COMPARATIVE STUDY ON R.C.C AND COMPOSITE BUILDING

Submitted by

Wasek Al Nafi

Student ID: 191-47-876

Ankon Chandra Paul

Student ID: 191-47-914

Peo Sarkar

Student ID: 191-47-906

Md. Nayeemul Hasan

Student ID: 191-47-955

Md. Jinnat Hossain Tushar

Student ID: 191-47-893

Supervised by

Mr. Md. Imran Hasan Bappy

Lecturer

Department of Civil Engineering

A Thesis Submitted to the Department of Civil Engineering, Daffodil International University in partial fulfillment of the requirements for the award of Degree of

Bachelor of Science in Civil Engineering

Department of Civil Engineering

DAFFODIL INTERNATIONAL UNIVERSITY

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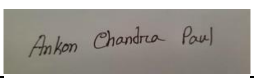
CERTIFICATION

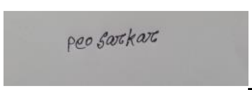
This is to certify that this project and thesis entitled “Comparative Study on R.C.C and Composite Building” is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the department of Civil Engineering under the faculty of engineering of a Daffodil International University in partial fulfillment of the requirements for the degree of **Bachelor of Science** in Civil Engineering. The presentation of the work was held on September 2022.

Signature of the candidates

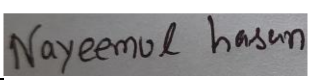
Wasek Al Nafi
Student ID: 191-47-876



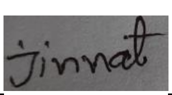
Ankon Chandra Paul
Student ID: 191-47-914



Peo Sarkar
Student ID: 191-47-906



Md. Nayeemul Hasan
Student ID: 191-47-955



Md. Jinnat Hossain Tushar
Student ID: 191-47-893

Countersigned

Mr. Md. Imran Hasan Bappy
Lecturer
Department of Civil Engineering
Faculty of Engineering
Daffodil International University.

The thesis titled “**Comparative Study on R.C.C and Composite Building”** was submitted by **Wasek Al Nafi**, Student ID: 191-47-876, **Ankon Chandra Paul**, Student ID: 191-47-914, **Peo Sarkar,** Student ID:191-47-906**, Md. Nayeemul Hasan,** Student ID:191-47-955 and **Md. Jinnat Hossain Tushar,** Student ID**:**191-47-893 has been accepted as satisfactory in partial fulfillment of the requirements for the award of Degree of Bachelor of Science in Civil Engineering on September 2022.

BOARD OF EXAMINERS

Mr. Md. Imran Hasan Bappy
(Supervisor)
Department of Civil Engineering
Daffodil International University

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Chairman
Department of Civil Engineering
Daffodil International University

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Department of Civil Engineering
Daffodil International University

Rayhan Md. Faysal
Member (Internal)
Department of Civil Engineering

DEDICATION

Dedicated to

OUR PARENTS & ALL WELL-WISHERS

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LIST OF ABBREVIATIONS

FEC Fully Encased Composite

PEC Partially Encased Composite

CFT Concrete Filled Tubes

fc' Compressive strength of concrete

fy Yield strength of steel

Es Modulus of Elasticity

Pe Elastic buckling strength

Pn Nominal compressive strength

ACKNOWLEDGEMENT

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ABSTRACT

The composite reinforced concrete structure has gained widespread recognition worldwide as an alternative to pure steel and pure concrete structures. However, this approach is a new concept for the construction sector. Composite reinforced concrete elements are widely used in modern buildings. Extensive research of composite column, composite beam and bridge deck, where the structural steel profile is packed in precast concrete. However, for medium to high buildings, the RCC structure is no longer economical due to increased self-loading, less rigidity, span control and dangerous shape. The results of this work show that composite structures are the most effective solution for high structure compared to the structure of R.C.C.

Keywords: Composite Structure, RCC Structure, Composite Column, composite floor, Steel Beam, Shear Connector, Time History Analysis, Equivalent Linear Static Method, Industrial Building, Cost Difference, ETABS software.

CHAPTER 1

INTRODUCTION

1.1 General

Steel and concrete are two building elements that are widely and inexorably employed in today's modern period of innovation for structures ranging from skyscrapers to bridges. Despite the fact that these two materials might have diverse qualities and traits, they seem to interact in a variety of ways. Although steel has a low weight-to-strength ratio and excellent resistance to tensile loads, thin profiles are frequently utilized in engineering. Conversely, concrete has strong compressive strength resistance. Steel is a crucial component for tall buildings because it may be utilized to increase ductility, and concrete can be used for corrosion protection and thermal insulation. Additionally, it is possible to stop steel from tying up in concrete. This entails maximizing the advantages of similar composite building materials, which are strongly favored when employing steel in construction, which is extremely low in Bangladesh compared to many developing countries. This is not a result of the economic scarcity of steel as a building material, as experience from other nations has demonstrated. The building industry has a significant potential to use more steel, especially considering Bangladesh's current development requirements. It is a major loss for the nation if steel is not investigated as a substitute for other building materials and is not utilized when it is cost-effective. Additionally, composite profiles made of steel-coated concrete offer more affordable, timely, and cost-effective options for huge civic projects like bridges and towering buildings. The goal of this research document is to examine the most recent methods for assessing how well R.C.C. and composite buildings withstand earthquakes. The structural behavior of R.C.C. and combination high-rise buildings is studied analytically in this paper. The factors taken into account include displacement, axial forces, base abrasion, and climatic conditions. Through the analysis, it is possible to see data like maximum displacement values, fundamental shear, and natural timings. The 3D analysis was carried out using ETABS structural analysis software.

1.2 ADVANTAGES OF COMPOSITE STRUCTURE

1. Composites outperform traditional materials like steel in terms of strength per pound. Composites' two main ingredients, fibers and resins, both contribute to their tensile strength. The weight is carried by the fibers, and the resins distribute it appropriately throughout the composite part.

2. In comparison to the majority of woods and metals, composites are lightweight. Why, though, is lighter better? Lighter items are simpler to move and install, including utility poles and bridge decks.

3. Composites are resistant to weather degradation and corrosive chemicals that can destroy other materials. Because of this, they are suitable for situations where salt water, hazardous chemicals, temperature changes, and other harsh conditions are present constantly.

4. Composites give for flexible design options due to the vast range of material combinations that can be utilized. The materials can be specially made to meet the particular requirements of each application. Additionally, composites are simple to mold into intricate designs.

5. Composite structures last a long time and require little upkeep.

1.3 COMPONENTS OF COMPOSITE BUILDINGS

The essential primary parts use in composite development comprises of the accompanying components.

1. Composite Deck Slab

2. Composite Beam

3. Composite Column

4. Shear connector

1.3.1 COMPOSITE DECK SLAB

Concrete, metal decking, and steel radiates make up the composite floor framework. They are combined in an incredibly efficient way so that the best qualities of each material can be used to improve development processes. A rolled or developed steel pillar connected to a shaped steel deck and substantial component is the most popular design used in composite floor frameworks. The metal deck serves as a working platform for cementing activity while typically spanning unsupported between steel individuals. The composite floor situation provides a rigid level stomach, ensuring the stability of the overall structure's framework while also circulating air and seismic shears to the horizontally opposing frameworks that bear the weight of the main structure. The heap transporting limit and solidity is constructed through composite activity using approximately 2 and 3.5 different parts. The steel provides the strain component, the significant structures the pressure rib, and shear connectors ensure that the segment operates compositely. The interior area can be best divided and customized with pillar ranges of 6 to 12 m. Steel decking that is 46 to 80 mm deep and can go 3 to 4.5 m without requiring a short setup is used with composite chunks. For shallow decking, piece thicknesses are typically between 100 and 250 mm, and between 280 and 320 mm for deep decking. Typically, composite pieces are intended as essentially upheld individuals in the normal state, with no record of the coherence being taken.

1.3.2 COMPOSITE BEAM

In a typical composite construction, large parts are supported by and rest over steel radiates. When under load, these two components move independently, and if there is no association between them, a general slide occurs at the site of interaction. They can be eliminated with the help of a purposeful and appropriate association. The steel bar and the chunk function as a "composite pillar" in this condition and behave like a solid Tee bar. However, steel and cement are the two materials that are most frequently used to make composite pillars. Other materials, like pre-focused cement and wood, can also be used Steel is helpless against pressure that locks in, and concrete is more grounded in pressure than in strain. We may utilize each person's benefit to the greatest extent possible by combining the two activities. Steel radiates are primarily connected to preassembled or projected in situ supported substantial parts in steel-substantial composite shafts. Zero at the midpoint and maximum at the support of the recently supported pillar exposed to appropriately uniform load. Shear is consequently less in connectors close to the centre and more extreme in connectors close to the support. Compo-site radiates are frequently designed with the assumption that the steel bar will support the development load as well as the weight of the primary steel or wet substantial. This method results in significantly fewer connectors than expected, allowing for the achievement of the composite pillar's largest twisting obstruction. However, using such a fractional shear relationship results in less obstruction and stiffness.

1.3.2.1 ADVANTAGES OF COMPOSITE BEAMS

1. Keeping the range and stacking unaltered, more conservative steel segment regarding profundity and weight is satisfactory in composite development contrasted and traditional non-composite development.

