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ViaMéca LES PÔLES DE COMPÉTITIVITÉ

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

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- Institut de Recherche en Génie Civil et Mécanique (GeM)

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Context of the study

Resource rationalization

Safety Assurance

Uncertainty of material parameters

Model analysis approximations

Optimization

Decision making tools

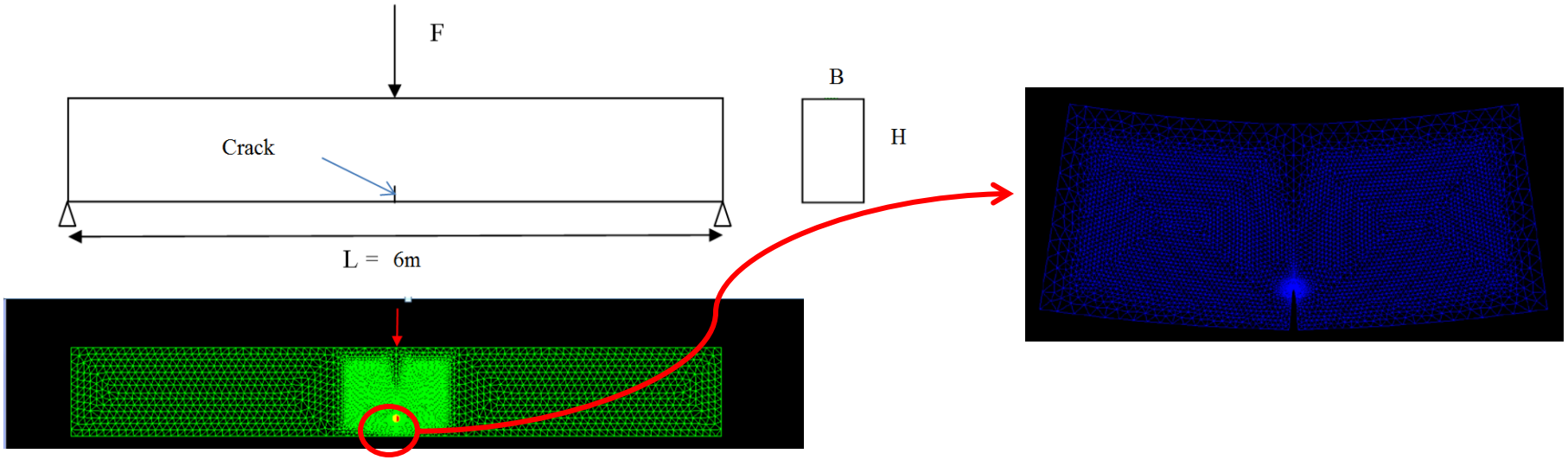
Material degradation (crack propagation)

Loading and climate fluctuation

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

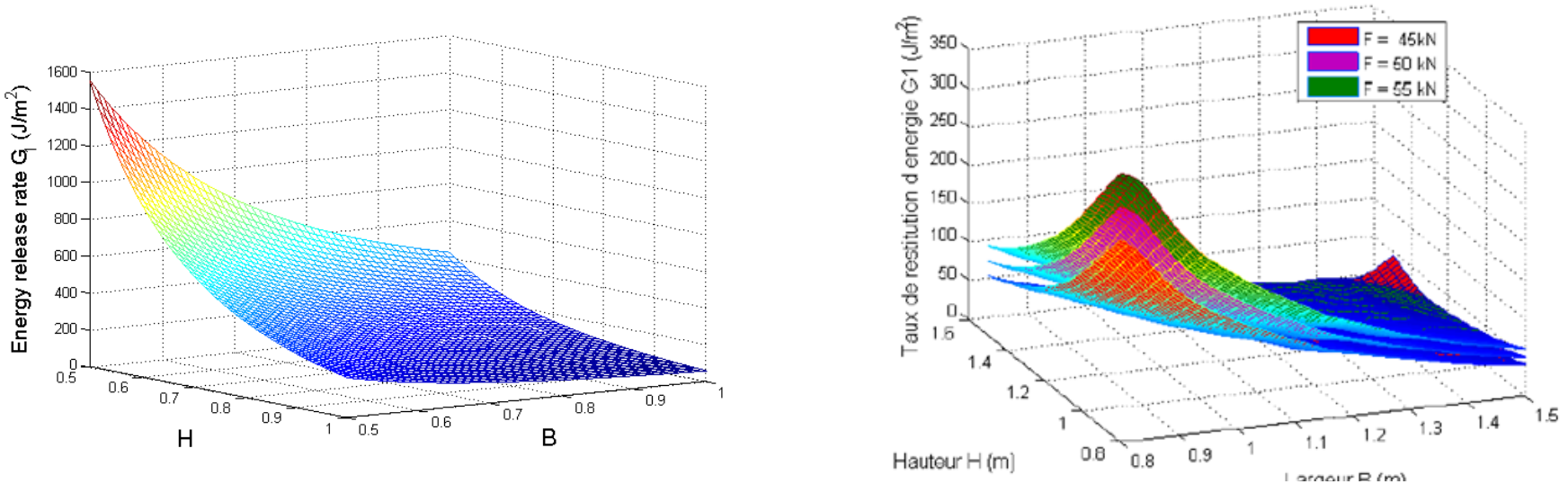
- Use of wood-based materials in sustainable constructions aims to reduce the environmental impact of buildings.
- Improve the competitiveness of timber structures by improving the prediction of the **mechanical behavior (crack propagation).**
- Take into account **uncertainties** in material properties 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.

	Optimal H (m)	Optimal B (m)	Maximum Breaking load (kN)	Probability of failure
Case 1	**0.94 *m***	**0.70 *m***	**50 kN**	**$2.32 \prec 10^{-4}$**
Case 2	**1.23 *m***	**0.92 *m***	**62.60 kN**	**$2.32 \prec 10^{-4}$**



Kriging approximation of the energy release **a)** Uncertain geometrical dimensions (H & B) **b) Uncertain geometrical, material parameters and load action.**