

## ABSTRACT

Yang, Yuxing. Ph.D., Purdue University, August 2015. Shear Strength and Behavior of Reinforced Concrete Structures with T-Headed Bars in Safety-Related Nuclear Facilities. Major Professors: Amit H. Varma and Michael E. Kreger.

The design of concrete structures for safety-related nuclear facilities is governed by demands calculated for load combinations involving the safe shutdown earthquake (SSE). Excessive amounts of longitudinal and transverse reinforcement (in excess of 2% reinforcement ratio) are required to provide essentially elastic behavior for the SSE and to resist the design demands. Additionally, conventional single-leg tie reinforcement with 90° and 135° hooks at alternate ends are required at some locations for seismic detailing. All these requirements lead to rebar congestion, and make conventional single-leg ties difficult to install in reinforced concrete structures. T-headed bars are being considered to resolve this issue. These consist of deformed reinforcing bars with T-heads in the form of welded or threaded rebar terminators with bearing area greater than or equal to four times the reinforcing bar area. To investigate the effectiveness of T-headed bars for use as single-leg ties, this type of reinforcement was used as shear reinforcement in beam specimens to investigate the anchorage ability of the T-heads to develop the yield strength of the tie bars. These tests were needed because the experimental data regarding the shear strength of reinforced concrete structures with T-headed bars is lacking.

This study presents the results of an experimental investigation and numerical analysis conducted to evaluate the shear strength and behavior of reinforced concrete beams using T-headed bars as shear reinforcement, and to extrapolate from those results the suitability of T-headed bars for use as single-leg ties. The behavior of specimens with three different depths of 18 in., 24 in., and 36 in. and three different T-headed bar sizes (#5, #7, and #9) are investigated and compared with the behavior of companion specimens with conventional stirrups.