INTALES

New methods for lay-up optimization of composites

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Introduction

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- **Goal**: optimal stacking
- Process:
  - Fast and efficient generation of the optimal stacking for one load case
  - Optimal stacking for all load cases by multiple runs

    → **robust layup**

Introduction

- With specification of:

$$\left.\begin{array}{l} nplies \\ ngrp \\ \varphi \end{array}\right\} \longrightarrow \text{one specific stacking}$$

Introduction

- To optimize:

$$F = f(nplies, ngrp, \varphi)$$

$F \ldots$ decisive failure criteria

$F \geq 1 \Longrightarrow$ failure

Parameter analysis

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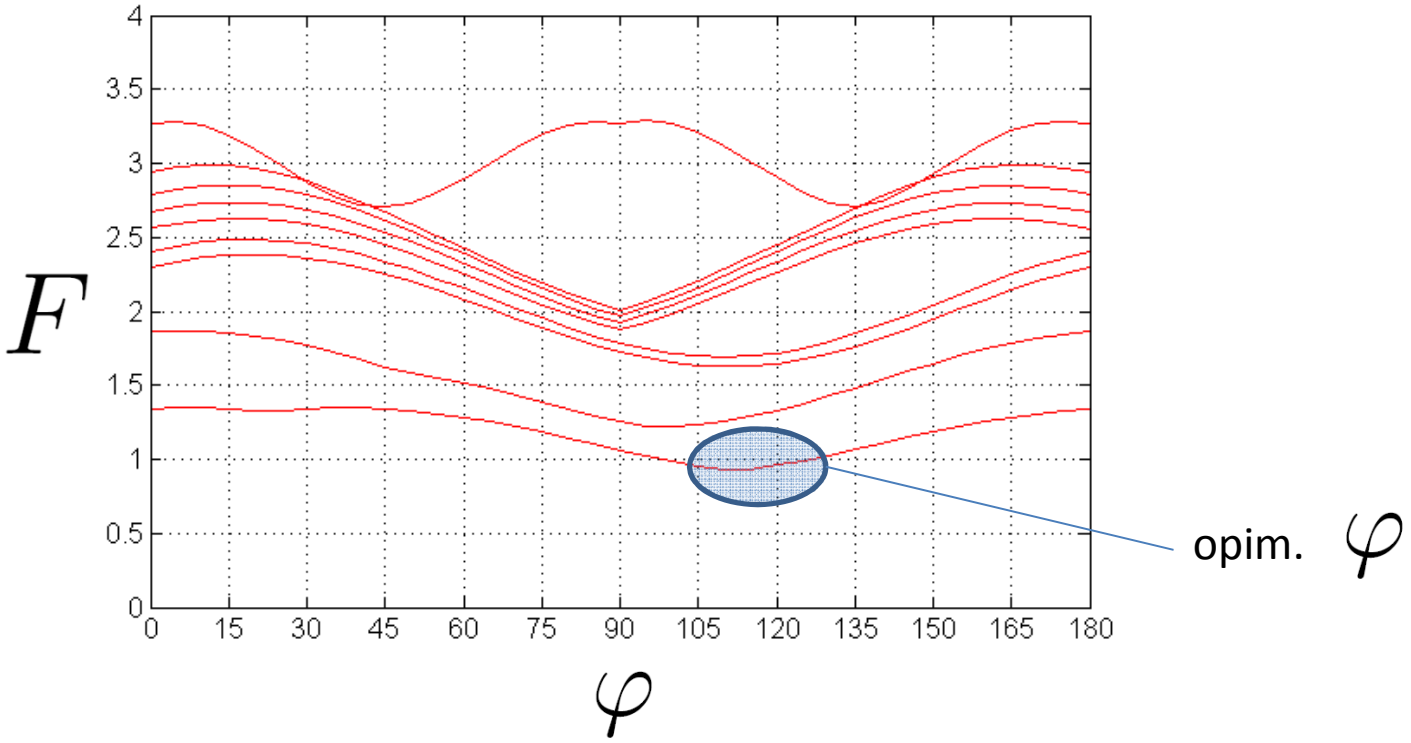
Variation of the draping angle:



