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شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

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شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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بالرسالة صفحات لم ترد بالأصل

B١٢٧٢٥

SEISMIC ANALYSIS OF PLANE FRAMES CONTAINING CRACKS

by

KHALED MOHAMED AHMED OSMAN

B.Sc., M.Sc. Civil Engineering

A Thesis Submitted to the Faculty of Engineering,
Cairo University in Partial Fulfillment
of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY
in

Civil Engineering (Structures)

Under the Supervision of

Prof. Mohamed H. EL-Haddad
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2001

DEDICATION

TO MY FAMILY

TO MY WIFE

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ABSTRACT

Cracks may initiate and propagate in structures due to various effects. Crack presence at critical, overstress sections may lead to failure of statically determinate structures. On the other hand, in statically indeterminate structures the presence of cracks causes redistribution of internal forces in the neighboring areas without necessary leading to complete structural failure. Also, the stiffness of the structure is reduced due to crack presence. Reduction of the structural stiffness is associated with a decrease in natural frequencies and modification of the natural modes of vibration. Consequently, the structure response to dynamic loads such as those produced by earthquakes is altered due to crack presence.

A computer program has been developed based on fracture mechanics and finite element method to investigate vibration and response spectral characteristics of plane frames containing stationary cracks. The program has been validated using published experimental and theoretical studies. Very good agreement was observed. Special post-processing subroutine, which produce graphical outputs for the vibration and response spectral analyses results, is also developed. Graphical output for mode shapes, distributions of modal moments, drift profile, and spectral bending moments distributions is produced in a script file format that can be viewed and printed using AutoCAD utility.

In the developed program a local compliance (flexibility) matrix is used to model the added flexibility at the cracked section. The terms of this flexibility matrix are calculated using fracture mechanics theory based on available expressions for the stress intensity factors and the strain energy release rates. Then, the stiffness matrix for cracked plane frame elements is formulated with a dimension similar to that of standard uncracked elements. These facilities the analysis of structures containing crack using the same programs used for uncracked structures.

An extensive parametric study is carried out to investigate the relative effects of different parameters. These parameters include, geometrical parameters (span to floor height ratio, number of bays, number of stories), support type, crack size, and crack location. The minimum number of vibration modes sufficient for adequate response spectral analysis of cracked plane frames is determined. Effect of input ground motion characteristics on drift profile and spectral bending moments of cracked and uncracked plane frame is also investigated.