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A REVIEW ON STEEL CONCRETE COMPOSITE STRUCTURES

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Abstract— Most buildings are designed and constructed using reinforced concrete, which generally depends on the availability of materials, appropriate construction methods and the results of the design. RCC is no longer commercial due to its increased weight and dangerous mold structure. However, composite structures are the latest development in the construction industry. Steel-reinforced concrete composite structures are now very popular as they have many advantages over traditional concrete and steel structures. Compared to composite buildings, where concrete buildings are heavier, seismic weight and deformation are more, composite structure has the advantages of reducing costs, fast construction, fire prevention, etc. It combines the best properties of steel and concrete. Using new modern composite construction, it was found that the slow construction of entire buildings while the RCC lines were being poured was economically prohibitive, while the erection of high-rise structural frames could be continued quickly. However, the seismic performance of composite cables and cables has long been known in Japan and is frequently used in construction in the region. There is also a need to develop seismic designs for the most commonly used structures in India to encourage the use of similar structures. This work shows that many aspects of architecture have been studied.

Index Terms— ***Comparative Study, Composite Structure, Steel Structure, RCC, Etabs Software, Seismic, Comparison Aspects. Response Spectrum Analysis, Seismic Responses, Time History Analysis, Pushover Analysis.***

I. INTRODUCTION

The main purpose of each type of structure used in the design group is to replace the material with good performance. The most common loads caused by gravity effects are dead loads, rigid loads and snow loads. In addition to these vertical loads, the structure is also exposed to horizontal waves, explosion or seismic loads. External loads can cause pressure, force or vibration. Therefore, it is important that the system has sufficient resistance to vertical loads and sufficient rigidity to resist lateral forces. (Saray and Nemodya 2013)

Different methods are used to satisfy demand in the building industry. Some of them are common because of men, materials & money availability, many of them seem to be famous due to the practicality of their design. Specifically, there have been three main types of construction methods used in the high-rise construction project, which are:

- RCC Structures
- Steel Structures
- Composite or hybrid Construction

The arrangement of different components including such Columns, Beams & Slabs is a R.C.C. Frame structure, each of which plays its own part in maintaining the structure. Columns are vertical component and a beam is a horizontal member of a frame as well as the slab functions as a platform. (Husain, Siddiqui, and Khan 2019)

Depending upon availability of needed materials as well as the workmanship required in the building industry, themajority of building frames are manufactured and made as reinforced concrete structures, consistent with the practicality of the latest design codes. High-rise building construction is needed nowadays to meet the demand ofthe population increase and RC construction is popular today in India

to meet the demand of the construction industry. (Rathod et al. 2017). Steel frames have an excellent strength-to-weight ratio and can withstand large plastic deformations until collapse. Tall buildings, bridges, towers, airport terminals, assembly factories, etc. Since steel structures are used in all kinds of structures, steel structures are more rigid, ductile and often costly. RCC systems are generally stronger in compression but generally have more buckling due to the higher strength-to-weight ratio of steel structures. (Shah and Saranya 2020)., money and equipment) etc. It was built for the use of industrial inventors. Modern construction methods offer alternative solutions to traditional use. These will be in the form of a combination or hybrid model, called a hybrid model, which can use the material mixture more effectively and efficiently than the RC model. Composite materials are made of various materials such as steel and concrete and consist of columns, beams, floors, etc. materials used to create it. Composite materials are now very popular abroad due to their suitability for construction, but also overcome their shortcomings. Characteristics of RCC and steel structures as composite materials or products Use composites for high-rise buildings, and composite materials absorb impacts better. RCC and steel structure Xiang Li.

Composite systems utilize the combination of steel and concrete to act as a single unit under load. Two different sources of consistent and complete information; their thermal expansion is almost the same; they provide a good combination of high performance and tensile strength of steel; The stone also provides corrosion protection for metal at high temperatures and can also seal magnets. In the composite structure, the concrete is supported by steel rods, the two elements move independently according to the load, and relative slip occurs under the interface effect of the concrete and steel beams. fashion. Therefore, the steel beam and steel plate behave like a composite beam, which acts like a T beam.