Parameter analysis

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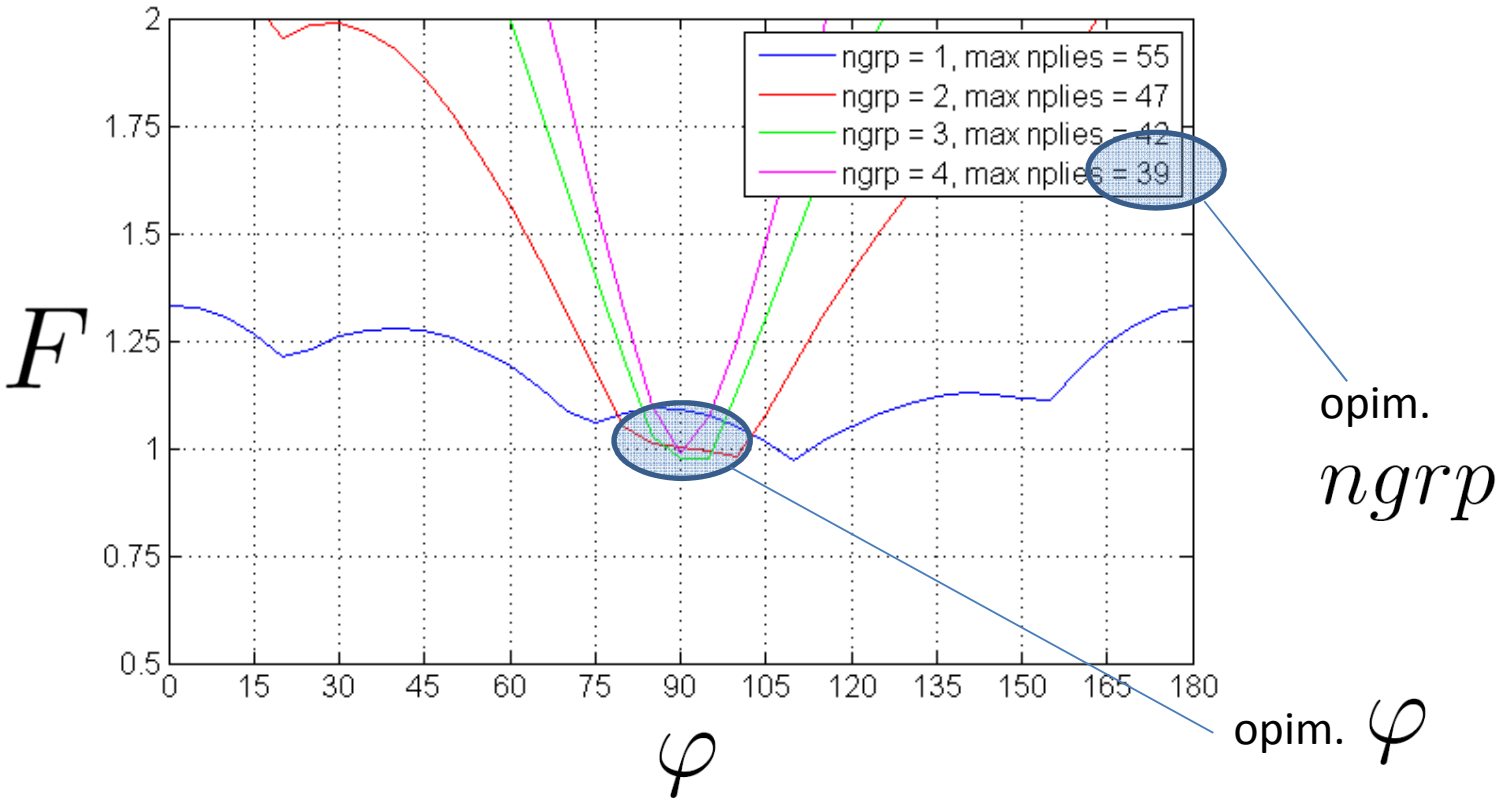
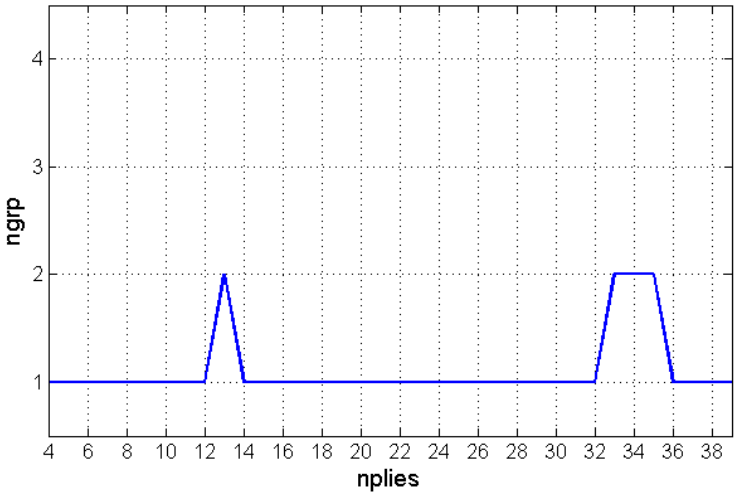
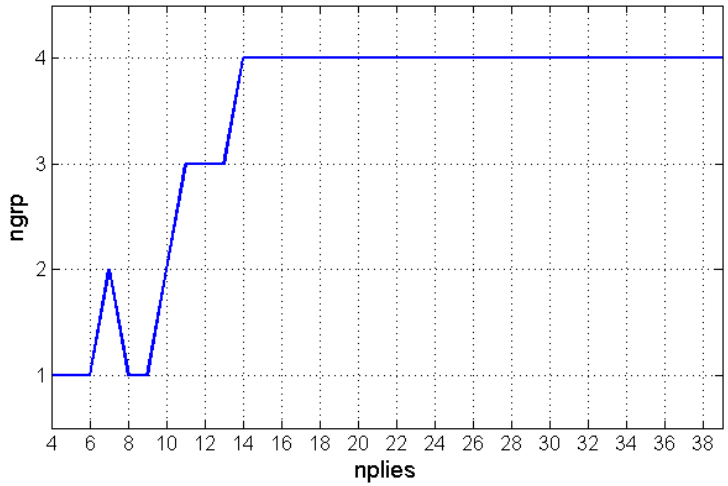
Variation of the draping angle and grouping num.



Parameter analysis





- Optimal grouping number with increasing the number of plies

Optimization

- Optimization Routine:
- In one load increment:
  - nplies, ngrp and phi of the previous step
  - Variation of phi
  - Control and variation of ngrp
  - Increasing nplies

Examples

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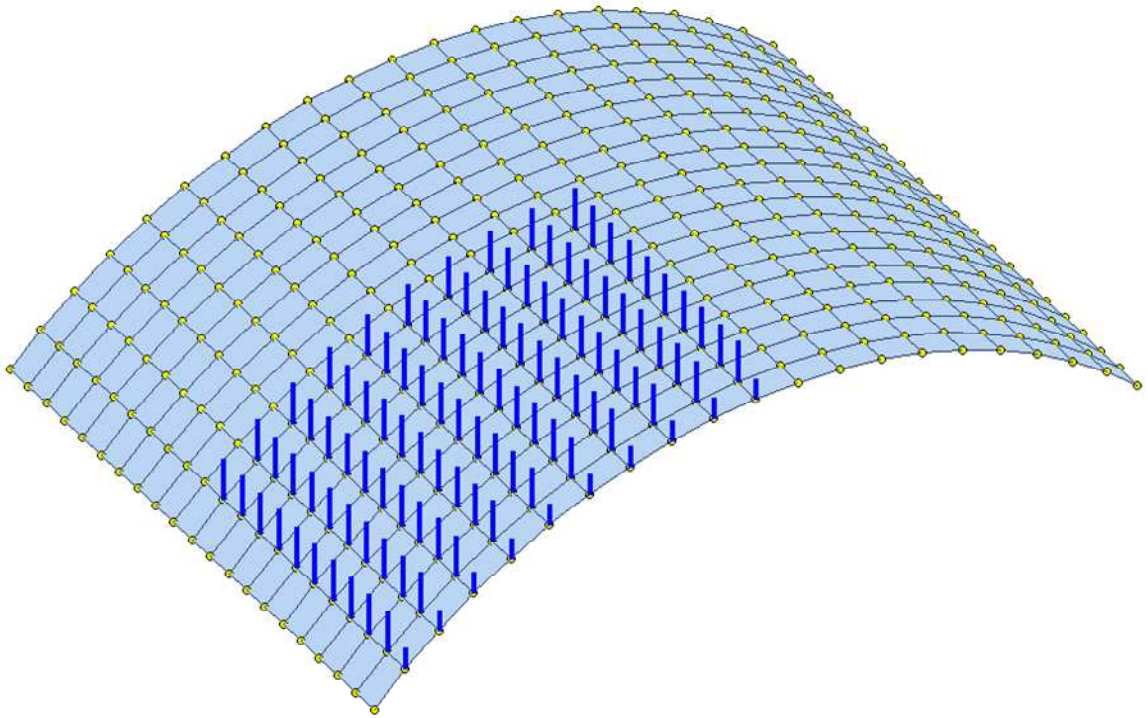
Cylindrical roof: Model



