Observation of Time history analysis in High seismic zone multistory building using staad pro software

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ABSTRACT

On demand of growing population construction of high –rise building is being made compulsory for avoiding land scarcity in future. So these high-rise are difficult to be analyzed manually. So many computerized commercial software are available for analyzing a structure digitally. It uses limit state method in RCC for designing by considering all the standard code books and gives the design. Structural Time history and design is an art and science of designing with economy elegance and durable structure. The entire process of structural Time history and designing is not only requires imagination and thinking but also sound knowledge of structural engineering besides knowledge of practical aspects such as relevant design codes and by-law backed up by experiences. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety. The design involves load calculations manually and analyzing the whole structure by STAAD pro and STAAD etc. Complicated and high-rise building need and very time taking and cumbersome calculations using conventional manual methods. STAAD pro provides us a fast, efficient, easy to use accurate platform for analyzing an multi-storey building. Finally we make an attempt to define the economical structure by STAAD.Pro.

KEYWORDS: Seismic Analysis, Wind Analysis, Multistorey building, Staad.Pro.

I. INTRODUCTION

Human life is affected due to nature's forces like floods, hurricanes, tornadoes, earthquakes etc. The structural design for a building must ensure that the building is able to stand safely, to function without excessive deflections or movements which may cause fatigue of structural elements, cracking or failure of fixtures, fittings or partitions, or discomfort for occupants.

It must account for movements and forces due to temperature, creep, cracking and imposed loads. It must also ensure that the design is practically buildable within acceptable manufacturing tolerances of the materials. It must allow the architecture to work, and the building services to fit within the building such that it is functionable (air conditioning, ventilation, lighting etc.).

Now a days due to the over population in the urban cities and high cost of the land, there is a need to accommodate in multi-storey building.

The determination of general shape, specific dimension and size is known as structure analysis, so that it will perform the function for it create and will safely withstand the influences which will act on throughout its useful life. The entire process of structural plTime history ing and designing requires not only imaginations and calculations, but also science knowledge of structural engineering decide knowledge of particle aspect, such byelaws and design codes, backed by sample experience and judgment.

Building construction is the engineering deals with the construction of building such as residential houses. In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans

II. ALTERNATIVES FOR STAAD

Struts, robot, sap, adds pro which gives details very clearly regarding reinforcement and manual calculations. But these software's are restricted to some designs only where as STAAD can deal with several types of structure. STAAD Editor: STAAD has very great advantage to other software's i.e., staad editor. staad editor is the programming For the structure we created and loads we taken all details are presented in programming format in staad editor. This program can be used to analyze another structure also by just making some modifications, but this require some programming skills. So load cases created for a structure can be used for another structure using STAAD editor.

Limitations of STAAD.Pro:

1. Huge output data
2. Even analysis of a small beam creates large output.
3. Unable to show plinth beams.

III. PROPOSED METHODOLOGY TIME HISTORY ANALYSIS

Time history analysis is one of the numerical methods used in structural dynamics to evaluate the dynamic response of structures under time-varying loads. It involves solving the equations of motion of a structural system at discrete time intervals, using either direct integration or modal superposition methods. The input for time history analysis can be either a recorded or a synthetic time history of forces or displacements, representing the actual or expected loading conditions. The output of time history analysis is a series of values of displacements, velocities, accelerations, stresses, or strains at each time step, which can be used to assess the structural performance and damage.

Time history analysis is useful for several reasons. First, it can capture the nonlinear behavior of structures, such as material or geometric nonlinearity, damping, or plasticity, which can affect the dynamic response significantly. Second, it can account for the frequency content and phase relationship of the loading, which can influence the resonance and amplification effects. Third, it can provide detailed information on the time history of structural response, which can help identify critical events, peak values, and failure modes.

Time history analysis requires you to define a structural model, choose a time history input, and select a time history analysis method. You should also set the parameters for the chosen method and run the analysis. Finally, analyze the output values to see if they meet the design criteria. By following these steps, you can use time history analysis to obtain accurate results about the structural response of a system.

Time history analysis can be difficult due to a variety of challenges. For example, it can be challenging to select an appropriate input that accurately represents loading conditions for the structure. Additionally, numerical solutions for nonlinear or long-duration problems must be accurate and stable. Furthermore, interpreting output values and identifying relevant parameters is difficult, as is comparing results from different time history analyses and selecting the most critical or representative cases.