2. Encased steel shaft segments have further developed imperviousness to fire and consumption.

3. It fulfilled prerequisite of long-range development a cutting-edge pattern in compositional plan.

4. Composite development is amiable to quick track development in view of purpose of moved steel segments.

5. Composite areas have higher solidness than the relating steel segments and hence the redirection is lesser.

6. Allows simple underlying fixes/adjustment.

7. Gives impressive adaptability in plan and simplicity of manufacture.

8. Empowers simple development planning for blocked locales.

9. Decrease in generally weight of the construction and there by decrease in establishment cost.

10. Appropriate to oppose rehashed seismic tremor stacking which requires high measure of opposition and ductility.

1.3.3 COMPOSITE COLUMN

A pressure part that includes both a substantial encased hot moved steel segment and a substantial filled empty part of hot moved steel is referred to as a steel substantial composite segment. It is typically used as a load bearing component in a compositely designed structure. Individuals who are composite are primarily subjected to pressure and bowing. There is currently no Bangladeshi standard code that covers the plan of composite section. In this report, the configuration technique generally follows EC4, which consolidates the most recent examination on composite development. The Bangladeshi composite development standard IS 11384-1985 makes no mention of composite sections. This technique also reinforces the European kicking bends for steel segments, which are an essential component of section design.

1.3.3.2 THE ADVANTAGES OF COMPOSITE COLUMNS ARE

1) Increased strength for a given cross sectional aspect.

2) Increased solidness, prompting diminished slimness and expanded building opposition.

3) Good imperviousness to fire on account of cement encased segments.

4) Corrosion security in encased segments.

5) Significant monetary benefits over either unadulterated primary steel or built up substantial other options.

6) Identical cross areas with various load and second protections can be delivered by shifting steel thickness, the substantial strength and support. This permits the external components of a segment to be held consistent over various floors in a structure, hence improving on the development and building specifying.

7) Erection of elevated structure in a very productive way.

8) Formwork isn't needed for concrete filled rounded segments.

1.3.4. SHEAR CONNECTOR

The total load carried by the shaft is multiplied by the total shear force at the point when a sizable chunk and a steel bar interact. As a result, mechanical shear connectors are anticipated at the site of engagement between the steel and the substantial. These connections are designed to (a) send longitudinal shear along the point of interaction and (b) stop steel bar and considerable section division at the point of interaction. shear connectors that are typically involved, as defined by IS 11384-1985. Unbending shear connectors, adaptable shear connectors, and dock shear connectors are the three main types of shear connectors

1.4 OBJECTIVE OF THE STUDY

Composite reinforced concrete systems have recently become popular for their advantages against the classic design. Concrete in compression and tensile steels have about the same thermal expansion, thus the composite construction utilizes their best qualities to create a structure that can be built quickly.

- To utilize latest BNBC 2020 in our study
- To perform a comparative analysis between RCC and Composite structure using ETABS

1.5 SCOPE OF THE STUDY

This paper is an attempt to study the current state of the art for evaluating the performance of RCC and composite building. In this work is an analytical study of the structural behavior of RCC and composite high-rise buildings the buildings were demolished. The parameters considered are displacement, weight of structure, base shear and natural time of period where. 3D analysis was performed using ETABS structure and results analysis software for the highest values of displacement, weight of structure, base shear and natural time period can be determined by analysis.

1.6 OUTLINE OF THESIS

The research consists of five chapters, references, and appendices arranged as shown below with a brief description.

CHAPTER 1 (INTRODUCTION)

This chapter contains the general description of composite structure, advantages of composite structure and components of composite structure. Also, objectives of the research, scope, and the methodology of the study.

CHAPTER 2 (LITERATURE REVIEW)

A general review of previous research done by researchers.

CHAPTER 3 (METHODOLOGY)

In the current work it is proposed to set up a limited component models of G+6 Story Residential structure utilizing ETABS with fixed base at ground level.

CHAPTER 4 (RESULTS AND DISCUSSION)

This chapter talks about the test results that we get from this experiment, analysis those results, and discusses the results.

CHAPTER 5 (CONCLUSION AND RECOMMENDATIONS)

This chapter discusses the major findings of the experiment & recommendations for future work about it.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

A literature review is an outline of what has been composed on a given subject by qualified scholastics and specialists. It's normal to be approached to think of one as a different work, yet at the same it's more normal for an article, research report, or proposal. The essayist's unbiased for delivering a artistic survey is to pass on to their peruse what data and sentiments have been laid out on a theme, as well as their assets and shortcomings. Literature review act as a manual for a particular subject. On the off chance that you simply have a restricted measure of time to lead research, writing surveys can act as a beginning stage. They're important reports for experts who need to keep steady over what's happening in their area. For scholastics, the profundity and broadness of the writing survey show the writer's validity in their subject. Literature review likewise give a strong structure to an exploration paper's investigation. Most examination projects require broad information on the field's writing.

2.2 ASSEMBLING THE LITERATURE REVIEW

The accompanying components ought to be remembered for writing surveys:

1. An outline of the subject, issue, or thought being talked about, as well as the survey's points.
2. Order of works viable (e.g., those on the side of a specific point of view, those went against, and those proposing total other options)
3. Portray how each piece is connected with and unique in relation to the others.
4. Ends on which components ought to be viewed as in their contention are the most Significant.

They should be convinced of their perspectives and deal the greatest commitment to the Understanding and progression of their field of study.

2.3 PREVIOUS STUDIES REGARDING RCC AND COMPOSITE BUILDING

Prof. Dr. M. Abdel Salam & Dr. Nadia E. Bondok (2015) To determine the flexural stiffness and dynamic characteristics of sandwich beams, a generalization model modeling sandwich beams was created. Investigations have been conducted on a number of situations, including core sandwich beams with various forms and orientations, multicellular sandwich beams, and multilayer sandwich beam cores. The free vibration analysis of the sandwich tree was performed using the boundary element program ANSYS 11, and the static deflection of the sandwich beams as well as the natural frequencies and shapes of the modes were estimated. The shape of core materials is being used in numerous broad variations. The most often utilized among them are corrugated, foam, honeycomb, and raft cores. Aluminum or composite materials like Nomex, glass thermoplastic, or glass phenol are frequently used to make the honeycomb core. Expanded foams, which are frequently the best for achieving comparatively high thermal tolerances, are among of the most popular core materials, while aluminum foams, thermoplastic foams, and thermoplastic foams are also employed. A broad model has been produced. The number of cores, multicell and hole shapes, as well as their orientation, can all have an impact on the tree, the static stiffness, natural frequencies, and consequently the dynamic properties of sandwich beams. The code for finite elements the calculation of the natural frequencies, mode shapes, and static deviation of the sandwich beams was done using ANSYS 11. The study demonstrated that increasing the number of cells and nuclei can alter both the static and dynamic reactions of sandwich bars.

Mahmadsabee (2015) The market's top design software at the moment is ETABS. This most recent software is used by numerous design firms. Since the multi-story concrete frame structure was developed using separate STAAD and ETAB software, the primary focus of this project development project is the virtual analysis of the data acquired. Buildings are constructed in the contemporary world to fulfill our needs and provide better services.

IshaBedi, Girish Sharma (2017) In essence, the RCC frame structure is a collection of connected slabs, beams, columns, and foundations. It is moved to the ground by pillars, followed by the lower pillars, and lastly the foundation. However, in a structure that can support weight, the load is transferred to the ground through walls that are built to do so. The breadth of the load-bearing walls for buildings with more than four stories grows abnormally thick since the brick has inadequate compressive strength compared to cement mortar 1: 2: 4, and frame constructions are built for such instances. A building with a R.C.C. frame has a floor area that is 10–12% bigger than a building with load-bearing walls. Therefore, there is actual economy in the case of RCC frame buildings, especially when the price of land is very expensive. We suggest using SAP, ETABS, and Staad Pro to analyze and compare RCC frame structures. We draw the conclusion that Staad Pro is more effective based on the presented research analysis. Compared to ETABS, de-rived power values are low.

Zhi-jia Zhang Bin Han (2017) in this paper, Sandwich beams with hybrid honeycomb corrugated cores are studied for their vibrational characteristics. To determine the relevant gross stiffnesses of the hybrid honeycomb corrugations, the homogenization approach was applied. Their vibrational properties were predicted using some simple methodologies and modal analysis techniques (i.e. their own frequencies and forms of vision). It turned determined that the predictions made using a comparable homogenization model (2D model) generally agreed with the outcomes of the research and the three-dimensional finite element analysis. Unclamped conditions were used to conduct the modal test on a sandwich rod. The sandwich tree mode's first three natural frequencies and related shapes are reported. An impact hammer, a B&K accelerometer, a charge amplifier, a clamping system, and an LMS-Test-Lab modal analysis system made up the experimental apparatus, as depicted in. Multipoint excitation and single point measurement were used to conduct the experiment. By homogenizing, the matching elastic constant models of the hybrid honeycomb and wavy core were produced. The vibrational behavior of sandwich beams was predicted using the relevant model (2D numerical model). The corresponding model can offer respectable predictions for the mode analysis of a sandwich rod with honeycomb corrugated hybrid cores when compared to the findings obtained using the 3D numerical model and experimental tests.

Additionally, it has been discovered that the honeycomb filling weakens the stiffness anisotropy and suppresses the local regimen's shape for the sandwich bar.

Vidhya Purushothaman, Vineetha Guru Prasad (2018) Sandwich beams are lightweight load-bearing components made of composite systems with a high stiffness to weight and strength to weight ratio. The construction industry is able to create strong, rigid, lightweight, and long-lasting buildings by first using thin, resilient leather straps, followed by thicker and lighter core materials. The dissertation's methodology is explained in this section. The methodology takes into account both ANSYS software and the sandwich tree investigation. The following sections make up the entire dissertation. The technique for the forthcoming dissertation is shown in the accompanying flowchart. The findings of the ANSYS analysis of the sandwich tree were compared. This section gives the findings from the verification of the finite element model for a sandwich beam with a 0.03 m high viscoelastic rubber core. Based on deformation, the steel-rubber-steel investigation came to the following results; Vibration-based lattice core performs better with less deformation; the circular core generates efficient responses.

