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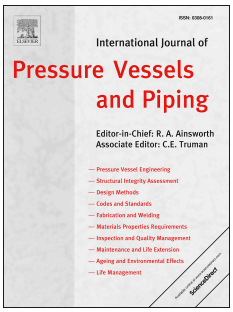

B_2 stress indices for thin walled straight pipes with D/t > 50 and imperfections

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B_2 stress indices for thin walled straight pipes with D/t > 50 and imperfections

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Abstract

The design equations for primary loads of piping components in the ASME Boiler and Pressure Vessel Code (ASME Code) are based on the B_1 and B_2 stress indices. In the present studies the B_2 stress indices of thin-walled straight pipes with D/t-ratios $20 \leq D/t \leq 140$ are determined using FE analyses. The analyses are performed for pipes made of ideal elastic-plastic materials and some selected steels. The B_2 index is calculated from the maximum bending moments obtained by nonlinear FE analyses. For the calculation of the B_2 indices for straight pipes with $40 < D/t \leq 100$ a formula derived in previous works is used. The obtained B_2 indices are only valid if they satisfy an additional relation, which follows from the design equation for primary loads. Formulas for the dependency of the B_2 indices from the D/t ratio and the yield stress are given. Finally, conservative equations for the determination of B_2 indices for ferritic and austenitic straight pipes are derived. For ferritic pipes there is a good agreement with the B_2 indices according to the ASME Code. In difference to the ASME Code the temperature dependency need not be considered for ferritic pipes. The B_2 indices for austenitic pipes with D/t =100 are 33% larger than the values of the ASME Code. The background for the deviations is explained.

Highlights

- The B_2 indices for thin-walled straight pipes with $40 < D/t \leq 100$ and technical possible imperfections are calculated with nonlinear FE analyses and specially derived formulas.
- Especially for larger D/t ratios the failure occurs by plastic buckling due to imperfections.
- A relation to the check the validity of the obtained B_2 indices is derived. For buckling additional corrections are necessary for the B_2 indices.
- Equations for the B_2 indices for ideal elastic-plastic, ferritic and austenitic straight pipes are derived and compared with the ASME Code.

Keywords

Piping design, ASME Code, primary loads, thin-walled straight pipes, stress indices, determi-