Tilt-Up Seismic Design

June 2003


Ventana Medical Systems, Inc. Corporate Headquarters

I agree with Mr. Remmetter that the IBC specifies minimum seismic forces for the design of the walls' out-of-plane anchorage to diaphragms.

However, out-of-plane anchorage of tilt-up walls to diaphragms is the most important structural component of a tilt-up building exposed to major earthquake hazard, as is true for much of California. A tilt-up building's primary mode of energy dissipation, yielding of the diaphragm, cannot be activated if the tilt-up walls' out-of-plane anchorages are inadequate. The performance of tilt-up buildings in the 1971 San Fernando, 1989 Loma Prieta, and 1994 Northridge earthquakes in California demonstrate the importance of the wall anchorage. A tilt-up with poorly performing wall anchorages is vulnerable to wall collapse, and partial roof collapse, which pose life safety hazards.

I also agree with Mr. Remmetter's observation that the connection of the base of tilt-up walls is often misunderstood. I disagree with his assertion that the building code does not require attachment of the wall to the footing. Chapters 16 and 18 of the 1997 UBC are frequently interpreted to mean positive connection between tilt-up walls, i.e. shear walls, and footings is required. In California, this typically is achieved by doweling from the base of the wall to the slab closure, and from the slab closure to the footing. I cite the 1997 UBC, as it is the basis for the building code currently enforced in California.

Mr. Remmetter postulates a seismic load path in which positive connection between the tilt-up walls (shear walls) and the footing is not necessary, reasoning that dowels between the base of the shear walls and the slab-on-grade enable the slab-on-grade to behave as a diaphragm that transfers seismic forces to the soil. I question the feasibility of transferring seismic forces from the slab-on-grade to the earth in instances where the slab-on-grade is cast over a 2 inch sand course, a plastic vapor barrier, and a 4 inch rock course, which is a common assembly for retail, office, and some warehouse occupancies. Can adequate friction over the bottom of the slab-on-grade be mobilized? Although slab-on-grade sliding would serve well as an energy dissipation mechanism, I ask if the tilt-up walls are vulnerable to sliding off the footings normal to the plane of the wall. Such an event could precipitate partial roof collapse. I do not know of cases in past earthquakes where the walls slid off the footings, but could that be a consequence of the presence of a positive connection between the walls and the footings?

I recognize that Mr. Remmeter is addressing a broad spectrum of readers whose practices and the environmental hazards they face vary greatly. Since the article is about seismic design, and much of California design is affected by California's earthquake hazard, I thought it appropriate to offer a perspective of California practice.

Thank you for your consideration and to Mr. Remmetter for this important discourse.

Jeff Taner, S.E.
San Rafael, California