Cobra: Tower crane with an articulated jib

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Europe and Switzerland

University of Applied Sciences of Western Switzerland

16 institutions

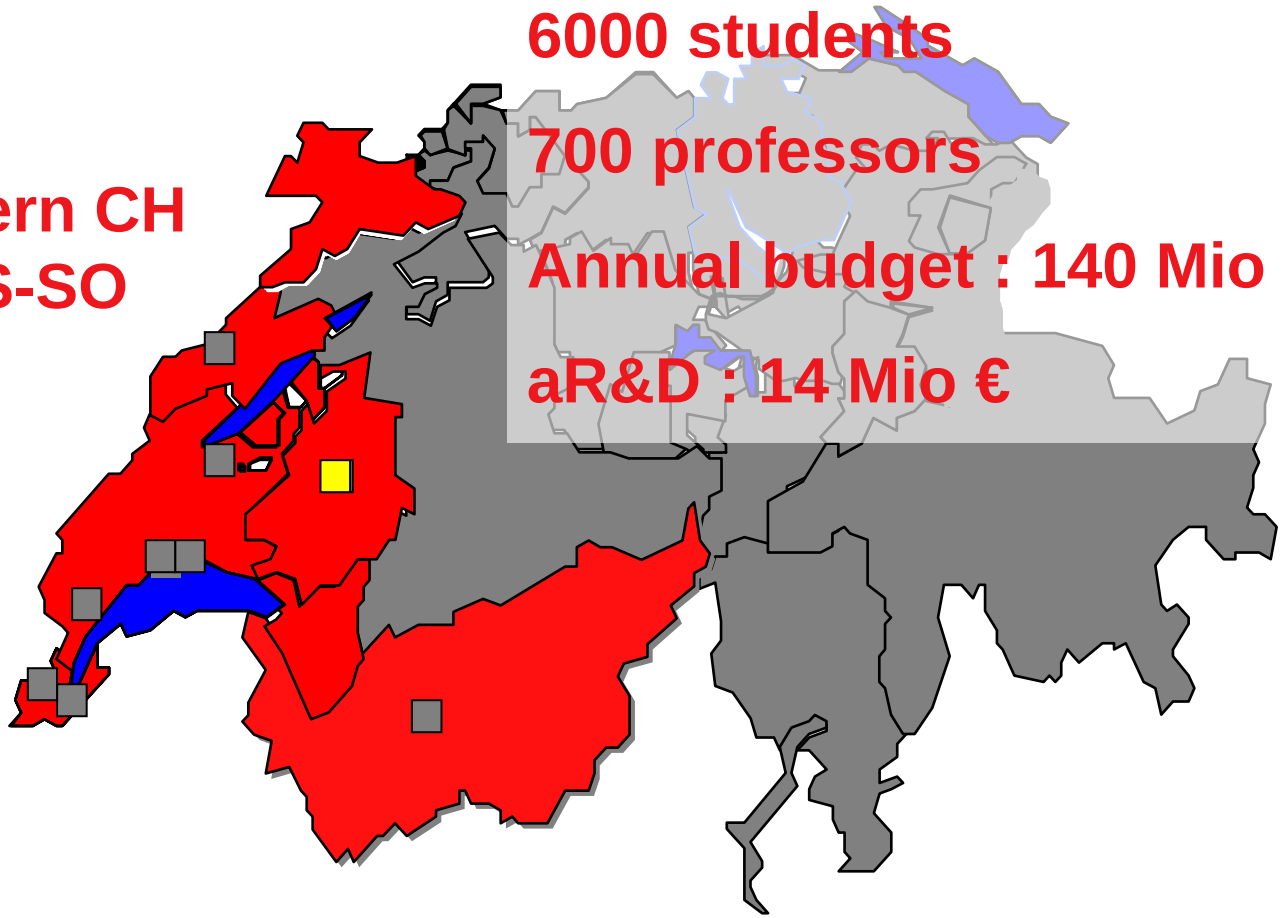
6000 students

700 professors

Annual budget : 140 Mio €

aR&D : 14 Mio €

Western CH HES-SO



