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Comparative study of RCC Frame Structures using Staad.Pro, ETABS, and SAP

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ABSTRACT

An RCC framed structure is basically an assembly of slabs,beams,columns, and foundation inter-connected to each other as a unit.The load transfer, in such a structure, takes place from the slabs to the beams,from the beams to the columns and then to the lower columns and finally to the foundation which in turn transfers it to the soil. However, for a load bearing structure, the loads are directly transferred to the soil through the walls that are designed to specifically carry the loads. Since brick is weak in compressive strength in comparison to 1:2:4 cement concrete, the width of load bearing walls for buildings having more than four storeys become abnormally thick and for such cases, framed structures are designed. The floor area of an R.C.C framed structure building is 10 to 12 percent more than that of a load bearing walled building. Hence, there is an actual economy in case of RCC framed structures, especially where the cost of land is very high. We proposed to analyze and perform acomparative study of RCC Frame Structures using Staad.Pro, ETABS, and SAP. From the proposed research analysis we conclude that Staad.Pro is much more efficient. The values of force derivative are low as Compared to ETABS and SAP. The maximum the value of Force derivative will result in the maximum difference between the values of Staad.Pro, ETABS, and SAP.

Keywords: RCC Structure, Loads Analysis, Structure Optimization, Dead Load, Live Load.

I. INTRODUCTION

Structural analysis means the determination of the general shape and all the specific dimensions of a particular structure so that it will perform the function for which it is created and will safely withstand the influences which will act on it throughout its useful life. Although hundreds of thousands of successful reinforced cement concrete (RCC) framed structures are annually constructed worldwide, there are large numbers of them that deteriorate or become unsafe due to changes in loading, changes in use, or changes in configuration. The occurrence of natural calamities may also lead to a review of engineering notions that make reworking of existing structures inevitable. The reworking is variously referred as repair, rehabilitation, retrofitting, and upgradation with distinct meanings attached to all these terminologies.

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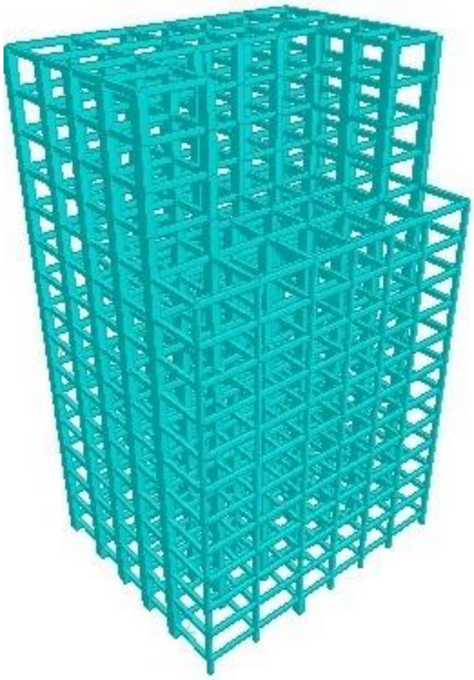

Fig 1: 3D View of Designed RCC Frame Structure

RCC frame structures

An RCC framed structure is essentially an assembly of slabs, beams, columns, and foundation inter-related to every different as a unit. The load transfer, in this kind of structure, takes location from the slabs to the beams, from the beams to the columns after which to the lower columns and sooner or later to the muse which in flip transfers it to the soil.

However, for a load bearing structure, the loads are directly transferred to the soil via the walls which might be designed to specifically carry the hundreds.

Since brick is vulnerable in compressive strength in evaluation to 1:2:4 cement concrete, the width of load bearing walls for homes having to say greater than 4 Storey's will become abnormally thick and for such cases, framed structures are designed.

The ground region of an R.C.C framed shape constructing is 10 to 12 percentage greater than that of a load bearing walled building. Hence, there may be areal economic system in case of RCC framed systems especially where the price of land may be very high.

Also, in thecase of RCC framed systems, the internal making plans of rooms, bathrooms, W.Cs and many others. May be altered by using converting the position of partition. Thus, there is extra flexibility in planning.

Monolithic production is viable with R.C.C framed systems and they can resist vibrations, earthquakes and shocks more efficaciously than load bearing walled homes. The speed of creation for RCC framed structures is greater speedy [4].

