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TN 143 DISCUSSION

General frame element for shear wall analysis

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The use of rigid arms to simulate the plane sections phenomenon in the wide column frame analogy has been shown by several investigators to be of great value in establishing a simple, but nevertheless powerful, mathematical model. Generally, however, rigid arms should not be used if they in any way overconstrain important deformations in a structure.

15. In the specific case of interconnected plane shear wall systems great care should be taken in the modelling of the beam–wall joint zone within which wall curvatures due to bending are partially constrained and axial deformations due to axial force are only slightly constrained.

16. Although horizontal arms are necessary to simulate the plane sections assumed in the walls, the use of vertical arms has limitations. In the case of walls interconnected by shallow beams the deformations associated with axial force in the walls are small and the presence of small vertical arms will have little effect on the analysis. Deeper interconnecting beams are capable of transferring large vertical shears resulting in highly significant axial displacements in the walls. In the joint zone free bending in the wall is partially restricted by the presence of the interconnecting beam and the use of a vertical arm seems justified, although one of reduced length should be considered when the necessary knowledge becomes available. However, if the use of a rigid arm constrains to zero the axial shortening or lengthening of the wall over the vertical limits defined by the arms then their presence is unacceptable as it leads to very overstiff results.

17. This restriction can be avoided by simply modifying the axial stiffness term in the wall element stiffness matrix to AE/L^* where L^* is the storey height. The flexible length L can still be used in bending stiffness terms. The modified matrix thus permits axial shortening or lengthening over the complete length of the walls with constraints imposed only on the bending in the walls over the depths of the interconnecting beams.

18. The Paper describes a general rigid arm, spring, flexible beam system, but we feel that a misapplication by using vertical arms in walls connected by deep beams would lead to grossly overstiff results in certain cases.

Professor MacLeod

I entirely agree with Dr Yeadon and Dr Harrison regarding the axial flexibility of the wall if the finite depth of the connecting beam is included in the model. I use the expression for axial flexibility of the element

$$EA/(L+x_1+x_2)$$

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For example, I suspect that the discrepancy between experimental results and a wide column–beam frame[6] may be due to a similar error.

Reference

6. KHAN A. H. and STAFFORD-SMITH B. A simple method of analysis for deflection and stresses in wall frame structures. *Bldg & Environment*, 1976, **11**, 69–78.