Examples

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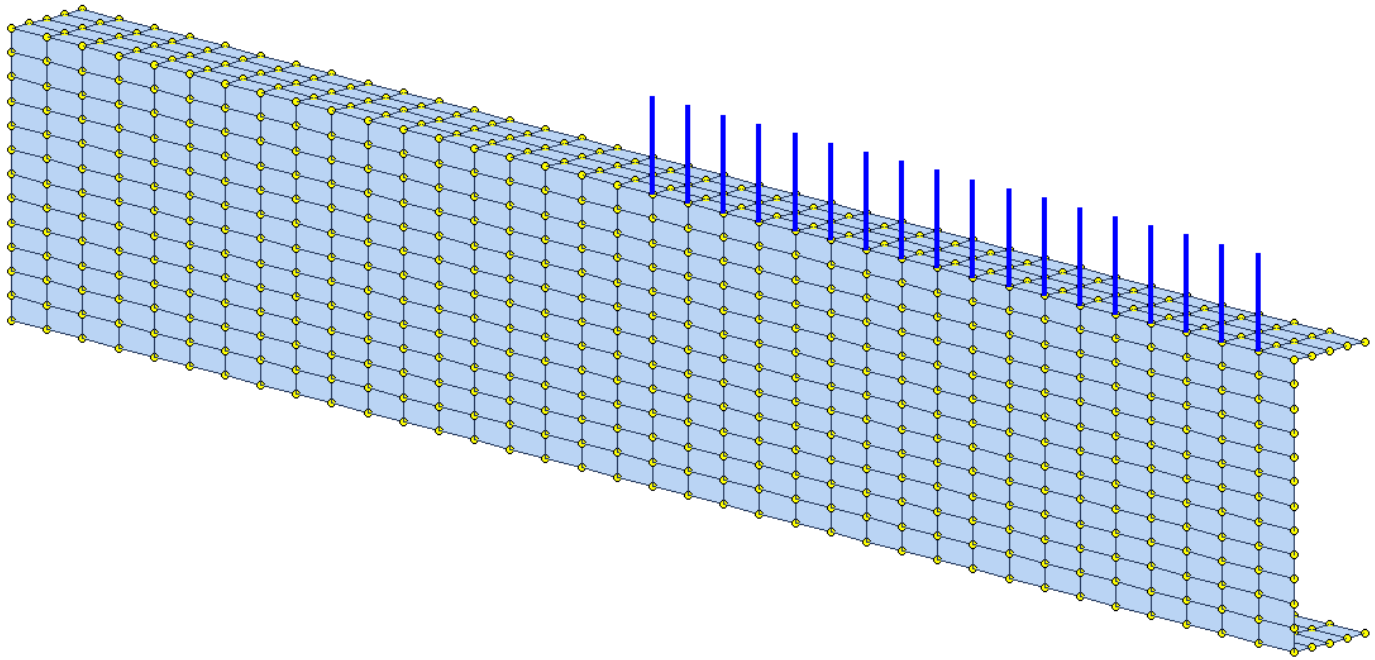
Channel section: Model



