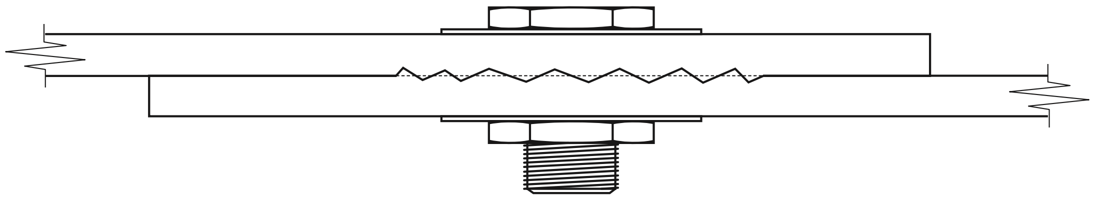
1. Select general layout of truss members and truss spacing.
2. Estimate external loads to be applied including self-weight of truss, purlins and roof covering, together with wind loads.
3. Determine critical (worst combinations) loading. It is usual to consider dead loads alone, and then dead and imposed loads combined.
4. Analyse the framework to find forces in all members.
5. Select the material and section to produce in each member a stress value that does not exceed the permissible value. Particular care must be taken with compression members (struts), or members normally in tension but subject to stress reversal caused by wind uplift.

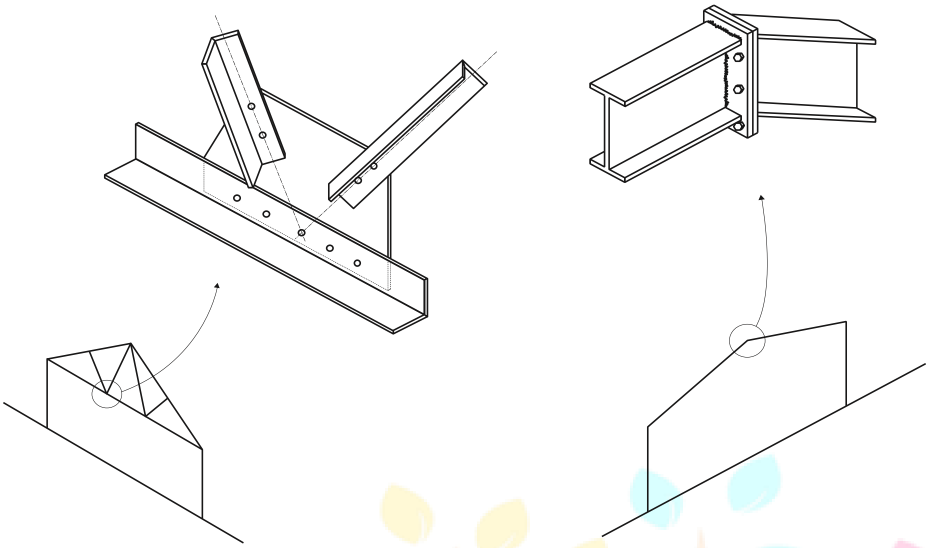


All welds to be 4mm fillet
All bolts to be M16
Gusset plates to be 8mm thick
Internal bracing shown 65 x 50 x 6 to use common section
(size can be reduced if others available)
All sections in grade 43 steel
Purlin supports: 70 x 70 x 6 with 2 x 6 ø holes.

Butt joints

The use of gussets permits members to butt against each other in the same plane, avoids eccentric loading on the joints and, where necessary, provides a greater joining area than is possible with lapped members. This is often an important factor in nailed and glued joints. Arrangement of members on a single centre line is usually possible with gussets. members may not provide sufficient gluing area and gussets must then be used to provide the extra area.





Connections in single shear at bottom boom of trussBolts in shear and tension at ridge of portal frame

Column Analysis and Design

Introduction

Columns are usually considered as vertical structural elements, but they can be positioned in any orientation (e.g. diagonal and horizontal compression elements in a truss).

Columns are used as major elements in trusses, building frames, and sub-structure supports for bridges (e.g. piers).

- Columns support compressive loads from roofs, floors, or bridge decks.
- Columns transmit the vertical forces to the foundations and into the subsoil.

The work of a column is simpler than the work of a beam.

- The loads applied to a column are only axial loads.
- Loads on columns are typically applied at the ends of the member, producing axial compressive stresses.
- However, on occasion the loads acting on a column can include axial forces, transverse forces, and bending moments (e.g. beam-columns).

Columns are defined by the length between support ends.

- Short columns (e.g. Support columns for beams).
- Long columns (e.g.Structural column& bridge, freeway piers).

Virtually every common construction material is used for column construction.

- Steel, timber, concrete (reinforced and pre-stressed), and masonry (brick, block, and stone).

The selection of a particular material may be made based on the following.

- Strength (material) properties (e.g. steel vs. wood).
- Appearance (circular, square, or I-beam).
- Accommodate the connection of other members.
- Local production capabilities (i.e. the shape of the cross section).

Columns are major structural components that significantly affect the building's overall performance and stability.

- Columns are designed with larger safety factors than other structural components.

End Support Conditions and Lateral Bracing

Previously, each column was assumed to have pinned ends in which the member ends were free to rotate (but not translate) in any direction at their ends.

- When the column buckles, it will do so in one smooth curve.
- The length of this curve is referred to as the effective length.

In practice, a column may not be pinned at the ends.

- The column length free to buckle is greatly influenced by its end support conditions.
- The load-carrying capacity of a column is affected by the end support conditions.

- Restraining the ends of a column with a fixed support increases the load-carrying capacity of a column.
- Allowing translation as well as rotation (i.e. free end) at one end of a column generally reduces its load-carrying capacity.

Column design formulas generally assume a condition in which both ends are pinned.

- When other conditions exist, the load-carrying capacity is increased or decreased and the allowable compressive stress is increased or decreased.

- A factor K is used as a multiplier for converting the actual column length to an effective buckling length based on end conditions.

Figure 1.5: **Structural Fabrication of beam column framing of one of the industrial Condition around plinth level**

Figure 1.6 Of Structural work and Surveying with levelling for Flooring

LATERALLY SUPPORTED BEAMS

The laterally supported beams are also called laterally restrained beams. When lateral deflection of the compression flange of a beam is prevented by providing effective lateral support (restraint), the beam is said to be laterally supported. The effective lateral restraint is the restraint which produces sufficient resistance in a plane perpendicular to the plane of bending to restrain the compression flange of a beam from lateral buckling to either side at the point of application of the restraint. The concrete slab encasing the top flange, so that the bottom surface of the concrete slab is flush with the bottom of the top flange, is shown in Fig. . It provides a continuous lateral support to the top flange of the beam. When other beams frame at frequent intervals into the beam in questions as shown, lateral support is provided at each point of connection but main beam should still be checked between the two supports.

