Design practice and its implications

Role	Case A	Case B1	Case B2
Member design	Engineer	Engineer	Fabricator
Joint design	Fabricator	Engineer	Fabricator
Fabrication	Fabricator	Fabricator	Fabricator

Roles of the parties in the design and fabrication processes

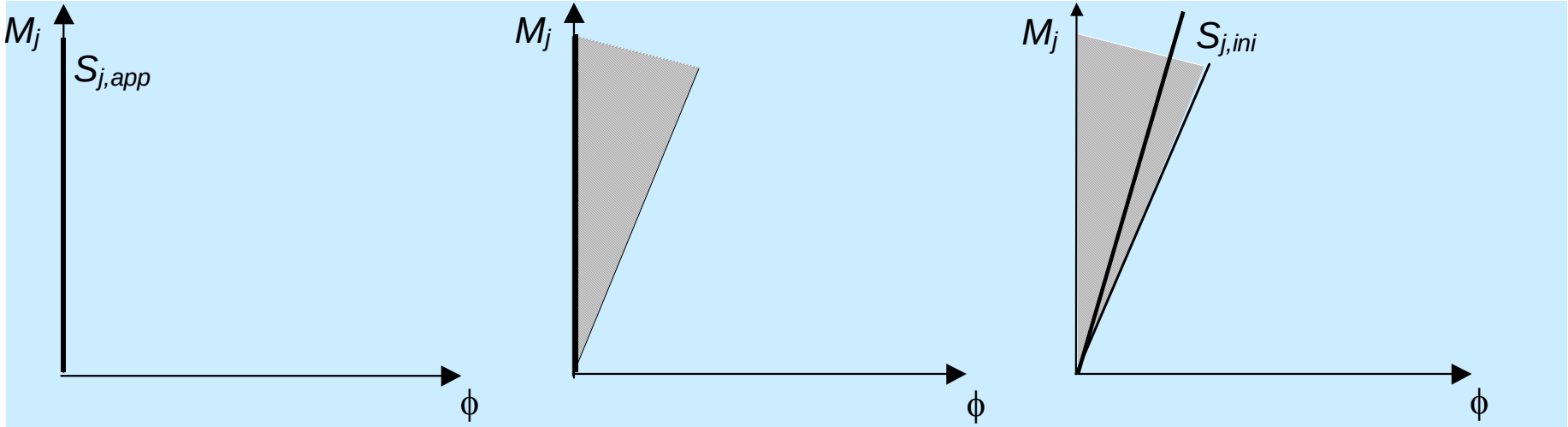
- Case A sometimes leads to costly joint reinforcement if rigid joints have been adopted
- Case B1 requires the designer to be aware of the implications of joint assumption on costs
- Case B2 is ideal for a consistent design approach which aims at global economy

Practical application of modern design approaches

Approaches easily integrated into current design practices:

- "Good guess stiffness" for semi-rigid joint + elastic analysis
- "Fixity factor" approach in the traditional approach using elastic analysis
- Rigid-plastic analysis of non-sway frames using partial strength joints