Examples

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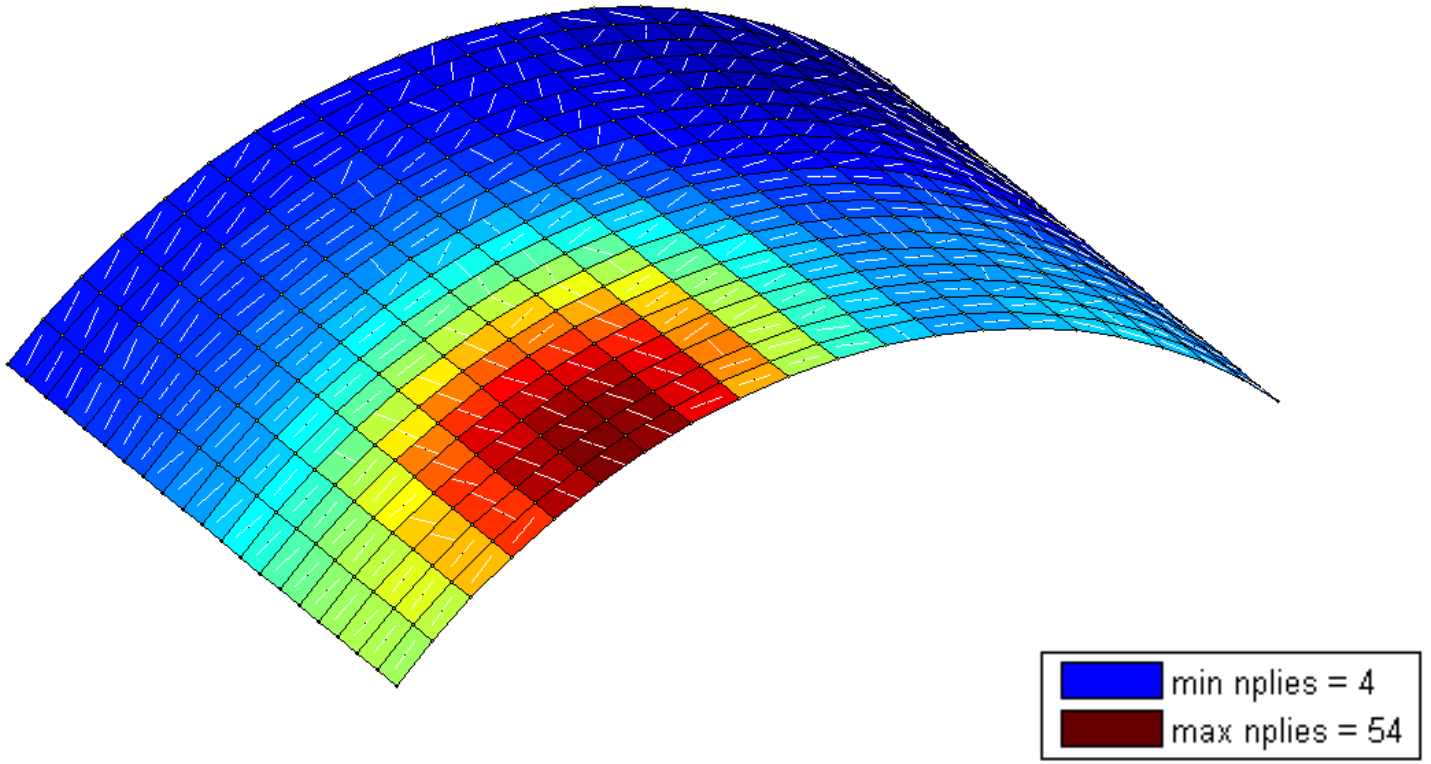
Draping angle and number of plies



Examples

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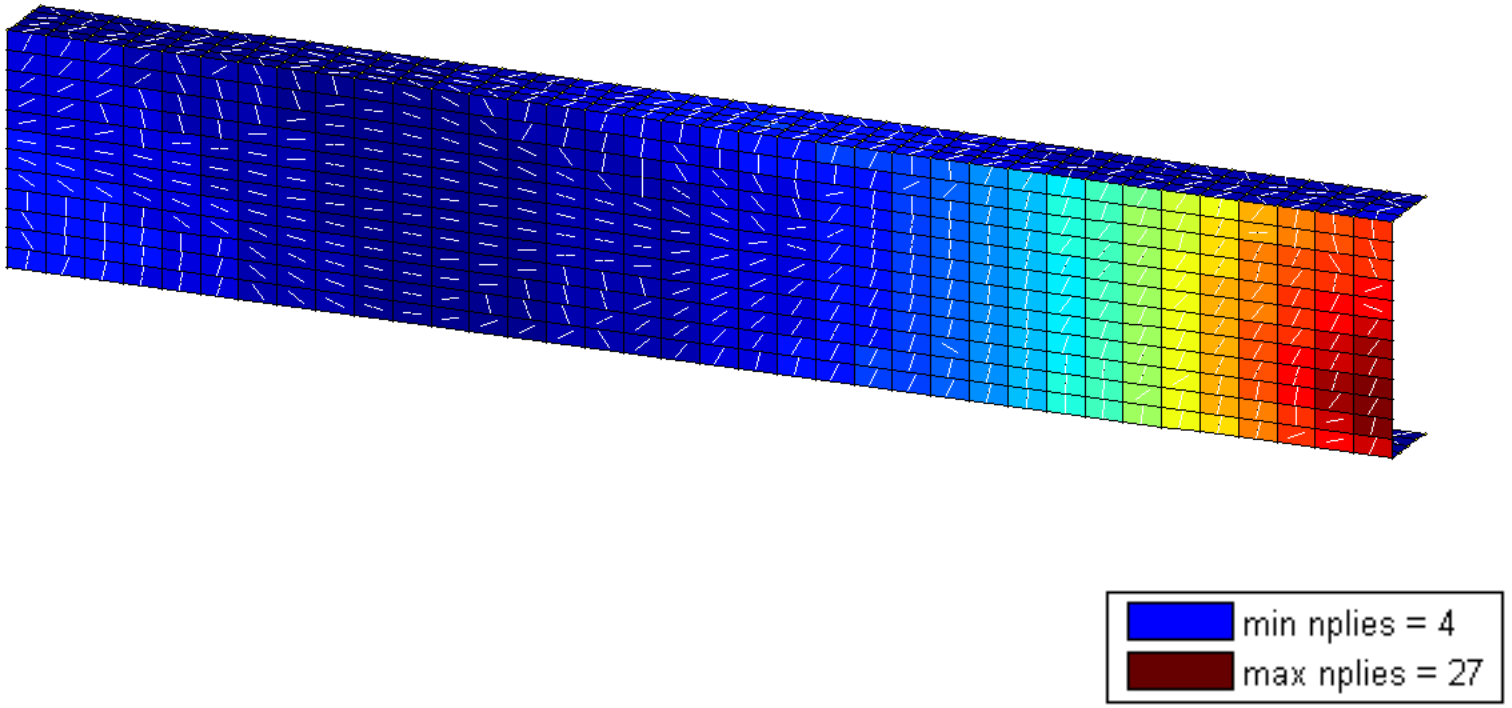
Draping angle and number of plies