P. Bangarubabu (2015) Studies on sandwich structure efficacy and loss factor effects of diffusion viscoelastic layer treatment was conducted. Investigations were made on the dynamics of a bare tree with free and constrained viscoelastic layers. The viscoelastic layer is firmly linked to the tree in proportion. The juveniles' modulus is taken into account depending on the frequency and loss parameters in the viscoelastic material model. Studies revealed that constrained viscoelastic layer beams have larger loss factors than free layer beams. A hexahedral element was used to model the dynamics of sandwich beams (3-D element). The model's anticipated natural frequencies and the experimental outcomes of the boundary condition of the console with free and bounded layers were compared. The causes of loss are predicted using the modal strength deformation approach. The findings demonstrate that with fewer viscoelastic layers, a larger probability of failure can be reached.

Hsueh (2018) studied the multilayer thin disks' biaxial strength. For the distribution of tensile stress under biaxial bending tests, an analytical model with generic closed-form solutions was created. studied the construction of sandwich beams and slabs with great structural efficiency using hierarchical cells. The measured results of the effective tensile constant in relation to bending stiffness demonstrate a good understanding of shape factors and material indices in another manner. These results are based on experimental tests of cell plates with different porosity intensities and different cross-sectional cavity arrangements.

Wang and McDowell and Hayes (2017) Extruded metal honeycombs, also known as linear cellular alloys, were investigated (LCA). The first work seeks to maximize the structural traction and flexural stiffness of a circular sandwich bar structure in terms of the triangular geometry of the sandwich core sub cells, while the second seeks to understand heat transfer and mechanical behavior.

M. R. Doddamani (2015) The authors present a dynamic analysis of flight-reinforced jute epoxy sandwiches with a functionally graduated (FG) flexible, adaptable rubber core. The standard molding method was used to create FG samples. Using the weighing method, the presence of gradation was discussed. He investigated the impact of fly ash mass, jute content, and core orientation on total thickness (C / N s), natural frequency (NF), and sandwich damping ratio (DR).

D.Ph.'s. Senthil Kumar (2013) The damping properties of a hybrid polymer composite that can be used in a variety of applications and engineering structures were investigated. The study's goal was to describe the mechanical and evaporative properties of glass epoxy composites prepared with carbon (600mesh) fillers of varying weight fractions. Manual unfolding and vacuum bag forming techniques are used to reinforce and manufacture the carbon filling. Damping properties were investigated using different amplitudes of free and forced vibration tests. The results showed that the damping properties improved as the weight percentage of carbon hardening content increased. Furthermore, a glass fiber epoxy matrix containing 5% carbon particles has better damping properties and can be used in structural applications.

Y. Mohammadi (2015) The free vibration analysis of sandwich panels was investigated using the law of performance of FG surface panels. The theory of high-order sandwich panels is evolving as a result of the consideration of nuclear stresses in aircraft. Using the new method and their solutions, the equations of motion are reduced from twenty-three to eleven. This analysis took into account both asymmetric and symmetric sandwich panels. The theoretical predictions of the basic frequency parameters and the results obtained from other references agree well for simple supported sandwich panels with functionally graduated faceplates. The findings also revealed that the aspect ratio and thickness ratio of the core to the sheet surface have an effect on the standard frequency parameters.

M Siva Prasad (2018) The sandwich beam is investigated as a composite structure with good stiffness to weight and strength to weight ratios used as lightweight load-bearing components. The construction industry is able to create strong, rigid, lightweight, and durable structures by first using thin, resilient leather straps, followed by thicker and lighter core materials. Sandwich beams may display time-dependent behavior when made of a viscoelastic polymeric material. The behavior of a sandwich beam with a viscoelastic rubber core was examined in this work. When sandwich systems are exposed to a concentrated point load in the mean length of the tree, the finite element method (FE) is utilized to examine the overall transient responses, harmonics, and static responses.

V.N. Burlayenko and T. Sadowski (2015) In a study, the dynamic response of sandwich panels having a partially broken interface between the face layer and the core was examined using a finite element model. To comprehend the impact of intermittent dynamic contact between particles, the scanned isolated interface was taken into consideration to model the vibrations of sandwich panels. Sandwich panels forced and transient dynamic reactions were harmed by deconstruction using ABAQUS / explicit code. Investigated was the impact of the strong nonlinear contact behavior on the overall dynamics of sandwich panels.

Ibrahim Sadeghpour (2018) Using high order theory, the free vibrational behavior of a connected bent sandwich tree was investigated. The Lagrange principle and the Rayleigh-Ritz method were utilized to find and resolve administrative equations. Two linear with contacting and non-contact models are utilized since the true situation of contact in the connected area is nonlinear.

Sudhakar R (2014) For the analysis of the free vibrations of composite and sandwich arcs, a higher order pure model with seven degrees of freedom per node was constructed, according to the research. The deformation field is characterized by cubic axial, cubic transverse shear, and linear transverse components of normal deformation if the collapse of the cross section is accurately modeled in this theory.

Vidhya Purushothaman (2017) Sandwich bars' excellent strength-to-weight ratio, flexibility, high bending, and knee resistance provide designers with a number of benefits. Higher natural frequencies are produced by the sandwich construction than without it, and it also creates an appropriately tuned vibration damper. In this study, it is determined for various core configurations and core materials what the natural frequencies and modes of the sandwich tree structure are. For tree analysis, the finite element approach (FE) was employed. Sandwich beams are lightweight load-bearing components made of composite systems with a high stiffness to weight and strength to weight ratio. The construction industry is able to create strong, rigid, lightweight, and lasting buildings by using thin, resilient leather straps in conjunction with thicker, lighter core materials. Sandwich beams have recently been developed and successfully used in civil engineering and construction. These include replacement bridge girders made of fiber composite, composite girders, and composite sleepers. As a result, the central length of the sandwich bar is exposed to a concentrated point load. A method is described for using ANSYS software to compare the relative performance of a sandwich tree in various combinations of tree materials.

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY OF THE STUDY

In the current work it is proposed to set up a limited component models of G+6 Story Residential structure utilizing ETABS with fixed base at ground level.

a) R.C.C structure.

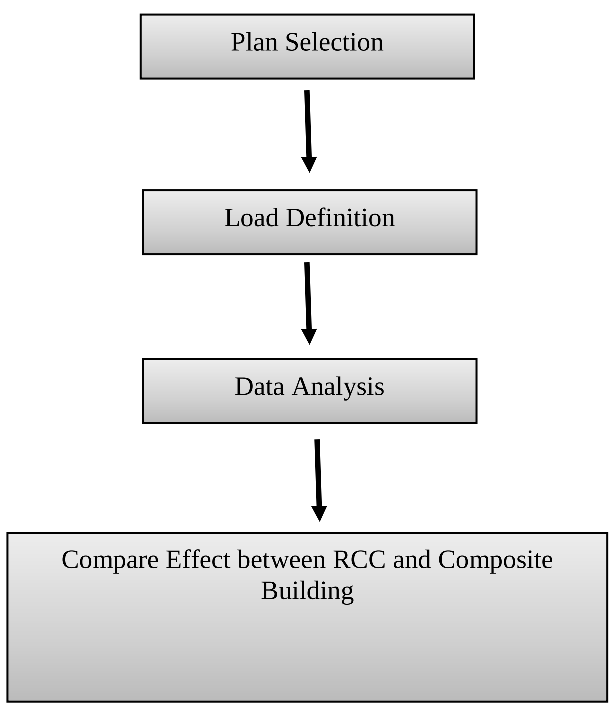
b) Composite Structure.

2) Apply Dead burden, live burden and Wind load/Earth shake load according to BNBC (2020).

3) Carry out Designs by Limit state strategy utilizing ACI 318, 1999.

4) Carry out amount studying for the two kind of structures.

5) Compares the effect between RCC and Composite Building.



3.2 PLAN SELECTION

When planning to build a new structure, it is critical to have an idea of when the project will begin and end. There may be variations as different type of building. The basic steps of selection in a building plan are briefly explained. We consider three major steps to selection the plan. These are

