

# Recent Considerations about Platform Design

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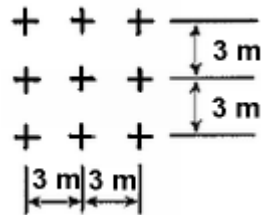
## Topics:

- Floor flatness
- Allowable stresses
- Catalog of FEM calculations for platform
- Points for supports
- FEM calculations
- Question on joints of yoke-platform
- Application of heavy-weight rollers

## Floor Flatness Standards

### International Standards:

- UK TR 34
- ASTM F-number system
- DIN 18202



Property IV limit of TR 34,  
floor classification FM1:

95% within 4.5 mm

100% within 7.0 mm

## Allowable Stresses

### Standards for steel constructions:

- Eurocode 3
- DIN 18800 (for high steel buildings)

### Procedure:

- Defining applied loads
- Defining allowable stresses
- Calculating nominal stresses
- Checking ratio (nominal stresses) / (allowable stresses) < 1

### Properties of EN10025 steel S235J :

- tensile strength  $f_{u,k} = 360$  MPa
- yield strength  $f_{y,k} = 240$  MPa

### Value commonly used for ductile materials with 2- and 3-dimensional stresses

- vonMises stress (equivalent tensile stress)  $\sigma_v$  , a scalar value  
for welded structures usually  $\sigma_{w,v} = \alpha_w * f_{y,k} / \gamma_m = 207$  MPa

### Capacity of floor

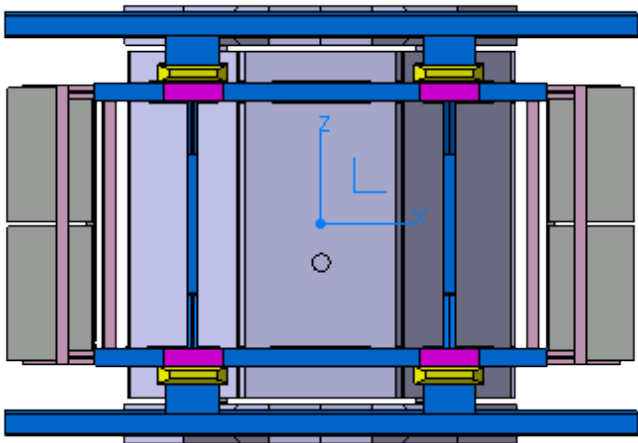
- 6 MPa on average?

## Catalog of FEM calculations for platform

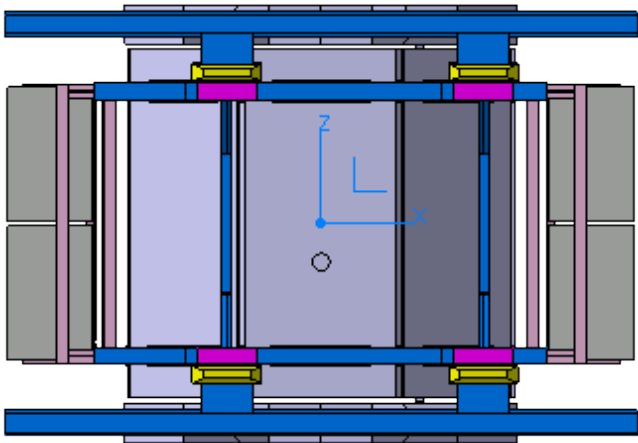
Mod.1	Platform on movers, end-cap doors closed and fixed to barrel, door rails not loaded
Mod.2	Platform on positioning supports, door rails fully supported, end-cap doors closed, but no more fixed to barrel, applying full weight on their rails
Mod.3	As Mod.2, but doors fully opened

	normal conditions	moving / aligning	seismic 0.05g	seismic 0.15g	assembly
Allowable stress	180 MPa ?	200 MPa ?	200 MPa ?	360 MPa ?	?
Mod.1	yes	yes	yes	yes	?
Mod.2	yes	--	yes	yes	?
Mod.3	yes	--	yes	yes	?