TIME HISTORY ANALYSIS

Time history analysis is a beneficial tool for civil engineering design. It can provide a comprehensive and realistic assessment of the dynamic response of structures under complex and variable loads. This allows for the design of structures that are resilient, robust, and efficient under dynamic loads, through the optimization of structural parameters such as stiffness, mass, damping, or shape. Additionally, time history analysis can help evaluate the performance and damage of existing structures under dynamic loads by calibrating the structural model with measured data, identifying weak points, and proposing retrofitting solutions.

Time-history analysis provides for linear or nonlinear evaluation of dynamic structural response under loading which may vary according to the specified time function. Dynamic equilibrium equations, given by $K\, u(t) + C\, {}^{d}/_{dt}\, u(t) + M\, d^2/_{dt}\, u(t) = r(t)$, are solved using either modal or direct-integration methods. Initial conditions may be set by continuing the structural state from the end of the previous analysis. Additional notes include:

- **Step Size** – Direct-integration methods are sensitive to time-step size, which should be decreased until results are not affected.
- **HHT Value** – A slightly negative Hilber-Hughes-Taylor alpha value is also advised to damp out higher frequency modes, and to encourage convergence of nonlinear direct-integration solutions.
- **Nonlinearity** – Material and geometric nonlinearity, including P-delta and large-displacement effects, may be simulated during nonlinear direct-integration time-history analysis.

Time-history analysis parameters

Damping

Opens either of the following dialogs, depending on the selected method.

- The **Damping** dialog allows you to determine detailed damping values of individual vibration modes for the modal decomposition method.
- the **Rayleigh Damping** dialog allows you to determine Rayleigh factors for the Newmark and the Hilber-Hughes-Taylor (HHT) methods.

Note: If you want to use the Hilber-Hughes-Taylor (HHT) method, you must specify the alpha coefficient.

Time

- **Time step** - The step of time variable for which the results are stored.
- **Division** - The number of time step divisions defining the storage frequency of analysis results.
- **End** - The end value of time variable for which the analysis is carried out.

Note:

If a method other than modal decomposition is selected, then the number of time step divisions (time step of saving results) is specified in the Division field to define the time step of integration. The time step of integration equals Time step / Division. When the division value equals 1, the time step of saving results is identical as the time step of integration.

If modal decomposition (linear time history analysis) is selected, the algorithm calculates the maximum value of the time step of integration for each mode, equaling the value of period divided by 20. This guarantees stability and the precision of results. Calculated step value is divided by the division value. The value received (step_1) is compared to the time step of saving results. A The smaller of these values (step_1 and time step of saving results) is adopted as the time step of integration. Take note that if the first value is applied in calculations, it is slightly modified so the time step of saving results is a multiple of this value.

STRUCTURAL PARAMETERS

Structural parameters are essential characteristics that describe the physical and mechanical properties of a structure. These parameters are crucial for the design, analysis, monitoring, and maintenance of structures. Here are various key structural parameters:

Load and Force Parameters:

Dead Load: The permanent, static weight of the structure itself, including all fixed elements like walls, floors, and roofs.

Live Load: Temporary or movable loads that the structure must support, such as people, furniture, vehicles, and equipment.

Dynamic Load: Loads that change over time, including wind, earthquakes, and vibrations from machinery or traffic.

Impact Load: Sudden or short-term loads, such as those from collisions or explosions.

Geometric Parameters:

Dimensions: Length, width, height, and thickness of structural elements.

Shape and Cross-Section: The form and cross-sectional area of elements like beams, columns, and slabs.

Span: The distance between two supports in a structural element like a beam or bridge.

G+11 Reinforced concrete framed structures were modelled in Staad. Keeping this model as a standard structures were modelled.

The structures were loaded as per IS 875: 1987 and analyzed as per IS 1893:2002.

Seismic analysis was performed using Seismic coefficient method as well as the response spectrum method.

The maximum displacement, shear and overturning moments were determined and compared.

IV. RESULT AND ANALYSIS

Design Criteria of Symmetrical, Asymmetrical and Diagrid Building

Design Parameters	**Values (m)**
Length	15
Height	15
Width	12
No of Base along Height	12
No of Base along Length	5
No of Base along Width	4
Slab Thickness	0.12
Column	0.23x0.4
Beam	0.23x0.3

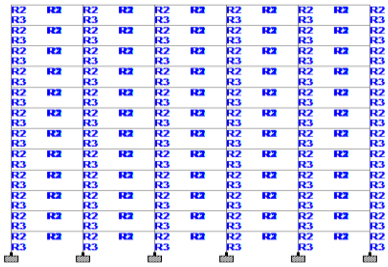

Fig.1 Design of G+11 storey building using staad-pro.