In the laterally supported beams, the value of allowable bending compressive stress remains unaltered and the reduction in its value is not made. Bending comprehensive stress is taken equal to the allowable bending tensile stress, ($\sigma_{bc}=\sigma_{bt}=0.66f_y$). The adequate lateral support is provided to safeguard against the lateral-torsional bucking. In case of doubt for adequate lateral support, the beams should be designed as laterally unsupported. In case the concrete slab holds the top flange (compression flange) of the beam from one side only, then, the lateral support is not credited. The concrete slab simply resting over the top flange of the beam without shear connectors also does not provide an lateral support. Sometimes, the plank or bar grating is attached to the top flange of beam by means of bolts. When the bolts are firmly fastened, then, they provide adequate lateral support temporarily. Even then, bolts have temporary nature of connections. It is possible that the bolts might be omitted or removed. As such, the top flange should not be considered laterally supported fully. The beams having lateral support from other members may buckle between points of lateral support. Therefore, the laterally unsupported length of beam is kept short.

DESIGN OF LATERALLY SUPPORTED BEAMS

The design of beams is generally governed by the maximum allowable bending stress and the allowable deflection. Its design is controlled by shear only when the spans are short and loads are heavy. The members are selected such that the sections are symmetrical about the plane of loading and the unsymmetrical bending and torsion are eliminated. The design of beams deals with proportioning of members, the determination of effective section modulus, maximum deflection and the shear stress.

In general, the rolled steel sections have webs of sufficient thickness such that the criterion for design is seldom governed by shear. The following are the usual steps in design of laterally supported beams:

Step 1. For the design of beams, load to be carried by the beam, and effective span of the beam are known. The value of yield stress, f_y for the structural steel to be used is also known. For the rolled steel beams of equal flanges as given in ISI Handbook no.1, the ratio of mean thickness of the compression flange ($T=t_f$) to the thickness of web used to be less than 2.00. Also the ratio of the depth of web d_1 to the thickness of web is also smaller than 85. The ends of compression flange of a laterally supported beam remain restrained against lateral bending (i.e., not free to rotate in plan at the bearings).

In the beginning of design, the permissible bending stress in tension, σ_{bt} or in compression, σ_{bc} may be assumed as 0.66 f_y. The bending compressive stress, σ_{bc} and the bending tensile stress, σ_{bt} are equal for the laterally supported beam.

Step 2. The maximum bending moment M and the maximum shear force F in the beam are calculated. The required section modulus for the beam is determined as $Z=(M/\sigma_{bc})$

Step 3. From the steel section tables, a rolled steel beam section, a rolled steel beam section, which provides more than the required section modulus is selected. The steel beam section shall have (D/T) and (l/r_y) ratios more than 8 and 40 respectively. As such the trial section of beam selected may have modulus of section, Z more than that required. Some of the beam sections of different categories have almost the same value of the section modulus Z. It is necessary to note the weight of beam per meter length and the section modulus, Z. The beam section selected should be such that it has minimum weight and adequate section modulus, Z.

Step 4. The rolled steel beam section is checked for the shear stress. The average and maximum shear stresses should not exceed the allowable average and maximum values of shear stresses.

Step 5. The rolled steel beam is also checked for deflection. The maximum deflection should not exceed the limiting deflection.

ISI Handbook no.1 provides tables for allowable uniform loads on beams and channels used as flexural members with adequate lateral support for compression flange. The values of allowable uniform loads corresponding to respective effective spans are given for various beams and channel sections. For given span and total uniformly distributed load found, rolled beam or channel section may be selected from these tables. The rolled steel I-sections and wide flange beam sections are most efficient sections. These sections have excellent flexural strength and relatively good lateral strength for their weights.

1.7 Structuiral Beam and Fixing of Stuff Column

Design Optimization of Overhead EOT Crane Box Girder

In this paper the design optimization of double box girder has been done and a comparative study of results of finite element analysis of a crane with 10 ton capacity and 12 m span length has been conducted. It is not possible for the real experimental studies to take into consideration the influence of the connections between the main beams and the rest parts of the construction, the influence of the longitudinal and transverse ribbings as well as the influence of the supports on the overall stressed state of the construction. Moreover, the researches that use for the majority of the test cases different strain measurements turn out to be quite hard and expensive. All these problems could be solved successfully by the use of computer modeling procedures. The crane design was modelled with solids; material, Loads and boundary conditions were applied to solid model. Finite Element meshes were generated from the solid model. After a comparison of the finite element analyses, and the conventional calculations, the analysis was found to give the most realistic results. As a result of this study, a design optimization for an overhead crane box girder has been done. In this paper, the comparison between the analytical calculations and the finite element analysis results were investigated. Thus from the above results, we can state that the design optimization of EOT crane box girder has been achieved without compromising the strength and rigidity. We have reduced the overall mass of the girder by 29%. As the overall mass of the girder has reduced, the initial cost for the structural building, civil work and electrical consumption for the crane has also reduced

