ABSTRACT

Previous to this document, the only installation guidance available for seismic restraint of suspended ceilings was contained in Uniform Building Code Standard (UBCS) 47-18, which has its origins in a 1972 Ceilings & Interior Systems Construction Association (CISCA) Recommended Standards for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies. The splay wire restraint requirements in UBC 47-18 were developed (and modified during the intervening years) for the lateral (earthquake) force design levels specified for Seismic Zone 4 (California). While the body of the UBC Code recognized lower lateral force levels for Seismic Zones 1-3, the implementation standard UBC 47-18 did not. The Building Officials and Code Administrators (BOCA) Code and Standard Building Code (SBC) Code included lateral force factors for suspended ceilings; however, no implementation standards are referenced.

Many architects and ceiling contractors began to encounter seismic requirements in specifications for projects located in the traditional "non-seismic" areas of the United States and Canada. Building code officials and other governmental agencies were in a quandary as to what to enforce. Manufacturers were uncertain as to what to recommend in a market area where seismic provisions have been virtually unknown in the past.

Since splay wire restraints only function if ceilings have sufficient displacement, it does not appear necessary to provide such restraint in moderate- or low-risk seismic areas (Zones 0-2) where expected ceiling displacement due to seismic shaking is considerably less than expected in higher-risk seismic areas (Zones 3-4).

A ceiling system that is sufficiently unrestrained or free to accommodate the movement of a structure can provide the desired performance during a seismic event given that certain specified installation caveats are met. This guide discusses the background of the UBCS 47-18 ceiling restraint provisions and provides separate recommendations for ceiling installation in Seismic Zones 0-2.

INTRODUCTION

During the 1980s, there was a heightened awareness of earthquake damage potential in the traditional "non-seismic" areas of North America. This was due to both the occurrence of noticeable earthquakes in the eastern United States and Canada and the effort that the National Earthquake Hazards Reduction Program (NEHRP) devoted to focusing concern about earthquake damage potential as a national issue rather than a local West Coast issue. The NEHRP developed (through the Federal Emergency Management Agency [FEMA]) the Recommended Provisions for Seismic Regulations for New Buildings, which is, in essence, the outline of a national seismic building code. Many of these provisions were incorporated into existing codes such as UBC, SBC, and BOCA NBC (National Building Code). Many design professionals began, for the first time, to include seismic requirements into specifications. The only guidance available for seismic restraint of ceilings was contained in UBC Standard 47-18 and ASTM E-580, which were originally based on the 1972 CISCA Recommended Standards for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies.

The purpose of this guide is to discuss the background of the UBC 47-18 provisions and make definitive recommendations for installation of direct-hung acoustical lay-in panel ceilings in Seismic Zones 0-2. The recommended revised provisions for ceilings in Seismic Zones 3-4 are presented in a separate document.

PREVIOUS UBC REQUIREMENTS

Due to the suspended ceiling damage noted after the 1969 Santa Rosa, California, and the 1971 San Fernando, California, earthquakes, the Structural Safety Section of the Office of the State Architect (OSA) of California prepared a set of staff notes that suggested certain improvements in ceiling design and installation practices. As a direct result of the extensive hospital damage caused by the 1971 San Fernando Earthquake, the State of California assumed responsibility for the design review of hospital construction. The state had previously assumed responsibility for school construction following the 1933 Long Beach earthquake. The OSA staff notes were used as the basis for certain sections of the state building code (a modified UBC) concerned with schools and hospitals. These staff notes also were used as the basis of the 1972 CISCA Recommended Standards for Seismic Restraint of Direct-Hung Ceiling Assemblies. Both the CISCA recommendations and the OSA modifications to UBC evolved into UBC Standard 47-18. While certain additions, such as the vertical strut, and other clarifications have been incorporated into UBC 47-18, the basic requirements have remained unchanged since the lateral design requirements were initially drafted.

The general damage modes to suspended ceilings noted by OSA (circa 1970) were as follows:

1. Frequent cross runner/main runner intersection pullout, which allowed the cross runners, panels, and supported light fixtures to fall to the floor
2. Buckling and loss of wall angle support or of main runners and cross runners around the perimeter of rooms and near the intersection of columns or other ceiling penetrations.

The OSA staff notes were a direct response to these observed failure modes. The cross runner/main runner connection needed a minimum load transfer strength and the perimeter damage indicated that the whole ceiling was loose and that the joints of the ceiling grid permitted too much free motion (based on Zone 4 earthquake levels). The perimeter grid members and the light fixtures needed a second means of defense to prevent their falling.

Thus, it was proposed that points within the ceiling be partially held in place, thus making smaller tributary areas of ceiling rather than having the whole ceiling of the room restrained only by the perimeter walls. This could be done by providing sway bracing wires at 45° in each direction, 12 ft. on center. The assumption was made that half the horizontal (seismic-induced) load was delivered to the brace point at a grid intersection