College of Engineering and Architecture Fribourg

600 students

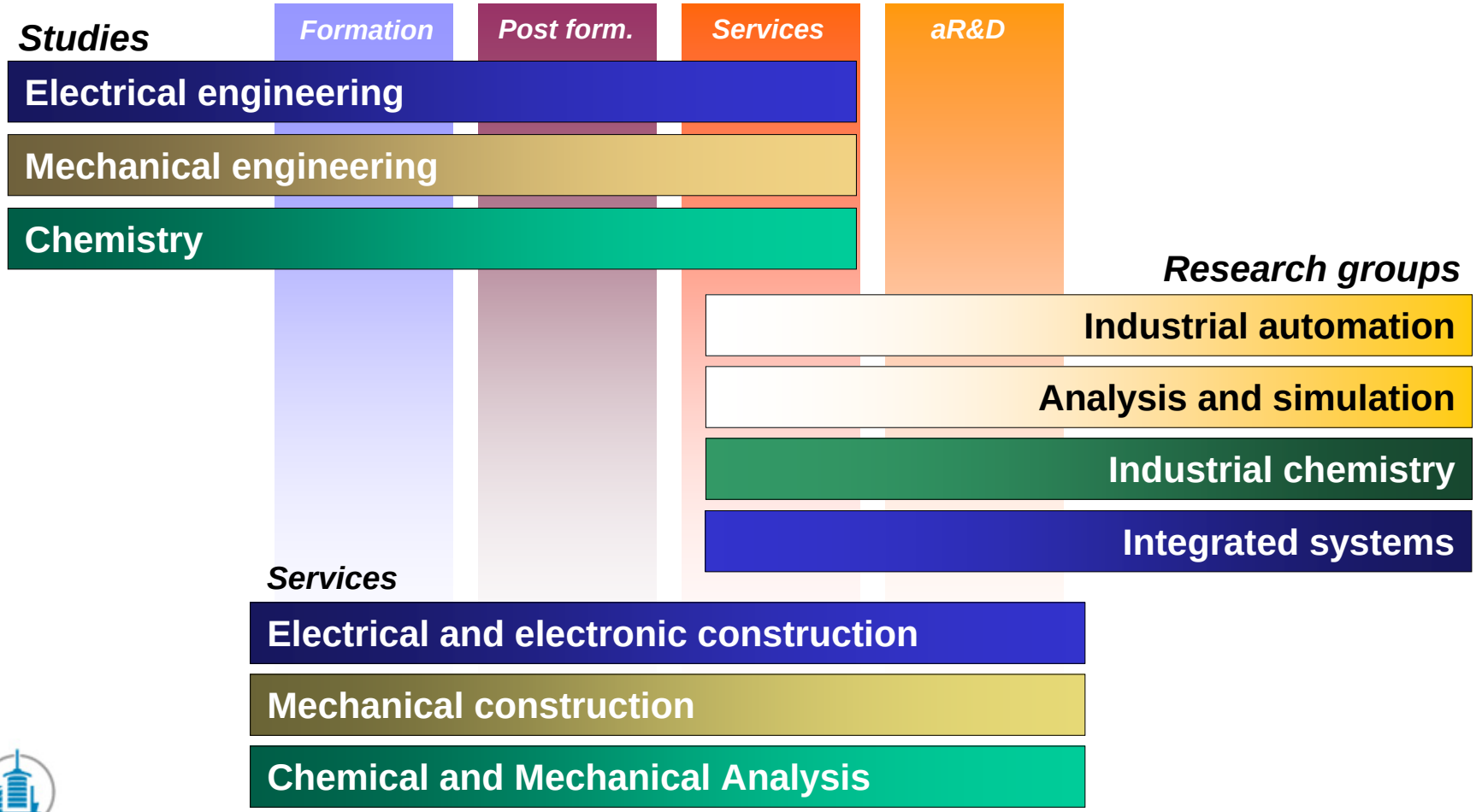
70 professors

70 researchers

Budget : 16 Mio €

aR&D : 4 Mio €

Department of Industrial Technology



aR&D Collaboration

Problems occuring with traditional cranes

New specifications

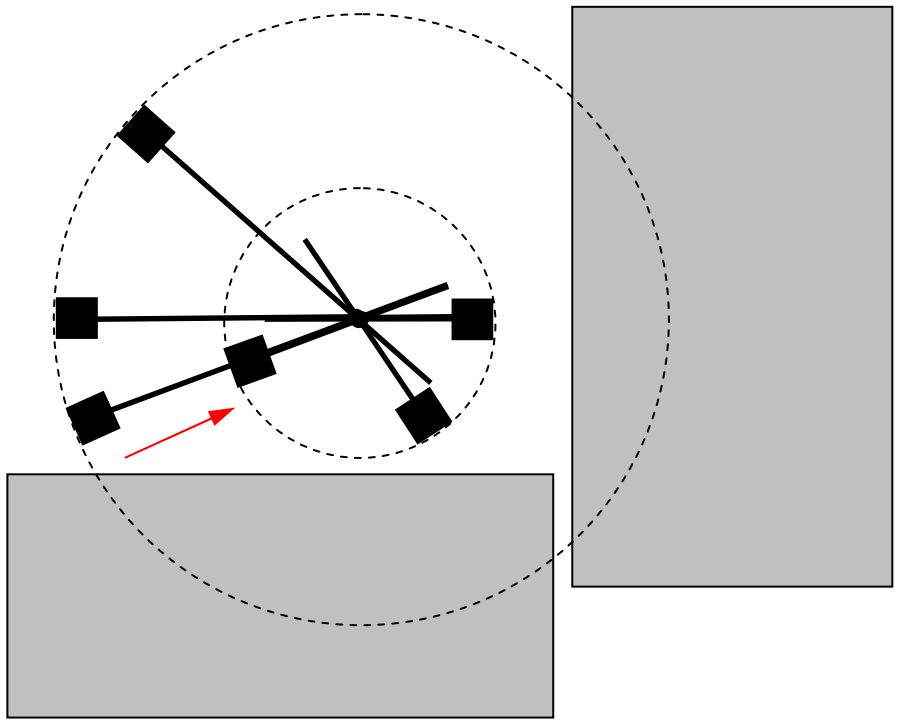
Basis idea:

