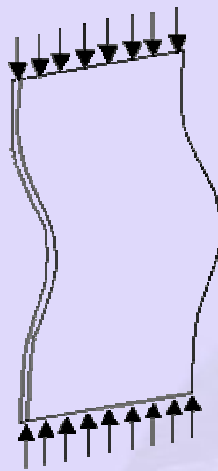
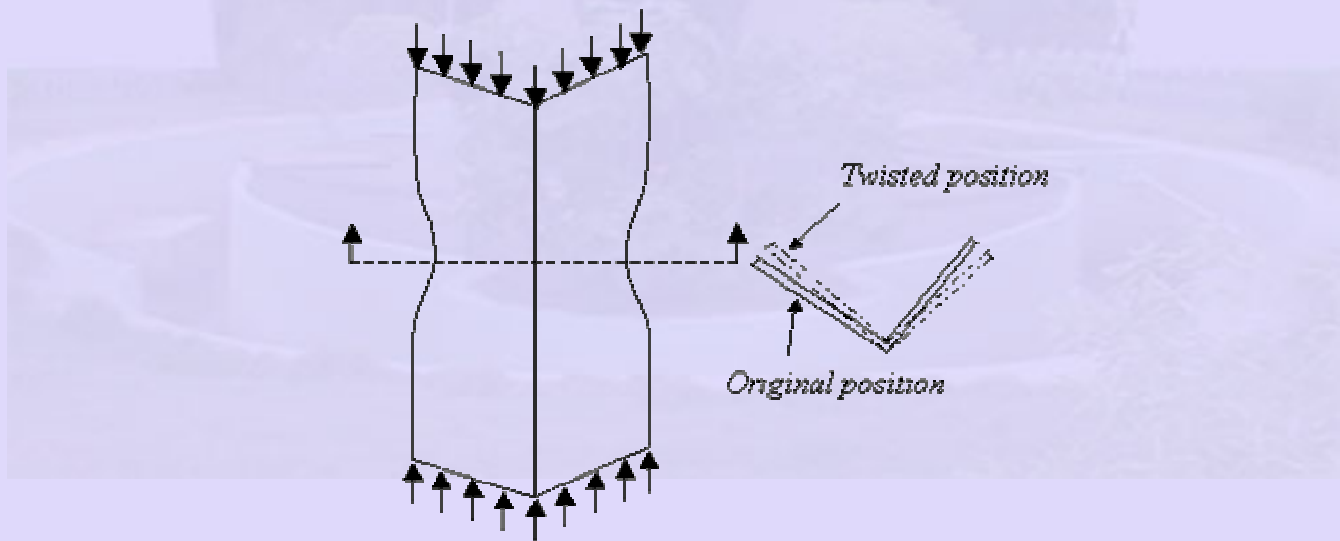


5.6 Torsional and torsional-flexural buckling of columns



Show the buckling figure [click here](#)

Fig 5.18(a) Plate with unsupported edges



Folded plate twist [click here](#)

Fig 5.18 (b) Folded plate twist under axial load

We have so far considered the flexural buckling of a column in which the member deforms by bending in the plane of one of the principal axes. The same form of buckling will be seen in an initially flat wide plate, loaded along its two ends, the two remaining edges being unrestrained. [See Fig. 5.18 (a)]

On the other hand, if the plate is folded at right angles along the vertical centre-line, the resulting angle section has a significantly enhanced bending stiffness. Under a uniform axial compression, the two unsupported edges tend to wave in the Euler type buckles. At the fold, the amplitude of the buckle is virtually zero. A horizontal cross-section at mid height of the strut shows that the cross-section rotates relative to the ends. This mode of buckling is essentially torsional in nature and is initiated by the lack of support at the free longitudinal edges. This case illustrates buckling in torsion, due to the low resistance to twisting (polar moment of inertia) of the member.

Thus the column curves of the type discussed before are only satisfactory for predicting the mean stress at collapse, when the strut buckles by bending in a plane of symmetry of the cross section, referred to as “**flexural buckling**”. Members with low torsional stiffness (eg. angles, tees etc made of thin walled members) will undergo torsional buckling before flexural buckling. Cruciform sections are generally prone to torsional buckling before flexural buckling. Singly symmetric or un-symmetric cross sections may undergo combined twisting about the shear centre and a translation of the shear centre. This is known as “**torsional – flexural buckling**”.

Thus a singly symmetric section such as an equal angle or a channel can buckle either by flexure in the plane of symmetry or by a combination of flexure and torsion. All centrally loaded columns have three distinct buckling loads, at least one of which corresponds to torsional or torsional - flexural mode in a doubly symmetric section. Flexural buckling load about the weak axis is almost always the lowest. Hence, we

disregard the torsional buckling load in doubly symmetric sections. In non-symmetric sections, buckling will be always in torsional – flexural mode regardless of its shape and dimensions. However, non-symmetric sections are rarely used.

Thin-walled open sections, such as angles and channels, can buckle by bending or by a combination of bending and twisting. Which of these two modes is critical depends on the shape and dimensions of the cross-section. Hence, torsional-flexural buckling must be considered in their design. This is normally done by calculating an equivalent slenderness ratio and using the same column strength curve as for flexural buckling.

