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Seismic Gap between Structures for Rigid Floor Diaphragm Inventions by Dynamic Analysis

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Abstract

In this seismic analysis of multi storey RC building frames has been carried out considering rigid diaphragm. A floor diaphragm system is area unit terribly economical in resisting lateral forces. ETABS software has been used for analysis purpose. Analyses of multi structure RC building frames area unit dole out in building frame with floor diaphragm. Two different type of floor diaphragm are used i.e. semi rigid diaphragm and rigid diaphragm. Results are collected in terms of story drift, maximum storey displacement, base shear and time period. Which are basically broke down to evaluate the impacts of different parameters this methodology centers around the diverse kind of floor stomach nature in a structure and their viability in diminishing the sidelong removal and minute at last to accomplish economy in development with comparable auxiliary edges.

Keywords: Seismic, Floor diaphragm, Maximum Storey drift, Maximum Base shear, Storey displacement

1. Introduction

The significantly stopped up structures of the metropolitan urban networks involve a noteworthy concern for seismic beating hurt. The clearest and an effective way for beating lightening and diminishing mischief due to beating is to give satisfactory parcel opening between structures. Nonetheless, it is on occasion difficult to be completed in metropolitan regions considering its obliged space and huge cost of land. Moreover, there is no unmistakable principle given to square beating in the past seismic codes, because of which there are various structures generally speaking which are starting at now innate contact or unbelievably close to another that could suffer beating hurt in future shudders. In this way, an alternative as opposed to the seismic segment opening course of action in the structure arrangement is to confine the effect of beating through reducing equal development which can be cultivated by joining bordering structures at essential regions so their development could be in-stage with one another or by growing the structures' damping limit by strategies for uninvolved fundamental control of imperativeness spread system or by seismic retrofitting.

The focal point of this examination is the improvement of an expository model and procedure for the definition of the nearby structure beating issue dependent on the old-style sway hypothesis, an examination through parametric investigation to distinguish the most significant parameters is completed. The fundamental target and extension are to assess the impacts of basic beating on the worldwide reaction of building structures; to decide the base seismic hole among structures and furnish engineers with functional investigative apparatuses for anticipating beating reaction and harm. A practical beating model is utilized for examining the reaction of auxiliary framework under the state of basic beating during elcentro tremors for medium soil condition at seismic zone V. Two contiguous multi-story structures are considered as an agent structure for potential beating issue. Dynamic and sucker examination is completed on the structures to watch removal of the structures because of seismic tremor excitation. The conduct of the structures under static burdens is straight and can be anticipated. At the point when we go to the dynamic practices, we are mostly worried about the relocations, speed and increasing velocities of the structure under the activity of dynamic burdens or quake loads. Unusualness in basic practices is experienced when the structure goes into the post-versatile or non-straight stage. The idea of push over examination can be used for evaluating the dynamic needs forced on a structure by tremor ground movements and the likely areas of the disappointment zones in a structure can be found out by watching the sort of pivot arrangements. The quality limit of the powerless zones in the post-flexible range would then be able to be expanded by retrofitting. With the end goal of this investigation, SAP2000 has been picked, a straight and non-direct static and dynamic examination and configuration program for three dimensional structures. The application has numerous highlights for taking care of a wide scope of issues from straightforward 2-D supports to complex 3-D structures. Creation and change of the model, execution of the examination, and checking and enhancement of the plan are completely done through this single interface. Graphical showcases of the outcomes, including ongoing activities of time-history removals, are effectively created.