# Points for Supports



symmetric about  $yz$ -plane



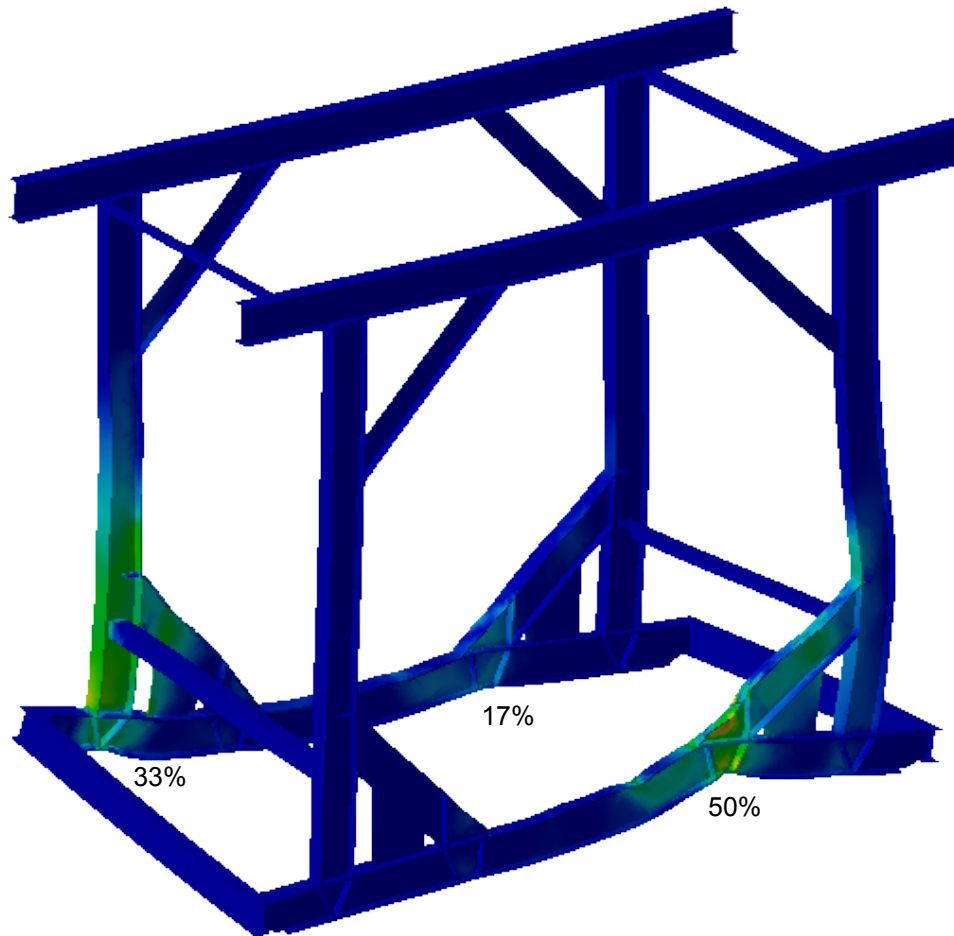
asymmetric about  $yz$ -plane

View from beneath

Yellow ... rollers

Lilac ... static supports

## FEM calculations

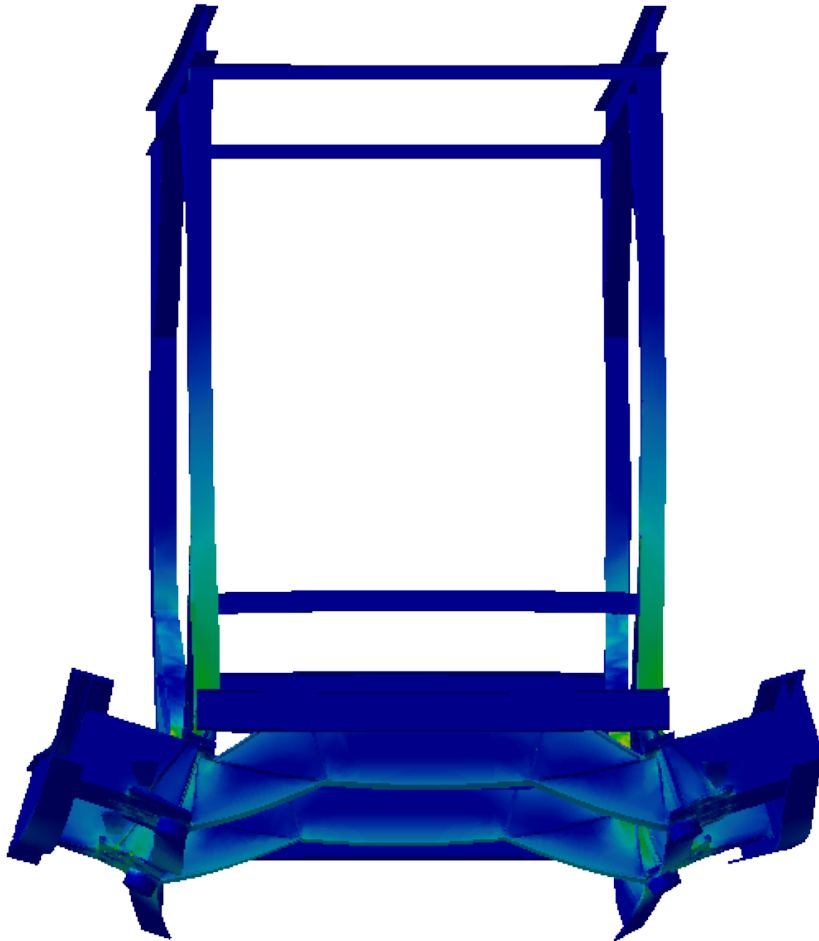


Deformation of simplified barrel frame for very stiff barrel and not fully supported platform (not shown)

Maximum stress < 200MPa

Lateral displacement of unloaded support w.r.t plane defined by the other 3 supports: 4mm

## FEM calculations



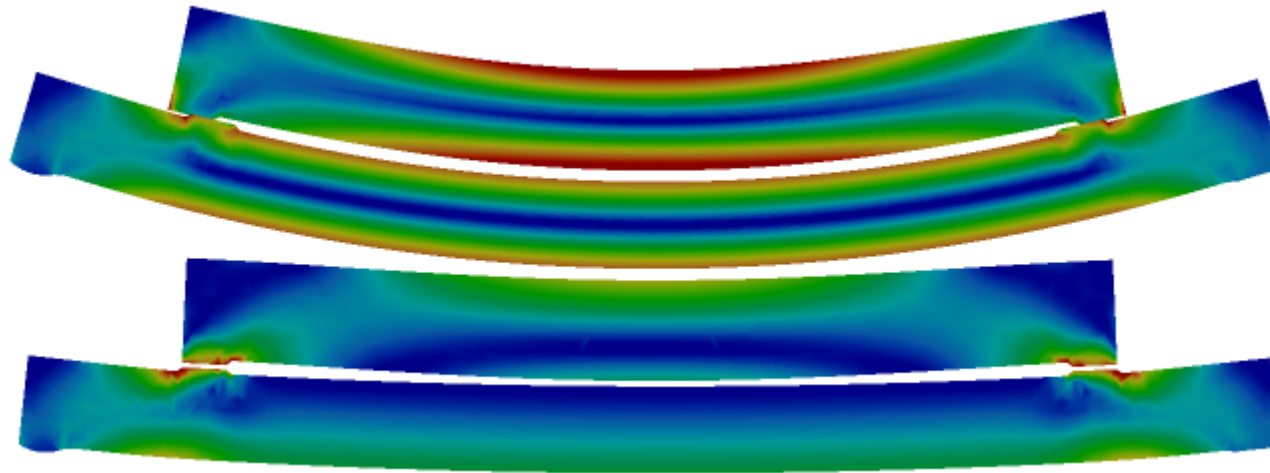
Deformation of platform when moved on rollers with no load on door rails

Spring constant of elastic pad between platform and each of the equally loaded rollers  
100\_tons/mm

Spread between upstream rollers and downstream rollers about 1\_mm

## Question on Joints of Yoke-Platform

Should joints be fixed or sliding in horizontal direction?



Comparison of deflection and stresses between 2 identical setups with a short beam put on a long beam. A load is applied to the short beam, the long beam is supported at the ends. In the 1st setup the short beam is sliding on the joints, in the 2nd setup the horizontal displacements at the joints are restricted.



## Application of heavy-weight rollers

Links of Manufacturers:

- <http://www.hilmanrollers.com/>
- <http://www.boerkey.com/>

Parameters which have influence on friction of rollers

- diameter of rolls
- hardness of rail
- load distribution on roller body

Rollers at ZEUS: very good conditions, very low friction

Rollers at STAR: moderate conditions, see [arxiv.org/pdf/nucl-ex/0205008](http://arxiv.org/pdf/nucl-ex/0205008) , 1100 tons are moved on 4 Hilman rollers with a capacity of 500 tons, each.

30-tons hydraulic actuators push the detector in approximately 1.5 m increments.

Moving by 33 m requires 4 hours.

Height required for heavy weight roller setup

- 11\_cm for rail
- 18\_cm for roller
- 5\_cm for elastic pad
- (7\_cm hydraulic jack)