Harbour’s cranes

Solution: The Cobra crane

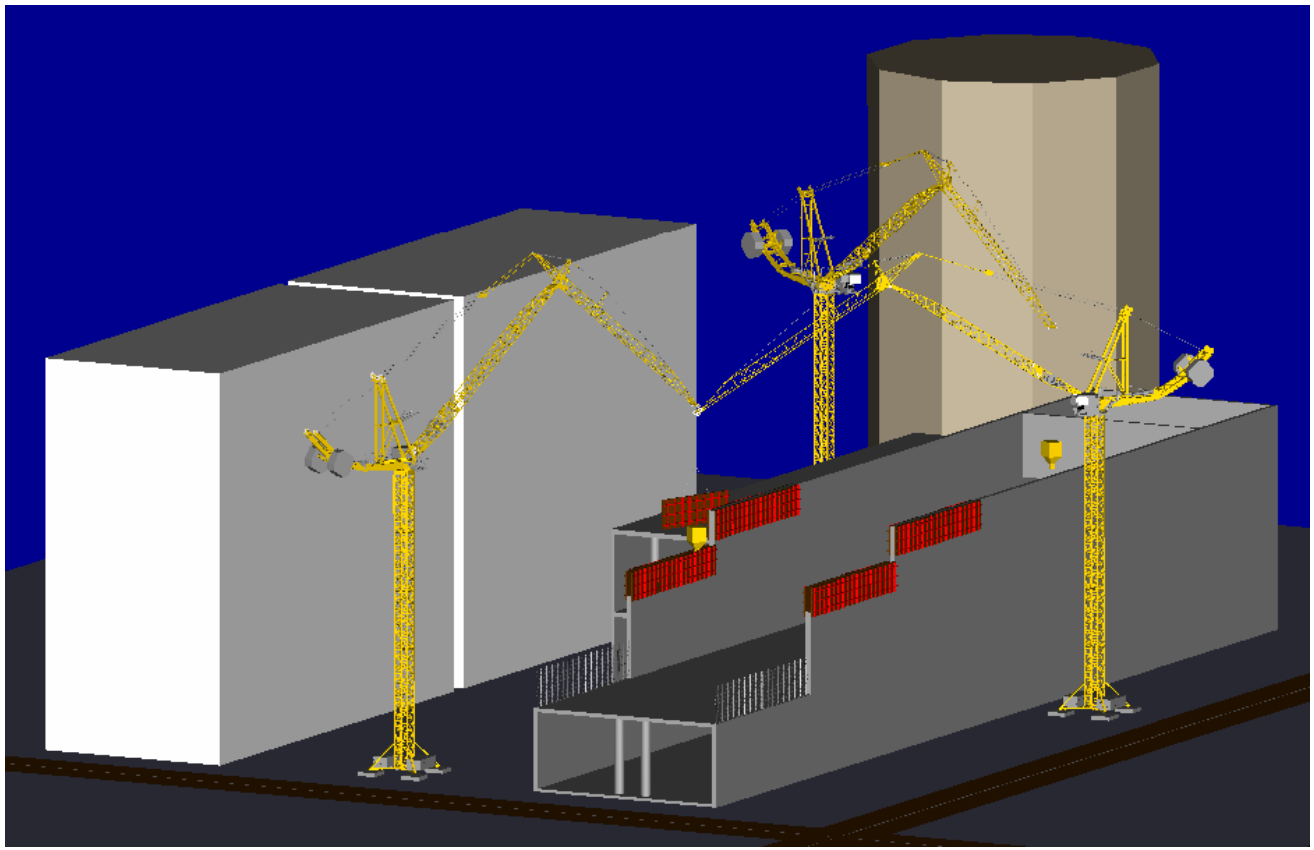
Cobra's advantages

- Obstacles can be bypassed and critical areas avoided



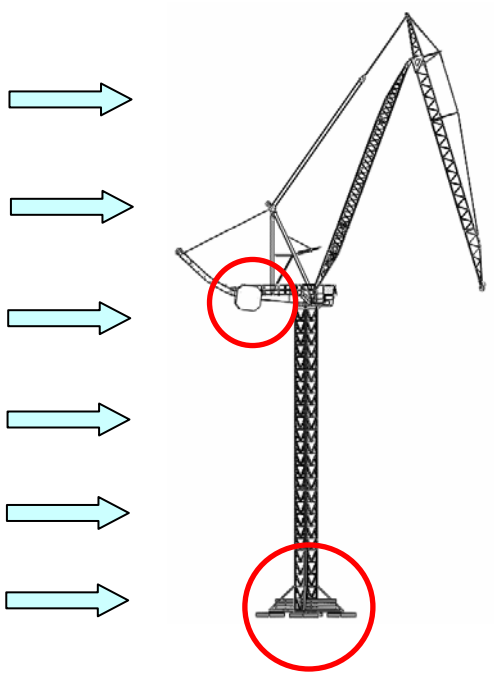
Cobra's advantages

⇨ Several cranes can work simultaneously



Cobra's advantages

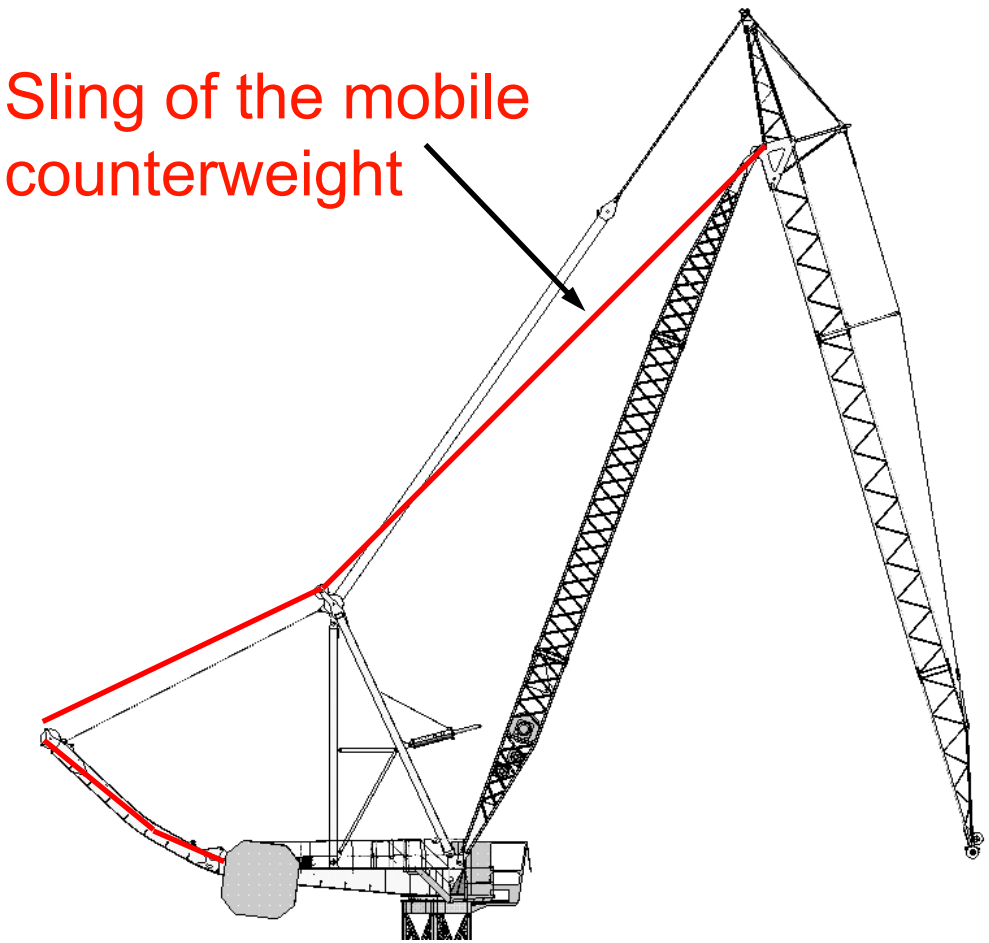
- Height under hook is reduced
- Fewer tower parts to be assembled
- Less ballast
- Smaller baseplate
- Reduced exposure to wind



