Non Linear Dynamic Analysis of Post Tensioned Beam Using Time History Analysis

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Abstract- *Earthquake is the result of sudden release of energy in the earth's crust that generates seismic waves. Ground shaking and rupture are the major effects generated by earthquakes. It has social as well as economic consequences such as causing death and injury of living things especially human beings and damages the built and natural environment. In order to take precaution for the loss of life and damage of structures due to the ground motion, it is important to understand the characteristics of the ground motion.*

Keywords- PGA, PGV,PGD,Prestressing.

I. INTRODUCTION

Ground motion is the movement of the earth's surface from blasts or earthquakes. It is generated by waves that are produced by sudden pressure at the explosive source or abrupt slip on a fault and go through the earth and along its surface. In this chapter, the characteristics of the six ground motions, which are used for the time-history analysis of the RC buildings, are explained. Then, a brief description is given for linear time-history analysis. The motion of sufficient strength that effects people and environment is called strong ground motion. It is described by three transitions and three rotations. The effect of the three rotations is very small which may be neglected. The maximum absolute value of the ground acceleration is peak ground acceleration (PGA).Pre-tensioning is a common prefabrication technique, where the resulting concrete element is manufactured remotely from the final structure location and transported to site once cured. It requires strong, stable end-anchorage points between which the tendons are stretched. These anchorages form the ends of a "casting bed" which may be many times the length of the concrete element being fabricated. This allows multiple elements to be constructed end-on-end in the one pre-tensioning operation, allowing significant productivity benefits and economies of scale to be realised for this method of construction.

The amount of bond (or adhesion) achievable between the freshly set concrete and the surface of the tendons is critical to the pre-tensioning process, as it determines when the tendon anchorages can be safely released. Higher bond strength in early-age concrete allows more economical fabrication as it speeds production. Where "profiled" or "harped" tendons are required, one or more intermediate deviators are located between the ends of the tendon to hold the tendon to the desired non-linear alignment during tensioning Such deviators usually act against substantial forces, and hence require a robust casting bed foundation system. Straight tendons are typically used in "linear" precast elements such as shallow beams, hollow-core planks and slabs, whereas profiled tendons are more commonly found in deeper precast bridge beams and girders.

Pre-tensioned concrete is most commonly used for the fabrication of structural beams, driven piles, water tanks and concrete pipes. Dynamic analysis using the time history analysis calculates the building responses at discrete time steps using discretized record of synthetic time history as base motion. If three or more time history analyses are performed, only the maximum responses of the parameter of interest are selected.

Time history analysis is the study of the dynamic response of the structure at every addition of time, when its base is exposed to a particular ground motion. Static techniques are applicable when higher mode effects are not important. This is for the most part valid for short, regular structures. Thus, for tall structures, structures with torsional asymmetries, or no orthogonal frameworks, a dynamic method is needed.

In linear dynamic method, the structures is modeled as a multi degree of freedom (MDOF) system with a linear elastic stiffness matrix and an equivalent viscous damping matrix. The seismic input is modeled utilizing time history analysis, the displacements and internal forces are found using linear elastic analysis. The playing point of linear dynamic procedure as for linear static procedure is that higher modes could be taken into account.

In linear dynamic analysis, the response of the building to the ground motion is computed in the time domain, and all phase information is thus preserved. Just linear properties are considered. Analytical result of the equation of motion for a one degree of freedom system is normally not conceivable if the external force or ground acceleration changes randomly with time, or if the system is not linear. Such issues could be handled by numerical time-stepping techniques to integrate differential equations.

In order to study the seismic behavior of structures subjected to low, intermediate, and high-frequency content ground motions, dynamic analysis is required. The STAAD Pro software is used to perform linear time history analysis.

A. Objectives

1. To find out natural frequency & time period of post tension beam under combined bending & shear
2. To find out Peak ground displacement in post tension beam.

II. METHODOLOGY

Buildings are subjected to ground motions. The ground motion has dynamic characteristics, which are peak ground acceleration (PGA), peak ground velocity (PGV), peak ground displacement (PGD), frequency content, and duration. These dynamic characteristics play predominant rule in studying the behavior of RC buildings under seismic loads. The structure stability depends on the structure slenderness, as well as the ground motion amplitude, frequency and duration.

A. MATERIAL PROPERTIES

Table 1.