1) Budget
2) Building Requirement
3) Use of purpose

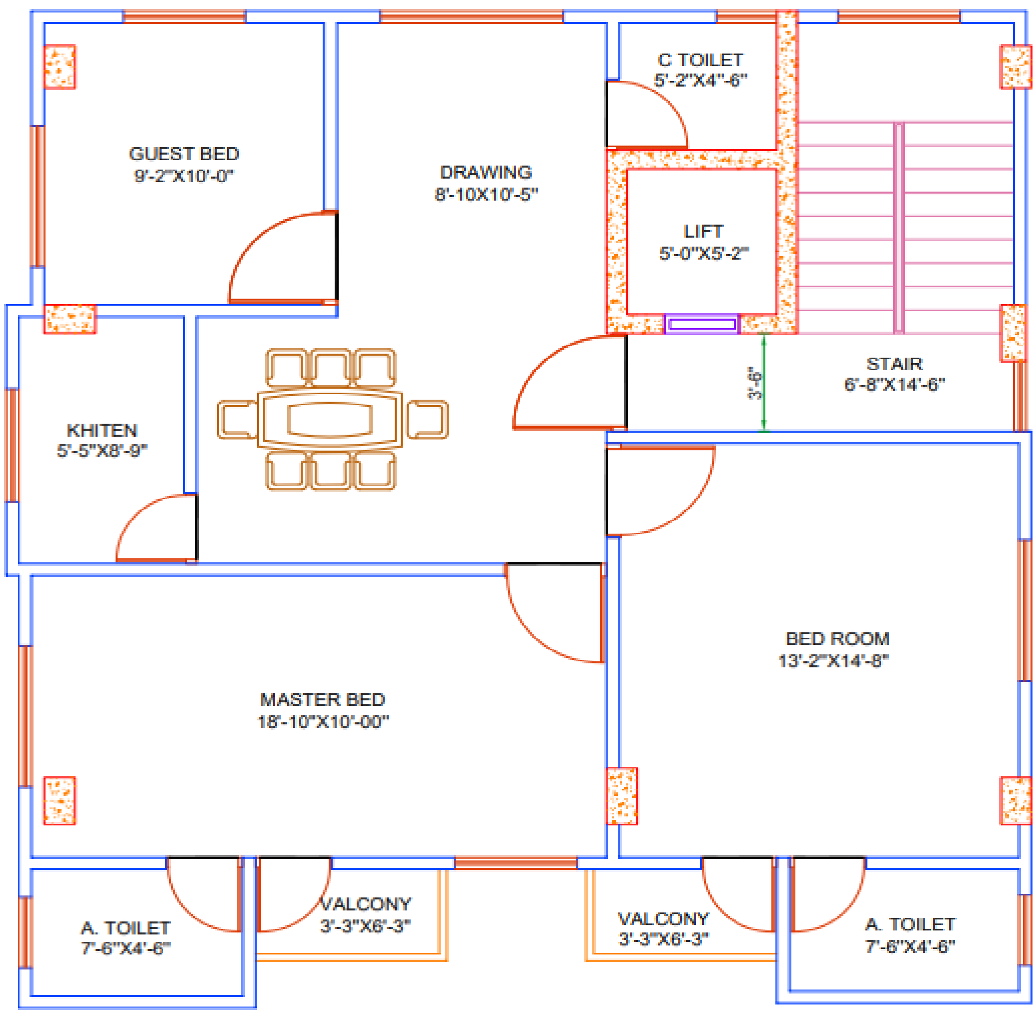


Fig 3. 1 Ground Floor Plan

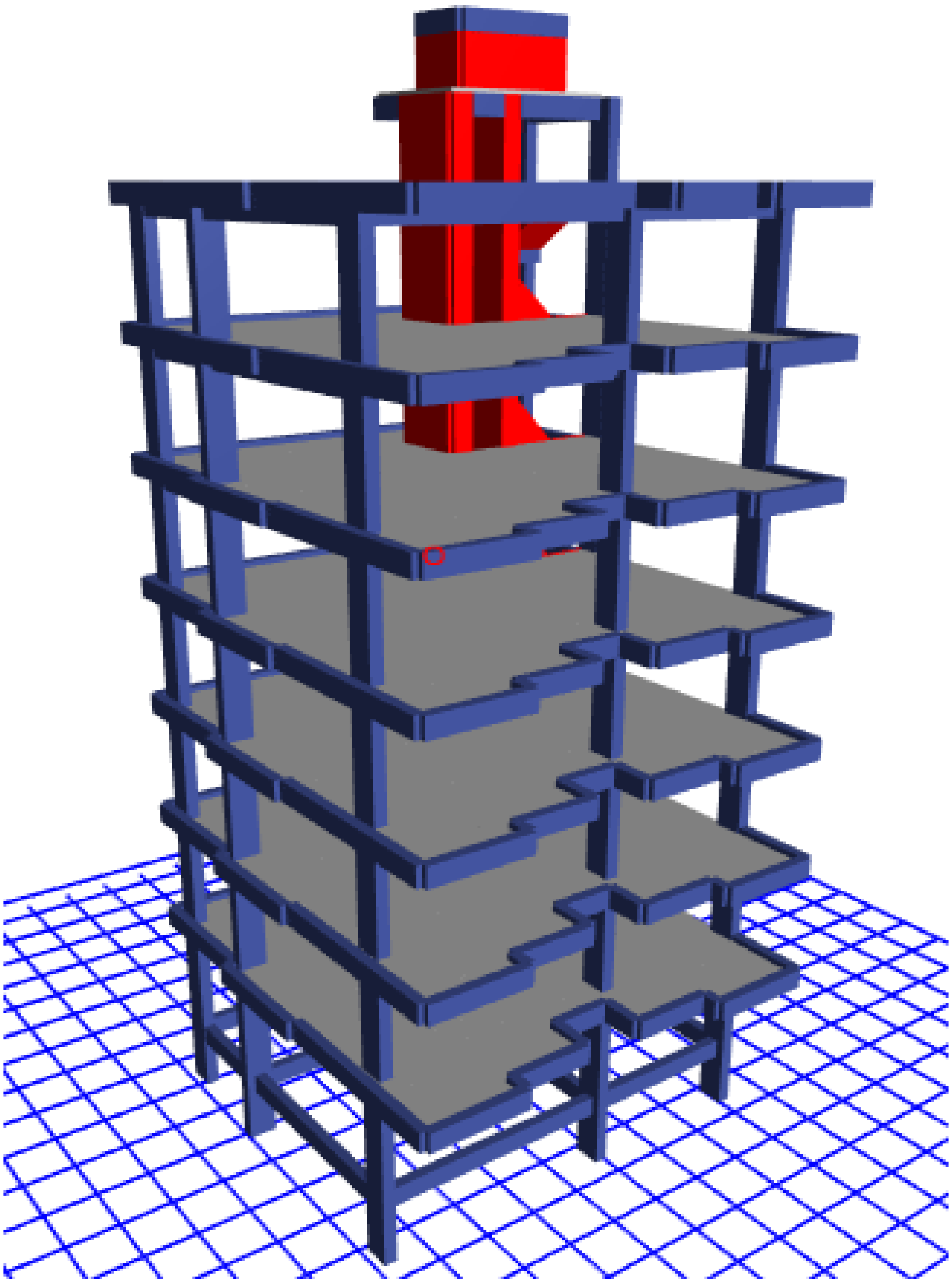


Fig 3. 2 3D view from ETABS 2016

3.2.1 GENERAL OVERVIEW OF THE BUILDING

Information	Description
Structural System	RCC Structure Residential Building Composite Structure Residential Building
Floor Area	Total Area= 1150sft (Approximately)
Foundation Type	Deep Foundation
Construction Materials	Concrete with Brick chips as coarse aggregate& Reinforcement deform bar.
Design Drawing	All drawings are available.

Table 3. 1: Shows the basic information of the building.

3.2.2 GENERAL DIMENSION OF THE BUILDING

Components	RCC Building(mm)	Composite Building(mm)
Beam	250 X 500	250 X 400
Column	300 X 650	300 X 450
Slab	125	125

Table 3. 2: Dimension of the Building.

3.2.3 STRENGTH CONSIDERATION OF CONCRETE AND REINFORCING BAR

1	Yield Strength of steel	f_y	60000 psi
2	Compressive Strength of Concrete	f'_c	3000 psi
3	Young's Modulus of Concrete	E_c	$57000\sqrt{f'c}$

Table 3. 3: Strength Consideration of Concrete Reinforcement

3.3 LOAD DEFINITION AND INPUT PARAMETER

The loads that may operate upon the building throughout its lifetime must be properly evaluated and incorporated into the structural study prior to construction. The following loads could apply to the structure:

3.3.1 DEAD LOADS (DL)

Dead loads (DL) are those gravitational loads that, throughout a structure's typical service life, continue operating on it permanently and unchanged. These are essentially the loads brought on by the weight of the various structural elements. This type of loads may occasionally be separated into the following categories for the convenience of the analysis, notably

A) Self-weight of the structure (DEAD), weight of slab, beam, and column.

B) Weight coming from floor finish (FF).

C) The non-structural permanent components of the building.

For the analysis and evaluation of the building, following are the values of unit weight considered to obtain the self-weight.

Unit weight of Reinforced concrete= 7.2 Kn/m^2

Unit weight of Soil=5.75 Kn/m^2 (For Loose Soil)

Floor finish = 1.2 Kn/m^2

3.3.2 LIVE LOAD (LL)

Live load is the gravitational load duet on stationary objects, including people, machines, and furniture. Based on the actual load acting on the building as well as the load that BNBC (2020) recommends for buildings in Bangladesh, analysis has been done. The analysis's live load figures are listed below.

Floor	Type of Loading	Load (kn/m^2)
Roof (Stair)	Live Load	1.5 Kn/m^2
Bottom Floor (Zone:1)	Live Load Considering all equipment's and BNBC Code	3 kn/m^2

Table 3. 4: Loading of Building considered for Live Load analysis (As per BNBC-2020)

3.3.3 EARTHQUAKE LOAD

Appropriate structural design of building structures must consider the loads caused by seismic vibrations. Although there have been no major earthquake events in Bangladesh in recent history, earthquakes are common in the region. Scientific geological surveys of Bangladesh's lower crust indicate that Bangladesh is in a medium to high seismic hazard zone. Statistical evidence from past large and minor earthquakes indicates that recent large earthquakes of geological magnitude are delayed. Therefore, it is necessary to prepare for possible earthquake disasters. The purpose of earthquake-resistant design for buildings is not to build strong buildings that can withstand earthquake damage. Instead, seismic design is essentially aimed at minimizing possible damage and loss to an acceptable level.

Regarding seismic structural design, it is important to comply with specific design regulations. Perform building analysis and design review according to the BNBC (2020) equivalent static force method. Finite element analysis according to BNBC 2020 considers the following seismic parameters:

Parameters	**Values**	**References/Remarks**
Seismic Zone	3	BNBC-2020
Reduction Factor, R	8	BNBC-2020
Zone Factor, Z	0.12	BNBC-2020
Soil Profile	S_D	BNBC-2020
Importance Factor	1	BNBC-2020
C_t	For RCC= 0.0466 For Composite = 0.0488	BNBC-2020 (Table-6.2.20)
m	For RCC= 0.9 For Composite= 0.75	BNBC-2020 (Table-6.2.20)

Height h_n	27.13 m	Height of the Structure
Time Period, T	For RCC=0.91s For Composite= 0.58s	BNBC 2020 (Equ- 6.2.38)
K	1.0	BNBC 2020 (Sec- 2.5.7.4)

Table 3. 5: Loading of Building considered for Earthquake Load analysis (As per BNBC-2020)

3.3.4 DEFINITION OF LOAD FOR ETABS ANALYSIS

The prior section addressed the fundamental sources of loads. Nine fundamental categories are used to apply these loads to the model. These are listed below:

Case 1: The structure's self-weight (SW).