Examples

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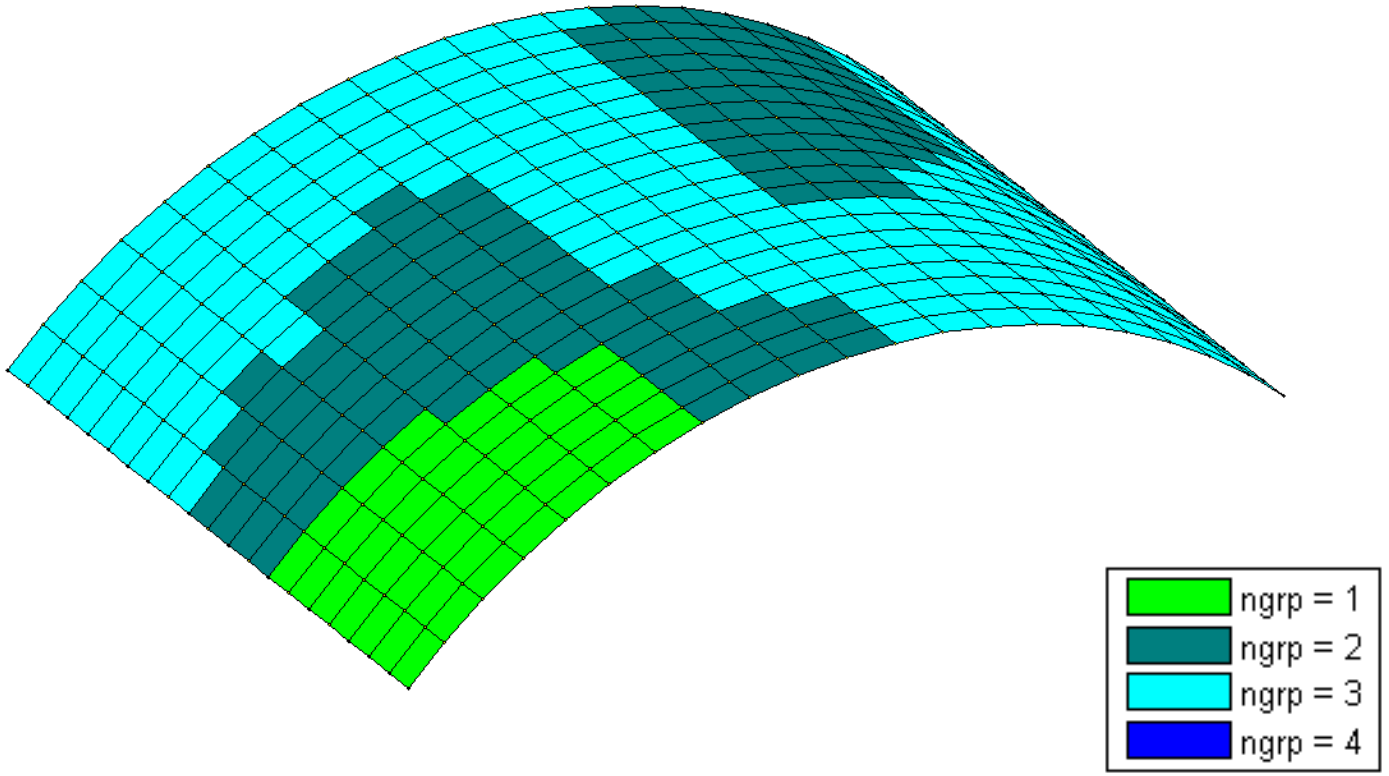
Grouping number



Examples

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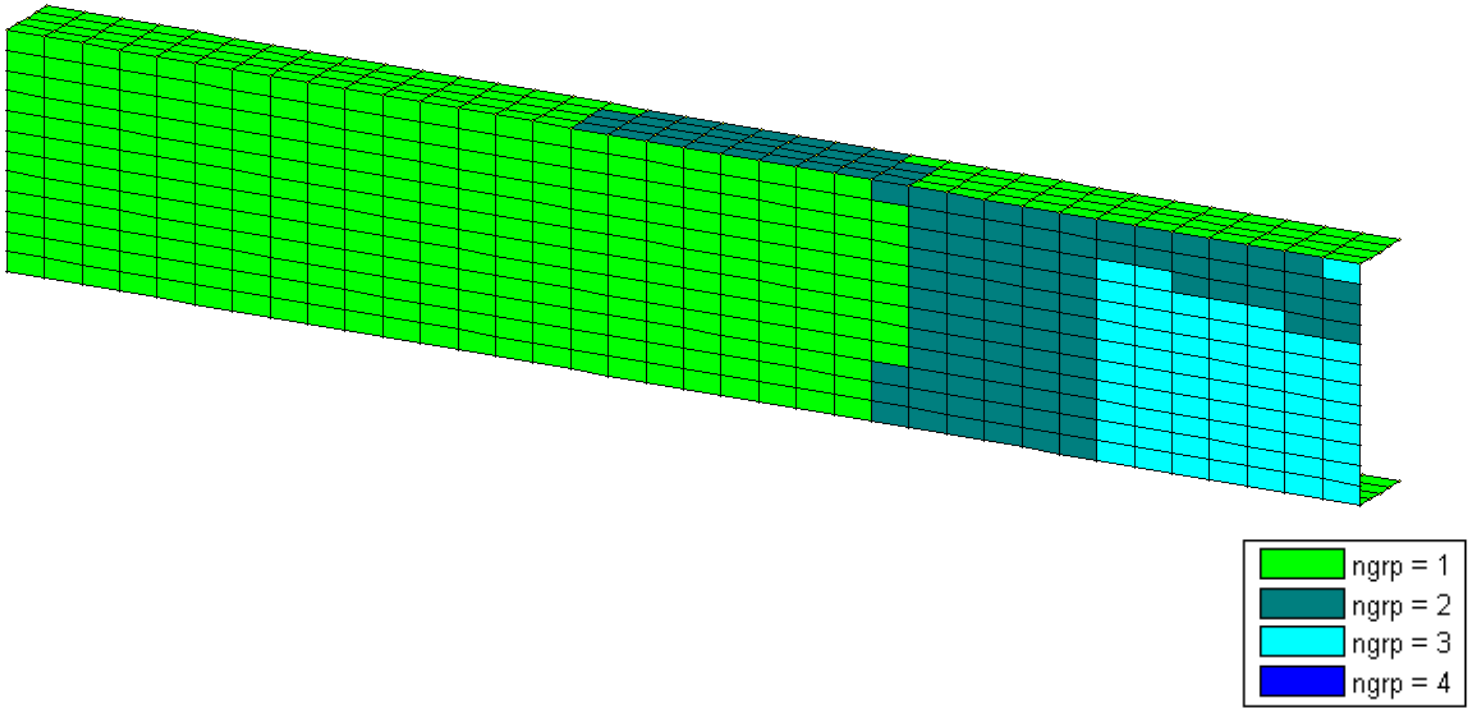
Grouping number