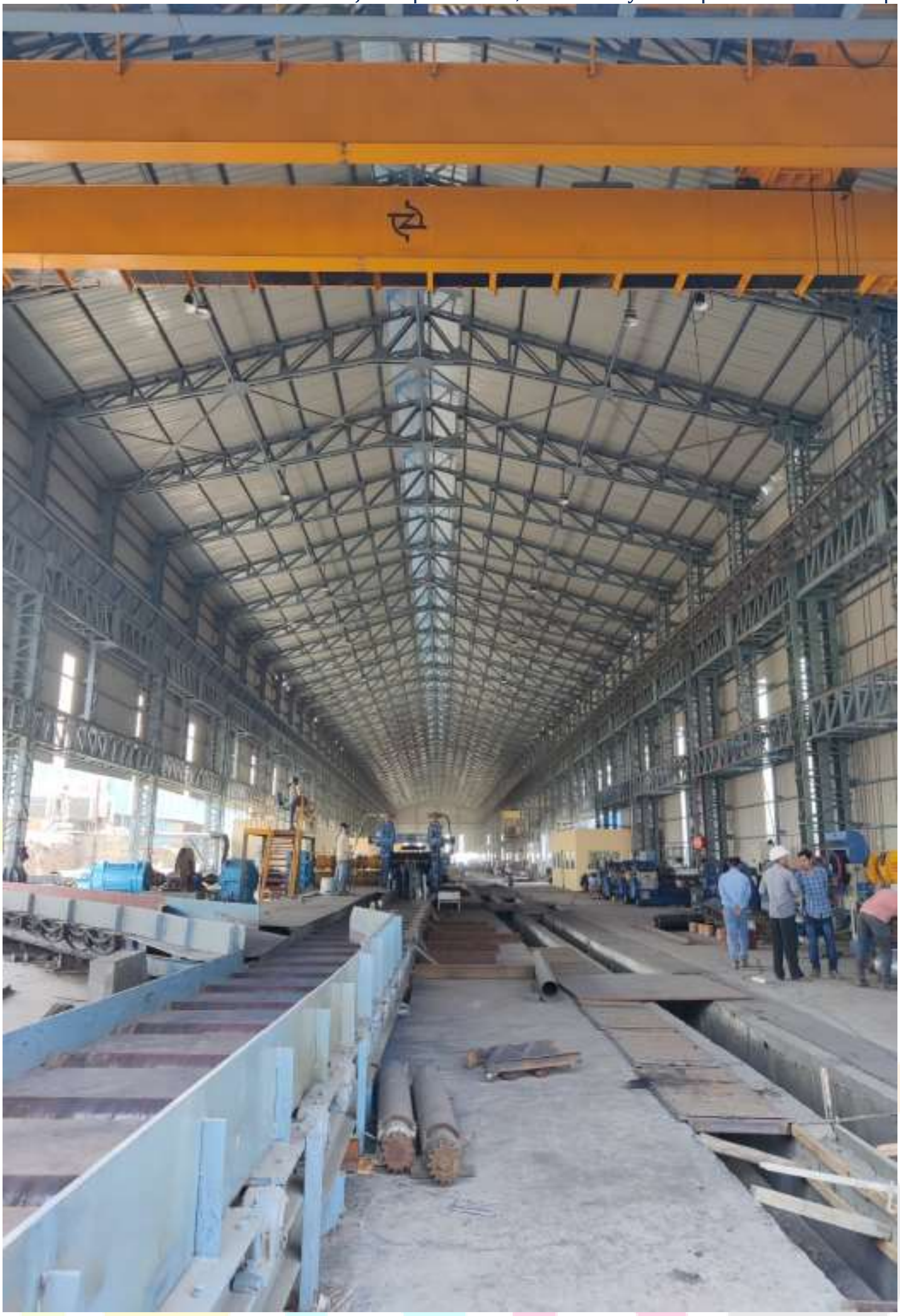


Figure1.8 EOT Crane fixing Work

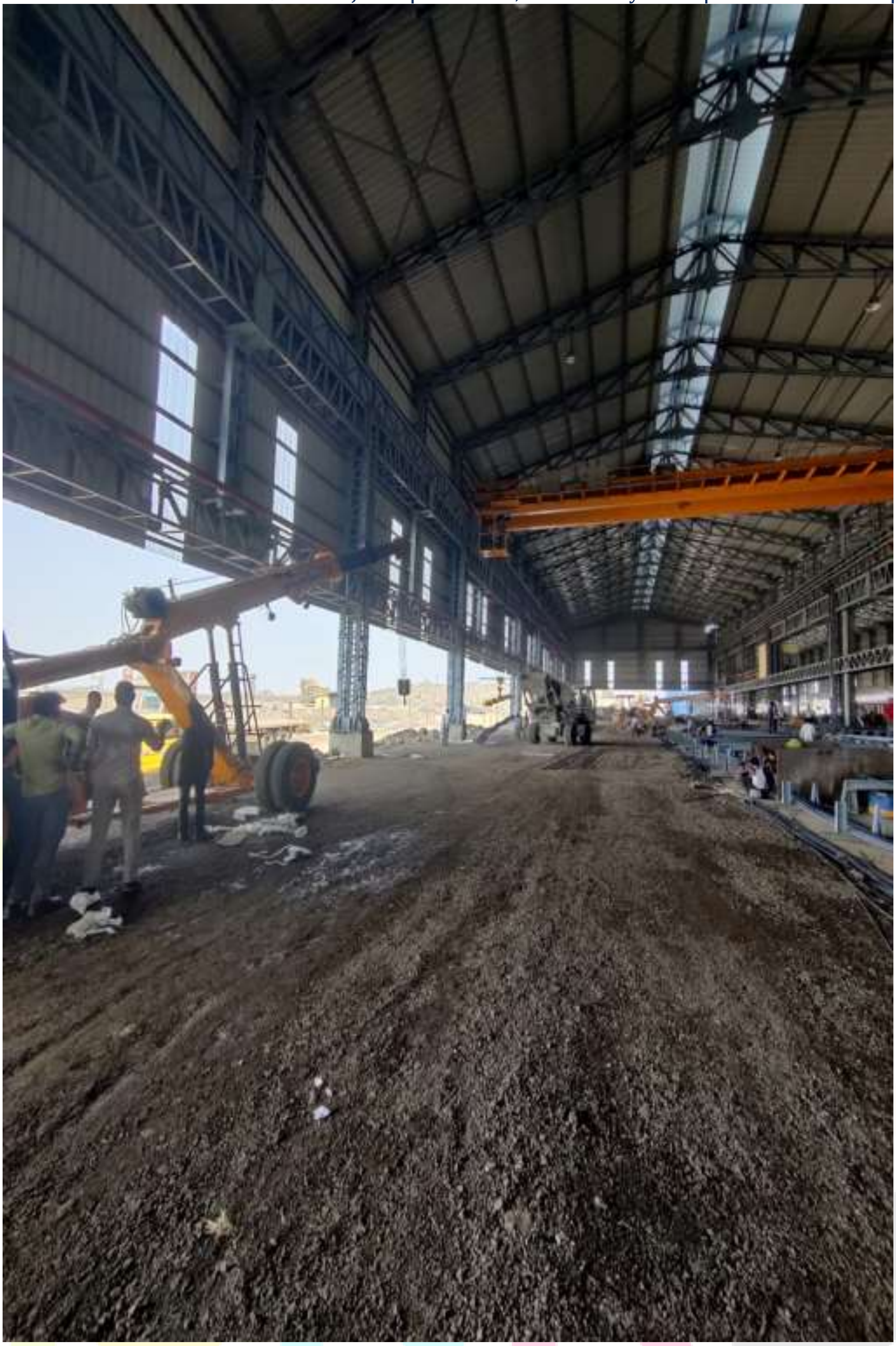


Figure 1.9 Electric Overhead Crane fixing Work

Figure 1.10 Actual Site Photos After Crane Fixing

Equivalent Lateral Force Acting on Structure

This method of finding lateral forces is also known as the static method or the equivalent static method or the seismic coefficient method. The static method is the simplest one and it requires less computational effort and is based on formulae given in the code of practice.

In all the methods of examining a Structural frame with foundation recommended in the code, the structure is treated as discrete system having concentrated masses at floor levels which include the weight of columns and walls in any storey should be equally distributed to the floors above and below. In addition, the appropriate amount of imposed load at this floor is also lumped with it. It is also assumed that the structure flexible and will deflect with respect to the position of foundation the lumped mass system reduces to the solution of a system of second order differential equations. These equations are formed by distribution, of mass and stiffness in a structure, together with its damping characteristics of the ground motion.