Case 2: Live Load (LIVE).

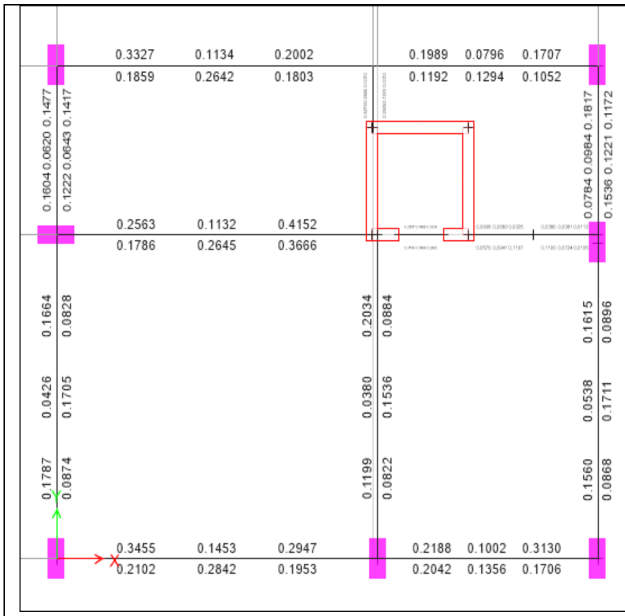
Case 3: Floor Finishing Load (FF).

Case 4: Earthquake load in Load East-West (Ex).

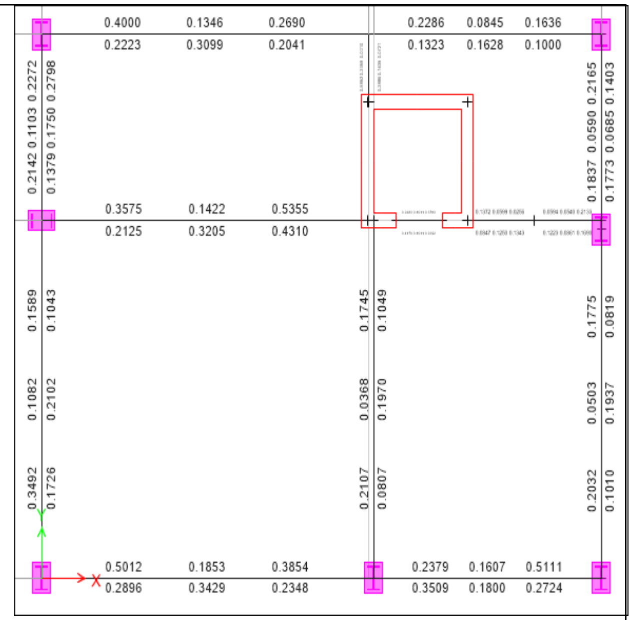
Case 5: Earthquake load in Load North-South Direction (Ey).

3.4 DATA ANALYSIS:

We got the values from ETABS Analysis. For the whole procedure we used ETABS 2016.