Reinforced concrete (RC) is a composite fabric wherein concrete's enormously low tensile strength and ductility are counteracted by using the inclusion of reinforcement having better tensile energy or ductility. The reinforcement is typical, even though no longer necessarily, metal reinforcing bars (rebar) and is normally embedded passively within the concrete before the concrete units. Reinforcing schemes are typically designed to

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resist tensile stresses especially areas of the concrete that might reason unacceptable cracking and/or structural failure. Modern reinforced concrete can contain numerous reinforcing substances made of steel, polymers or change composite material alongside rebar or not. Reinforced concrete will also be completely stressed (in compression), for you to improve the behavior of the final shape underneath running loads. For a sturdy, ductile and study creation the reinforcement needs to have the following properties as a minimum:

- High relative energy
- High toleration of tensile pressure
- Good bond to the concrete, no matter pH, moisture, and similar elements
- Thermal compatibility, not causing unacceptable stresses in reaction to converting temperatures.
- Durability in the concrete surroundings, no matter corrosion or sustained strain as an example[9].

Advantages of RCC construction:

- Materials used in RCC construction are easily available.
- It is durable and long lasting.
- It is fire resisting and not attacked by termites.
- It is economical in ultimate cost.
- The reinforced concrete member can be cast to any shape because of the fluidity of concrete.
- Its monolithic character gives much rigidity to the structure.
- The cost of maintenance is nil.

Disadvantages of RCC construction:

- Scrap value of reinforced members is almost nil.
- Constant checking is required.
- Skilled labor is engaged in the work.
- The advantages of RCC outweigh its disadvantages.

II. LITERATURE REVIEW

E Hoek et.al in (2001)[2] proposed a method for obtaining estimates of the strength of jointed rock masses, based upon an assessment of the interlocking of rock blocks and the condition of the surfaces between these blocks. This method was modified over the years in order to meet the needs of users who applied it to problems that were not considered when the original criterion was developed (Hoek 1983, Hoek and Brown 1988). The application of the method to very poor quality rock masses required further changes (Hoek, Wood and Shah 1992) and, eventually, the development of a new classification called the Geological Strength Index (Hoek 1994, Hoek, Kaiser and Bawden 1995, Hoek and Brown 1997, Hoek, Marinos and Benissi (1998).

B.D. Jones et.al in (2002)[5] due to limitations in their manufacturing stage, many composites can exhibit a considerable level of randomness in their microstructure. Such variations can affect the mechanical response of the resulting specimens, especially when localized phenomena are involved. When multi-phase materials exhibit statistically inhomogeneous characteristics, as in the case of random media with a built in gradient in composition, the analysis becomes considerably more complex as the spatial dependency of their probabilistic descriptors cannot be disregarded. This thesis presents a probabilistic simulation approach to the issue of

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characterizing and generating samples of such composites. Furthermore, the effects of randomness on the mechanical properties of these materials are investigated using micromechanical-based techniques. A novel method that is capable of generating non-Gaussian, non-stationary samples through a nonlinear translation technique is introduced and applied to the generation of two-phase random media .

S Babendererde et.al in (2004)[1] The characterization of the granitic mass of Porto for the design and construction of the Metro works of the city was based on weathering grades and structural features which were used for the derivation of the design parameters. The highly variable nature of the deeply weathered Oporto granite posed significant challenges in the driving of the 2.3 km long C line and the 4 km long S line of the project. Two 8.7 m diameter Herrenknecht EPB TBMs were used to excavate these tunnels but the nature of the rock mass made it extremely difficult to differentiate between the qualities of the mass and apply an open or a closed mode operation of the TBM accordingly. Thus early problems were encountered due to over excavation and face collapse. The matter was finally resolved by the introduction of an Active Support System, which involves the injection of pressurized betonies slurry to compensate for deficiencies in the face support pressure when driving in mixed face conditions. Both the C and S lines have now been completed with minimal surface subsidence and no face instability .

B Suresh et.al in (2012)[7] STAAD stands for Structural Analysis and Design. STAAD.Pro software is widely used in analyzing and designing structures – buildings, bridges, towers, transportation, industrial and utility structures. Designs can involve building structures including culverts, petrochemical plants, tunnels, bridges, piles; and building materials like steel, concrete, timber, aluminum, and cold-formed steel .