Examples

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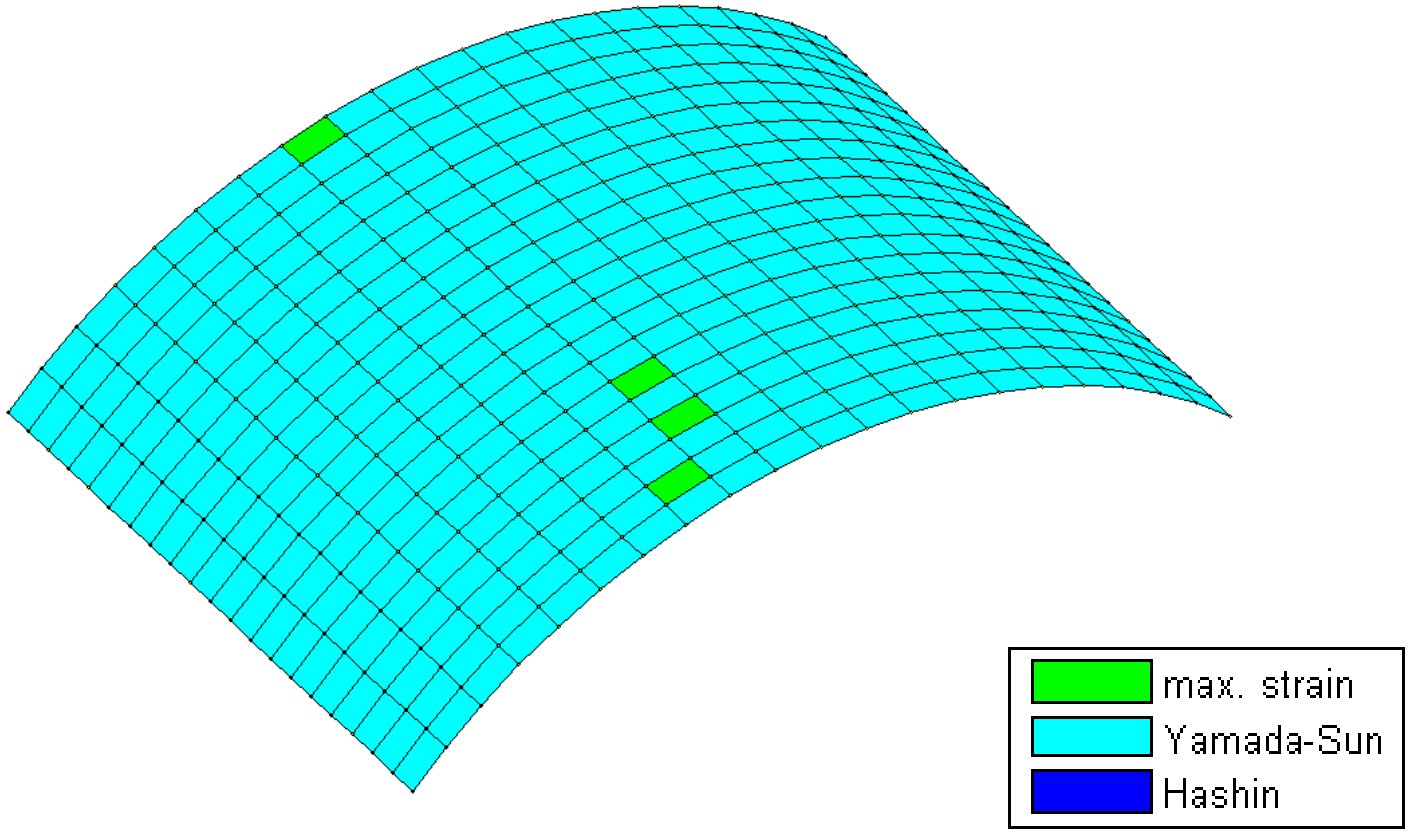
Decisive failure criteria



Examples

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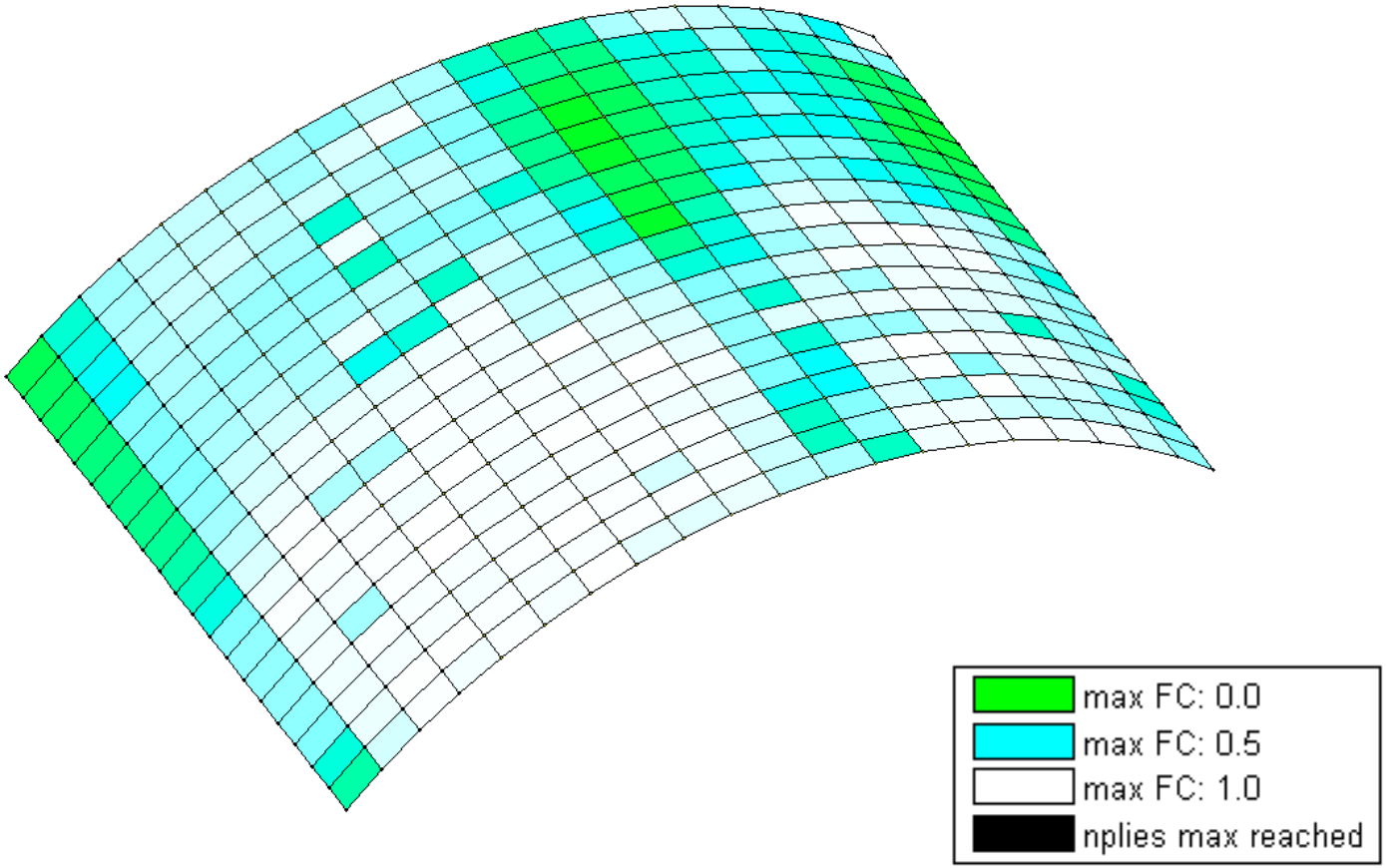
Reserve factor F