Innovation: Mobile counterweight patented

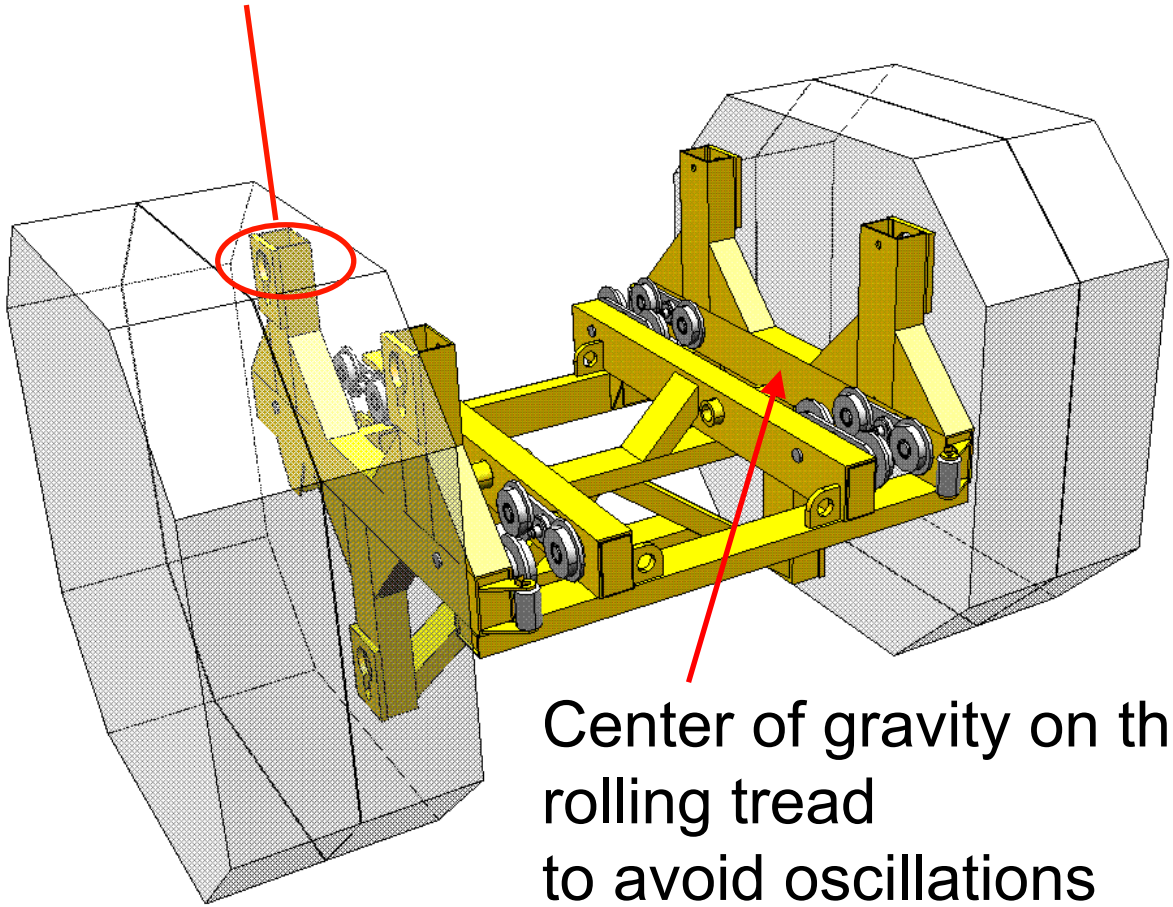
- ⇨ Optimal extension of the articulated jib
- ⇨ Increased stability of the crane
- ⇨ Higher lifting capacity for equal outreach

Innovation: Mobile counterweight patented



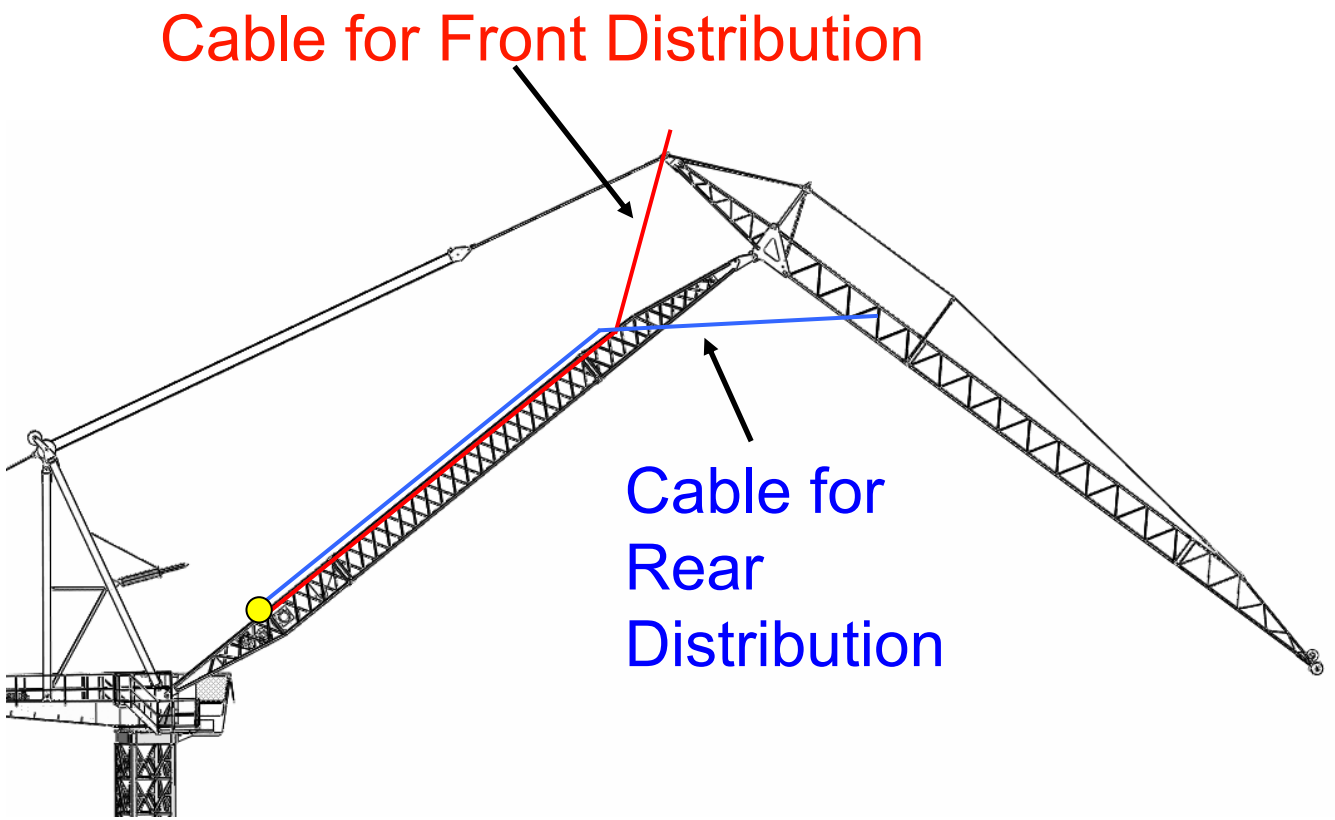
Innovation: Mobile counterweight patented

