Ain Shams University
Faculty of Engineering

Behavior of Adjacent Structures under Pounding Forces

By

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A Thesis

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Statement

This thesis is submitted to Ain-Shams University, Cairo, Egypt, in March 2015 for the degree of Master of Science in Civil Engineering (structural department).

The work included in this thesis was carried out by the author in the department of structural engineering, Ain-Shams University, from March 2013 to March 2015.

No Part of this thesis has been submitted for a degree or qualification at any other university or institute.

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I believe that I have given my utmost effort in developing this research as accurately and truthfully as possible. Moreover, I am surely personally responsible for the conclusions and opinions expressed in this research.

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Abstract of M.Sc. Thesis Submitted by/
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ABSTRACT

This thesis presents an analytical study of the behavior adjacent buildings with different configurations, having non-sufficient separation distance to avoid their impact, when subjected to seismic loads. The research work was done by applying four ground motion records normalized to PGA = 0.25g in a non-linear time history analysis.

First the selected software (CSI ETABS) was verified, regarding it's time history analysis and the implemented link element (gap element) that has only compression stiffness. Verification is done by numerical comparison between software results and numerical time stepping procedure (using Excel Spreadsheets) for different single degree of freedom (SDOF) and multi-degree of freedom systems under dynamic loads.

The first case was a heavy (stiff) building adjacent to a light (less stiff) one. This case has been modeled three times in a 2D model, replicated frame elements model with no slabs, and (frame + slab) elements model. The three models were tuned to have same fundamental period, then compared in order to be evaluated. It was concluded that the three models have responded similarly to pounding. A sensitivity study is done next for the gap element stiffness used. In-fill walls inertia were added and their effects on displacements and pounding behavior were studied. The gap element distribution was changed in order to study its effects on pounding behavior (in case of no torsional moments). The effect of mass and stiffness and damping of each building on pounding forces is studied for each variable in each building. The code separation distance (SRSS) was assessed for different records.

The second case was a 4-story (stiff) building adjacent to a 7-story (less stiff) one, maximum lateral displacements for each building in approach and restitution phases were plotted, as well as displacement time history, story acceleration time history and pounding force time history for different separation distances. In addition to comparing columns maximum bending moments in each direction, for no pounding and pounding with different separation distances cases. It was concluded that the 7-story building responses were significantly affected by pounding more than the 4-story building, especially in the restitution phase.

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