Examples

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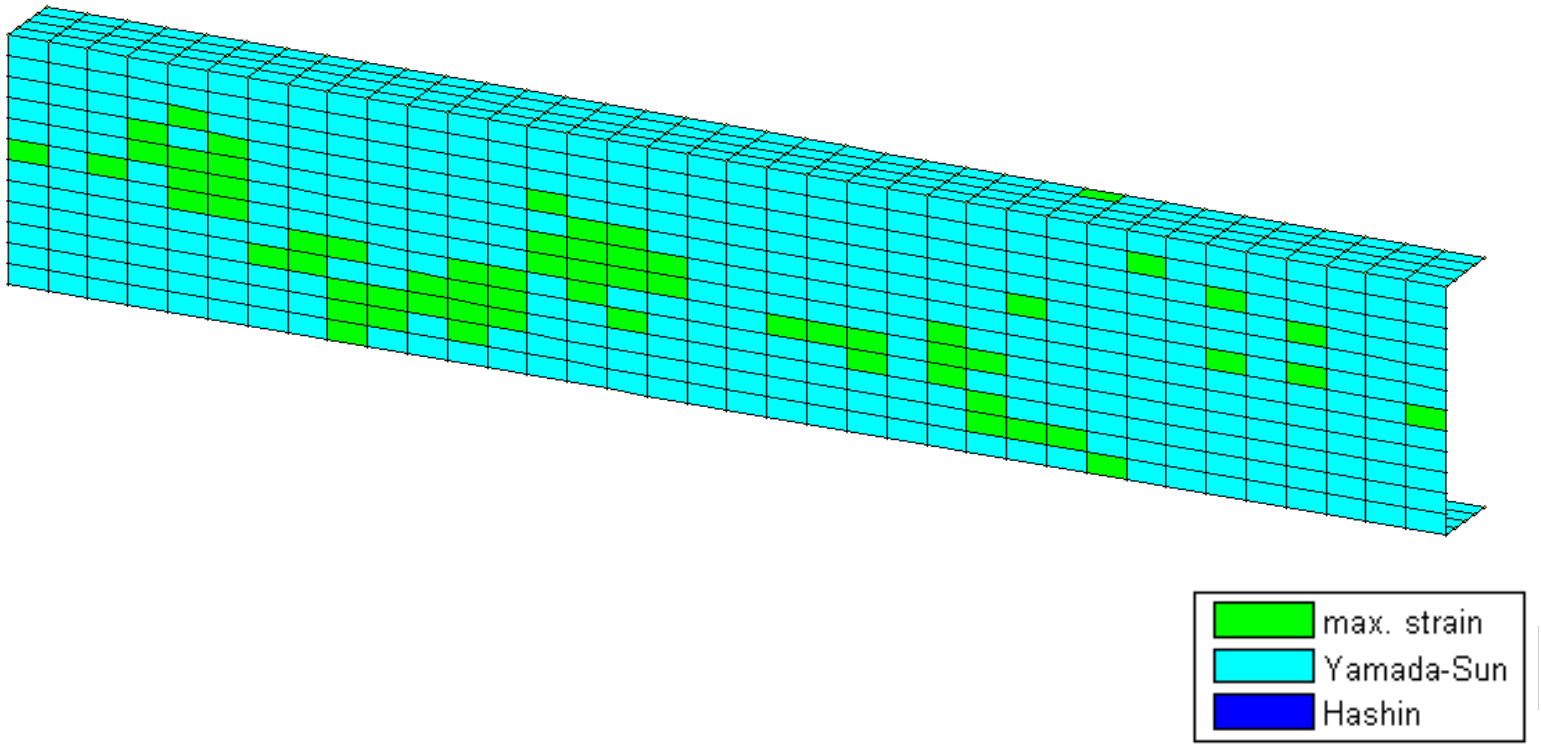
Decisive failure criteria



