Defining seismic vulnerability on flat-slab buildings is currently based solely on historic accounts of damage, without regarding instrumental records or a clear understanding of possible source mechanisms. Improvements to the FEMA handbook addressing the effects of seismic events on critical regions of a flat-slab building such as slab-column and slab-wall connections are needed in the Midwest and Eastern parts of the United States. The objectives of the following study are (1) to evaluate the seismic vulnerability of a mid-rise RC flat slab-core building that had not been designed for such forces and (2) to formulate suggestions for improving the FEMA handbook.
Since the building had more than 25 stories and possessed vertical irregularities, dynamic analysis utilizing a 3D analytical model and response spectra representing the expected seismic characteristics at the site was required. The 3D analytical model was identified from experimentally determined lateral flexibility coefficients and dynamic properties. The model was constructed in conjunction with ETABS software (Habibullah 1989).

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Block Diagram of the Hardware and Software for Swept-Sine Excitation Control

- Exciter
- Hydraulic Pump
- Digital Servo-Controller

Linear Inertia-Mass Exciter was Mounted on the RC Column at the 25th Floor


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This was simulated in the analytical model by vertical and horizontal springs. The foundation flexibility coefficients associated with the rocking of the core foundations and displacements of the column foundations were used to calibrate the spring stiffness.

Results indicated that the EW flexibility correlated well with the measured value and the NS flexibility of the model was 35% larger than the measured value. (This increase can be attributed to improperly simulated slab coupling of the two cores in the NS direction.) The lateral flexibility coefficients was used as a starting point for sensitivity analyses to estimate the seismic demand envelopes.
Regarding seismic vulnerability of specimen buildings, it is not possible to confidently quantify under expected or maximum credible events. Due to a lack of knowledge on the seismic behavior of this type of building, further experimental research involving destructive testing of some prototypes is warranted in order to confidently establish the seismic behavior of this type of building.

For reasons unrelated to the buildings seismic vulnerability, the specimen building was imploded. The implosion of the lowermost three stories precipitated the collapse of the building; the implosion of the upper stories regulated the debris.