International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 10 | Oct 2022 www.irjet.net p-ISSN: 2395-0072

Response Spectrum and Time History Analysis of a Multistorey Building

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Abstract – *The current analysis and design of a building are weak under adjacent forces due to earthquakes. In previous studies it has been analyzed that the buildings under lateral earthquake forces have been failed and some structures have been collapsed. A G+15 building model is generated and the design and analysis is done with the ETABS software as per Indian Standard codes. The response spectrum and time history analysis has been analyzed and its structure is designed with ETABS software. The response spectrum, analysis of time history results and also the displacements, storey shears and storey stiffness of a building is generated by using the ETABS software. The structural elements like columns, beams, shear and slabs wall have been designed as per the Indian Standard codes.*

Key Words: **Building Frame, Response Spectrum and Time History Analysis**

1. INTRODUCTION

High-rise structures are chosen as a solution to the land scarcity caused by the growing population. These kinds of high-rise structures are vulnerable to natural disasters. Because they can't be controlled and inflict damage and mayhem to the structural components, natural disasters like earthquakes are the most harmful. These natural disasters disrupted the course of regular lifecycle development and caused property destruction. Given that it is a worldwide issue, extensive research must be done, and the findings must be presented in order to prepare the framework and meet the deadline. With the development of technology, man has attempted to resist these natural disasters in numerous ways, including by creating early warning systems for disasters, implementing fresh preventative strategies, and putting in place effective relief and rescue efforts. But regrettably, not all natural calamities fall within this category. There are periodic revisions to the risk maps that identify seismic zones in seismic codes (IS 1893:2002), which increases the base shear requirement on existing structures. If the following factors are taken into account, the risk of a building collapsing is reduced.

2. METHODOLOGY

The structural analysis modes are categorized into five classifications they are –

i. Response Spectrum Analysis
ii. Equivalent Static Analysis
iii. Linear Dynamic Analysis
iv. Non-Linear Static Analysis
v. Non-Linear Dynamic Analysis

2.1 EQUIVALENT STATIC ANALYSIS

The analysis performing upon the structure resembling the impact of seismic activity motions usually defined with a response spectrum. This one assumes that the structure reacts around its primary modes and its true that the construction have to be low-rise in addition to it should not twist ominously with movements if the ground.

2.2 RESPONSE SPECTRUM ANALYSIS

The method approves the various methods of response of structure to be procured into analysis and these modes can also be combination of some special modes. These techniques for the structure of each mode for which a response is to be supplied from the design spectrum may be resolved using computer analysis. Based on modal mass and modal frequencies, the overall response of the structure is given and calculated. This allows us to calculate the forces' magnitudes in all X, Y, Z directions. As a consequence, Research into the response spectrum that makes use of ground-motion response spectra will provide results that vary from those obtained from a straightforward linear dynamic analysis of ground-motion data. In cases where the structure is irregular (or) too tall the response spectrum is approached no longer appropriate to the complex study.

2.3 LINEAR DYNAMIC ANALYSIS

The structure is modelled in this study as having many degrees of freedom, an equal viscous damping ratio and a linear elastic stiffness matrix. In linear dynamic analysis, a structure's reaction to earth movement is estimated using time domain data from the past.

2.4 NON-LINEAR DYNAMIC ANALYSIS

The analysis makes use of the sequences of ground movement data by a detailed pattern of the structure hence, it is efficient to generate solutions by comparatively low uncertainty and in this the non-linear dynamic analysis the detailed structural representation subjected to the recorded estimate of ground motion which that each component deformation to every degree of freedom within modal. But the analyzed response can remain extremely subtle to the features of the specific earth movement used as per seismic input.

2.5 NON-LINEAR STATIC ANALYSIS

In overall, the linear procedure remains appropriate after the structure is predictable to persist approximately in elastic form used for the parallel to ground movement (or) while the design outcomes stay approximately for equal distribution of non-linear response all over the structure. This is similarly called as "Pushover Analysis" where arrangement of forces is useful to the structural pattern containing non-linear properties. These can be combined with acceleration-displacement response spectrum (ADRS) and also it moderates the problematically to single degree of freedom (SDOF).

Table -1: Structural Data of Reinforced concrete elevated over head water tank

Height of Building Height of storey	45m 3m
Beam Size	450mm X 300mm
Column Size	450mm X 300mm
Characteristic Strength of Concrete (fck)	35MPa
Thickness of Slab	230mm

3. STRUCTURAL DATA OF REINFORCED CONCRETE & STEEL ELEVATED OVER HEAD WATER TANKS

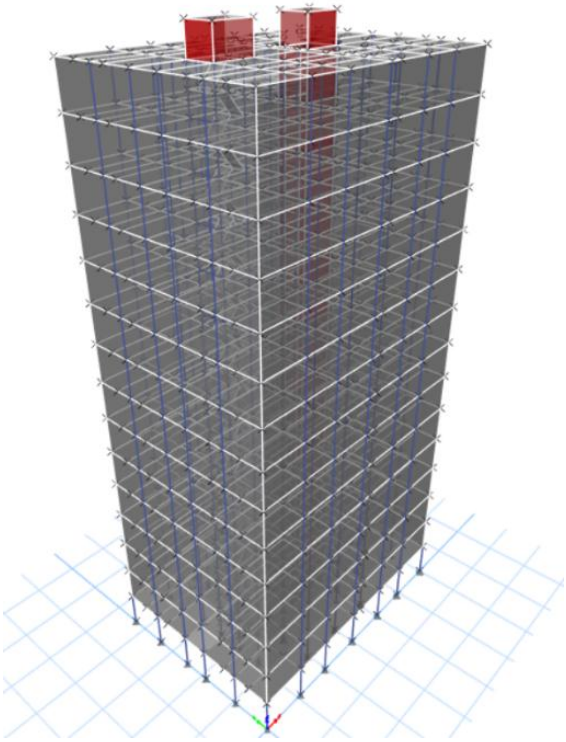

Fig -1: Multi-Storey Building of storey's G+15

4. RESULTS

The multi-storey building which consists of G+15 storey's which are subjected to the seismic events in ETABS software.