Examples

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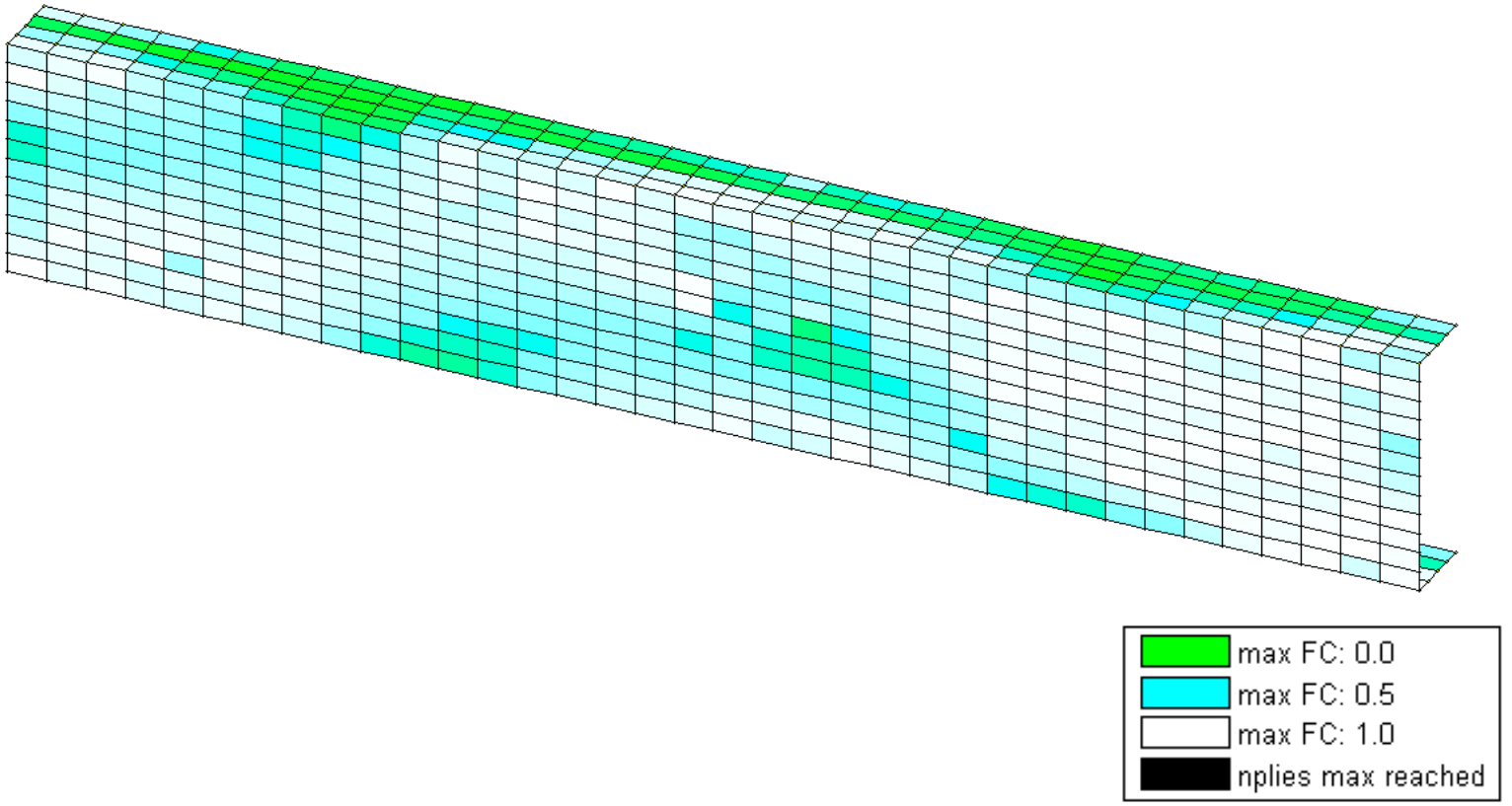
Reserve factor F



Examples

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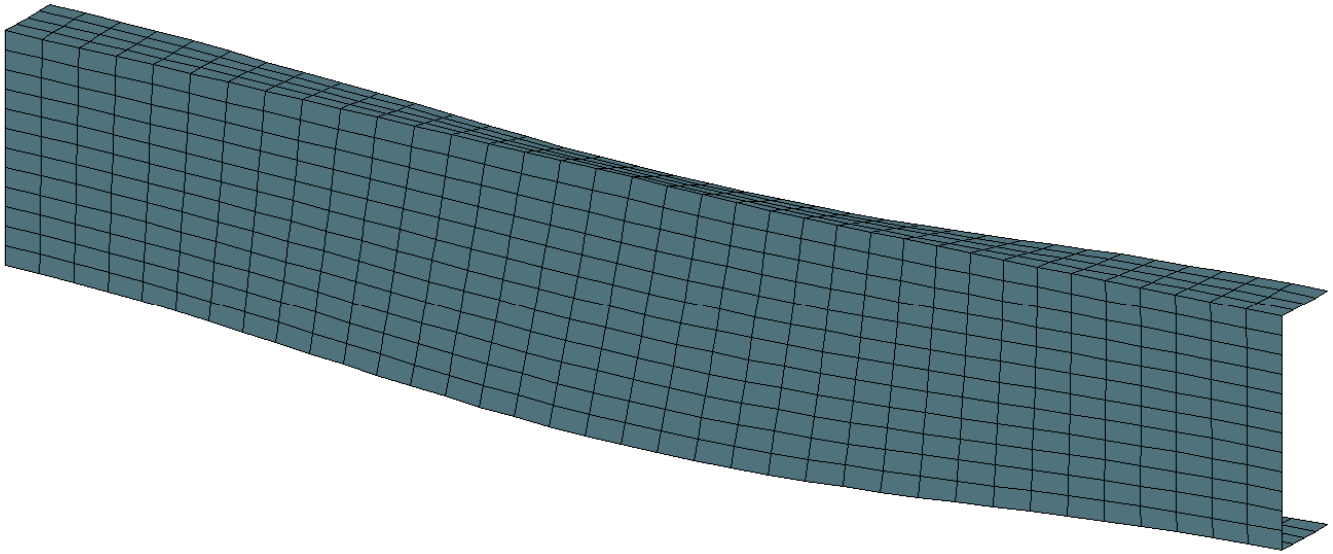
Deformation



Conclusion

- Good optimization and fast convergence for draping angle
- Stable grouping number
- Convergence number of plies including a smoothing routine

Thank you for your attention!