In steel-concrete composite, steel and concrete work together to protect external objects and appear to limit the swaying of the building frame. It is worth mentioning that the unique combination of concrete, steel frames and floor structures has become a common design for many commercial buildings in many countries. The main reason for this choice is that the profiles and elements best resist repeated seismic loads, which require protection and ductility. (Ratho et al. 2017)

Composite elements are designed to work as a whole by combining concrete and steel elements. We know that stone has good compressive strength but not good tensile strength, while steel has good tensile strength but does not have good compressive strength. The compressive strength of concrete is obtained by the tensile strength of steel, which in itself creates a very good cross-section. These elements perfectly combine metal and stone. The main features used in the composite model include the following items.

A. Composite Slab
B. Composite Beam
C. Composite Column
D. Shear Connector

Composite Slab

The panels were joined with concrete to support the shear connection and the steel panels were used as extensions and also to lower the steel floor slabs so that the hard rock would be used nearby. It is a composite material that interacts with beams and columns to form a unit. The trapezoidal deck is placed on the beams with profiled sheets, steel bars are placed and concrete is poured on it. The process is efficient because the profiled panels are placed before the concrete is poured. There are basically two types of decks: trapezoidal and notched steel decks.

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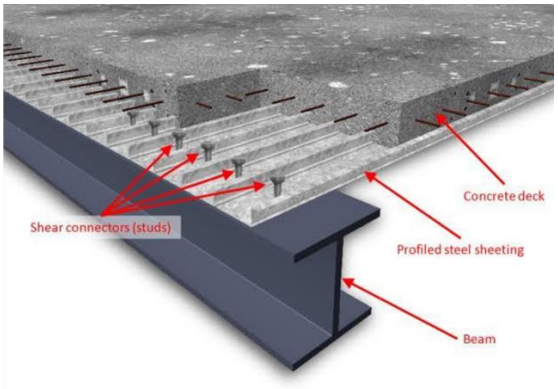

Fig -1: Composite Slab

Composite Beam

Composite beam is a steel beam and can be a part of the beam that is usually bent and extended to support the composite panel. Composite beams are generally composite materials consisting of slabs and beams joined together to form a single, unified structure. Generally, the load from the slab will be distributed equally to the beam. Composite beams are obtained by forming steel elements into beam form and supporting them with concrete at a certain level. An important part of the cable connector that acts as a shear support is the shear connector. The profile can be fixed inside the beam formwork or filled with fillers.

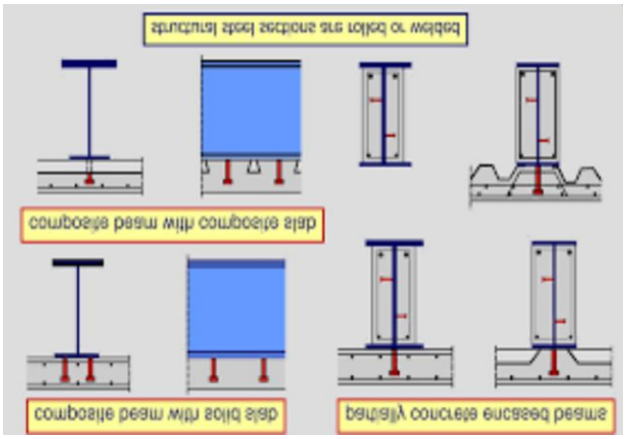

Fig -2: Composite Beam

Shear Connectors

They are used as connections between concrete and steel structures to provide sufficient strength and stiffness to composite elements. It is important to support the combination of concrete and steel beams throughout the transition. It is also beneficial for the composite system to withstand extreme stresses and transfer the load to the lateral load-resistant system. The reason for developing shear fasteners is to remove reinforced concrete slab and steel beam sections and transfer the horizontal shear forces present throughout the concrete and steel structure. Different types of shear connectors can be used according to need.