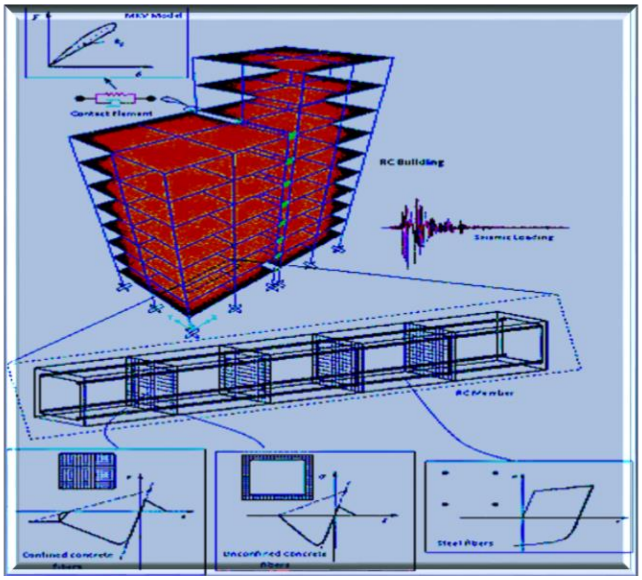

Figure 1 Seismic Pounding between Adjacent Buildings

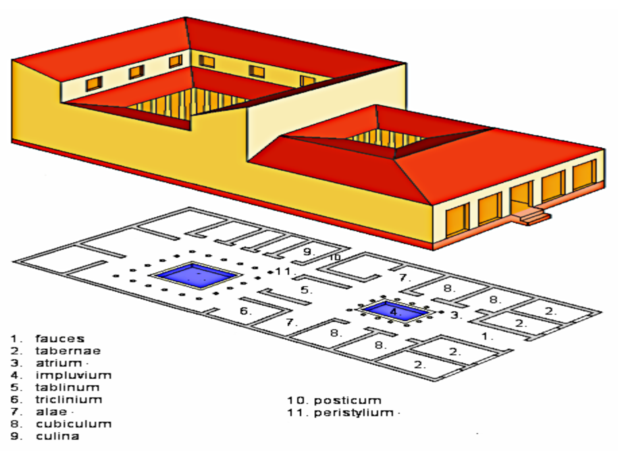

Figure 1 A diagram of a Roman house

1.1 Dynamic Analysis

All genuine physical structures, when exposed to burdens or relocations, carry on powerfully. The extra latency power from, Newton's subsequent law, are equivalent to the mass occasions the quickening. In the event that the heaps or relocations are applied gradually, at that point the latency powers can be disregarded and a static burden examination can be defended. Subsequently, dynamic examination is a basic expansion of static investigation.

The power harmony of a multi-level of-opportunity lumped mass framework as a component of time can be communicated by the accompanying relationship.

$F(t)i + F(t)d + F(t)s = F(t)$ (1)

in which the force vectors at time t are

$F(t)I$ is a vector of inertia forces acting on the node masses

$F(t)d)$ is a vector of viscous damping, or energy dissipation, forces

$F(t)s$ is a vector of internal forces carried by the structure

$F(t)$ is a vector of externally applied loads.

Equation (1) is based on physical laws and is valid for both linear and nonlinear systems if equilibrium is formulated with respect to the deformed geometry of the structure.

For many structural systems, the approximation of linear structural behavior is made in order to convert the physical equilibrium statement,

Equation (1), to the following set of second-order, linear, differential equations:

$M\ddot{u}(t)a + C\dot{u}(t)a + K u(t)a = F(t)$ (2)

in which M is the mass network (lumped or steady C), is a gooey damping grid (which is ordinarily chosen to rough vitality dissemination in the genuine structure) and K is the static solidness framework for the arrangement of auxiliary components.

The time-subordinate vectors u (t)a, u. (t)a) and u. (t)a are the supreme hub relocations, speeds and increasing velocities, individually.

For seismic stacking, the outside stacking F(t) is equivalent to zero. The essential seismic movements are the three segments of free-field ground relocations (u(t)ig)that are known sooner or later underneath the establishment level of the structure. Hence, we can compose Equation (12.2) as far as the relocations u (t)a, speeds u. (t)a and Accelerations u. (t)a that are comparative with the three segments of free-field ground relocations.