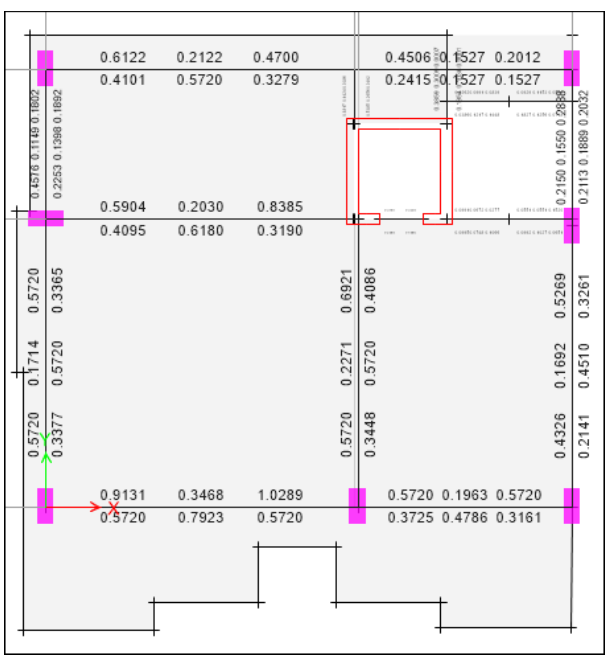


RCC Structure

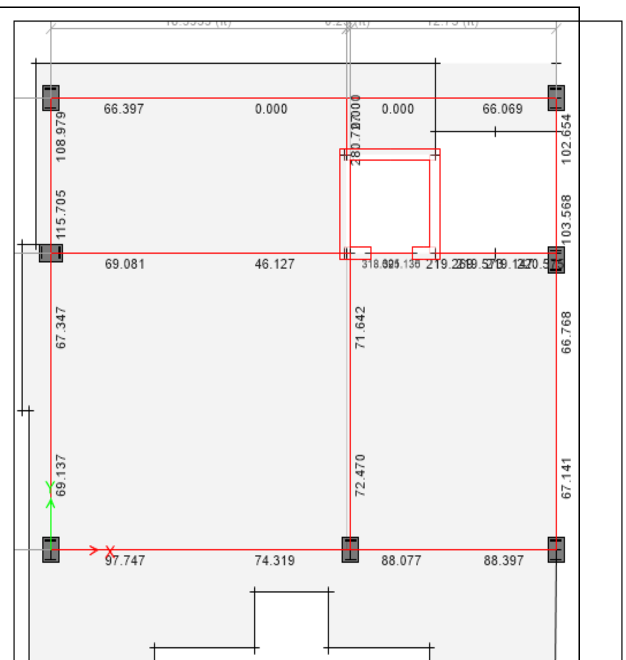


Composite Structure

Fig 3. 3 Moment of Grade Beam

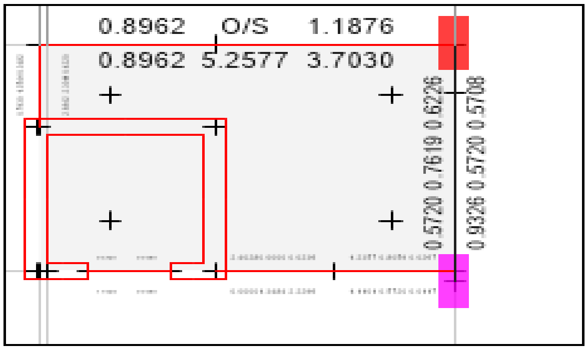


RCC Structure

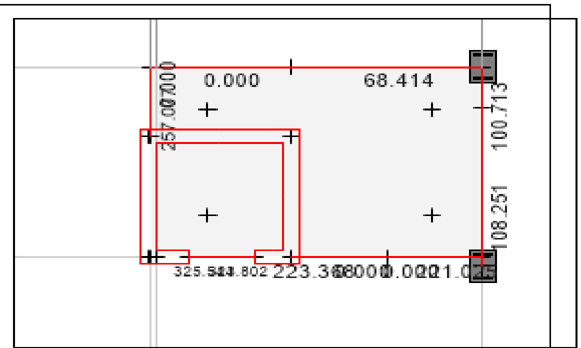


Composite Structure

Fig 3. 4 Moment of Top Floor

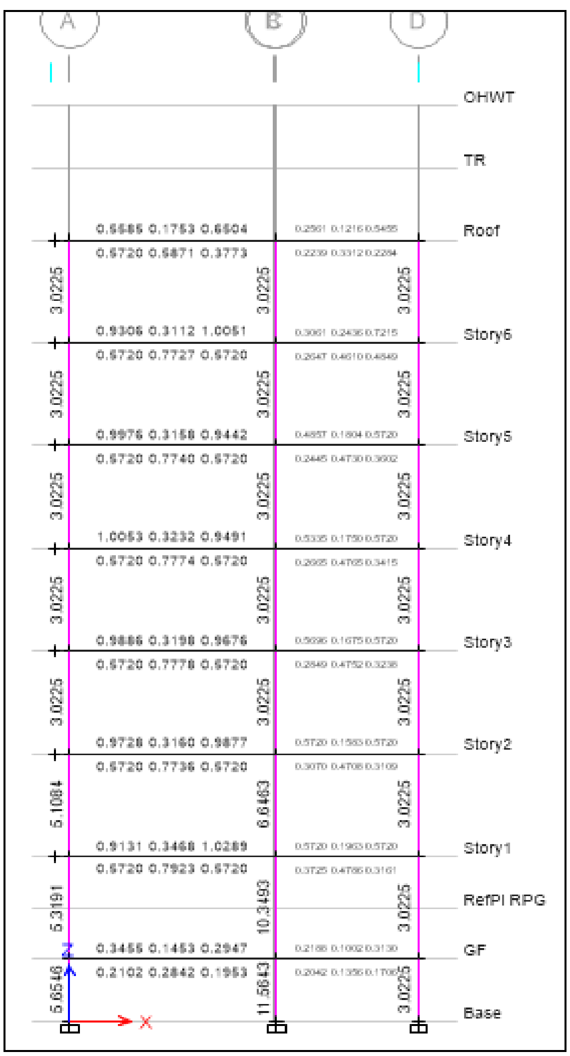


RCC Structure

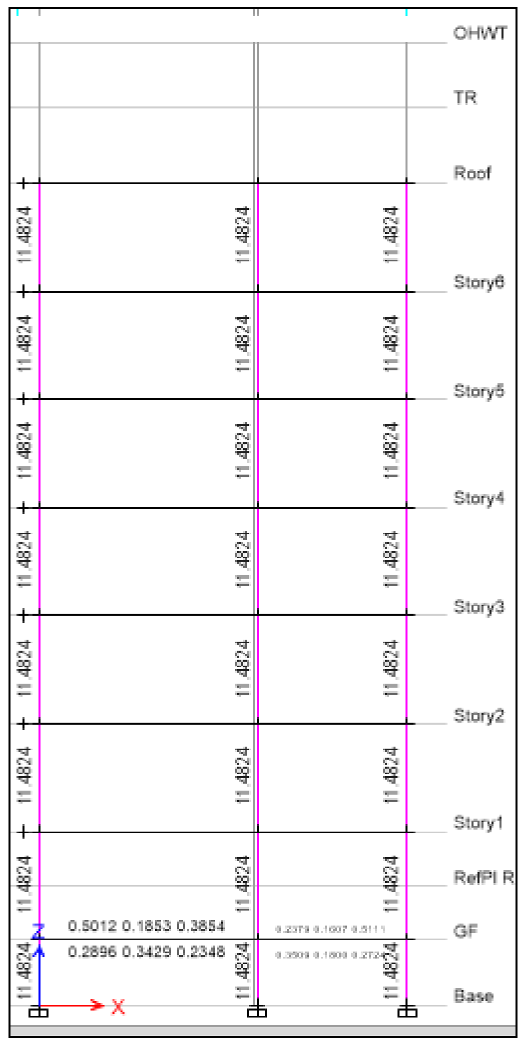


Composite Structure

Fig 3. 5 Moment of Stair

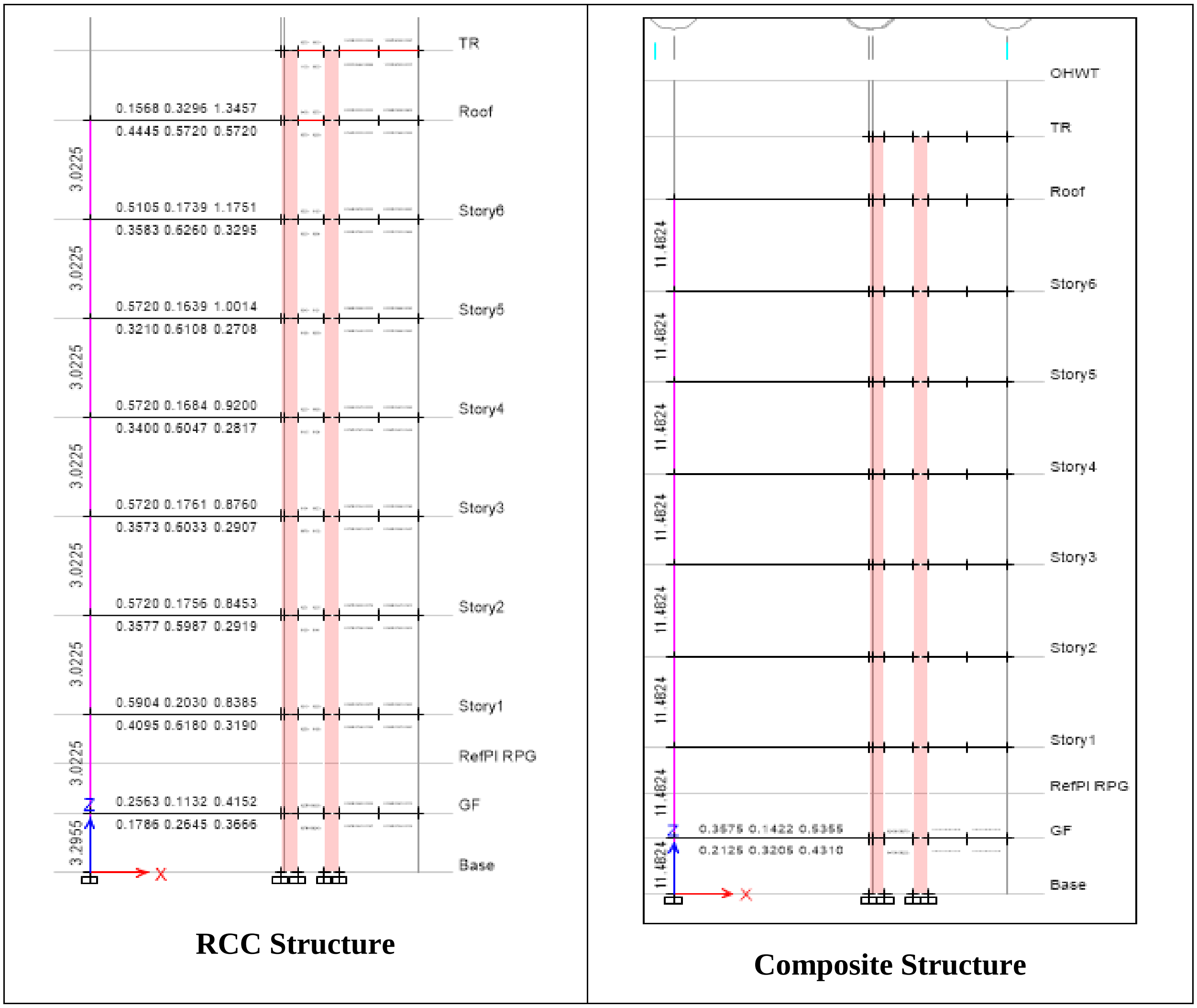


RCC Structure



Composite Structure

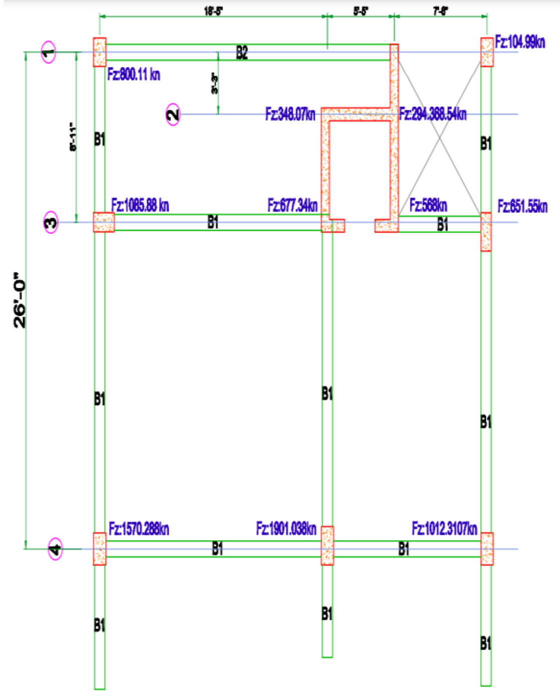
Fig 3. 6 Axial Load of Column in North Side



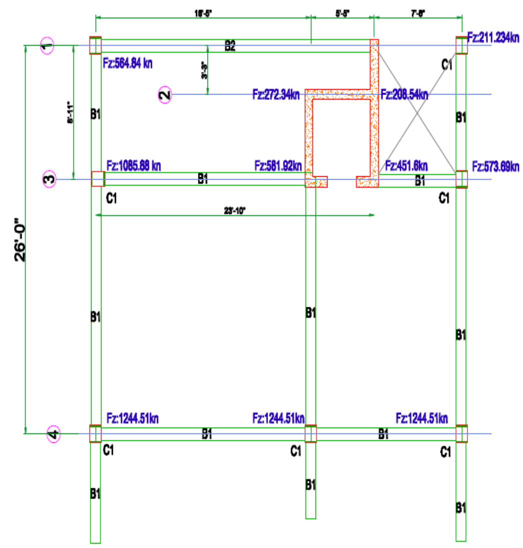
RCC Structure

Composite Structure

Fig 3. 7 Axial Load of Column in East Side

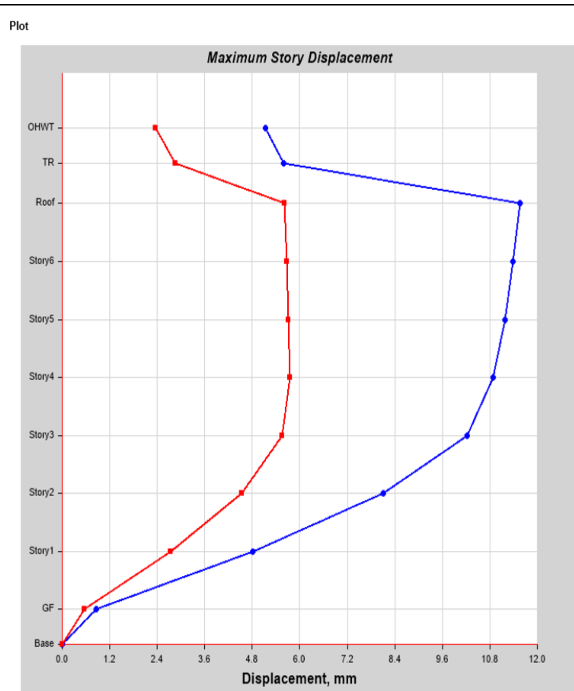


RCC Structure

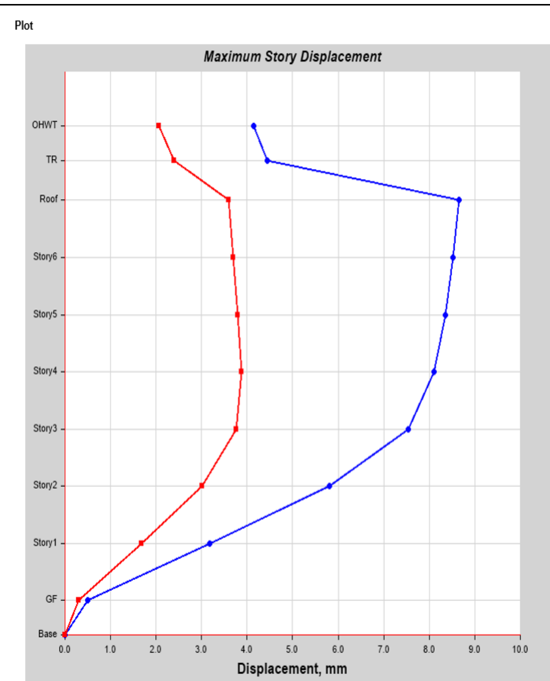


Composite Structure

Fig 3. 8 Weight of Structure



RCC Structure



Composite Structure

Fig 3. 9 Maximum Displacement

CHAPTER 4

RESULT AND ANALYSIS

4.1 WEIGHT OF STRUCTURE

The load a structure experiences due to its own weight is known as weight of Structure. The material density of the structure has a direct impact on self-weight. Self-weight must be activated in order to be simulated because it is disabled by default. The material and section of each part will determine the self-weight. It is advised that Double-check the components and materials used in project to ensure that the self-weight of building is as precise as possible. It can enter multipliers for the acceleration due to gravity (g) in the X, Y, and Z axes in the self-weight window. The default self-weight acts on the Y-axis with a magnitude if it is turned on.