Easy assembling of ballast



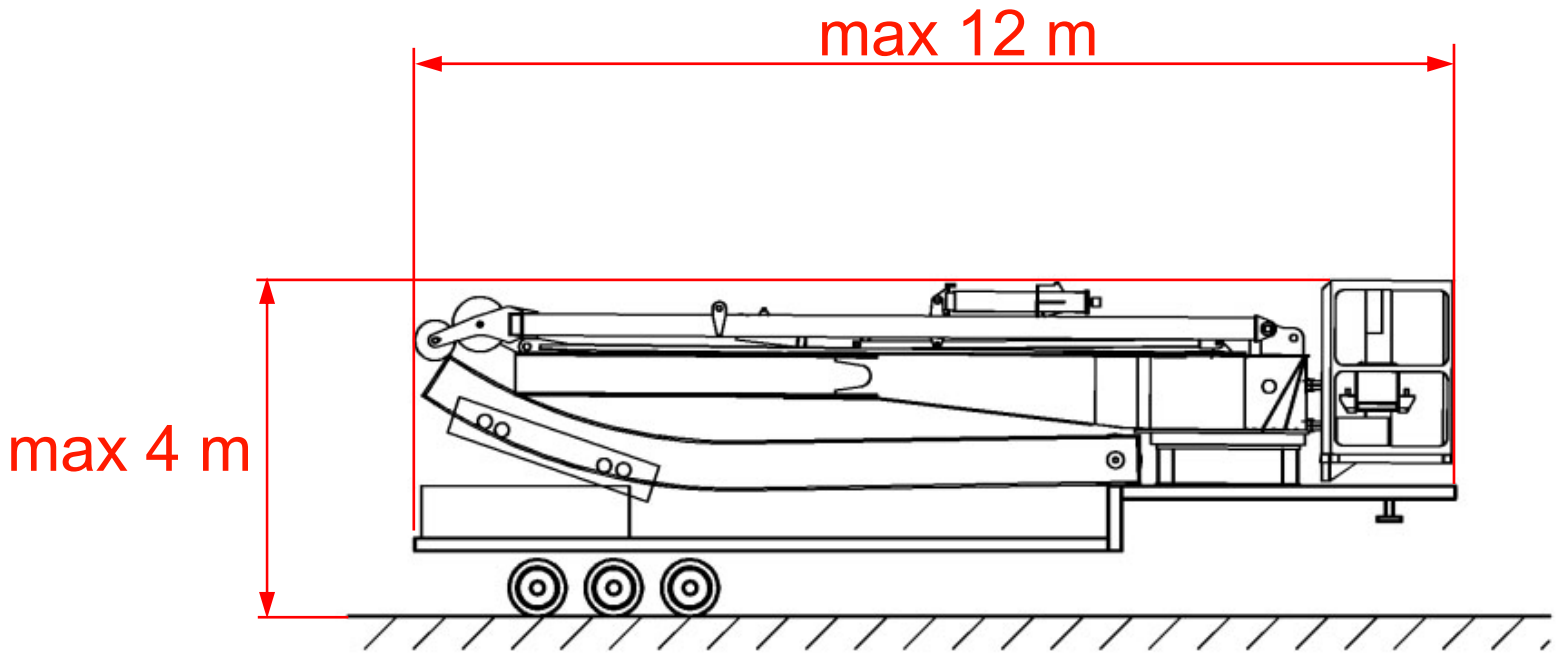
Center of gravity on the
rolling tread
to avoid oscillations

Innovation: Antagonistic cables for jib controlling



Requirements for road transport

Maximum truck load: 40 tons

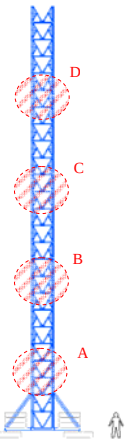
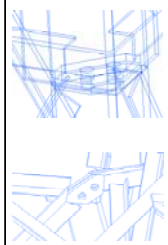


Risk Analysis

Risks concerning the staff during assembling and disassembling

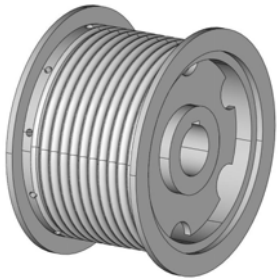
Definition of the assembling steps

Chart of preliminary risk analysis for each step

E10-1	Schéma 3D	Lieux de montage	Détail de la connexion	Etapes
Montage des éléments de tour			Détail des connexions A-D 	- Un ouvrier attache les élingues du camion grue à un élément de tour - Camion grue met l'élément en position pour le montage - Le monteur (installé sur l'élément du dessous) fixe l'élément au moyen d'une clef dynamométrique les 8 boulons (au serrage définit) et s'assure de la qualité du serrage - Le monteur monte au moyen de l'échelle centrale au sommet de l'élément suivant et détache les élingues - L'aide monteur attache les élingues du camion grue à un second élément de tour…etc...