Hence, the supreme removals, speeds and increasing velocities can be wiped out from Equation (2) by composing the accompanying basic conditions:

$u(t)a = u(t)a + Ix\, u(t)xg + I y\, u(t)yg + I z\, u(t)zg$

$\dot{u}(t)a = \dot{u}(t)a + Ix\, \dot{u}(t)axg + I y\, \dot{u}(t)ayg + I z\, \dot{u}(t)a\, u(t)zg$

$\ddot{u}(t)a = \ddot{u}(t)a + Ix\, \ddot{u}(t)axg + I y\, \ddot{u}(t)ayg + I z\, \ddot{u}(t)a\, u(t)zg$

Where Ii is a vector with ones in the "i" directional degrees-of-freedom and zero in all other positions. The substitution of Equation (3) into Equation (2) allows the node point equilibrium equations to be rewritten as

$M\ddot{u}(t)a + C\dot{u}(t)a + K u(t)a = (-Mx\, \ddot{u}(t)a\, xg - My\ddot{u}(t)a\, yg - Mz\, \ddot{u}(t)a\, zg)$

The simplified form of Equation is possible since the rigid body velocities and displacements associated with the base motions cause no additional damping or structural forces to be developed.

1.2 Classification of Chimneys

A] Based on number of flues
i) Single flue (each boiler will have an independent chimney)
ii) Multi flue (Single chimney serves more than one boiler; more flues are housed inside a common concrete windshield)
B] Based on material of construction
i) Concrete (Chimney); Reinforced/P.re-stressed
ii) Steel (stack)
iii) Masonry
C] Based on structural support
i) Guyed stacks (used in steel stacks for deflection control)
ii) Self-supporting (cantilever structures)
D] Based on lining
i) With Lining: Lined chimneys/stacks
ii) Without lining: Unlined chimneys/stacks

1.3 Scope and Objective of Work

Age of 3D models of structures for inflexible floor stomach glorification to dissect dynamic and sucker examination utilizing SAP2000 Nonlinear
Performing straight and non-direct powerful investigation of unbending floor stomach glorification for medium soil at Zone V.
Examining the removal of structures for Four Story (G+4) and Eight Story (G+8) building cases to allow development, so as to abstain from beating because of quake by Linear and Non-direct Dynamic Analysis.
Performing Pushover examination for inflexible floor stomach romanticizing for three parallel burden designs on the models.
Correlation of sucker bends and limit ranges of unbending floor stomach glorifications for weakling investigations.

2. Literature review

[1]. ShitalMadhavraoBilapate et. al. Major seismic events such as those that have occurred in Northridge, Imperial Valley (May 18, 1940), California (1994), Japan (1995), Taiwan (1999) and Bhuj, Central Western India (2001) have continued to demonstrate the destructive power of earthquakes, with the collapse of uncountable engineered buildings, bridges, industrial and port facilities as well as giving rise to great economic losses. It has been observed that seismic induced pounding is one of the major causes of these structural damages. As a result, a parametric study on buildings' pounding response as well as proper seismic hazard mitigation practice for adjacent buildings has been carried out in this paper. Seismic pounding between adjacent buildings can cause severe damage to the structures under earthquakes due to their different dynamic characteristics. During earthquake, the buildings vibrate out of phase and at rest separation is insufficient to accommodate their relative motions leading to severe collisions. This deadly phenomenon can be prevented by providing safe separation distances between structures which will allow enough space for the lateral movements of the buildings during earthquake jolts. Sometimes provision of required safe separations is not possible in metropolitan areas due to high land value and limited availability of land space. In such cases, there should be some secure and economic methods to prevent structural pounding between adjacent buildings. Within the limited scope of this paper an attempt has been made to detect the time instant of pounding with the help of wavelet transform which is has an advantage over FFT plot as it gives information about both time and frequency content of the input signal. A comparative study of different prevention techniques such as shear walls, bracing, dampers and isolators has also been carried out to find out the best mitigating measure both in terms of their efficacy and cost effectiveness.