B Kanoksilapatham et.al in (2013)[6] It this presentation, some recent developments in verification and validation (V&V) of predictive models are introduced. Verification is a mathematical concept which aims at assessing the accuracy of the solution of a given computational simulation compares to sufficiently accurate or analytical solutions. Validation, on the other hand, is a physics-based issue that aims at appraising the accuracy of a computational simulation compare to experimental data. The proposed developments cast V&V in the form of an approximation-theoretic representation that permits their clear mathematical definition and resolution. In particular, three types of problems will be addressed. First, apriori and a-posteriori error analysis of spectral stochastic Galerkin schemes, a widely used tool for uncertainty propagation, are discussed. Second, a statistical procedure is developed in order to calibrate the uncertainty associated with parameters of a predictive model from experimental or model-based measurements. An important feature of such data-driven characterization algorithm is in its ability to simultaneously represent both the intrinsic uncertainty and also the uncertainty due to data limitation. Third, a stochastic model reduction technique is proposed in order to increase the computational efficiency of spectral stochastic Galerkin schemes for the solution of complex stochastic systems

Anamika Tedia et.al in (2014)[8] presented Steel-concrete composite production way metallic section encased in concrete for columns & the concrete slab or profiled deck slab is attached to the metal beam with the assist of mechanical shear connectors in order that they act as an unmarriedunit. Steel-concrete composite with R.C.C. Alternatives are considered for comparative observe of G+5 storey workplace constructing with 3.658 m peaks, which is situated in earthquake region III(Indore)& wind speed 50 m/s. The average plan size of the building is fifty six.3 m x 31.Ninety-four m. Equivalent Static Method of Analysis is used. For modeling of Composite &

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R.C.C. Systems, staad-seasoned software is used and the consequences are compared; and it's far discovered that composite shape more low-cost .

T.T. ISoong et.al in (2014)[3] Structural engineering is mainly a sub-division of civil engineering in which structural engineers are trained to understand, predict, and calculate the stability, strength, and rigidity of built structures for buildings and nonbuilding structures, to develop designs and integrate their design with that of other designers, and to supervise construction of projects on site. They can also be involved in the design of machinery, medical equipment, and vehicles where structural integrity affects functioning and safety .

III. PROBLEM FORMULATION

RCC (Reinforced Cement Concrete) is the combination of using steel and concrete instead of using only concrete to offset some limitations. Concrete is weak in tensile stress with compared to its compressive stress. To offset this limitation, steel reinforcement is used in the concrete at the place where the section is subjected to tensile stress. Steel is very strong in tensile stress. The reinforcement is usually round in shape with approximate surface deformation is placed in the form in advance of the concrete. When the reinforcement is surrounded by the hardened concrete mass, it forms an integral part of the member. The resultant combination of two materials is known as reinforced concrete. The present trend is to adopt reinforced concrete for bridges of small, medium and long spans resulting in aesthetically superior and economic structures in comparison with steel bridges. Due to thedevelopment of modern concrete, the desired properties of concrete such concrete strength and durability can be achieved for any type of construction but the quality and the performance of RCC are very important. As it is crucial for RCC to have a great balance between its own weight and its load capacity.

IV. PROPOSED RESEARCH METHODOLOGY

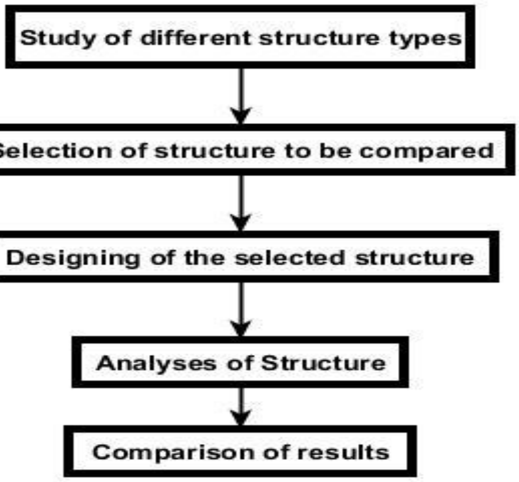

Fig 2: Proposed Research Methodology

V. SIMULATION AND EXPERIMENTAL RESULTS

We proposed to analyze and perform acomparative study of RCC Frame Structures using Staad.Pro, ETABS, and SAP. Reinforced concrete framed buildings are adequate for resisting both the vertical and the horizontal

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load acting on them. However, when the buildings are tall, beam and column sizeworkout quite heavy, so that there is alot of congestion at these joint and it is difficult to place and vibrate concrete at these places, which fact, does not contribute to the safety of buildings. Our comparative study shows that how various software's response to the same configuration given to Staad.Pro, ETABS, and SAP.