Check for joint stiffness when rigid joints are assumed



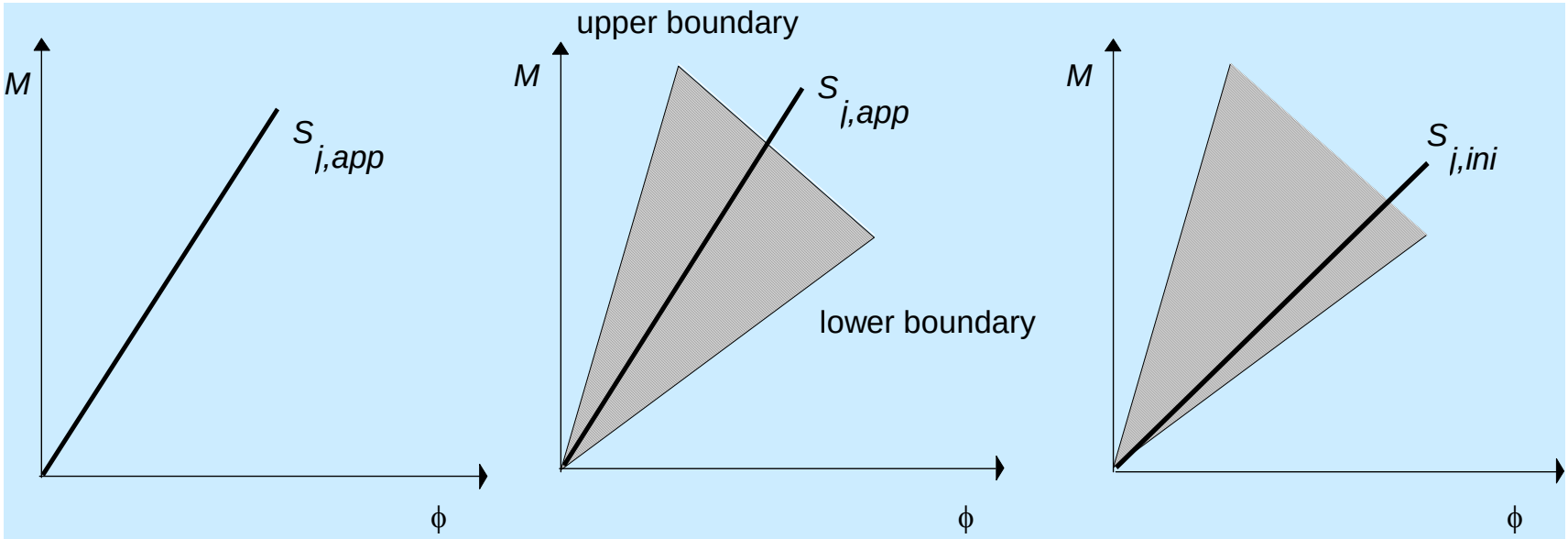
Step a) :
Frame analysis based on the assumption $S_{j,app} = \infty$ (joint *presumably* rigid)

Step b) :
Stiffness range for rigid joints based on $S_{j,app} = \infty$ see *Eurocode 3*

Step c) :
Check if actual initial stiffness $S_{j,ini}$ is in range

Joint must meet "rigid joint" classification criteria

Check of initial semi-rigid joint "good guess" stiffnesses



Step a): engineer

Frame analysis based on a design joint stiffness derived from $S_{j,app}$

Step b): fabricator

Stiffness range for semi-rigid joints based on $S_{,app}$

Step c): fabricator

Check if actual initial stiffness $S_{j,ini}$ is in range

Semi-rigid joint stiffnesses can vary within a fairly wide range without significantly altering the frame resistance

Fixity factor approach: check for joint stiffnesses

Frame	Lower boundary	Upper boundary
Braced ($f = 0{,}5$) $S_{j,app} = \frac{3EI_b}{L_b}$	$S_{j,ini} \geq \frac{24EI_b}{13L_b}$	$S_{j,ini} \leq \frac{6EI_b}{L_b}$
Unbraced ($f=0{,}8$) $S_{j,app} = \frac{12EI_b}{L_b}$	$S_{j,ini} \geq \frac{48EI_b}{7L_b}$	$S_{j,ini} \leq \frac{30EI_b}{L_b}$

Semi-rigid joint stiffnesses can be within a fairly wide range without significantly altering the frame resistance

Rigid-plastic design - partial strength joints

For non-sway frames essentially

- Initial sizing

  - beam (class 1) as 1 section size smaller than if simply supported

  - column sized as if pinned at ends

- Rigid-plastic analysis provides the joint moments : must choose ductile joints
- Modify member sizes if needed

Summary

- Choice of type analysis/design: depends on type of structure, available tools , EC3 requirements, etc.
- The more sophisticated the analysis tool used, the lesser the design ULS checks
- Joint representation: a consistent approach can permit optimisation of costs
- Simple aids exist for integrating the « consistent approach » into traditional practice/breakdown of design tasks

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Examples

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Thank you

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