[2]. Pankita L. Patel et. al. Elevated water tank are one of the most important lifeline structures in the earthquake region. As water tanks required to provide water for drinking and fire fighting purpose. This type of structure has large mass concentrated at the top of slender supporting structure. So extremely vulnerable under lateral forces due to an earthquake. At near fault region water tank damages more during earthquake. Elevated water tanks collapsed or damaged during earthquakes because of unsuitable design and wrong selection of supporting system. The aim of the study is analyses seismic effect on different shape and types elevated water tank due to near fault and far field earthquakes. So it is very important to select proper supporting system and shape of tank according to codal provisions. For this purpose study, Intez types of elevated water tanks with different staging Height 12m , 16m , 20mand different capacity. Here model two different staging profiles such as shaft and frame and simulated to near fault and far field ground motion with STAAD.PRO. Software. Here analysis time history records from past earthquake ground motion records. Seismic responses including base shear have been observed under different earthquake time history records

[3]. C. Zhai, S. Jiang, S. Li et. al. In this study the seismic pounding response of adjacent multi-degree-of-freedom (MDOF) buildings with bilinear inter-story resistance characteristics is investigated through dimensional analysis. The application of dimensional analysis leads to a condensed presentation of the response, and the remarkable self-similarity property for bilinear MDOF buildings with inelastic collision is uncovered. It is shown that when the response is expressed in the appropriate dimensionless form, response spectra for any intensity of the excitation collapse to a single master

curve. The reduced Π set explicitly describes the interaction between the colliding structures. The effect of pounding on the MDOF building's response is illustrated using three well-divided spectral regions (amplified, de-amplified and unaffected regions). Parametric studies are conducted to investigate the effects of the story stiffness of structures, the story stiffness ratio and mass ratio of adjacent buildings, the structural inelastic characteristics and the gap size values. Results show that (i) the influence of system stiffness ratio to the lighter and more flexible building is more significant in the first spectral region, where the maximum response of the building is amplified because of pounding; and (ii) the velocity and pounding force of the heavier and stiffer building is unexpectedly sensitive to the mass ratio of adjacent buildings.

[4]. B. Madani, F. Behnamfar et. al. A 2D model of two adjacent buildings with different heights (6 and 12 floors) and foundation levels without separation distance under seismic load and considering SSI is investigated. A special arrangement of contact elements (gap elements) each 1 m of the low height building in the contact zone is taken into consideration to fulfill all possible deformation contact modes which take place under seismic load (earthquake). Soil is modeled by 2D shell elements in contact with foundations of the two adjacent buildings. This paper focuses on the study of double pounding that takes place between the two adjacent buildings in some upper points at superstructure in the contact zone and also at foundation level. The forces of double pounding between the two adjacent buildings, which increase by softening of the soil, give a valuable assessment of straining actions of the two adjacent buildings and change the behavior of soil under the foundations and around basement floor.

[5]. Mahdi Heydari et. al. In the past few years, numerous studies on the effects of near-field earthquakes on the response of structures and their differences with far-field earthquakes imply the attention of researchers to this issue. In this regard, the objectives of present study are to study the effects of near-field earthquakes on the behavior of structures and to compare these types of earthquakes with far-field ones. To do this, the characterization of near-field earthquakes and their descriptions are used to define the differences between near-field and far-field earthquakes in regard to radically distinctive responses of structures. In the present study, the incremental dynamic analysis of a seven-storey building with concrete structure for few near-field and far-field earthquakes is done and the associated diagrams of relative structural displacement are compared. In the end, the comparison of these plots is used to denote the differences in the structural behaviors of these two types of earthquakes.

[6]. M. Davoodi et. al. The distinctive characteristics of near-field earthquake records can lead to different structural responses from those experienced in far-field ones. Furthermore, soil-structure interaction (SSI) can have a crucial influence on the seismic response of structures founded on soft soils; however, in most of the time has been neglected nonchalantly. This paper addresses the effects of near-field versus far-field earthquakes on the seismic response of single degree of freedom (SDOF) system with considering SSI. A total 71 records were selected in which near-field ground motions have been classified into two categories: first, records with a strong velocity pulse, (i.e. forward-directivity); second, records with a residual ground displacement (i.e. fling-step). Findings from the study reveal that pulse-type near-field records generally produce greater seismic responses than far-field motions especially at high structure-to-soil stiffness ratios. Moreover, the importance of considering SSI effects in design of structures is investigated through an example. Finally, parametric study between Peak Ground Velocity to Peak Ground Acceleration ratio (PGV/PGA) of pulse-like ground motions and maximum relative displacement indicate that with increase in structure-to-soil stiffness ratios, earthquakes with higher PGV/PGA ratio produce greater responses. © 2015, Iran University of Science and Technology. All rights reserved.

