AD 395:
Nominally pinned connections and axial forces

SCI is aware of a number of problems arising when the designers of structural frames have assumed “nominally pinned” connections in the frame design, but also require the connections to carry significant axial forces. This AD note offers advice with the aim of avoiding costly disagreements between the frame designer and the connection designer.

The difficulty arises when shear and axial forces (usually in combination) are to be resisted by the connection which has been assumed in the frame design to be “nominally pinned”. It should be emphasised that the axial forces are not tending forces (which would not be considered in combination with the shear forces) - they are “real” axial forces. Such axial forces may arise when floors are not assumed to act as diaphragms, or when beams must carry forces around voids, or for other reasons.

The frame designer is likely to design the columns as “columns in simple construction”, with nominal moments (only) due to the assumed eccentricity of the beam shear force. Special provisions are made in BS 5950-1:2000 (clause 4.7.7) and for BS EN 1993-1-1:2005 in NCCI (SN005 and SN048, www.steelbiz.org) for this common approach to column design.

If significant axial forces must be carried through the connection, it is highly likely that the relatively thin end plates (or fin plates) used in the standard nominally pinned connections will have to be increased in thickness. Plates may need extending, or other measures taken, but it is very likely that the principles governing the detailing of flexible connections cannot be maintained. A second, more easily addressed problem, is that the Green Books (SCI P212 and P358) do not cover the situation when connections are subject to shear and axial forces. The checks for tying resistance are (a) completed in isolation, without shear force and (b) assume irreversible deformation in the connection components, so cannot be used directly to consider “real” axial force in combination with shear force.

SCI has two recommendations in these circumstances, with the primary responsibility lying with the designer of the frame:

Firstly, the frame designer must recognise that if the connections must transfer shear and significant axial force, they may not be nominally pinned. This will have an impact on the design of the columns.

Secondly, if connection designers are asked to design nominally pinned connections subject to shear and significant axial force, they should advise the frame designer of the connection detail, pointing out that this may invalidate the assumptions made. This second recommendation is made to try and resolve potential problems before they become a significant issue.

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