Optimization procedure of an overboarding chute with standards, mechanical and numerical considerations

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Outline

- Scope of the work: improve mechanical efficiency
- Parametric modelling
- Structural analysis
- Insights on piston buckling verification
- Results and comparisons
Innovative overboarding chute design
Innovative overboarding chute design
Parametric modelling

From the Real Structure to the Mechanical Model
Variable force computation
Piston weight according to DNV regulation

Stop giving solutions!

$I_2 < 0!$
Buckling problem: regulation vs numerical/theoretical

1D FEM  3D FEM

Graph showing various curves with labels $I_2/I_1 = 0, 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2$.
Structural design loads

- Bending moment
- Axial force
- Shear force
Cross-section analysis

\[ f = \frac{F_{pymax} a^2 b^2}{3EIL} \quad I_{xx} = \frac{F_{pymax} L_1^2 (L_2 - L_1)^2}{3EL_2 L_2 / f} \]

\[ \sigma_n = \sigma_f + \sigma_a \rightarrow \frac{M_f}{W} + \frac{N}{A} \quad \sigma_n = \sigma_{vm} < \frac{\sigma_y}{SF} \]

\[ \tau = \tau_f < \frac{\sigma_y}{SF\sqrt{3}} \rightarrow \quad \tau_f = \chi \frac{V_{ay}}{A} \]
Total optimized solutions in terms of weight and cost

-15% in terms of cost and total system weight!
First optimized solution: $AB = 10m$

It can not be built!

Initial configuration

Final configuration
Second optimized solution: $AB = 12m$

This optimized configuration can be physically realized.
Conclusions

- More competitive offer
- Versatile use of the presented MATLAB procedure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Predesign</th>
<th>Optimized</th>
<th>Difference [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston length [m]</td>
<td>8.6</td>
<td>7.4</td>
<td>-16</td>
</tr>
<tr>
<td>Piston weight [t]</td>
<td>7.6</td>
<td>7.0</td>
<td>-8.5</td>
</tr>
<tr>
<td>System weight [t]</td>
<td>23.9</td>
<td>20.9</td>
<td>-14.5</td>
</tr>
<tr>
<td>System cost [k€]</td>
<td>223</td>
<td>211</td>
<td>-6</td>
</tr>
</tbody>
</table>
Thank you for your attention

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