### **Column Buckling**

The problems of column buckling are studied using different number of two-node elements and comparing the analytical solutions provided by Chen and Lui (1987).



525.408



Figure 1 Various column buckling problems with I-type cross section

#### (1). Fixed-free column buckling

The critical load of a fixed-free column in Fig. 1 (a) with I-type cross section under end-load is analyzed using the new formulation. The critical load is obtained analytically as

 (1.6)

#### (2). Pinned-ended column buckling

The pinned-ended column in Fig. 1 (b) has the same cross sectional properties and applied loading. Analytical critical load:

 (1.7)

#### (3). Two axial forces cantilever column buckling

A column similar to that of Fig. 1 (c) is subjected to two axial forces. One applied at the free end and the other at mid height. Analytical critical load:

 (3.8)

#### (4). Continuous member

A continuous beam in Fig. 1 (d), which also has I-type cross section, is subjected to end load. Analytical critical load:

 (3.9)

The present finite element solutions are compared with the analytical results in Table 1. The results calculated by **XFRAME** give a good agreement with reference

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | Number of elements over length L | | | | | |
| 2 | 4 | 6 | 8 | 10 | Exact |
| (a) | 0.112392 | 0.112295 | 0.112283 | 0.11228 | 0.112278 | 0.117542 |
| (b) | 0.431049 | 0.426177 | 0.425566 | 0.425376 | 0.425293 | 0.470200 |
| (c) | 0.098872 | 0.098796 | 0.098803 | 0.098823 | 0.098852 | 0.098468 |
| (d) | 0.345164 | 0.263485 | 0.261421 | 0.26089 | 0.260692 | 0.280588 |

Table 1Critical loads of column buckling problems (×108 N)