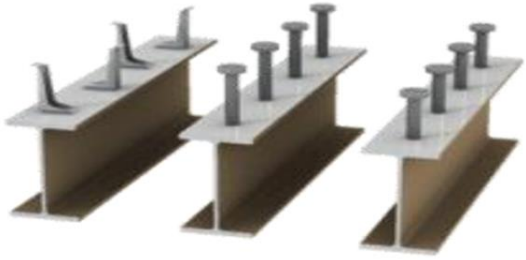

Fig -3: Shear Connectors

Composite Columns

It is appropriate to consider compression members formed of steel and concrete components as composite columns of steel concrete. There are two types of composite columns.

- Steel embedded in concrete
- Hallow steel section filled with concrete

The opposite of metal and concrete working together as a whole, as in composite lines, is friction and bonding. The traditional construction method for the construction of composite systems is to place hollow steel profiles after pouring concrete around I-beams or I-profiles, or even I-profiles supporting the main structure. Lateral deflection and buckling of steel elements can be prevented due to the concrete content. These composite columns have a narrower cross-section and are heavier than RCC columns. Basic costs are also reduced due to increased floor usage in mixed-use buildings

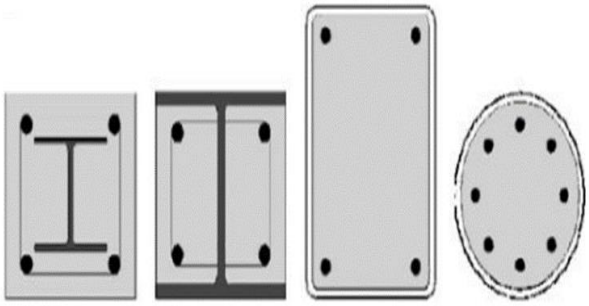

Fig -4: Composite Column Sections

II. LITERATURE REVIEW

1. (Patel and Thakkar 2013), authors ten, twenty and thirty layer steel tube (CFT), R.C.C. According to the steel building structure, according to the deviation standard, the allowable span of the 30-storey building is 180 mm, and the span of the top of the RCC building is 179.6 mm, which is very close to the allowable limit. . It can also be said that RCC with geometric configuration is not effective above 30 times. The time percentage decreased by 26.2% and 3.5% for 30-storey CFT buildings compared to reinforced concrete and steel construction, while for 20-storey RCC and steel house, these rates were 25.5% and 17.8%. Compared with the steel structure and RCC structure, the load capacity of the 20-storey CFT structure increased by 19.1% and 27.3%, respectively, while the load capacity of the 30-storey CFT structure increased by 22.8% and 11.8%, respectively, compared with the RC and RCC structure. steel structure respectively. Research shows that reinforced concrete steel pipes are used in the construction of high-rise buildings because they are much more economical than steel buildings. Performance results are also better than RCC and steel structures.

2. (Patil and Kumbhar 2013) conducted a structural weakness study of a ten-storey RCC building and examined the seismic response of the structure considering different earthquakes. The building in question was modeled using the SAP2000-15 program. Therefore, there are differences in the seismic response, especially in the slip base, ground displacement and ground slides in two axes, time history in all directions, and comparison of the usage patterns of all models (V to X) used in this study. to work. It is known that parameters such as seismic field parameters, base shear force, story changes and story drifts are in the order of development of different seismic intensities from V to X for each period history and all models. For each model (i.e. stratified and unstratified), base shear force, layer properties displacement and layer displacement (X, Y directions) were measured. Since time history is the main technique used during seismic surveys, it is best to examine the reliability of measured and designed models using criteria set by IS codes.

3. (Parasiya and Nimodiya 2013) For the simulation and examination of braced frame reinforced concrete structures and horizontal load-resistant frame structures, the relationships and differences were compared with some previous studies. In terms of earthquake dynamic response, studies have

examined braced frame effects, shear wall effects, brace system types (such as lateral load-bearing systems), brace system materials paper, tension of various brace types, brace training, etc. Contains. This system is used to resist external loads and works better than systems that resist lateral loads when the structure is subjected to dynamic loads. Support mechanisms also increase the strength and ductility of structures when seismic forces are applied. Support systems are a good way to strengthen high-rise RCC structures to improve seismic warning systems. It can also be said that the support is a safety factor for the operation of high RCC structures, it increases the lateral load resistance of the structure by strengthening the characteristics and control and reduces the damage of the RCC structure during dynamic loads.