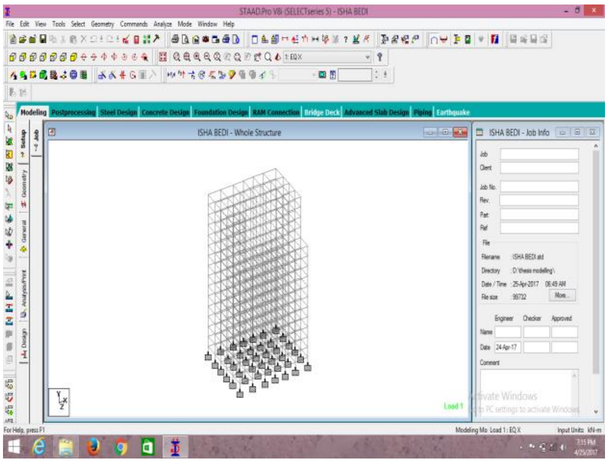
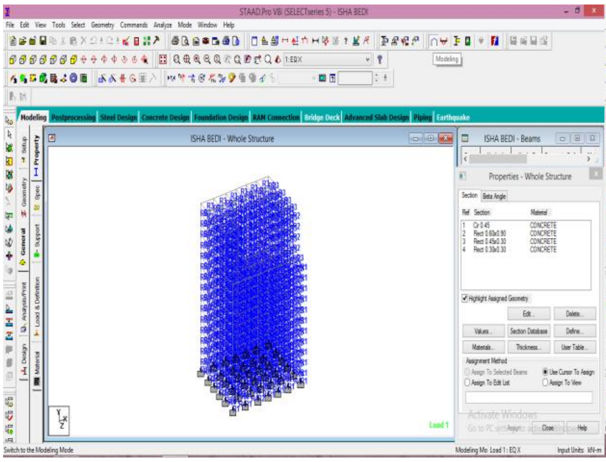


Fig 3: Structure designed using Staad.Pro for RCC Frame Structure Analysis



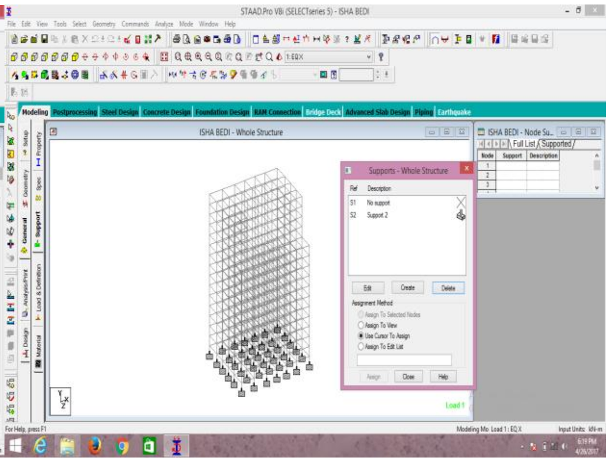
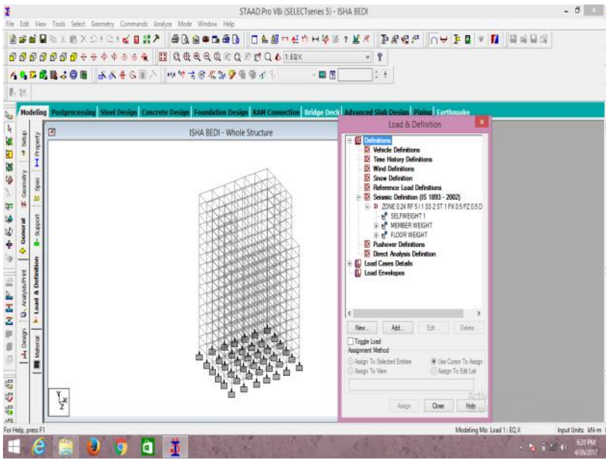


Fig 4: Properties of RCC Frame Structure **Fig 5: Supports of RCC Frame Structure**



