

Study of base shear and storey drift by dynamic analysis

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Abstract—In the present paper, effect of height of building on base shear, lateral forces and storey drift is evaluated by using STAAD software and the results are compared with IS1893 (Part1:2002). For these purpose seismic coefficient method (SCM) specified in IS1893 (Part1:2002) is taken into consideration and results are obtained in STAAD by SCM. The study includes the modeling of two buildings having plan areas 15 m x 9 m and 25m x 15m and the height is varied from 3m, 6m, 9m and 12m. The study is conducted by varying the geometrical properties of the structure but the seismic properties are kept constant. The buildings are located in zone II region. The results obtained for base shear and other design parameters obtained from STAAD software match with IS1893:2002. Spring mass model with the lateral forces are also plotted for the different buildings. Percentage change in storey shear for the different buildings is also evaluated. It can be observed that as the height and area of building increases the base shear and storey drift increases.

Index Terms—Base shear, Earthquake Seismic coefficient method, STAAD software.

I. INTRODUCTION

An earthquake may be defined as release of elastic energy by sudden slip on a fault and resulting ground shaking and radiated caused by slip. Earthquakes are one of the worst among the natural disasters. About 1 lakh earthquakes of magnitude more than three hit the earth every year. According to a conservative estimate more than 15 million human lives have been lost and damage worth hundred billions of dollars has been inflicted in the recorded history due to these. Some of the catastrophic earthquakes of the world are Tangshan of China (1976, $M_w=7.8$, casualty > 3 lakhs), Mexico city (1985, casualty > 10,000) and North-West Turkey (August 17, 1999, $M_w=7.4$, casualty > 20,000). In India, casualty wise, the first three events are Kangra (>20,000), Bihar-Nepal (>10,653) and Killari (>10,000). Moreover, Indian-Subcontinent, particularly the northeastern region, is one of the most earthquakes-prone regions of the world. The concept of earthquake magnitude was first developed by Richter (e.g., Richter 1958), and hence, the term "Richter scale". The value of magnitude is obtained on the basis of recordings of earthquake ground motion on seismographs. In practice, there are several different definitions of magnitude; each could give a slightly different value of the magnitude. Hence, magnitude is not a very precise number. Usually, earthquakes of magnitude greater than 5.0 cause strong enough ground motion to be potentially damaging to structures. Earthquakes of magnitude greater than 8.0 are often termed as great earthquakes. Intensity indicates the violence of shaking or the extent (or

potential) of damage at a given location due to a particular earthquake. Thus, intensity caused by a given earthquake will be different at different places. Prior to the development of ground motion recording instruments, earthquakes were studied by recording the description of shaking intensity. This lead to the development of intensity scales which describe the effects of earthquake motion in qualitative terms. An intensity scale usually provides ten or twelve grades of intensity starting with most feeble vibrations and going upto most violent (i.e., total destruction). The most commonly used intensity scales are: *Modified Mercalli (MM) Intensity Scale* and the *Medvedev-Sponhener-Karnik (MSK) Intensity Scale*. In India, IS 1893(Part 1): 2002, is used to calculate earthquake loads on the structures. In this Indian Standard, three methods of analysis are given. In the first method, which is used for most of the buildings, static earthquake loads are obtained at each floor of building using empirical time period. This method is termed as Equivalent Static Analysis (ESA) or Seismic Coefficient Method (SCM), it is very easy to use and is based on empirical time period and empirical distribution of earthquake loads on each floor along the height of the building. Next method given in IS 1893 is Response Spectrum Analysis (RSA), wherein, from the structural model of building, natural frequencies and natural modes are obtained. For this purpose, free vibration analysis is performed, wherein mass of structure is to be properly modeled. For determining seismic forces we have the design horizontal seismic coefficient given in equation 1

$$A_h = \frac{z}{L} \frac{I}{R} \frac{S_a}{g} \quad (1)$$

The third method given in IS 1893 is Time History Analysis (THA). In the time history analysis (THA), dynamic response is obtained by using either modal superposition method or numerical integration method. Here time history of ground acceleration is used and dynamic response in the form of time history of response is obtained. Figure 1 shows the seismic zone and intensity map of India. Literature reviewed for the study includes Shimozaki (1992)^[1] who investigated the storey shear distribution of high rise reinforced concrete buildings for the purpose of the earthquake resistant design. The invariant oscillatory mode shape of the building designed with the appropriate shear distribution was investigated and revealed approximately same elastic stiffness mode shape. The results show that the seismic coefficient obtained by SRSS method using elastic stiffness is the best and this higher mode effect can be ignored. The investigation of storey overturning moment showed that the axial load of first storey column could be reduced from the

Study Of Base Shear And Storey Drift By Dynamic Analysis

Tao Wei



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