4. (Tedia and Savita Maru 2014) Comparison of a six-storey commercial building with a height of 3.658 meters per floor and a wind speed of 50 m/s in Earthquake III. The pole type is steel-concrete composite pole with R.C.C. Consider the options. Area = 56.3 m x 31.94 m. Composite and RCC frame structures were modeled using Staad-pro software and the results were compared. Cost analysis shows that steel-concrete composite designs are more expensive, which will make the steel-concrete composite design economical and reduce the direct cost of the rapid development of steel-concrete composite structures. Additionally, due to their performance, steel-reinforced concrete structures can perform better than RCC structures due to seismic reasons. model.

5. (Panchal 2014) In the Indian context, composite steel concrete is a new design concept and there is no new concept available for the same. The simple approach discussed in this work not only avoids expensive testing, VB.NET is fully object-oriented and provides programming code that runs as a runtime language (CLR), making it powerful, stable and secure. It also provides an easy connection to the Microsoft Access database, which has been found to be very useful in terms of quick access to the materials required for different metal structures. As part of the pre-processor and post-processor, many tables for creating different types of composite plates, beams and columns make the software not only very useful and flexible, but also very useful. The included method can provide detailed information for composite columns with multiple steel sections and multiple composites embedded in concrete.

6. (Fahad and Bhalchandra 2015) The authors used 6, 11 and 16 buildings for continuous study of RCC and composite structures. The deflection of the frame in earthquake forces is more than the RCC frame, but it is within the limits, but the deflection of the simply supported frame is greater than the deflection of all frames up to the appropriate deflection limit. In high-rise buildings, continuous frames are cheaper than R.C.C. It is better than frame and simple braced composite frame. The self-weight of the RCC frame is greater than that of the continuous beam and simply supported frame. For low-rise buildings, the cost difference between composite and RCC buildings is not significant, but composite structures are best for high-rise buildings. 7. (Shariff and Devi 2015) This article is based on a comprehensive study of modern architecture. Consider different numbers such as times fifteen, twenty, and twenty-five. Axial force, shear force and bending moment are not included in the method, and it has been determined that the composite structure can withstand seismic forces more than the RCC structure and finally, the mixed model performs better in the working model.

8. (Zaveri et al. 2016) In this study, low-rise buildings were compared in which the same seismic analysis was used for each model, and the analysis results were compared to determine which is suitable for RCC, steel and concrete under seismic. Compound low rise building. The authors concluded that CS is stiff and therefore earthquake resistant compared to RCC or SS (steel structures).

9. (Mandlik, Sharma and Mohammad 2016) The purpose of this article is to describe the development of different methods of all different types of construction for multi-storey systems (11, 16 and 21 floors respectively) under earthquake influence. and wind energy. RCC In these buildings, steel and steel were considered to protect the protection system from external forces. This study uses STAAD for the 11-storey, 16-storey and 21-storey study. Comparison of ProV8ii results shows that the displacement of the steel column under this load is smaller than the wind load and seismic load of the RCC structure. Column forces in RCC in case of seismic loading. Larger models than metal models. Since the ductility of steel can withstand wind forces better than concrete, the column strength under

wind loads is almost the same for 16- and 21-storey RCC and steel systems, but not for the columns of an 11-storey RCC building. It is smaller than steel. The bending moment of RCC structures under both seismic and wind loads is much higher than steel structures. The bending moment in steel buildings is very small. 10. (Sutar and Kulkarni 2016) Compared to RCC frame with more Lateral Displacement, the weight of the concrete mix decreases due to its weight. The composite steel-concrete frame follows the strong column-weak beam behavior because the hinges are made in the beam member rather than the column. No unexpected plastic hinges were observed in inelastic studies on RCC and composite frames. However, the composite method is better than RCC because the composite method has better performance in high seismic performance than RCC.