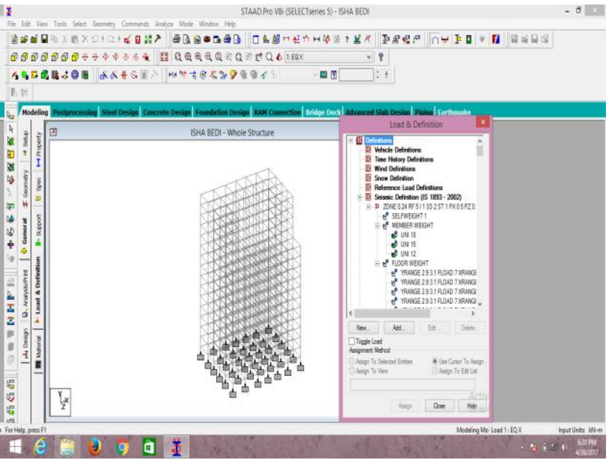


Fig 6: Load Definitions of RCC Frame Structure **Fig 7: Load Details of RCC Frame Structure**

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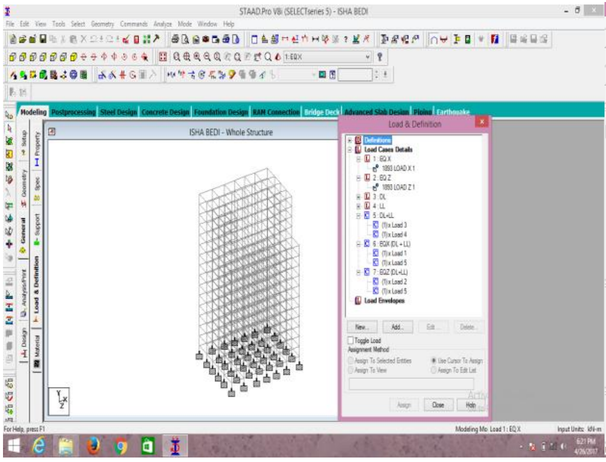