[7]. M Phani Kumar et. al. This project aims at studying seismic pounding effect between adjacent buildings by linear and nonlinear dynamic analysis using ETABS (Non Linear) computer program. A detailed parametric study is carried out to investigate the effect of various parameters on the structural pounding by Response Spectrum (Linear Dynamic) Analysis for medium soil at zone V and Time History (Non-Linear Dynamic) Analysis for Bhuj earthquake recorded excitation on different models with varying separation distances. Pounding produces acceleration and shear at various storey levels that are greater than those obtained from the no pounding case, while the peak drift depends on the input excitation characteristics. Also, increasing gap width is likely to be effective when the separation is sufficiently wide practically to eliminate contact. Finally the results are observed to study the effect of structural displacements and pounding forces between two adjacent buildings.

[8]. Chetan J Chitte et. al. The pounding of adjacent structures during earthquakes has been receiving considerable attention in recent years. This is because adjacent structures with inadequate clear spacing between them have suffered considerable structural and nonstructural damage as a result of their collision during major earthquakes. The different dynamic characteristics of adjacent buildings make them vibrate out of phase, and pounding occurs if there is a lack of sufficient space between them. Pounding between closely spaced building structures can be a serious hazard in seismically active areas. Past seismic codes did not give definite guidelines

to preclude pounding, because of this and due to economic considerations including maximum land usage requirements, especially in the high density populated areas of cities, there are many buildings worldwide which are already built in contact or extremely close to another that could suffer pounding damage in future earthquakes.

3. Modeling and analysis

The limited component investigation programming SAP2000 Nonlinear is used to make 3D model and run all examinations. The product can anticipate the geometric nonlinear conduct of room outlines under static or dynamic loadings, considering both geometric nonlinearity and material inelasticity. The product acknowledges static burdens (either powers or removals) just as unique (increasing speeds) activities and can perform eigenvalues, nonlinear static sucker and nonlinear powerful investigations.

3.1 Details of the Models

The models which have been embraced for study are hilter kilter four storey(G+4) and eight story (G+8) structures. The structures are comprising of square segments with measurement 500mm x 500mm, all pillars with measurement 350mm x 250mm. The floor chunks are taken as 125mm thick. The establishment tallness is 1.5m and the stature of the every one of the four stories is 3m. The modulus of flexibility and shear modulus of cement have been taken as E = 2.55 ×107 kN/m^2 and G = 1.06 ×107 kN/m^2.

Three models have been considered with the end goal of the investigation.

- Four storey(G+4) adjacent building with equal floor levels.
- Eight storey(G+8) adjacent buildings with Unequal floor levels.

4. Conclusions

The primary degree of the examination includes the plan and investigation of the model and Linear unique examination for medium soil condition has been done on those models to see uprooting at the joint of the structure. Contingent on the investigation results, alteration of the equivalent with the end goal of no beating is completed on those models. In light of the perceptions from the examination results, the accompanying ends can be drawn. Reaction Spectrum investigation gives result that the two models include removal inside as far as possible for seismic beating between nearby structures with the seismic hole gave according to IS 4326-2005. It was discovered that base seismic hole can be give 0.012m per story between two four story building and two eight story working for no seismic beating between structures.

In the second degree of the task Nonlinear powerful examination with Elcentro quake excitation information as info is completed on those models to watch the conduct of the structure under tremor excitation. The floor reactions because of seismic tremor excitation in the Eight story building is higher than the Four-Story building. In sucker examination three diverse sidelong burden designs are utilized; illustrative, triangular and uniform. In light of the outcomes got from these examinations, the accompanying ends are drawn for the structures under investigation.

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