EFFECTS OF AXIAL LOADING ON SLENDER STRUCTURAL WALLS IN EARTHQUAKE-RESISTANT MULTISTORY BUILDINGS

by
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In buildings required to resist earthquake excitations, efficient lateral load resistance as well as superior damage control may be attained with the use of properly proportioned and detailed structural walls, (shear walls).

As a step towards the evolution of rational and practical design procedures for slender structural walls governed by flexure, a parametric study directed to a thorough understanding of variables affecting the strength, stiffness and ductility of such walls has recently been undertaken at Portland Cement Association. This paper presents an in-depth study of one of the most important variables - the level of axial loading to which a wall section is subjected. The approach used is a computer simulation of the behavior of a large number of structural wall sections subject to varying amounts of axial loads. The complete moment-curvature as well as axial load-moment interaction diagrams of these sections are examined.

The most critical aspect of the analytical results is found to be the drastic reduction in sectional ductility caused by the presence of axial loads. Although some ductility is always available as long as failure is governed by tension, the amount of this ductility decreases severely as the level of axial load approaches that corresponding to balanced failure. It may, therefore, be desirable, for design purposes, to impose an upper limit on the level of axial loading that may be permitted on a structural wall section. It may be noted in this connection that ACI 318-71 recommends vertical boundary elements, with concrete adequately confined by transverse reinforcement, for structural walls subject to axial loads exceeding 40% of balanced axial loads.

It must be mentioned that although the presence of axial loading definitely has an adverse effect on the curvature ductility of a section, its effect on the overall (rotation or deflection) ductility of a member may actually be beneficial. This is because the presence of axial loads results in an enlarged compression concrete zone capable of transmitting shear. The possibility of occurrence of premature non-ductile shear failure is thus minimized. This particular aspect, however, is far from fully explored, and is currently under investigation.

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