THE LATERAL INSTABILITY OF MILD STEEL BEAMS OF RECTANGULAR CROSS-SECTION BENT BEYOND THE ELASTIC LIMIT

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Abstract

It is well know that a thin deep beam, loaded in a vertical plane so as to cause flexure about the stronger, or primary principal axis of the cross-section, may fail by buckling laterally out of that plane. This type of instability is characterised by the development of twist in the beam. A component of the applied load then causes flexure about the weaker, or secondary principal axis, and lateral deflection occurs.

The critical load causing instability in an initially straight beam therefore depends on the flexural rigidity of the beam about its secondary principal axis, and its torsional rigidity. Values of the critical load have been calculated for many loading systems and types of end-constraint for beams that behave elastically under the applied loads. This dissertation discusses rectangular section beams of mild steel in which yield occurs in the more highly strained outer fibres before the critical condition causing lateral instability is reached.

For such beams the secondary flexural rigidity decreases progressively as the load increased above the value at which yield first occurs. The torsional rigidity, however, remains constant at its elastic value.

In the first part of the dissertation the reduction of the secondary flexural rigidity is calculated, and the critical lateral buckling moment is estimated for a beam bent by pure terminal couples, the ends of which are prevented from twisting but a free to rotate about the secondary principal axis. Experimental confirmation of the results is given.

In the second part of the dissertation the calculations are extended to problems in which the primary bending moment varies linearly along the beam, so that a constant shear force exists. The two particular examples considered are a simply supported beam with a

central concentrated load, and a cantilever. No experimental evidence in support of these calculations is available.