Topology Optimization of a High Speed Support for a HSC Milling Machine

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Manual Topology Optimization

High speed support for a HSC milling machine

Manual topology optimization:
~ 90 engineering hours and
~ 150 computing hours

Displacement under lateral acceleration
(Result of the FEM calculation)

Material: EN-GJS-400-18, Weight: ~140 kg
Dimensions: 1400 x 500 x 150 mm

Optimization for weight and stiffness
Load-compatible ribbing:
• 50 % lower displacements
• 15 % lower mass
• 10 % lower costs
Automatic Topology Optimization with TOSCA Structure

Definition of the optimization task

Optimization area

Frozen area

~ 20 engineering hours
~ 48 computing hours

Result of the automatic topology optimization

Time exposure for the topology optimization

<table>
<thead>
<tr>
<th></th>
<th>Engineering hours</th>
<th>Computing hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Automatic</td>
<td>22%</td>
<td>32%</td>
</tr>
</tbody>
</table>

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Comparison of Optimization Results

Classical design

\[ u_{\text{max}} = 4.8 \, \mu m \]

Manual Topology optimization

\[ u_{\text{max}} = 2.4 \, \mu m \]

Automatic Topology optimization

\[ u_{\text{max}} = 1.7 \, \mu m \]

Material: EN-GJS-400-18, weight: ~140 kg
Measures: 1400 x 500 x 150 mm

Castable design after topology optimization

Advantages vs. Manual topology optimization:
- 30% lower displacement
- 2% lower mass
- 305 shorter development time
Manufacturing Constraints

- New in TOSCA Structure 6.1: Restriction of wall thickness (maximum member size)
- Important for injection casting

High speed support optimized with pull direction and maximum member size constraint

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