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Safe and Economical Simulation for the Built Environment

(A Correction and some Additional Results)

Correction

In the following figure the equation for P with the von Mises yield criterion has a incorrect sign for the linear term and should read $P = 1.0134 + 0.3086L + 3.2345L^2$.

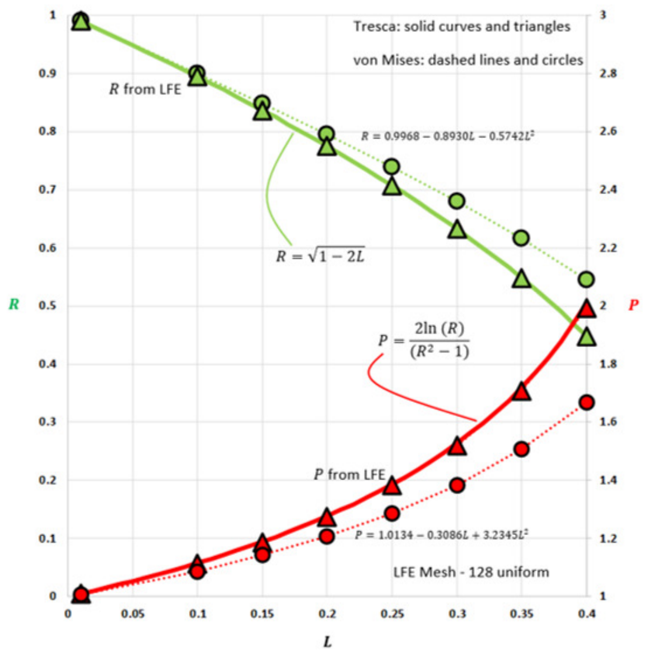

Figure 4: Design chart for internally pressurised pipes (Tresca & von Mises)

Additional Results

The following paper has been read.

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Limit analysis of flaws in pressurized pipes and cylindrical vessels. Part I: Axial defects

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Section 2 of the paper presents the following:

2. The extreme cases

2.1. Thick pipe without defect

The burst pressure p_0 of the thick-walled pipe without defects is

$$\frac{p_0}{\sigma_u} = D\ln\frac{r_2}{r_1} = D\ln\left(1+\frac{t}{r_1}\right) = D\left[\frac{t}{r_1} - \frac{1}{2}\left(\frac{t}{r_1}\right)^2 + \frac{1}{3}\left(\frac{t}{r_1}\right)^3 - \cdots\right], \quad (6)$$

which realistic limit load solutions for the cracked pipe must assume asymptotically. Therefore the constraint factor D is introduced in all equations below, although it is omitted in most of the equations that have been cited from different references. The series expansion (6) converges for $\frac{t}{r_1} \leqslant 1$. The solution for the Tresca yield function applies independently of the conditions at the pipe end. The solution for the hypothesis after von Mises applies for any plane strain state. Therefore it does not apply to the open pipe with free ends.

The approximation

$$\frac{\bar{p}_0}{\sigma_u} = D\frac{t}{r_1} \quad (7)$$

for thin pipes over-estimates the load-carrying capacity of thick pipes, as the series expansion (6) shows. For $\nu = 0.3$ the assumption of small deformations applies and therefore Eq. (6) remains valid with the Tresca

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hypothesis up to $\frac{r_2}{r_1} = 5.43, 6.19$ and 5.75 for closed end, open-end and plane-strain conditions, respectively [24]. In the following analysis a closed pipe is assumed.

With the following definition for D:

$$D = \begin{cases} 1 & \text{for Tresca,} \\ \dfrac{2}{\sqrt{3}} & \text{for von Mises} \end{cases} \quad (5)$$

This approach would appear to be incorrect as the parameter D is not constant but a function of the radius ratio R and, as shown in the following figure, cannot achieve the maximum value quoted above in the range of practical radius ratios.