Lateral Force Distribution of Base Shear on foundation

The computed base shear is now distributed along the structure, the shear force , at any level depends on the mass at that level and deforms shape of the structure . Earth quake forces deflect a structure into number of shapes known as the natural mode shapes. Number of natural mode shapes depends up on the degree of freedom of the system Generally a structure has continuous system with infinite degree of freedom the magnitude of the lateral force at a particular floor (node) depends on the mass of the node , the distribution of stiffness over the height of the structure , and the nodal displacement in the given mode. The actual distribution of base share over the height of the building is obtained as the superposition of all the mode of vibration of the multi - degree of freedom system

Deformation Based Design of Structure

Deformation is the key parameter in performance-based structural design rather than force or strength that is used in conventional code design approaches because performance is characterized by the level of damage and damage is related to the degree of elastic and inelastic deformation in components and systems.

Deformations can be classified into three types:
1. Overall Structural and foundation movements
2. Foundation drifts and other internal relative deformations.
3. Inelastic deformations of structural components and elements. Overall Structural movement enables a qualitative assessment of project performance only. Although total structural deformation can provide some measure of the significance of $P - \Delta$ effects on the response of a structure, this is of limited value since peak deflection is transitory. When a structure vibrating. An earthquake can be resolved in any vibrating. An earthquake can be resolved in any three mutually perpendicular directions-the two horizontal directions (longitudinal and transverse displacement) and the vertical direction (rotation).This motion causes the structure to vibrate or shake in all three directions; the predominant direction of shaking is horizontal. All the structures are

designed for the combined effects of gravity loads and seismic loads to verify that adequate vertical and lateral strength and stiffness are achieved to satisfy the structural performance and acceptable deformation levels prescribed in the governing building code. Because of the inherent factor of safety used in the design specifications, most structures tend to be adequately protected against vertical shaking. Vertical acceleration should also be considered in structures with large spans, those in which stability for design, or for overall stability analysis of structures.

In general, most earthquake code provisions implicitly require that structures be able to resist:

1. Minor earthquakes without any damage.

2. Moderate earthquakes with negligible structural damage and some non-structural damage.

3. Major earthquakes with some structural and non-structural damage but without collapse.

The structure is expected to undergo fairly large deformations by yielding in some structural members.

To avoid collapse during a major earthquake, members must be ductile enough to absorb and dissipate energy by post-elastic deformation. Redundancy in the structural system permits redistribution of internal forces in the event of the failure of key elements, when the element or system forces yields to fails, the lateral forces can be redistributed to a secondary system to prevent progressive primary failure.

PARAMETERS INFLUENCING VIBRATION WITH LATERAL FORCES ON STRUCTURE AND MACHINE FOUNDATION

Structural parameters that influence the vibrations of a machine-foundation system are mainly(i) overall foundation size, (ii) depth of embedment, (iii) sizes of the foundation members like columns, beam, deck slab, cantilever projections, etc., (iv) dynamic soil parameters or dynamic soil-pile properties and (v) dynamic forces, both internally generated as well as externally applied. The three constituents, viz., machine, foundation and soil, contribute to the frequencies of the system. When the system is subjected to dynamic forces (whether internally generated, externally applied, or transmitted through the soil), we get response of the system. If the response is well within the prescribed limits, it is fine; otherwise, it calls for modifications in the system till the response achieved becomes satisfactory. Such a statement is qualitative and its implementation requires complete knowledge of each constituent and experience to precisely identify the modification. At the design stage it is possible to play with the parameters of each constituent to bring down the response under the control limits. However, if such a check/modification is not implemented at the design stage, it may not be that simple to apply desired modifications after the foundation is cast and the machine is placed in position. In either case it may be desirable to know the uncertainties associated with each constituent before one even attempts the design or its modification.

Figure 1.11 LATERAL FORCES ON STRUCTURE AND MACHINE FOUNDATION

Figure 1.12 Rolling Mill Hot Iron Bar Rolled front and Back For TMT

FOUNDATION PARAMETERS FOR DYNAMIC LOADS

Foundations for equipment transmitting dynamic loads can be either rigid mat foundations, flexible raft foundations or deep foundations (piles and piers). The quality of the soil, the magnitude of the loads, geometry requirements and vibration performance criteria will define which type should be selected. In case of rigid mat foundations, several sources provide procedures to define the soil springs and damping constants, to be used in a model of six degree of freedom possible vibration/excitation modes

When a foundation becomes larger so that it is classified as flexible, it is required to model it as a series of discrete elements (with at least bending capability), connected by springs and damping elements and supported by soil springs and damping elements. The soil spring constant calculated for the total foundation should be adjusted to the joint regarding the bordering areas for a rigid mat.

This analysis requires computer aided engineering (CAE) for the dynamic analysis. On the other hand, deep foundations have a different behavior than direct foundations requiring special methods for evaluation of the spring and damping constants.

Figure 1.13 Dynamic load Acting on Foundation

Comparative Study on Analysis and Cost of R.C.C. and Steel-Composite Structure

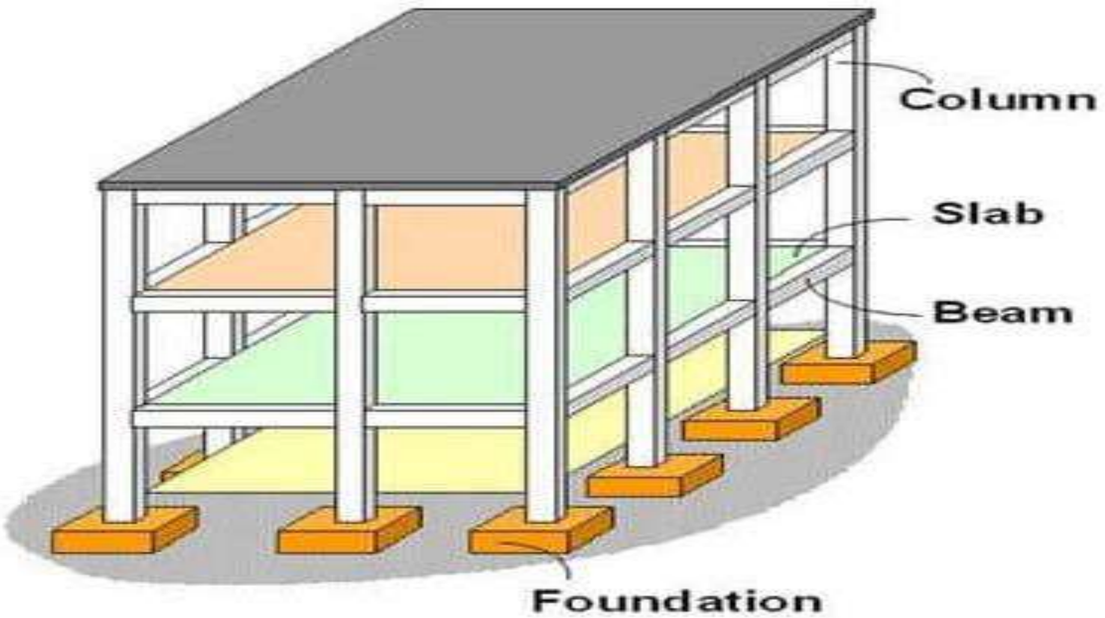
Structures in which composite sections made up of two different types of materials such as steel and concrete are used for beams, and columns is called as Composite structures. In this paper we compared the RCC with steel – concrete

Comparative study includes Storey Stiffness, Displacement, Drifts, Axial Force in column, Shear force in column, Twisting Moment, Bending Moments in composite with respect to RCC Sections. Steel-concrete composite frame system can provide an effective and economic solution to most of these problems composite

1). Conventional RCC System:

The design of housing and residential building is influenced by many factors, including durability, long life and aesthetics. Presently the method which predominantly used in surrounding is Reinforced Cement Concrete (R.C.C.). This conventional method of RCC structure is sturdy and durable, but in rural or some semi-urban localities people compromises with the quality of concrete which actually needs to be used.