Concrete Properties		Steel Bar Properties	
Unit weight (γ_c)	25 (kN/m^3)	Unit weight (γ_s)	76.9729 (kN/m^3)
Modulus of elasticity (E_c)	22360.68 (MPa)	Modulus of elasticity (E_s)	2x10^5 (MPa)
Poisson ratio (ν_c)	0.2	Poisson ratio (ν_s)	0.3
Thermal coefficient (α_c)	5.5x10^{-6}	Thermal coefficient (α_s)	1.170x10^{-6}
Shear modulus (G_c)	9316.95 (MPa)	Shear modulus (G_s)	76923.08 (MPa)
Damping ratio (ζ_c)	5 (%)	Yield strength (F_y)	415 (MPa)
Compressive strength (F_c)	30 (MPa)	Tensile strength (F_u)	485 (MPa)

III. PROBLEM STATEMENT

Storey height-: G+4
Slab Thickness-: 150mm
Column Thickness-: 230mm x 450mm
Eccentricity-: 275mm
Prestressing Force-: 1850KN
Floor To Floor Height-: 3m

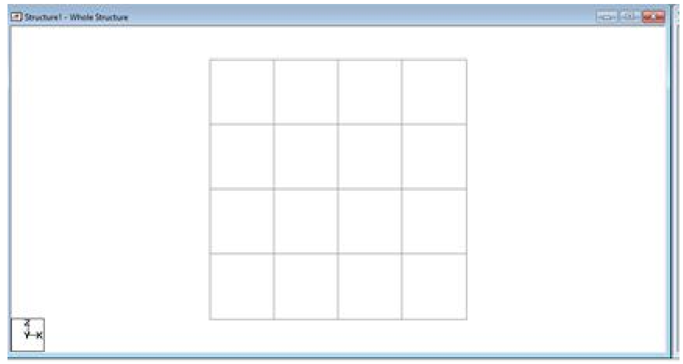

Figure 1. Plan of Bay Frame

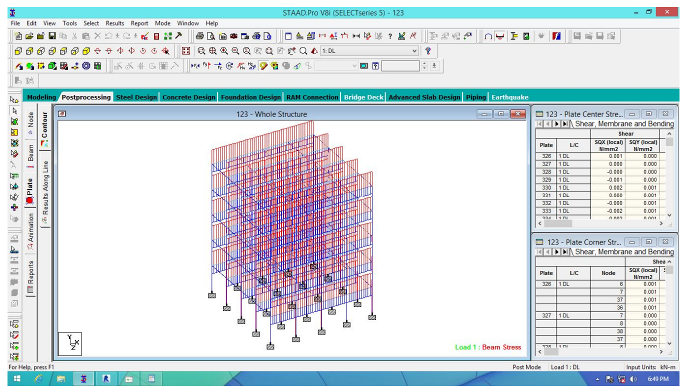

Figure 2. Stresses in Beam

IV. RESULTS & DISCUSSION

Table 2.

MODE	FREQUENCY	PERIOD
1	0.918	1.08942
2	1.031	0.96951
3	1.233	0.81083
4	2.814	0.35539
5	2.988	0.33464
6	3.243	0.30833

Max. Displacement

Table 3.

LOAD CASE	MAX. DISPL.
LOAD CASE 1	0.008
LOAD CASE 2	0.082
LOAD CASE 3	0.002
LOAD CASE 4	0.091

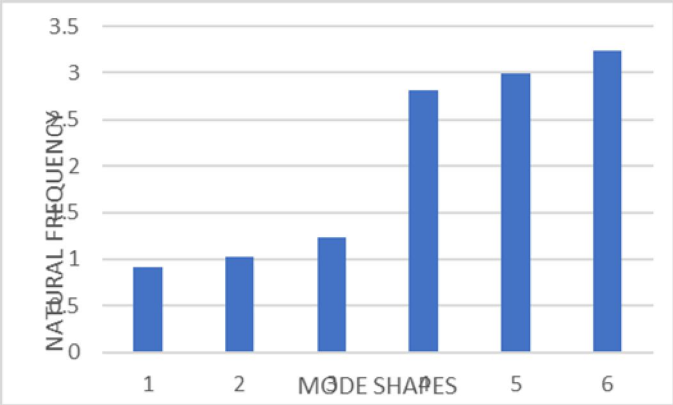

Figure 3.

V. CONCLUSION

- From above results, max displacement occurs in load case4 i.e 0.091.
- Maximum natural frequency occurs at mode no. 6 having time period 0.3083.
- Maximum Bending moment in X direction of bay frame is 0.115 KN.m and minimum is 0.03 KN.m.

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