Optimal and Reliable Design of Timber Beams for a Maximum Breaking Load considering uncertainties.

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Reliability-Based Design Optimization offers a suitable framework for the consideration of the uncertainties in the design optimization and to find the best compromise between cost reduction and safety assurance.
Context of the study

- Use of wood-based materials in sustainable constructions aims to reduce the environmental impact of buildings.
- Improve the competitiveness of timber structures by improving the prediction of the mechanical behavior (crack propagation).
- Take into account uncertainties in material properties and actions and increase the reliability of timber structure with cracks.
- Optimal Calibration of the partial safety factors to ensure the best compromise between cost reduction and safety assurance.
Main results

- The crack propagation prediction may consider uncertainties due to material parameters and maximum breaking load.
- The Reliability-Based Design Optimization approach proposes the best design that satisfies the reliability requirement for the maximum breaking load.

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Optimal H (m)</th>
<th>Optimal B (m)</th>
<th>Maximum Breaking load (kN)</th>
<th>Probability of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.94 m</td>
<td>0.70 m</td>
<td>50 kN</td>
<td>2.32 \times 10^{-4}</td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>1.23 m</td>
<td>0.92 m</td>
<td>62.60 kN</td>
<td>2.32 \times 10^{-4}</td>
</tr>
</tbody>
</table>

Kriging approximation of the energy release

- a) Uncertain geometrical dimensions (H & B)
- b) Uncertain geometrical, material parameters and load action.