BEHAVIOR OF FRAMED SHEAR WALLS UNDER SHEAR LOAD

by

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ABSTRACT

Results of tests on two-thirds scale reinforced concrete shear walls framed by composite constructions of steel and reinforced concrete and subjected to cycles of alternating shear load are presented. Sixteen specimens, with varying reinforcement ratio, P_s, crossed steel brace ratio, P_b, and height-to-width ratio, h/w, were tested. The specimens were loaded in such a way that the same quantities of tensile and compressive forces were produced in the diagonal directions of the specimens as shown in Fig. 1. Methods for prediction of initial behavior, cracking load, behavior after cracking load, and ultimate load are proposed based on the results of the experiments and analyses.

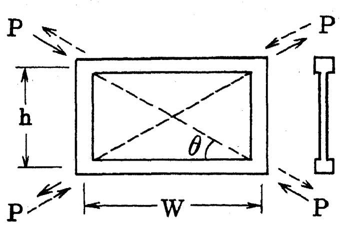
The findings indicate the following: (1) Shear stresses are almost uniformly distributed in the wall in the initial elastic range. (2) Therefore, the cracking load, τ_{cr}, per unit sectional area of concrete of the wall can be predicted well using the formula, $\tau_{cr} = {}_cF_t = 0.1\,{}_cF_c$, where ${}_cF_t$ and ${}_cF_c$ are the tensile and compressive strengths of the concrete respectively. (3) After cracking, the behavior of the framed shear wall can be replaced by a truss mechanism such as concrete struts in the frame subjected to the load and the internal force due to yielding of the wall reinforcement, as shown in Fig. 2. (4) The pattern of deterioration at ultimate load can be divided into two types. The one, type A, is caused due to compressive failure of concrete in the wall, and the other, type B, is due to shear failure of the frame. The shear wall fails by either type in whichever resistance is smaller. The ultimate load, τ_u, can be estimated as follows:

$$\tau_u = 0.5P_s \cdot {}_r\sigma_y + k \cdot {}_cF_c + P_b \cdot {}_b\sigma_y \qquad \text{(for type A)}$$

$$\tau_u = P_s \cdot {}_r\sigma_y + (\Sigma Q_f)/A + P_b \cdot {}_b\sigma_y \qquad \text{(for type B)}$$

where ${}_r\sigma_y$ and ${}_b\sigma_y$ are yielding stresses of wall reinforcement and steel brace respectively, k is 0.2 ~ 0.3 dependent on the degree of confinement by the frame, and A (=txh) is the sectional area of the wall in case of $h < w$. (5) The behavior after ultimate load depends on the failure mode mentioned above. Also, buckling of the steel brace has a significant influence on the behavior.

Methods for application to structural design of framed shear walls are also studied.



$\tau = 2P\cos\theta/tw$
$= 2P\sin\theta/th$

P: load
i: internal force
t: thickness of wall

Fig. 1

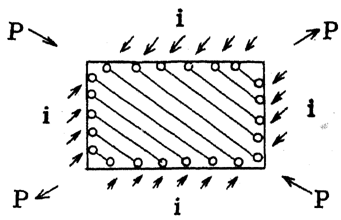


Fig. 2

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