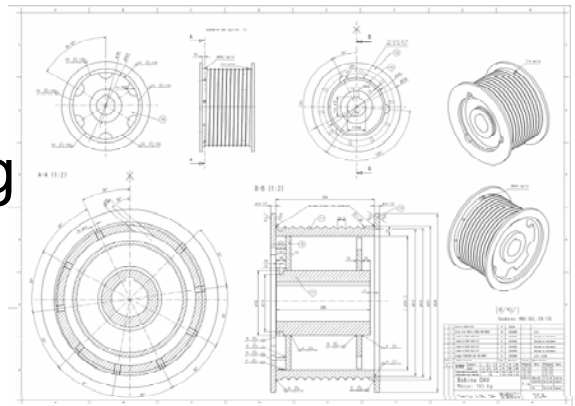
Design with I-DEAS

Modeler

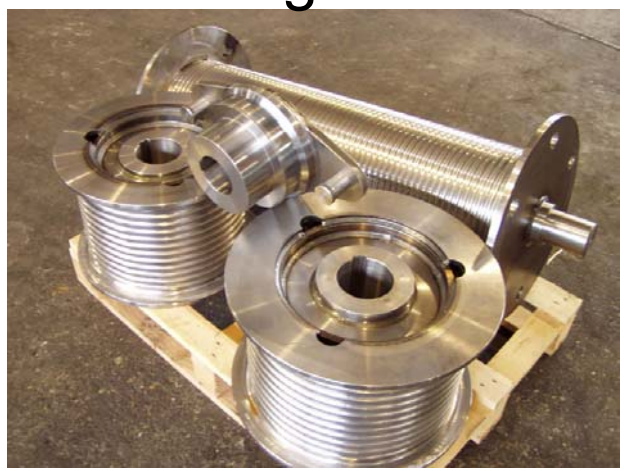


Assembly

Drafting



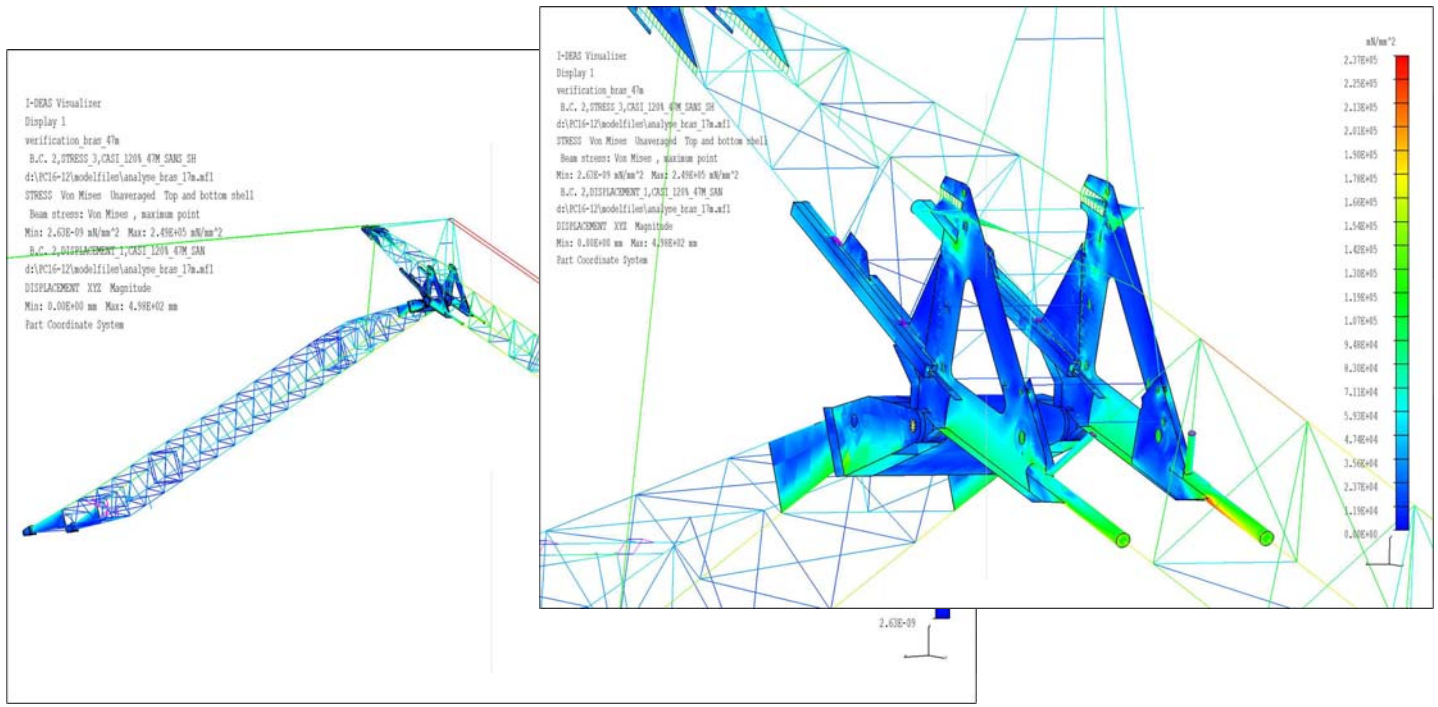
Manufacturing



Finite Element Analysis

Load cases according to European Handling Federation standards

Static and dynamic load cases



Dynamic analysis: Failure mode

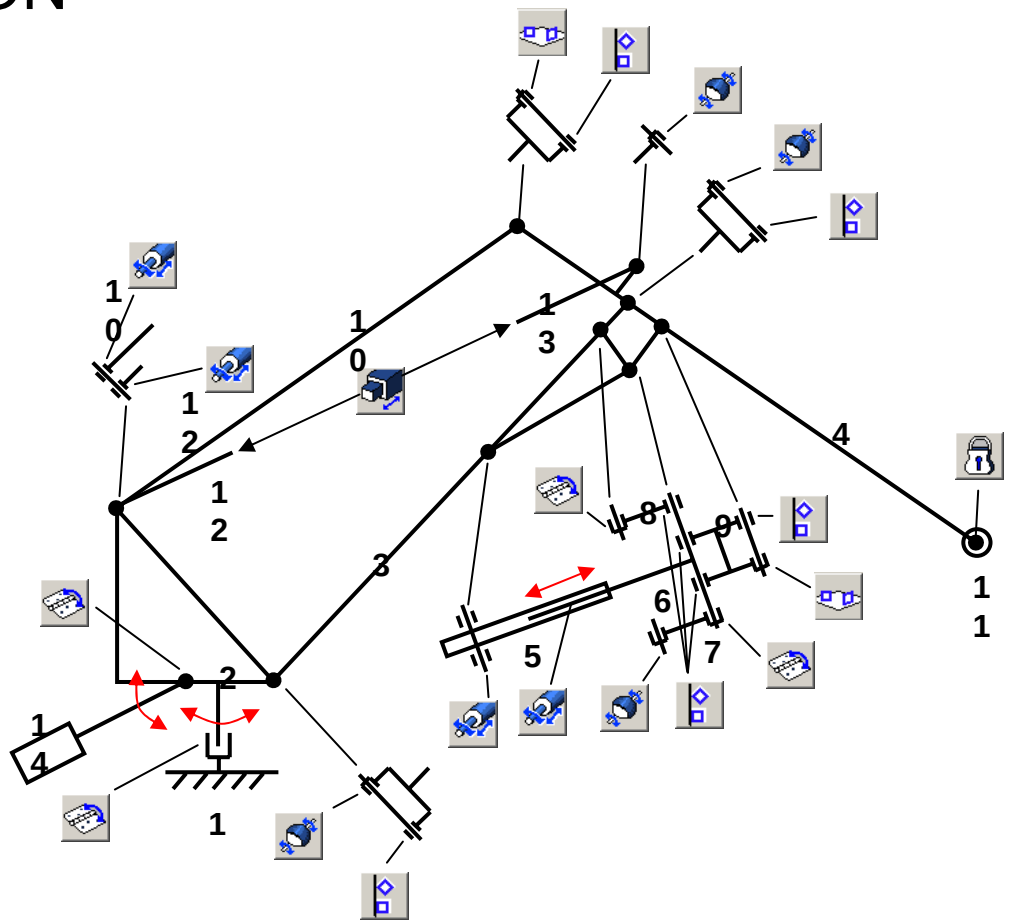
Blocking during extension of the articulated jib

