EXPERIMENTS ON CURVED THIN-WALLED TUBES

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Abstract

The stresses and the flexibility of curved thin-walled tubes have been estimated in the past by Karman's approximate analysis, but experiments have shown that misleading results are obtained when the radius of curvature is not considerably larger than the radius of the tube.

In this dissertation, Karman's analysis is extended to pipe bends in which the radius of curvature and the pipe radius are of the same order of magnitude, by introducing the second and the third approximations for the shape of the deformed centre-line, as well as a correction of Karman's assumption that this deformation does not alter the length of the centre-line.

By measuring strains, for the first time, not only on the outside but also on the inside surface of curved tubes, this extension was checked for the usual small-radius pipe bends and was also applied to an extreme case. The measurements of the strain confirmed that the largest stress occurred on the inside surface, that it was a stress in the transverse direction, and that it was induced in the cross-section where, from similarity with curved bars, the stress-fress axis was assumed to be. It was also found that after local yielding has taken place, the load can be roughly doubled before unduly large deflexions occur.

A comparison of the behaviour of seamless and pressed-welded pipe bends showed that neither the flexibility nor the stresses are significantly influenced by the presence of the weld.

Experiments are also described in which the pipe-bends were subjected to uniform internal pressure, strain measurements being taken for the first time inside pipes under high water-pressure. The stresses can be estimated by assuming that the pipe-bend behaves like a thin-walled torus of circular cress-section. But initial deviations from circularity superimpose additional bending stresses.

In the course of comparing the behaviour of seamless and pressed-welded bends when they were subjected to internal pressure, it was found that the ultimate pressure that could be sustained was lower in the latter because of imperfections in the weld.