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بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

SEISMIC STRENGTHENING OF R.C. BUILDINGS USING STEEL BRACINGS

By

Mohammed Ahmed Ahmed El Kady
B.Sc. Degree in Civil Engineering, 1985
M.Sc. Degree in Civil Engineering, 1992

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
in Civil Engineering (Structures)

Structural Engineering Department
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ABSTRACT

During earthquakes that have recently occurred in Egypt, many of the gravity loads designed reinforced concrete buildings have experienced severe damage. Assessment of their levels of damage has proved that they are not capable of resisting earthquake forces incurred even from moderate events. Upgrading measures for these buildings need to be taken to improve their seismic performance and to prevent their damage during future earthquakes.

The main objective of this research is to provide design guidelines for the optimum location of braced bays throughout the building and the selection of suitable brace sections. In addition, an analytical model representing the force-displacement behavior of the brace connections is developed for use in advanced analysis of strengthened buildings under earthquake ground motions.

The inelastic behavior of low to medium-rise buildings strengthened with steel bracing is investigated to study the individual and combined effects of brace area and brace slenderness ratio on the structural response to earthquakes. In evaluating the seismic response results, problems of foundation uplift and large column axial forces are examined.

Inelastic lateral static (push-over) analysis and dynamic (time-history) analysis, considering three earthquakes of different frequency contents are carried out. For the static response analysis, the building stiffness and strength, as well as the sequence of plastic hinge formation are examined. For the dynamic response analysis, the story shear, story displacements, columns axial forces, foundation uplift force and the inelastic deformations of the different building components are evaluated. Results of the analyses indicate that steel bracings are well suited for the improvement of the structural strength, lateral stiffness and building ductility and can be used to achieve a variety of objectives ranging from drift control (serviceability state) to damage prevention (ultimate state). It is also proved that an economical choice of a small brace sectional area and small brace slenderness ratio is recommended for a satisfactory structural performance. Besides, the problem of foundation uplift could be minimized by the appropriate choice of bracing arrangement.

The criteria of selecting the brace-to-building connection configuration are discussed and the aspects concerning the behavior of anchor bolts under shear or tension loading is studied. The force-displacement relationships of the brace connections are developed. The effect of the brace connection modeling on the overall structural behavior is investigated by carrying out a series of inelastic static and dynamic response analyses. Results indicate that the inclusion of the connection flexibility affects, to a varying extent, the response of strengthened buildings to earthquake ground motions.

Guidelines for seismic strengthening are provided. These guidelines are supported by the conclusions drawn from this study, in addition to the available information gathered from other research works.