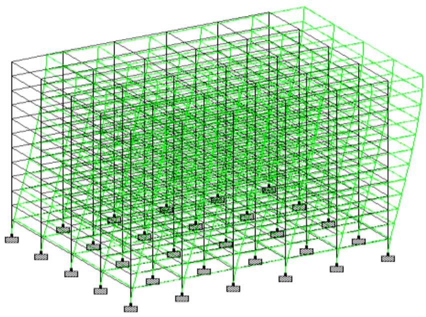

Fig.2 Displacement of G+11 Building.

Table 5.13 Summary.

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.881902
R Square	0.777751
Adjusted R Square	0.694417
Standard Error	3.894677
Observations	13

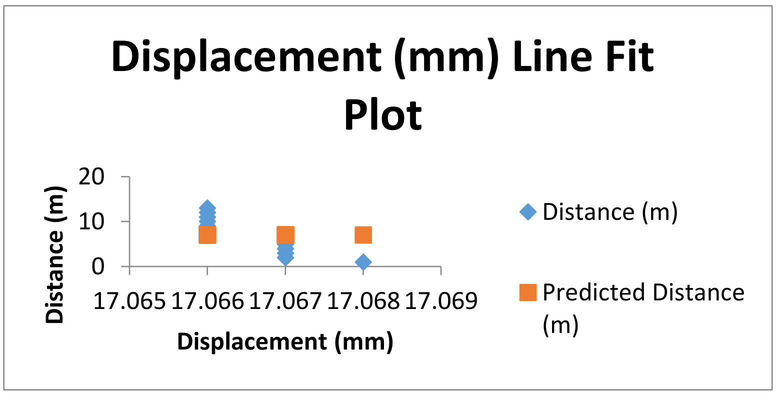

Fig.3. Prediction

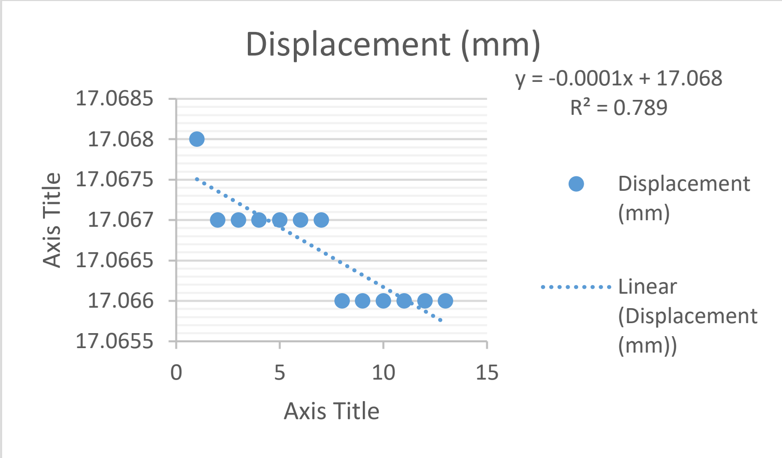

Fig.4. Time history.

V. CONCLUSION AND FUTURE SCOPE

In the early design phase, designers and clients aspire to compare multiple structural designs, considering both different stability frameworks and variations in geometry. Unfortunately, the current process of evaluating multiple designs is time-consuming. To address this challenge, predictive models can be used to estimate performance in terms of structural and environmental costs based on the given geometry. These models rely on the established relationship between performance and input geometry where the established relationship is depending on the used predictive model. Traditional curve fitting methods, such as polynomial regression models, often fall short in accurately predicting a complex nonlinear relationship. Therefore, in this research the potential of artificial neural network was examined as an alternative. It was found that the artificial neural network is able to accurately predict structural and environmental based on the input geometry.

Time history and building a civil engineering structure is a serious and complex project, designing a safe architecture for the structure is of course an essential part to avoid risks. Nowadays, conventional methods to verify the safety of a complex and non linear structure can be very time expensive. Neural Network approaches can help to reduce this computational time. With this work we proved the potential of neural network models by predicting approximations of solutions for beam structures designs in less time than with a traditional method.

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