Horizontal Vessel on Two Saddles: Reactions and Zick Moments

Saddle reaction and longitudinal bending moments at the saddles and at mid-span of a horizontal vessel on two saddles (Zick), with the mid-span bending stress.

Method: Zick's analysis of saddle-supported vessels

Input parameters

Unit system: SI

Parameter	Value	Unit
Total operating or test weight	600.00	kN
Tangent-to-tangent length	12.000	m
Saddle centre to tangent line	1.5000	m
Shell mean radius	1.2500	m
Depth of head	0.62500	m
Shell thickness (corroded)	14.000	mm

Calculated results

Parameter	Value	Unit
Reaction per saddle	300.00	kN
Longitudinal moment at the saddle	68.121	kN·m
Longitudinal moment at mid-span	405.26	kN·m
Mid-span longitudinal bending stress	5.8970	MPa

Notes for this case

• Zick treats the vessel as a beam on two supports with the liquid load and the heads' contribution. M_1 (usually hogging, negative means the shell sags over the saddle) and M_2 (sagging) are positive as given by Zick's formulas. $\sigma_2 = M_2/(\pi R^2 t)$ adds to the pressure stress; saddle horn and ring stresses need Zick's K factors and the user's code. Placing saddles at A ≤ 0.2L and near the heads (A ≤ R/2) lets the heads stiffen the shell.

Formula and method

$$M_1 = QA\left[1 - \frac{1 - \frac{A}{L} + \frac{R^2 - H^2}{2AL}}{1 + \frac{4H}{3L}}\right], \quad M_2 = \frac{QL}{4}\left[\frac{1 + \frac{2(R^2 - H^2)}{L^2}}{1 + \frac{4H}{3L}} - \frac{4A}{L}\right]$$

Variables

W	Total operating or test weight	N
L	Tangent-to-tangent length	m
A	Saddle centre to tangent line	m
R	Shell mean radius	m
H	Depth of head	m
t	Shell thickness (corroded)	m
Q	Reaction per saddle	N
M_1	Longitudinal moment at the saddle	N·m
M_2	Longitudinal moment at mid-span	N·m
σ_2	Mid-span longitudinal bending stress	Pa

Method and standards

Saddle moments.

Assumptions and limits

- Two identical saddles; uniformly distributed weight.

References

Zick's analysis of saddle-supported vessels

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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