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LETTER TO THE EDITOR

Discussion of "Large-deformation analysis of flexible beams", *Int. J. Solids Structures*, Vol. 33

This paper presented an elastic analysis of curved beams subjected to extremely large rotations in three dimensional space. The authors' geometrically nonlinear model for naturally curved and twisted beams is basically the same as that shown by Goto *et al.* (1985). However, as a numerical example, the authors made an interesting comparison to the numerical results of the problem of the deployable and collapsible ring originally studied by the writers (Goto *et al.*, 1992). In this comparison, the ring with $h/b = 3$ and $R/h = 20$ was analyzed. According to their analysis, there is about 7.8% difference in the predicted maximum moment. Considering that the problem of our deployable and collapsible ring may be used again in the future as severe bench mark checks for nonlinear beam or shell models, it is important to examine the reason why such a difference was produced between the writers' method and the authors' method. The authors suspect that the difference is caused by the fact that we neglected the influence of initial curvature and/or that we used truncated Taylor expansions in our solution method. However, we precisely examined the effect of the above mentioned factors on the accuracy of the numerical results and confirmed that 200 finite elements are enough in modeling the half ring (Goto *et al.*, 1992). Specifically, the effect of curvature was examined by using a rigorous geometrically nonlinear theory for a naturally curved and twisted rod presented by Goto *et al.* (1985).

We reexamined the problem of the deployable and collapsible ring and found out that we made a small mistake in Figs 8 and 10 (Goto *et al.*, 1992) which were used by the authors to estimate the maximum moment. To correct these figures, the values of the non-dimensional moment MR/EI_{YY} have to be multiplied by 0.914. The corrected versions of Figs 8 and 10 are shown below. This correction makes the difference of the two methods less than 1%. Since the authors seem to read our maximum moment from Figs 8 or 10, an error of more than 1% will be included in the value so obtained. Further, the authors do not use the incremental governing equation in their analysis. This implies that the location of the limit point (maximum moment point) is not exactly identified on the equilibrium curve. Taking all these factors into account, the difference of 1% is small enough to be able to conclude that the two methods numerically yield similar results for the ring with $h/b = 3$ and $R/h = 20$.

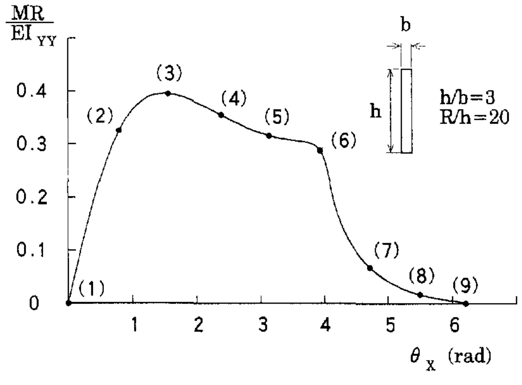

Fig. 8. Moment–rotation curve of the ring with $h/b = 3$ and $R/h = 20$ (Goto *et al.*, 1992).

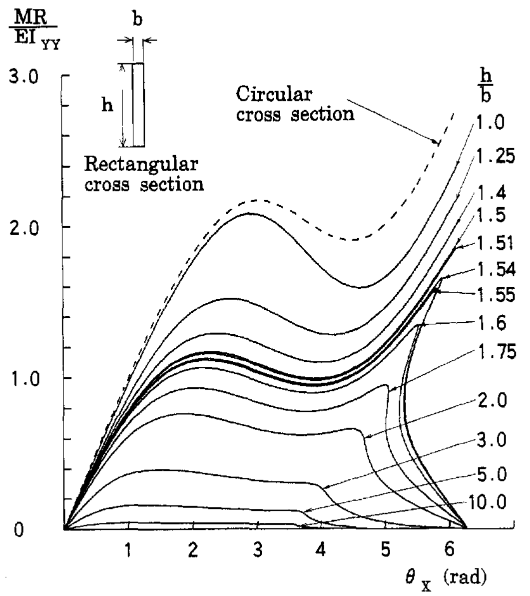

Fig. 10. Moment–rotation curves of rings with various kinds of cross-sectional parameters (Goto *et al.*, 1992).

In order to confirm the numerical equivalence of the two methods more precisely, the writers would like to see the authors' results for the more severe case of $1.5 < h/b < 1.6$ which are shown in Fig. 10. In addition, we would like to know the boundary value of h/b below which the ring cannot be collapsed into a small ring.

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