If it happens so, building in its design life lacks in serviceability. Speed of construction is also one factor of RCC. An over dependence on concrete is alarming to environment. Once the building life is completed it is demolished and the remaining waste concrete is non-degradable and cannot be recycled. So it is important to find alternative options.



2). Steel Structural System:

Steel structure is used on large scale in industrial sector but now it is a need to make it possible in construction of residential and commercial buildings also. Steel framed structure can overcome the above mention flaws. The section which will be formed will not be much heavier, either they can be easily transported from fabrication plant or can be fabricated on site.

The most important advantage is that the speed of construction will be much faster than other prevailing work. Off all the structural building material in use today steel is the most used and versatile material for engineering construction. Steel being light weight it has supremacy, that steel structures are generally light in comparison to those constructed using other available materials. The durability and potency that steel provides is not matched by concrete or wood. Steel structure is an assemblage of group members which are design to sustain the upcoming loads.

Steel is highly elastic, ductile, malleable and weld able. Steel have high tensile strength and also stands wear and tear much better. The most important characteristics of steel used are its flexibility that it can bend without cracking. Steel structures are particularly good at providing an energy dissipation capability. Steel is a material which has high strength per unit mass. This Steel structure can be one of the solutions to the many housing schemes govern by different authorities where they plan to provide roof to needy peoples.

STRUCTURE DESCRIPTION

Structural steel building as per the name suggests that 'structural steel' is major compotent/construction material of this building. Structural steel is generally taken to include a wide variety of elements or components used in the construction of buildings; they include beams, girders, column sections, plates and purlins. Many of these elements are made from standard hot rolled sections, cold formed shapes or made up from plates using welding. These components are joined at connections using plates, structural components, welding or fasteners. A variety of steel types are used to produce these structural elements, plates and other components, depending on the intended use, cost and weight of the structure and corrosion resistance. When discussion is on different components of steel building which helps in ideal behaviour and load carrying of building, comprises of columns, stanchion, beams, girders, slab systems, etc.

In its simplest terms in steel frames, similar to the other systems, the vertical load carrying structure comprises a system of vertical load carrying columns and other elements interconnected by horizontal beam elements which support slab systems. The resistance of lateral loads is provided by column-to-column beams or primary beams, secondary beams and slab systems.

1). Column

Usually universal columns, standard hot rolled sections or rectangular and circular hollow columns are used for the vertical load transferring in the steel structures since they provide the easiest connection details. According to them, rectangular and circular hollow columns have better stability and therefore they are preferred prior to other options of columns. In multistory structures the dimensions of the steel columns can easily be kept constant with or without changing the thickness of member.

1.14 Structural Column After Placing on Bolts

2)Beams and Girders

Members that carry transverse loads are beams. The structural steel deck floor construction generally consists of secondary floor beams in-situ concrete slab. The most efficient floor plan in steel structures is in rectangular shape. The secondary floor beams which are closely spaced at the distance of about a meter are supported by primary beams.

These primary beams are usually of rolled sections but can often take the form of castellated beams, fabricated plate girders or taper beams because of heavy loading, deeper construction and the possible need for service penetration.

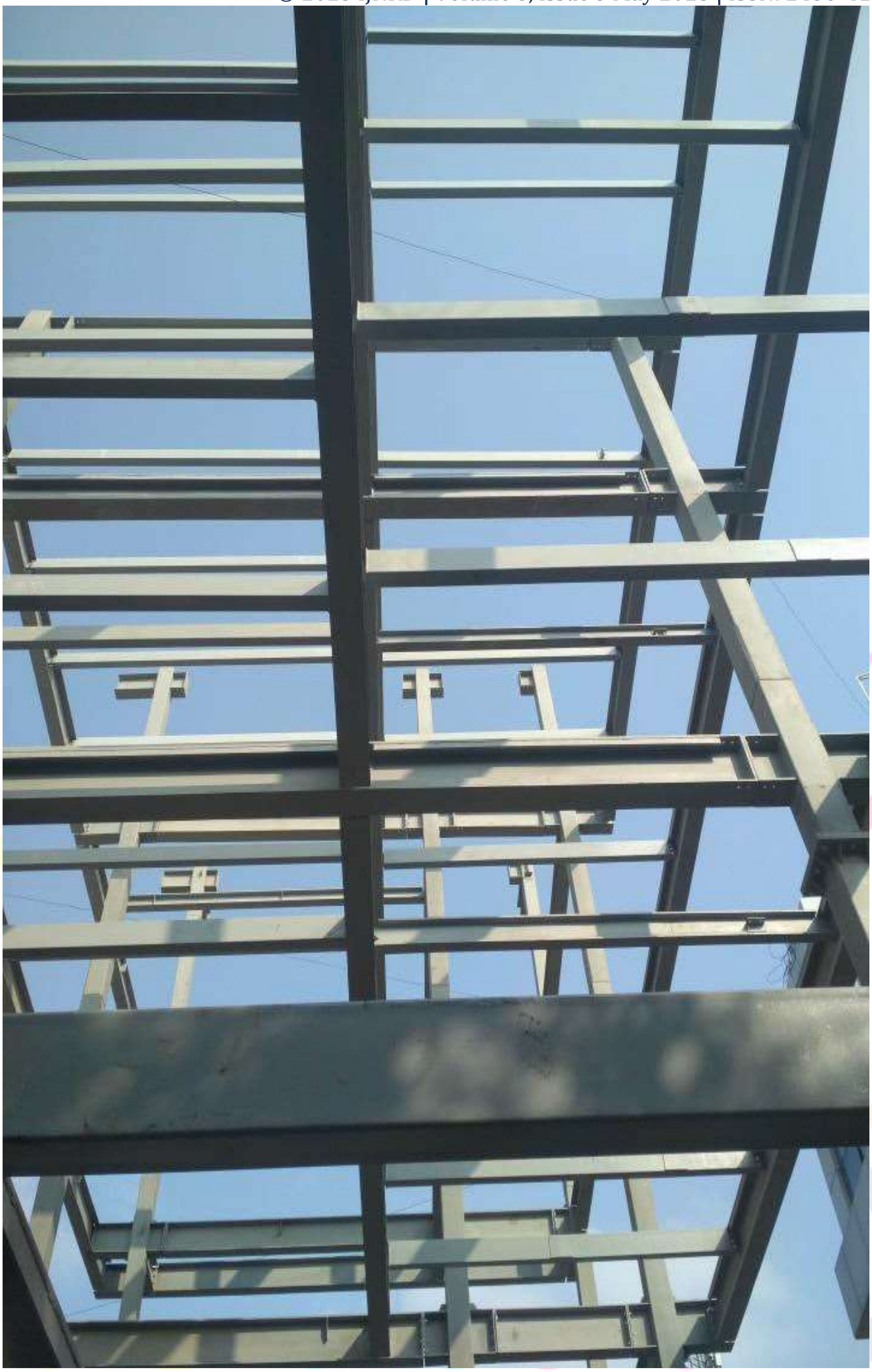


Figure 1.15 Structural Bolted Beam Work

4) Connections:

Connections are required to join individual members of the steel structures together to ensure composite action thus to transfer axial loads, shear, moment and torsion from one component to another. The design of connections between individual frame components is the most important aspect of structural steelwork for buildings.

There are several methods of connecting steel members. The selection of a particular connection system should be governed not only by its capability to support the applied load, but also by the ease of connection to other components.

Figure 1.16 Welding Connections

Riveting and Welding:

Figure 1.17 7 Structural riveting and welding.

Steel sections can be fastened together by rivets, bolts, and welds. Although rivets were used quite extensively in the past, their use in modern steel construction has become almost obsolete. Bolts have essentially replaced rivets as the primary means to connect non-welded structural components. It is generally cheaper to make a bolted joint than a welded one (particularly on site) so a designer will usually choose bolted work for both site and workshop with some shop welding where warranted by engineering design. According to the literature, site welding is utilized where the full strength of a member must be used at a connection and where tolerance, geometry or aesthetics require welded connections.

In externally exposed work, welding is often preferred to avoid rainwater penetrating behind splice plates on exposed steel. High strength friction grip (HSFG) bolts work in much the same way. The bolt is tightened to some predetermined stress and it is this prestress which holds the two components together by friction. HSFG bolts are made from quenched and tempered alloy steel in order to obtain a high yield point combined with good ductility. Welding is perhaps the most important process used in the fabrication and erection of structural steelwork.

It is used very extensively to join components to make up members and to join members into assemblies and structures. Welding can save costs and reduce member sizes by dispensing with the need for brackets and plates at connections and by allowing the use of the whole cross-section of a member by eliminating holes for bolts. Whatever the process, all welds should comply with two requirements as above mentioned.

ADVANTAGES

Compared to the conventional RCC building structure, the new steel building structure has below enlisted advantages:

i) Steel building structure is light weight, high intensity and good seismic performance.
ii) The uniformity in the quality of structural steel used for construction.
iii) Steel building structure has quick construction speed and investment recovery is faster.
iv) Steel building structure is easy for large scale production.
v) In steel building structure architectural space decorations are varied.
vi) Steel building structure is environmentally protected and energy saving.
vii) Steel building fireproof performance is good
viii) Economically Cost saving is on much higher side compared to RCC Structure.

CHAPTER 2

LITERATURE REVIEW

In order to understand the latest trends, past and ongoing research development, a focused survey of the technical articles and journal paper was performed, to understand the research components which are been done and the methodology used for it and the arriving conclusion.

J.Dario ochao- (2015) has taken various structural design as well as provides guideline and value information related to structural loading and weather related loads, Relative reliability based on design and loading specific applird to prevent different type of failures as well as loads

Umesh P. Patil , (2015) have studied a comparing the RCC structures, steel concrete composite system are being more popular due to the various advantages they offer.

Design of Steel Structures: By Limit State Method as Per IS: 800-2007" by S S Bhavikatti
"Design of Steel Structures: By Limit State Method as Per IS: 800-2007" Book Review: This book is written for the undergraduate students of metallurgical engineering. It can also be used by working professionals as a reference.

Steel Structures: Design and Practice" by N Subramanian
"Steel Structures: Design and Practice" Book Review: This book is written for the postgraduate students of metallurgical engineering.

Design of Steel Structures" by Negi
"Design of Steel Structures" Book Review: This book is written for the undergraduate students of metallurgical engineering.

Fundamental Aspects of Structural Alloy Design (Battelle Institute Materials Science Colloquia)" by Robert Jaffee
"Fundamental Aspects of Structural Alloy Design (Battelle Institute Materials Science Colloquia)" Book Review:

Brittle Fracture in Steel Structures" by G M Boyd and G M Boyd
"Brittle Fracture in Steel Structures" Book Review: This book is written for the undergraduate students of metallurgical engineering.

The Structures of Alloys of Iron: An Elementary Introduction" by D W Hopkins and W S Owen
"The Structures of Alloys of Iron: An Elementary Introduction" Book Review: This book is written for the undergraduate students of metallurgical engineering.

Barkan, D.D. (1962). "Dynamics of Bases and Foundations", McGraw-Hill Book Company, NewYork, U.S.A.

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IS:875(part 3)-1987. Code of practice for design loads(other Than earthquake) for buildings and structures, wind loads.
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Gorakh Vinit, Nishit Kadia and Kiranmoy Samanta (2018), "Comparative Study of R.C.C. and Steel Structures for Different Floor Heights".

Pramod M Gajbe and Prof. R. V. K. Prasad (2016), "Analysis of Soft story Multistoried Steel Structure Building", International Journal of Engineering Sciences and Research Technology (IJESRT).

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Prof. Prakash Sangave, Mr. Nikhil Madur, Mr. Sagar Waghmare and Mr. Rakesh Shete (2015), "Comparative Study of Analysis and Design of R.C. and Steel Structures",

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P. Sudheer Kumar, Meghashree T. N., T. Pranay Kumar (2017), "Seismic Analysis of Multi-storey Steel Structure", International Research Journal of Engineering and Technology.

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Ms. Deepika P. Hiwrale, Prof. P. S. Pajgade (2012), "Analysis and Design of Steel Framed Building with and without Steel Plate Shear Walls", International Journal of Scientific and Engineering Research,.

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Bimala Pillai and Priyabrata Guha (2015), "Comparison Between RCC and Steel Structure with Wind and Earthquake Effect using Staad Pro", International Journal of Applied Research.

.**Bhavin Zaveri, Jasmin Gadhiya and Hitesh Dhameliya** (2016), “A Review on the Comparative Study of Steel, RCC and Composite Building”,

.**Sattainathan Sharma, G. R. Iyappan and J. Harish** (2015), “Comparative Study of Cost and Time Evaluation in RCC, Steel and Composite High Rise Building.

