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EXPERIMENTAL EVALUATION OF THE SHEAR STRENGTH OF THE UNIDOME SLAB SYSTEM

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ABSTRACT

The Unidome Slab System (USS) is a new system that can provide significant reduction in the self-weight of the structure. The shear strength of the USS was evaluated experimentally by testing four-full scale slab segments. The principal objective was to obtain the ratio between the shear strength of the USS and companion conventional solid slabs and to assess the applicability of the ACI 318 Code Provisions for estimating the shear strength of the USS. Four specimens were fabricated and tested including a reference conventional solid slab and three identical USS. The width, length, and thickness of the four slabs are 80 cm x 195 cm x 20 cm, respectively. The slabs were tested under 3-point loading setup with a single loading applied uniformly across the width (a/d = 4).

All slabs experienced typical shear failure modes with sudden failure near the support accompanied by formation of large diagonal major crack. Prior to failure, cracks were developed mainly as diagonal-web shear cracks in the shear zone as well as flexural cracks near the mid region. The overall response of the solid slab was almost linear up to ultimate, whereas the USS response was almost linear up to about 40% of the ultimate load followed by a non-linear response up to failure. The ultimate strength of the USS was 0.71 of the conventional solid slab, and the stiffness and toughness of the USS were 0.88 and 0.96 of the reference solid slab. Based on the results and findings, it was concluded that the ACI-318 Code equation for estimating the design shear strength (Vn) of one-way solid slabs (Equation 1), can be safely used for the USS with a modification factor of 0.70.

$$V_u = 0.7 * 0.75 * \frac{1}{6}\sqrt{f'_c} b_w d \qquad (1)$$

In addition, the USS can be designed in terms of deflection limit as a solid system with a modifier in stiffness based on the selected void size.

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