ASCE 7-02/05 reference section(s)		2001 CBC reference section(s)	Other standard reference section(s)
ASCE 7-02 9.5.2.2	ASCE 7-05 12.2.1	1629.9.2	

Background

The staggered truss system was developed at MIT in the 1960s (Scalzi 1971). Its arrangement of story-deep trusses in a staggered pattern allows large column-free areas and low floor-to-floor heights. With fewer columns than other steel framing systems, staggered truss frames can also offer faster fabrication and erection schedules and reduced foundation costs (Wexler and Lin 2003).

Most staggered truss systems are in areas of low seismic hazard. Because of the apparent benefits of the system, AISC, structural steel contractors, and others have expressed interest in using the system in California. The American Institute of Steel Construction (AISC) has published a design guide with a chapter on seismic applications (Wexler and Lin 2003). The following statement appears in its introduction:

> One added benefit of the staggered-truss framing system is that it is highly efficient for resistance to the lateral loading caused by wind and earthquake. The stiffness of the system provides the desired drift control for wind and earthquake loadings. Moreover, the system can provide a significant amount of energy absorption capacity and ductile deformation capability for high-seismic applications.

In contrast to these assertions, the SEAOC Seismology Committee position is that the staggered truss system is not addressed as a seismic force-resisting system in ASCE 7-02 Table 9.5.2.2 or in ASCE 7-05 Table 12.2-1 and that it is an "undefined structural system" per 2001 CBC section 1629.9.2 and subsequent editions. Therefore, pending review of substantiating cyclic test data and analytical studies, the Committee recommends against use of the staggered truss system as a seismic force-resisting system in ASCE 7-02/05 Seismic Design Categories (SDCs) C through F and in 2001 CBC Seismic Zones 3 and 4. While SDCs C-F effectively cover all of California, the "substantiating test data" requirements of ASCE 7 and the 1997 UBC apply to all SDCs and Seismic Zones.

Description of the System

The staggered truss system is contemplated for buildings from 6 to 25 stories tall (Wexler and Lin 2003). Its benefits are most apparent in regular buildings with rectangular floor plans. The system consists of full story-deep trusses spanning the transverse direction of the building; truss spans are typically 60 feet. From one story to the next, the trusses are horizontally offset by one column bay (typically 20 to 30 feet) so that the truss locations are staggered up the height of the building. See Figure 1. The stagger is typically of a uniform dimension and symmetric in plan. Floor diaphragms are typically precast planks spanning from the bottom chord of one truss to the top chord of the adjacent truss. Exterior columns support the ends of the truss and provide frame columns for the lateral force-resisting system in the longitudinal direction of the building. To maximize the architectural benefits of the system, there are frequently no continuous interior columns.

Each truss acts as a braced frame in the transverse direction. A Vierendeel panel is often provided at the midspan of the truss to accommodate passageways. Under transverse seismic loads, the Vierendeel panel would be subject to high deformations (much like the similar panel in a special truss moment frame) and would therefore have to be designed to dissipate energy through flexural yielding. The trusses resist transverse shear, overturning forces, and interstory drift, and the floor diaphragm acts as a load path element between adjacent trusses. The longitudinal lateral force-resisting system is typically a perimeter moment frame or braced frame.