Fig 8: Load Details of RCC Frame Structure

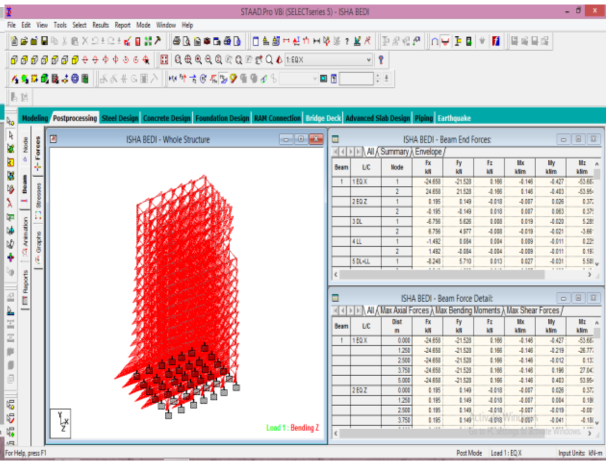

Fig 9: Beam and Forces of RCC Frame Structure

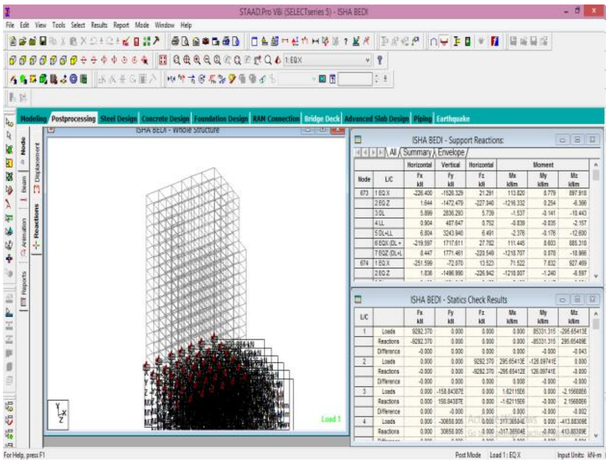

Fig 10: Support Reactions of RCC Frame Structure

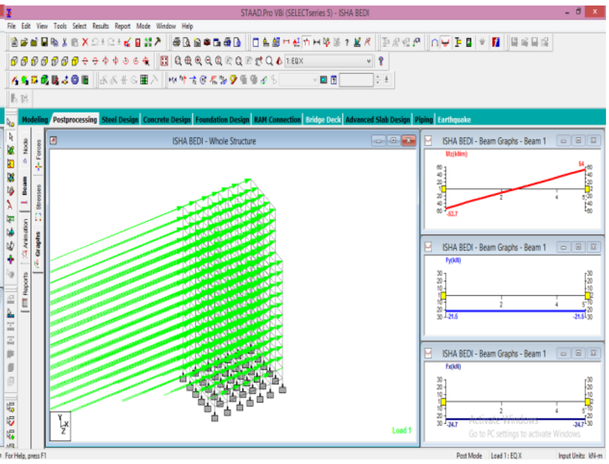

Fig 11: Graphs of RCC Frame Structure

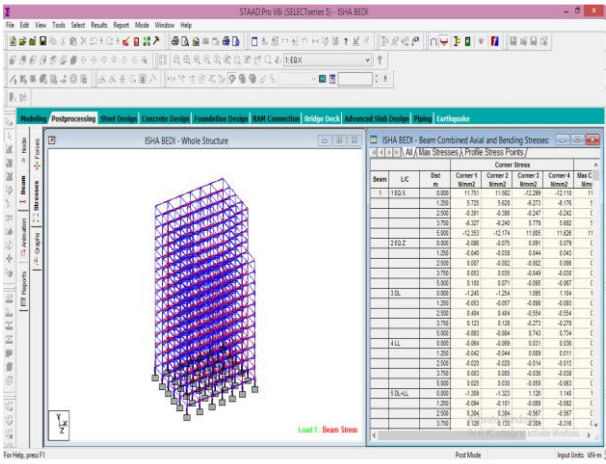

Fig 12: Stresses of RCC Frame Structure

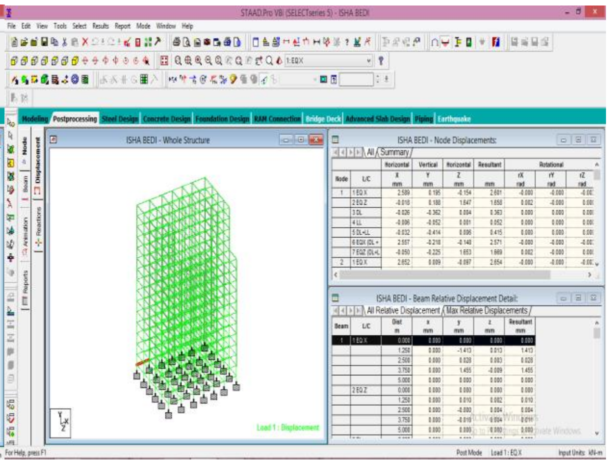

Fig 13: Displacement of RCC Frame Structure

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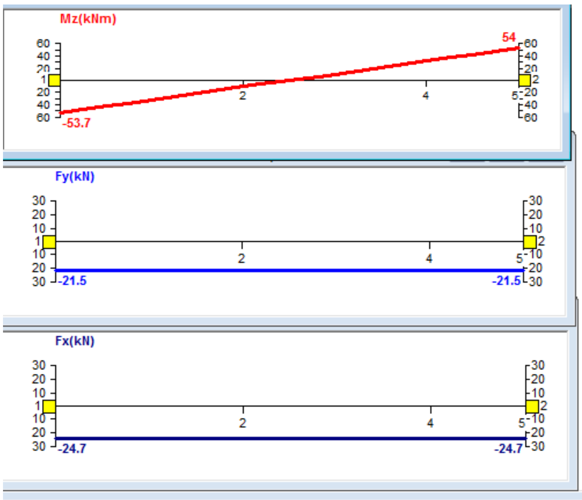