Column and Shear Wall	RCC Load (KN)	Composite Load (KN)
Column 1	800.1	564.8
Column 2	1085.9	1085.9
Column 3	1570.3	1244.5
Column 4	1901.0	1244.5
Column 5	105.0	211.3
Column 6	651.6	573.9
Column 7	1012.6	1244.5
Shear wall point 1	348.1	272.8
Shear wall point 2	677.3	581.9
Shear wall point 3	294.4	208.5
Shear wall point 4	568.0	451.6

Table 4. 1 Weight of Structure

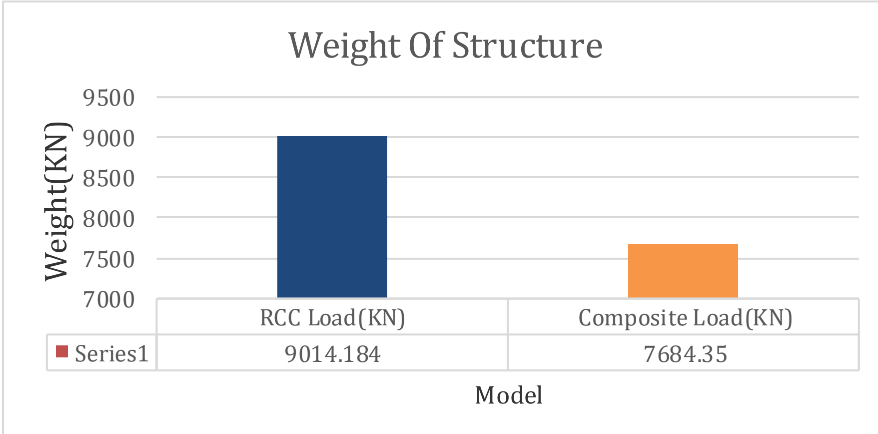


Fig 4. 1 Weight of Structure

The weight of RCC Structure is greater than Composite Structure, due to larger cross section of RCC structure. From this Fig 4.1 Weight of Structure for RCC is 9014.184 KN and Composite is 7684.35 KN. It can find weight of RCC Structure more than 14.75% than Composite Structure.

4.2 DISPLACEMENT

The displacement of a node or element (beam, column, frame, etc.) from its initial location is measured. The movement may be caused by a beam deflecting, but it may also be the consequence of the complete object moving, undistorted, as a box sliding across a friction-free surface. Both distance and rotational measurements of displacement are possible.

4.2.1 DISPLACEMENT IN X DIRECTION

Story	Composite	RCC
OHWT	5.126	4.141
TR	5.601	4.442
Roof	11.566	8.648
Story6	11.38	8.517

Story5	11.172	8.359
Story4	10.88	8.111
Story3	10.214	7.532
Story2	8.112	5.81
Story1	4.805	3.181
GF	0.867	0.496

Table 4.2. 1 Displacement in X Direction

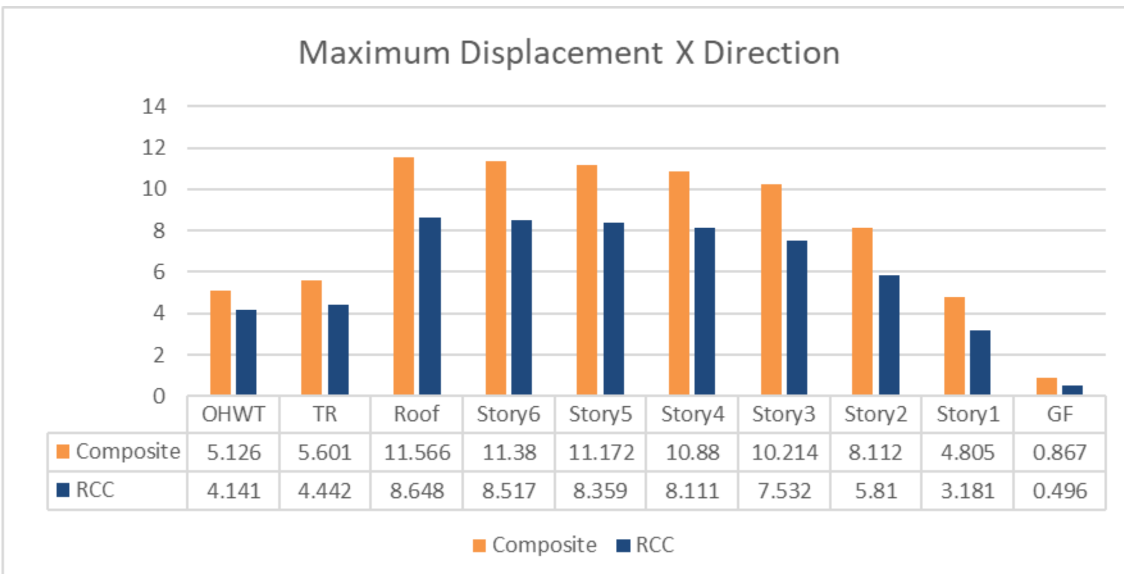


Fig 4. 2 Maximum Displacement in X Direction

From4.2 shows that the maximum displacement value for composite frame as compared t o RCC frame is greater when calculated using similar static approach in the X-direction. The height value of maximum displacement finds in roof which is in Composite for 11.566 mm and in RCC it is 8.648 mm. Because of its greater stiffness, the RCC frame has lower maximum displacement value. Maximum Displacement value of Composite structure more than 25.26% than RCC Structure. This value satisfies BNBC Code.

4.2.2 DISPLACEMENT IN Y DIRECTION

Story	Composite	RCC
OHWT	2.355	2.059
TR	2.854	2.396
Roof	5.606	3.593
Story6	5.661	3.691
Story5	5.72	3.796
Story4	5.75	3.875
Story3	5.552	3.766
Story2	4.524	3.008
Story1	2.736	1.681
GF	0.553	0.292

Table 4.2. 2 Displacement in Y Direction

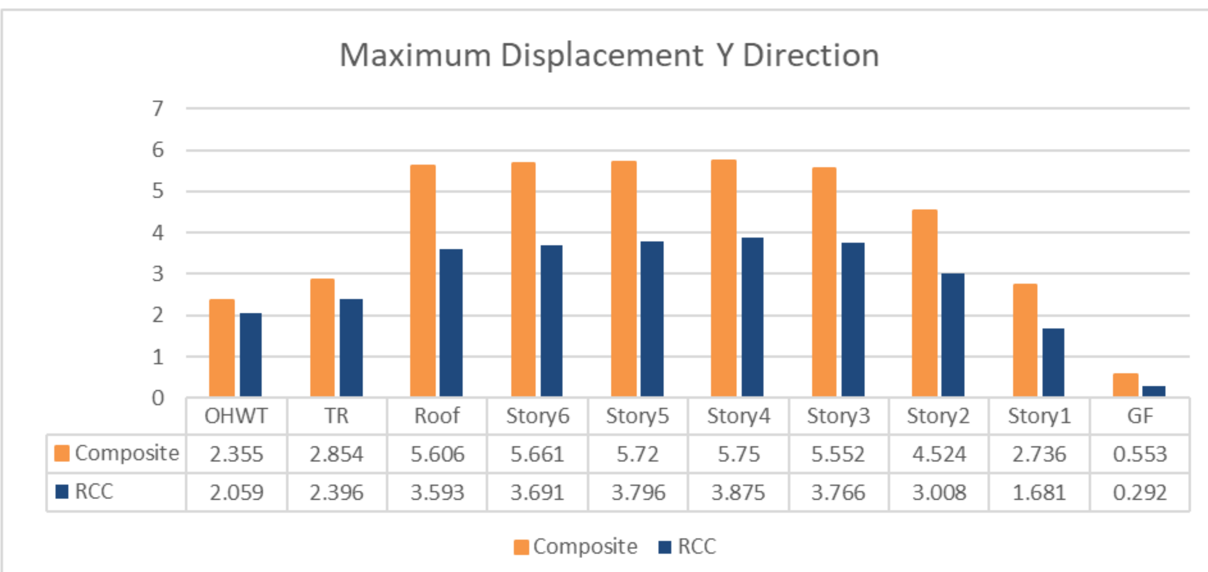


Fig 4. 3 Maximum Displacement Y Direction

Fig 4.3 shows that the maximum displacement value for composite frame as compared to RCC frame is greater when calculated using similar static approach in the Y-direction. The height value of maximum displacement finds in story 4 which is in Composite for 5.75 mm and in RCC it is 3.875 mm. Because of its greater stiffness, the RCC frame has lower maximum displacement value. Maximum Displacement value of Composite structure more than 32.60% than RCC Structure. This value satisfies BNBC Code.

4.3 BASE SHEAR

Base shear is the horizontal reaction to the lateral force, which comes from the weight of the floor.