.**Avani Mandlik, S. K. Sharma and Shahjad Mohammad** (2016), “Behavior of Symmetrical RCC and Steel Framed Structures under Seismic and Wind Loading”,

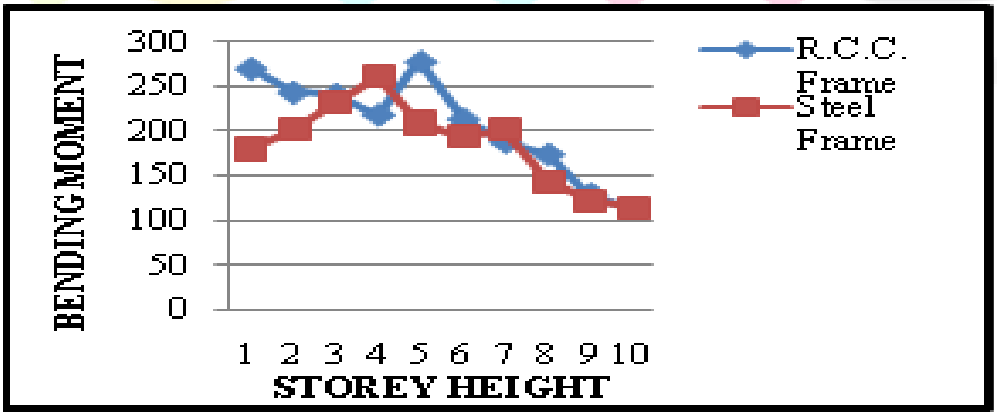
CHAPTER- 3

Methodolody & Analysis:

The methodology & analysis is carried out using equivalent static method for both the type of building. By using Extended-three dimensional Analysis of Building Structure (E-TABS) software, the models of both structures were analyzed. The study parameters were deflection, shear force, bending moment, story drift, stiffness and displacement. Since the design is related to India, for calculation of seismic loads and parameters, Indian standard of code for earthquake resistant design of structures IS 1893 (PART-1): 2002 and IS-875 (PART-3) were referred for values.

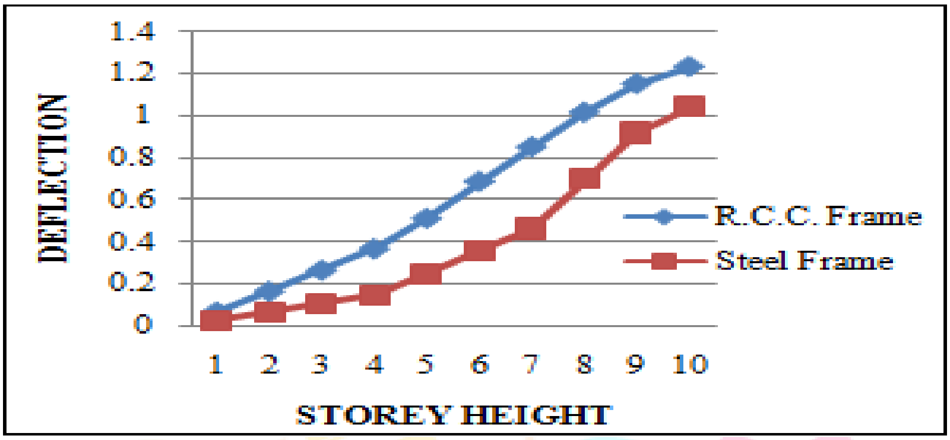
Comparison of various parameters RCC and Composite Structure

Comparision Property	RCC	Composite	Reduction, %
Max.Axial Force (kN)	9874.87	7587.08	23.16
Max.Shear Force (kN) x-axis y-axis	166.9 kN 131.1 kN	113.45 100.25	2.05 23.56
Max.B.M (kN.m) (x-axis) (z-axis)	510.4 581.2	434.7 441	14.76 24.12
Weight (kN)	309387.5	239813.8	22.48

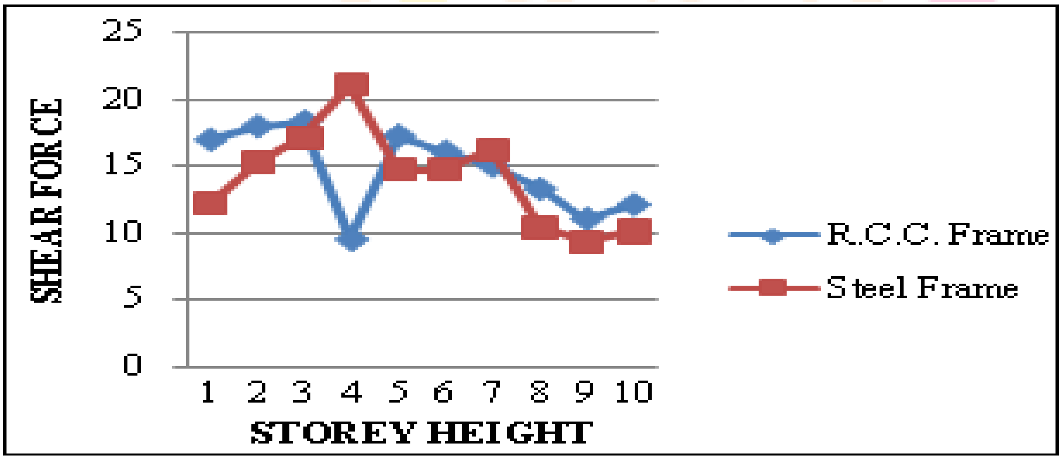


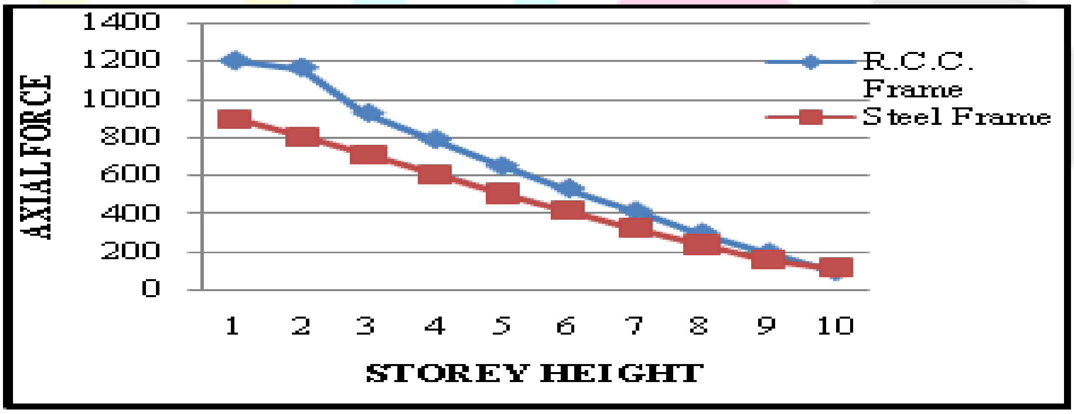
After analyzing the model the bending moments for different combinations are obtained and from that the maximum value of bending moments are considered for the design of the beams and connections in steel structural systems. Comparison graph has story levels on X-axis and bending moment in kNm on Y-axis.