Breaking of the load cable

Emergency stop during rotation of the crane

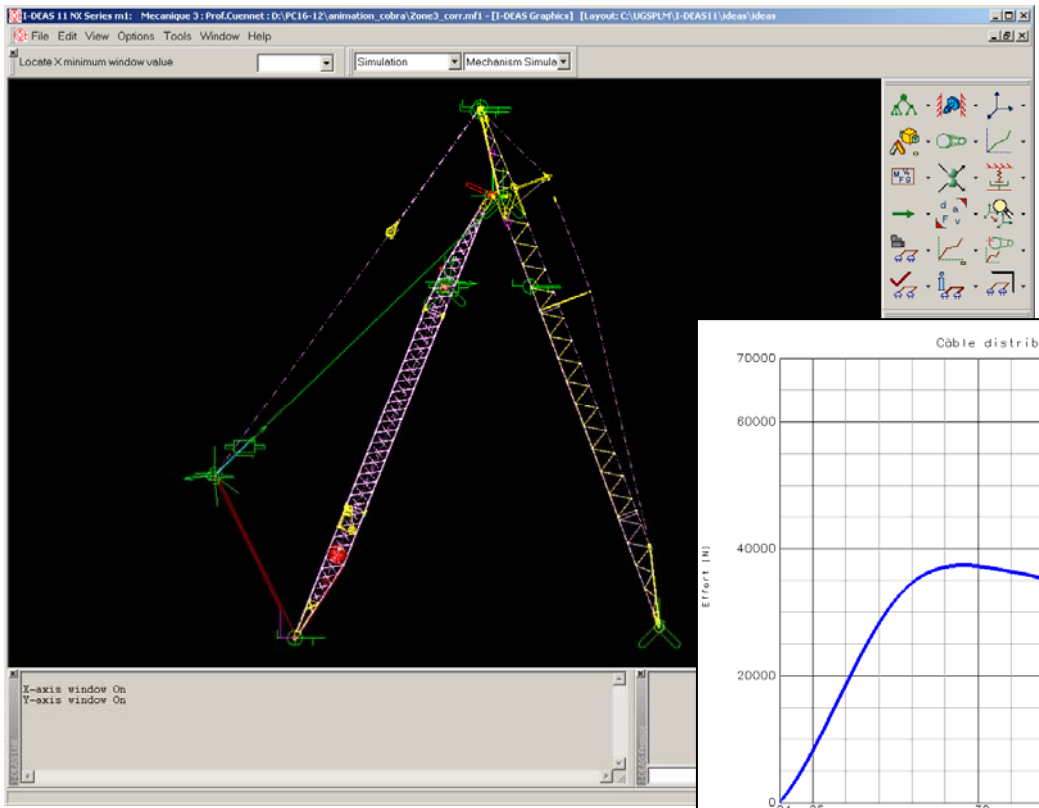
Dynamic analysis

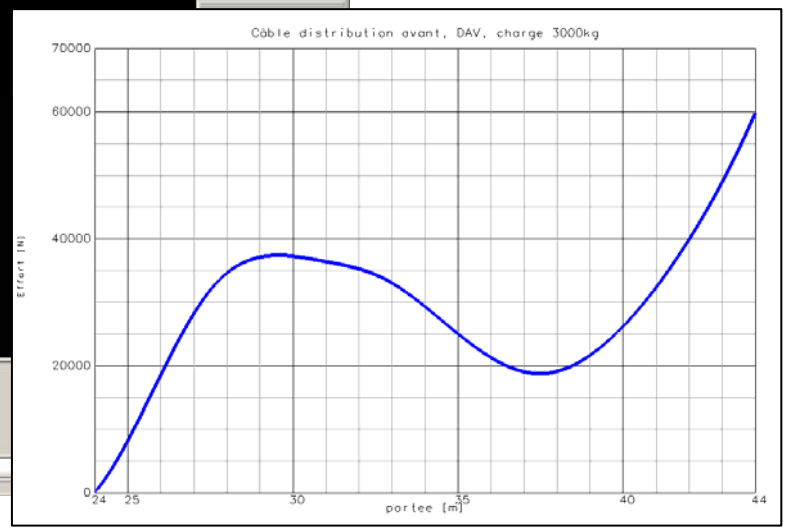
1. Definition of the mechanism in I-DEAS MECHANISM SIMULATION



Dynamic analysis

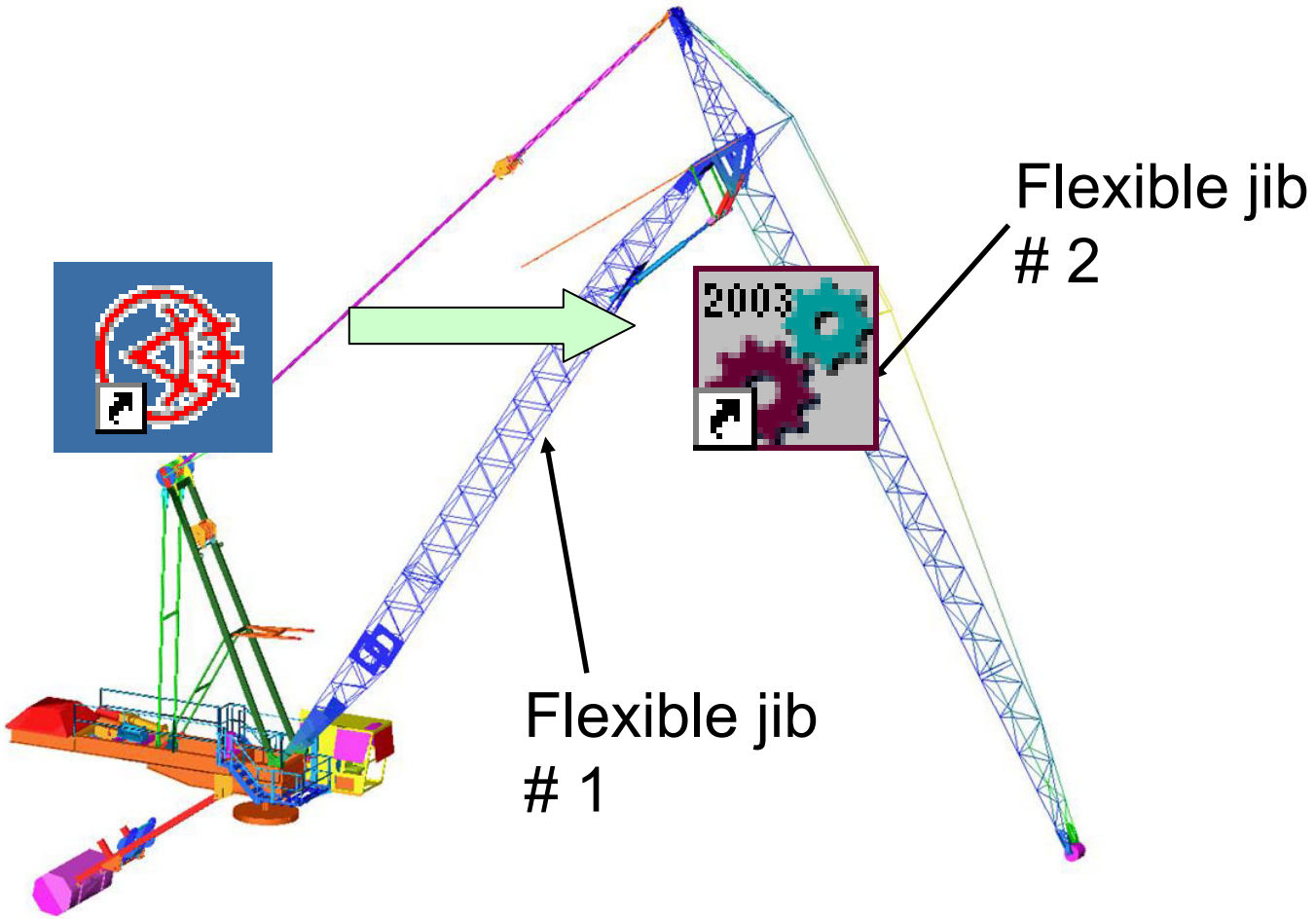
2. Computing forces resulting from the mechanism