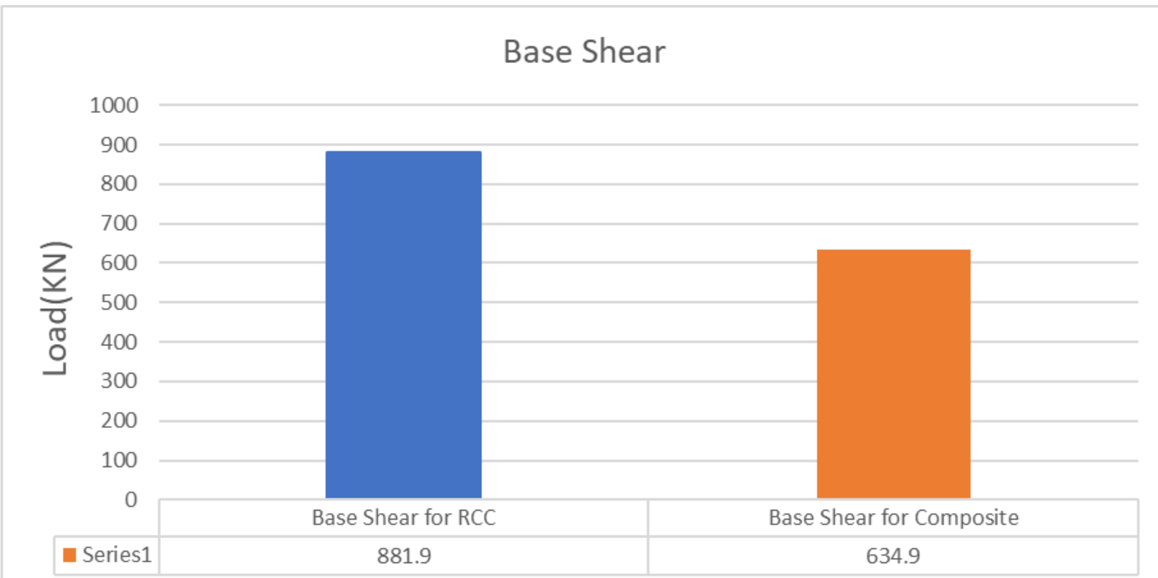


Fig 4. 4 Base Shear

The self-weight is greater in RCC than Composite, which causes the base shear to be at its highest value. It can see from the Figure 4.4 Base Shear for RCC Structure loads is 881.9 KN and Composite Structure load is 634.9 KN. It can reduce base share compare Composite Structure more than 28.01%.

4.4 TIME PERIOD ANALYSIS

When the natural time periods of the two structures are compared, the composite building has a higher natural time period than the RCC building, indicating that it is more able to oscillation back and forth when lateral forces are applied to it. Additionally, the R.C.C. building has a lower natural time period than the other two structures, which suggests that it is less flexible.

Composite building is lighter than RCC building, because it is smaller in shape. Shifting the steel thickness, the considerable strength, and the support can be used to provide identical cross regions with different load and second safeguards. This improves the development and building specifying by allowing the external components of a segment to be maintained constant over different floors in a structure.

Time Period

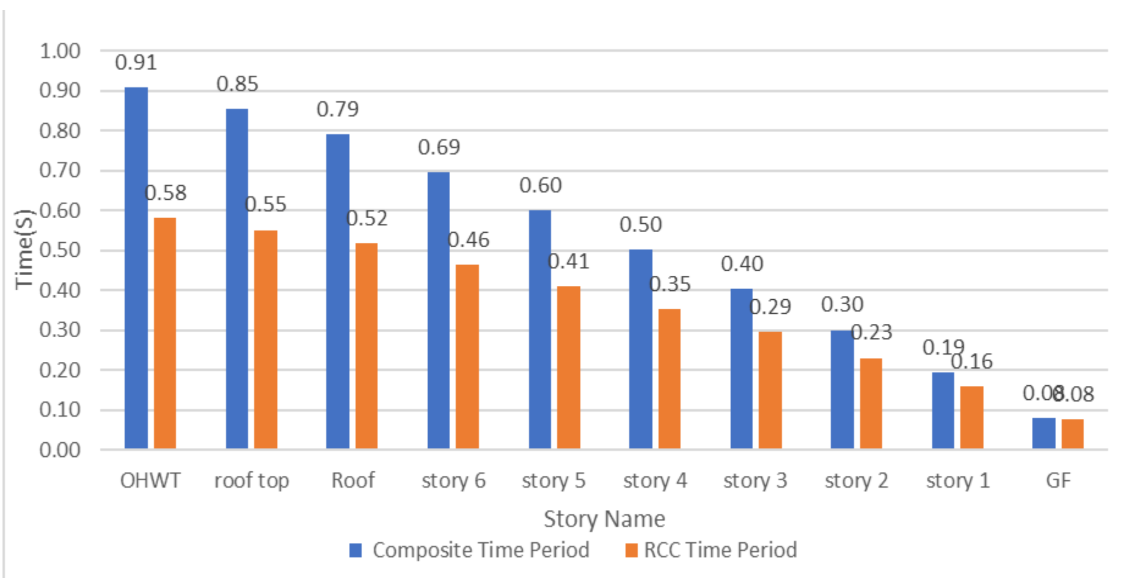


Fig 4. 5 Time Period

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

1. It is evident from Fig 4.1 that the weight of the composite structure is lower by 14.75% compared to the RCC structure.

2. It is evident from Fig 4.2 and 4.3 when compared to RCC, the composite structure's story displacement is 25.26% higher in X direction and 32.60% in Y direction.

3. It is evident from Figure 4.4 that the base shear of the composite construction is lower than that of the RCC structure by 24.8%.

4. It is seen from Figure 4.5 that the time period of Composite is longer by 18.97% than that of RCC.

5. Because no form work is necessary, the construction of composite structures takes less time than RCC structure.

From this analysis we saw that between RCC and Composite Structure the weight of structure and base shear is high in RCC. But the displacement is higher in Composite compare to RCC, but it satisfies the BNBC. So that composite needs less dimensional column, beam and slab. Since the live load and dead load are comparatively less in Residential building so there is not much gap. Finally, we can say that composite structure is very suitable for high rise industrial buildings.

5.2 RECOMMENDATION

1. From this study we can say Industrial buildings are more appropriate for Composite structure.

2. In this study we have considered only PEC column, FEC and CFT column may also be considered for future study.

3. Further study can be carried out regarding the dimensions of the building components.

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APPENDIX

SLAB THICKNESS

Slab Size (Clear Span)

No of Slab	Dimension
1	18'-10"x10'-0"

Slab Thickness=$\frac{Slab\ Perimeter}{180}$

$= \frac{2\times(18.833+10)\times 12}{180}$

=3.84 inch

$\approx 97.65\ mm$

Thickness provided 125 mm

(Ok)

TIME PERIOD CALCULATION

As per BNBC 2020 The value of the fundamental period, T of the RCC structure shall be determined from one following method:

For all buildings, the value of T may be approximated by following formula:

$\mathbf{T_a=Ct\ (h_n)^{m}}$

TIME PERIOD CALCULATION FOR RCC

Story	Ct	Height (hn|)	m	Time Period (T)
OHWT	0.0488	27.13	0.75	0.58
Roof top	0.0488	25.29	0.75	0.55
Roof	0.0488	23.26	0.75	0.52

story 6	0.0488	20.112	0.75	0.46
story 5	0.0488	17.07	0.75	0.41
story 4	0.0488	14.02	0.75	0.35
story 3	0.0488	10.97	0.75	0.29
story 2	0.0488	7.92	0.75	0.23
story 1	0.0488	4.87	0.75	0.16
GF	0.0488	1.83	0.75	0.08

Time Period Calculation for RCC

TIME PERIOD CALCULATION FOR COMPOSITE

Story	Ct	Height (hn|)	M	Time Period (T)
OHWT	0.0466	27.13	0.9	0.91
Roof top	0.0466	25.29	0.9	0.85
Roof	0.0466	23.26	0.9	0.79
story 6	0.0466	20.112	0.9	0.69
story 5	0.0466	17.07	0.9	0.60
story 4	0.0466	14.02	0.9	0.50
story 3	0.0466	10.97	0.9	0.40
story 2	0.0466	7.92	0.9	0.30
story 1	0.0466	4.87	0.9	0.19
GF	0.0466	1.83	0.9	0.08

Time Period Calculation for Composite.

BASE SHEAR FOR COMPOSITE STRUCTURE

From Etabs Result:

DL (Selfweight)	=	4071.0 kN	
SDL (FF+PW Load)	=	1187.0 kN	
LL1 (<3kN/m2)	=	190.0 kN	25% of LL1 considered for Sesimic Weight
LL2 (>3kN/m2)	=	95.0 kN	50% of LL2 considered for Sesimic Weight
LL3 (For Permanent Equipment/Spool in floor)	=	190.0 kN	100% of LL3 considered for Sesimic Weight
Building Weight , W	=	5543.0 kN	
Base Shear from Etabs , V	=	72.7 kN	
			Variation 88.55%
Design Spectral Acceleration, S_a	=	0.11455	
Base Shear Calc. using Weight of Etabs , W	=	634.9 kN	

Base Shear (Seismic Load) Percentage of Building Weight	=	1.3%

Base Shear for Composite Structure

BASE SHEAR FOR RCC STRUCTURE

From Etabs Result:

DL (Selfweight)	=	6093.0 kN	
SDL (FF+PW Load)	=	1186.0 kN	
LL1 (<3kN/m2)	=	280.0 kN	25% of LL1 considered for Sesimic Weight
LL2 (>3kN/m2)	=	140.0 kN	50% of LL2 considered for Sesimic Weight
LL3 (For Permanent Equipment/Spool in floor)	=	280.0 kN	100% of LL3 considered for Sesimic Weight
Building Weight , W	=	7699.0 kN	
Base Shear from Etabs , V	=	101.0 kN	
			Variation 88.55%
Design Spectral Acceleration, S_a	=	0.11455	
Base Shear Calc. using Weight of Etabs , W	=	881.9 kN	

Base Shear (Seismic Load) Percentage of Building Weight	=	1.3%

Base Shear for RCC Structure