The Fig.7 shows that there is significant reduction in B.M of column (Z-DIR) in composite structure.



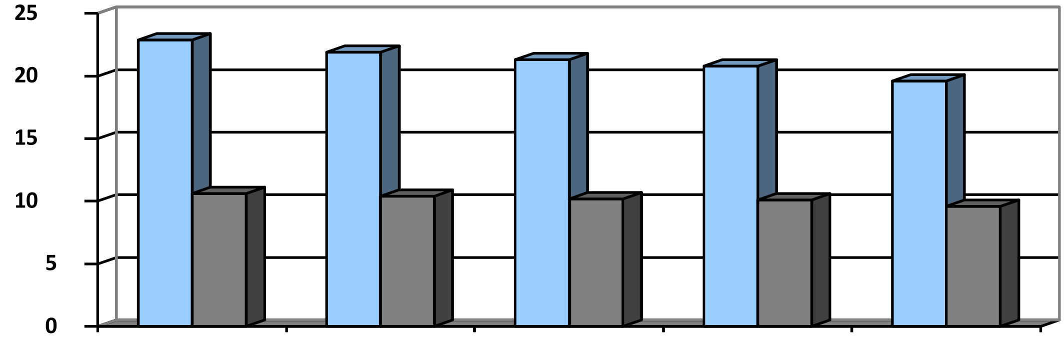
The Fig.4 shows that the deflection in composite structure is nearly double than that of R.C.C structure but within permissible limit





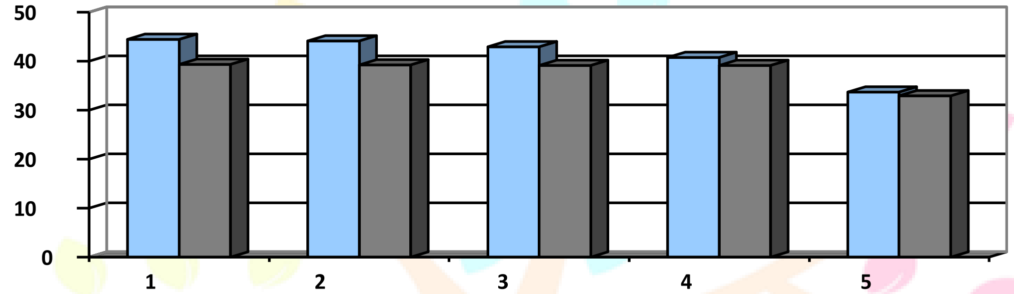
BENDING MOMENT

After analyzing the model the bending moments for different combinations are obtained and from that the maximum value of bending moments are considered for the design of the beams and connections in steel structural systems. Comparison graph has story levels on X-axis and bending moment in kNm on Y-axis.



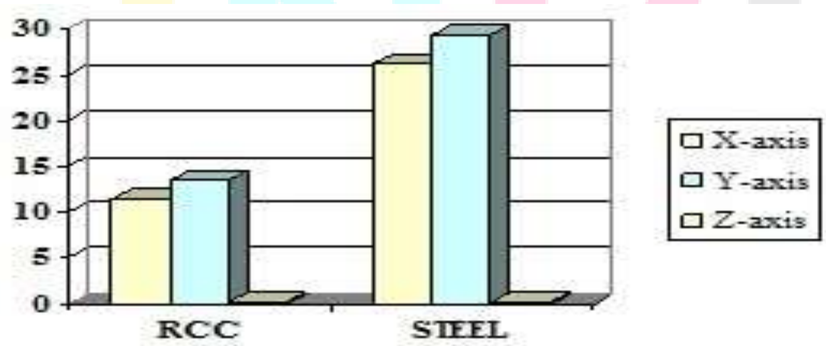
SHEAR FORCE:

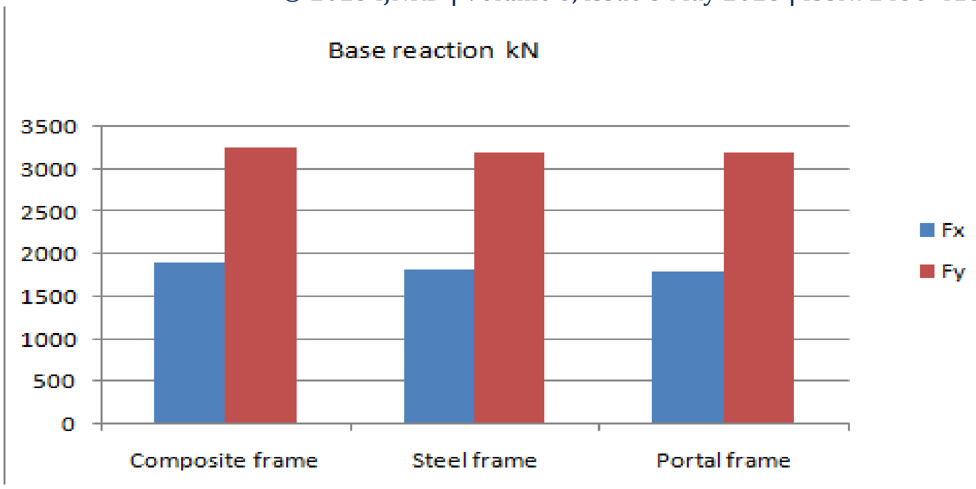
After analyzing the model the Shear Force for different combinations are obtained and from that the maximum value of Shear Force are considered for the designing of shear reinforcement in RCC and connections in steel structural systems. Comparison graph has story levels on X-axis and shear force in kN on Y-axis.



DISPLACEMENT:

Maximum displacement of the building is obtained from the displacement at tower level, at that level displacement in three different directions is be compared. As we known that more the displacement is less is the stability of the building, in that way the graph will be studied. Comparison graph has different structural systems with 3 different axis details on X-axis and displacements in mm on Y-axis.





The base reaction of different frames is listed corresponding to X and Y directions. And this ascertains the variations in base reaction of entire structure as the frame section is replaced by 3 different types of frames

CHAPTER 4

CONCLUSION

On the following work carried out we conclude that,

1. Steel structures are expected to show superior performance under earthquake due to high ductility than the conventional RCC structure.

2. Axial forces are lower in steel structure due to lower weight of steel structure compared to RCC structure. Due to this the reaction obtained in steel is lesser than RCC, which gives better response during earthquake conditions.

3. According to the results of analysis when maximum displacement and story drift is compared it is quite higher in steel structure than in RCC. This shows that Steel Structure is more durable and sturdy.

4. Bending moment and Shear force in beams of RCC structures is more as compared to that of steel structures.

5.Cost Wise Steel Structure is more economical than RCC Structure.

6.RCC Structure needs large foundation for its sustainability as compared to steel structure has no demand for large foundations.

7. According to result the deflection of steel structure is quite higher than RCC as steel is a ductile material and allows a large deflection.

8. The Project Was Executed and Completed by Rehoboth Construction Engineer in Charge: Er. Jibin George Abraham.