4.1 Storey Displacements

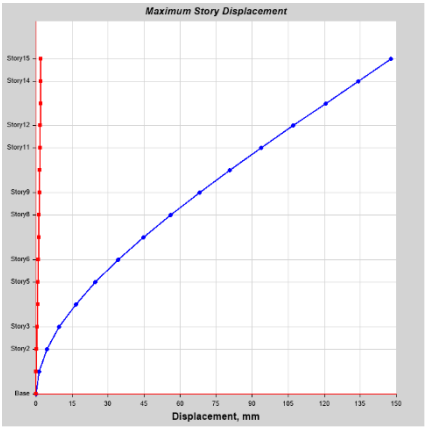

Fig-2: Storey displacement from response spectrum analysis.

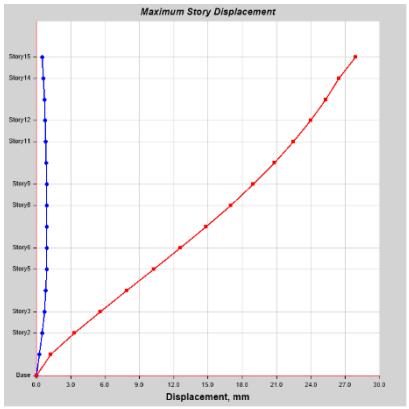

Fig-3: Storey displacements which is subjected to wind load.

4.2 Storey Shears

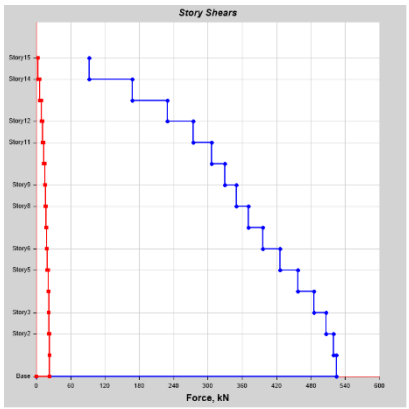

Fig-4: Storey shears of the multi-storey building

4.3 Storey Stiffness

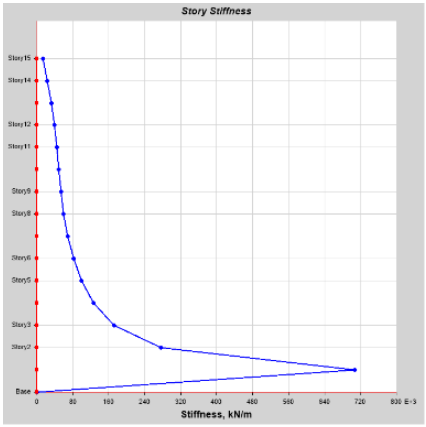

Fig-5: Storey stiffness of the multi-storey building

4.4 Response Spectrum Plots from Time History Analysis

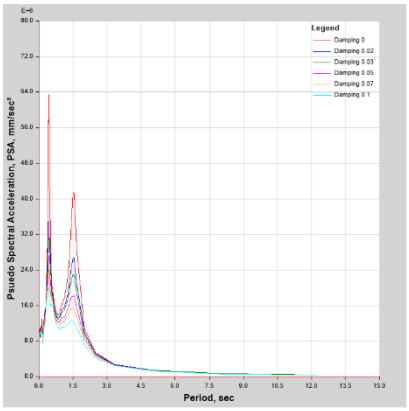

Fig-6: Response spectrum plots from time history study of the multi-storey building

4.5 TIME HISTORY ANALYSIS PLOTS

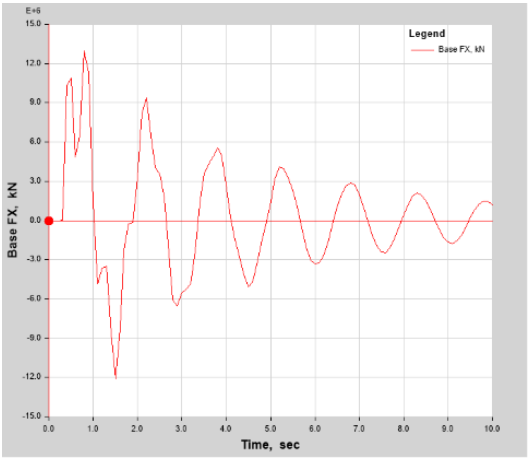

Fig-7: Time history study of the multi-storey building

5. CONCLUSIONS

This presents a method of analysis based on spectrum. Response spectrum analysis (RSA) for predicting the forces generated by the earthquake in the multi-storey building. In order to take into account, the linear combination impact of vibration modes in seismic response of a multi-story structure, a linear response spectrum was introduced into the time history analysis (THA) approach in response spectrum studies. The above results shows that multi-storey structure built using standard code provisions which are subjected to the seismic events and generate the displacements, storey shears, and storey stiffness and also generated the response spectrum and time history curves so that it shows the variation between the plots and curves of multi-storey building, the structure is made to resist the seismic

induced forces from previous records and also resist the lateral loads which are done using the ETABS software.

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