IDARC: Computer Program for Inelastic Damage Analysis of Reinforced Concrete Structures

by Andrei Reinhorn and Sashi Kunnath

Abstract

The need to evaluate structures which experience nonelastic behavior as designed by current seismic codes motivated the development of a specialized computer program which models such behavior in an efficient way The primary modeling technique employed in the computer program IDARC (Inelastic Damage Analysis of Reinforced Concrete Structures) is the representation of the overall behavior of components in terms of macromodels. Each component of the structural system is discretized into a series of macroelements: beam-column elements whose inelastic behavior is characterized by a primarily flexural response, shear-wall elements that may deform inelastically in flexure or shear, floor-slabs that are capable of deforming inelastically in the plane of the diaphragm, and inelastic rotational springs that may be attached at any node. Special-purpose elements, such as viscoelastic braces and other friction devices for hysteretic energy dissipation were also developed The reliability of the macroelements is enhanced through the introduction of distributed flexibility models which account for the effects of spread plasticity. Nonlinear material behavior is specified by means of a generic hysteretic force-deformation model that incorporates stiffness degradation, strength deterioration and pinching or bond-slip effects. Solution modules for nonlinear static, monotonic, quasistatic cyclic, and transient seismic loads were implemented. The final response quantities are expressed in terms of damage indices that provide engineers with a qualitative interpretation of the analysis.

All modules are incorporated into a state-of-the-art computer program that executes in personal computer, workstation, mainframe and supercomputer environments The program has been used in a variety of applications ranging from the design of laboratory experiments and shaking table tests to the seismic evaluation of buildings and bridges. Most importantly, IDARC continues to grow as a result of the wide interest generated by its concepts and procedures. Extended versions of IDARC for (1) fully three-dimensional analysis of structures subjected to multi-directional seismic input and (2) analysis of bridge systems are currently in the final stages of development.

Collaboration

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