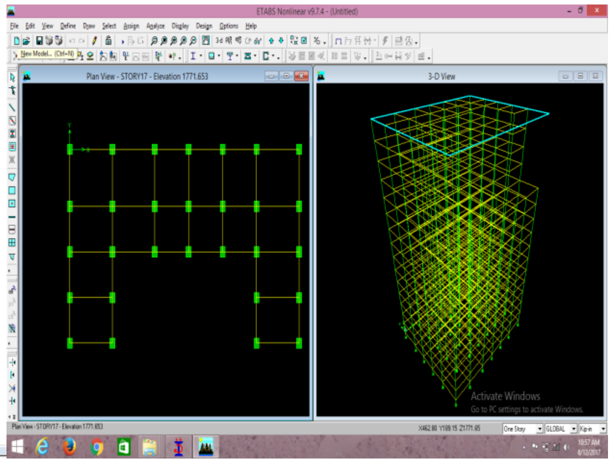
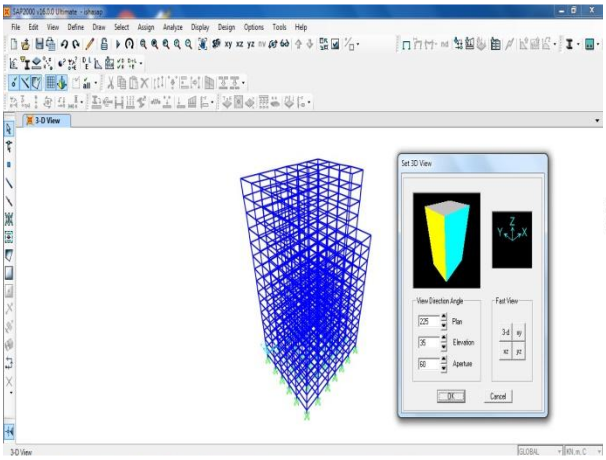


Fig 14: Beam Graphs **Fig 15: RCC Frame Structure Imported and analyzed using ETABS**



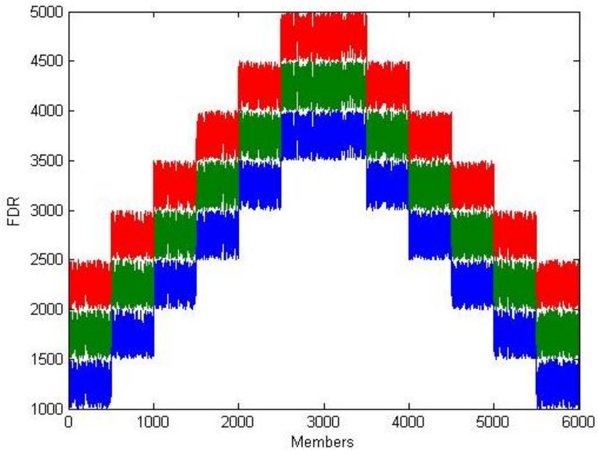


Fig 16: RCC Frame Structure Imported and analyzed using SAP **Fig 17: Comparison Graph of Force Derivative of RCC Frame Structure**

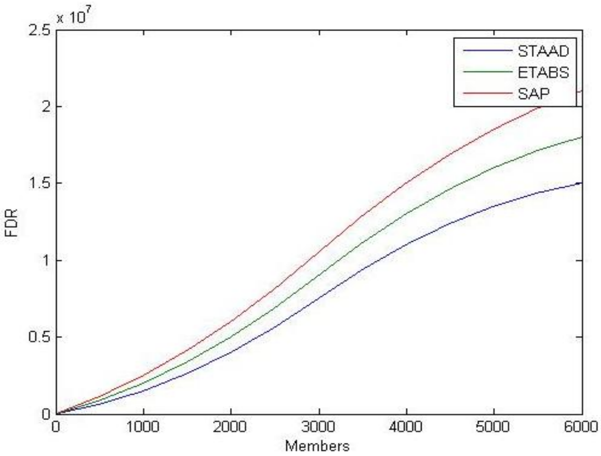


Fig 18: Cumulative Graph of Force Derivative of RCC Frame Structure

The RCC frame structure designed is analyzed using Staad.Pro, ETABS, and SAP. From the analyses of Figure 17 and Figure 18, it is concluded that Staad.Pro is much more efficient. The values of force derivative are low as

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Compared to ETABS and SAP. The maximum the value of Force derivative will result in the maximum difference between the values of Staad.Pro, ETABS, and SAP.

VI. CONCLUSION AND FUTURE SCOPE

The present trend is to adopt reinforced concrete for bridges of small, medium and long spans resulting in aesthetically superior and economic structures in comparison with steel bridges. Due to thedevelopment of modern concrete, the desired properties of concrete such concrete strength and durability can be achieved for any type of construction but the quality and the performance of RCC are very important. We proposed to analyze and perform acomparative study of RCC Frame Structures using Staad.Pro, ETABS, and SAP. From the proposed research analysis we conclude that Staad.Pro is much more efficient. The values of force derivative are low as Compared to ETABS and SAP. The maximum the value of Force derivative will result in the maximum difference between the values of Staad.Pro, ETABS, and SAP.

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