11. (Vaseem and Patagundi 2016) The authors examined the seismic effect of a 10-storey reinforced concrete and steel structure in the 4th seismic zone, modeled and analyzed by ETABS 2015 and using MS Excel for cost estimates, and pointed out earthquake and rolling effects. compression It has many benefits compared to concrete and steel is more expensive than RCC framing. The results were compared through the comparison diagram of nodal point, fat storey, tensile storey, drift storey, natural moment and base shear.

12. (Abhishek Sanjay Mahajan and Kalurkar 2016) The behavior of the entire composite structure (FEC) was studied by the authors who simulated certain time frames of twenty stories and considered two different types of models for comparative seismic analysis. " Push analysis" is done in a twenty-one-layer model. The analysis and design were done using ETABS software, as a result, the shear force of the RCC structure due to the weight of its own weight will be greater than that of the composite structure due to the tighter nature of the composite model. , RCC Compared to shorter cycle frames. 13. (Rathod et al., 2017) This was done in a 12-storey multi-storey building and ETABS was used to perform the pushover analysis. The study found that ETAB was used to perform inelastic/thrust analysis of RCC and composite frames. Research results were determined through variance and qualitative analysis using the RCC framework. The study concluded that in terms of dead load and base shear force, steel, EIS-SB, CIS-SB and CFT SB sites provided the least dead load compared to RCC sites. The content output of CFRC compares favorably to RCC. For this reason, they will definitely say that composite materials are suitable for buildings over RCC.

14. (Bani-hani and Malkawi 2017) compared the time history method and the response spectrum method and explained the use of response spectra for nonlinear dynamic analysis. It takes into account earthquake history and spectral information. Examination of two multi-storey buildings constructed in response to earthquakes in two different parts of Kabul. Analyze and compare artificial forces with seismic forces according to the design. By creating an accelerometer, the two methods are compared by creating a model and studying them in different situations.

15. (Mathew 2017) This study aims to compare the seismic analysis of D.C.C columns and composite G+15 buildings (GFRG filled and unfilled) in earthquake zone V. The study research was conducted to determine the role of S.C.C and concrete in buildings. ETABS software was used for analysis. There is a difference between design and composition. The authors stated that the difference in base shear force for both composite systems was approximately 10% to 15% compared to the structure with reinforced concrete structure. Older buildings can also be evaluated compared to modular buildings in terms of foundation shear and inter-storey displacement, which are 40% higher than modular buildings. In addition, the deflection of each building is within the limits of the IS regulations. Compared with the mixed structure of concrete with columns and semi-concrete with metal lines, the concrete in the production line is better.

Conclusion

The foregoing conclusions are drawn from the aforementioned literature.

- Composite structures can be recommended instead of RCC materials due to rapid development and location in terms of construction time. However, proper procedures need to be followed to achieve better performance.

- Since the composite structure is light, the foundation shear force and foundation moment are much smaller than the traditional RCC structure, and the shear strength of RCC samples is higher than the composite samples due to their weight.
- When the two composite structures were compared, it was determined that there was no significant change in the negative behavior of the steel pipe column and the I-shaped concrete column.
- In RCC, the duration is shorter in composite structure. In addition to being more efficient, composites resist external forces better than RCC structures.
- The variation and fold difference of the RCC model are more than the composite model, but both are within the allowable range. This is due to the flexibility of the composite structure compared to the RCC structure. Composite structure provides lateral stability and greater ductility.
- Cost is an important consideration when comparing steel structures with RCC buildings. Consumers still prefer cheaper options and ignore time-consuming and expensive options. Since columns and pillars do not require construction, they are less costly than RCC members. Finally, in the steel column, the reaction and axial force of the column is small, thus reducing the cost of the support column and the entire steel structure. Due to the rapid development of the metal frame and simple stone formwork, the construction of the building will take less time. Incorporating construction time into the cost equation as a feature of all costs will undoubtedly help improve the economics of composite structures.
- This study recommends time domain analysis because it determines response more reliably than observational response.
- Static analysis shows more values than spectrum analysis which shows that the behavior of the model is more reliable than static analysis.
- Choose between steel frame instead of RCC but for high rise buildings Composite frame is best.
- The final performance of composite structures is higher than RCC and steel structures.

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