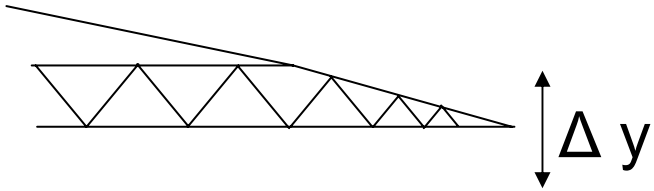
Dynamic analysis

3. Integration of the flexible bodies in MSC.ADAMS



Dynamic analysis

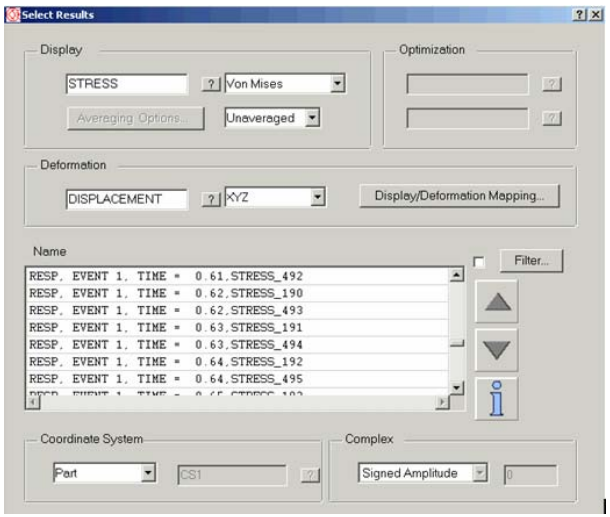
4. Solving the load cases in MSC.ADAMS

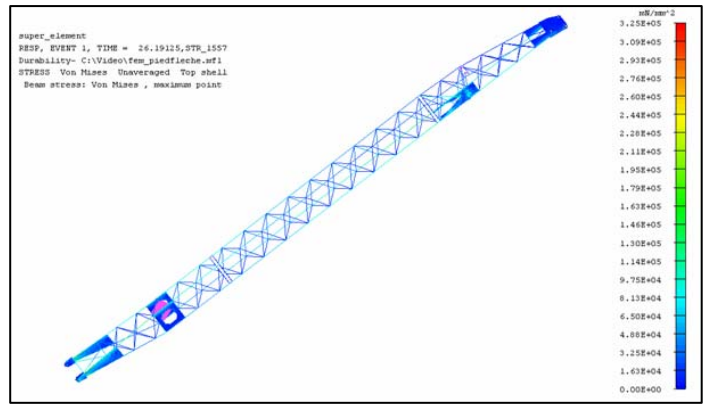


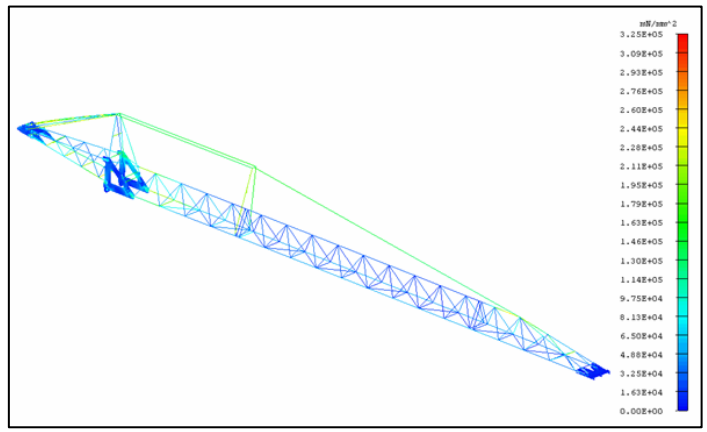
Vertical oscillation of the jib due to breaking of the cable

Dynamic analysis

5. Transfer of MSC.ADAMS results in I-DEAS Response Analysis

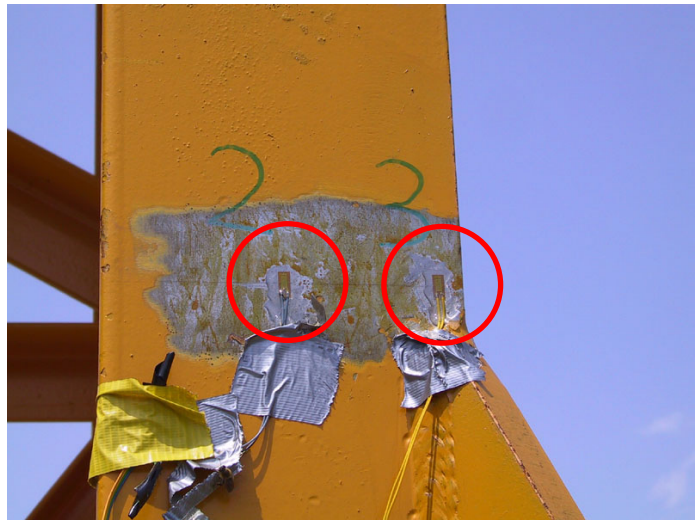






Tests on prototype

Measures with strain gauges



Tests on prototype

Comparison with computational results

Load cases	**Error on Beam Elements**	**Error on Shell Elements**
Static	10 %	5 %
Dynamic	20 %	10 %

Conclusion