Modeling and Analysis of Guide Rail Brackets and Attaching Parts

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Presented by Ing. Adem Candaş

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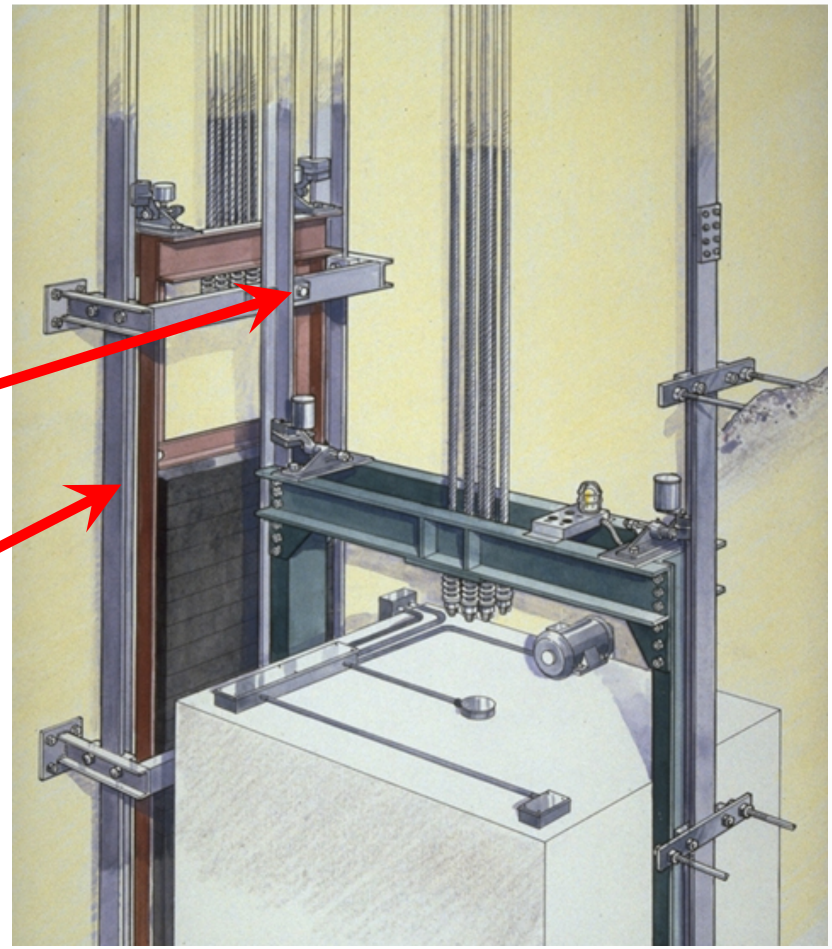
Introduction

brackets

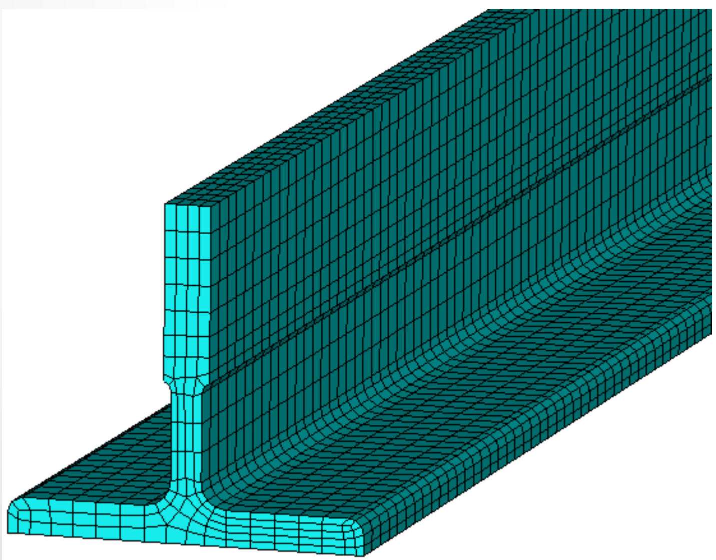
guide rail

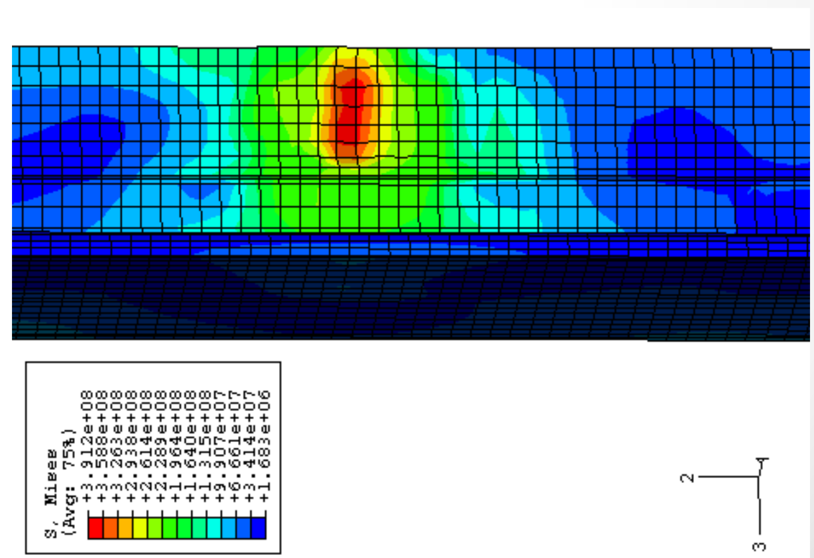


Studies on Guide Railing Equipment

Finite Element Analysis of Elevator Guide Rails During Safety Gear Operation, *Elevator Technology 15, Proc. of ELEVCON'2005*

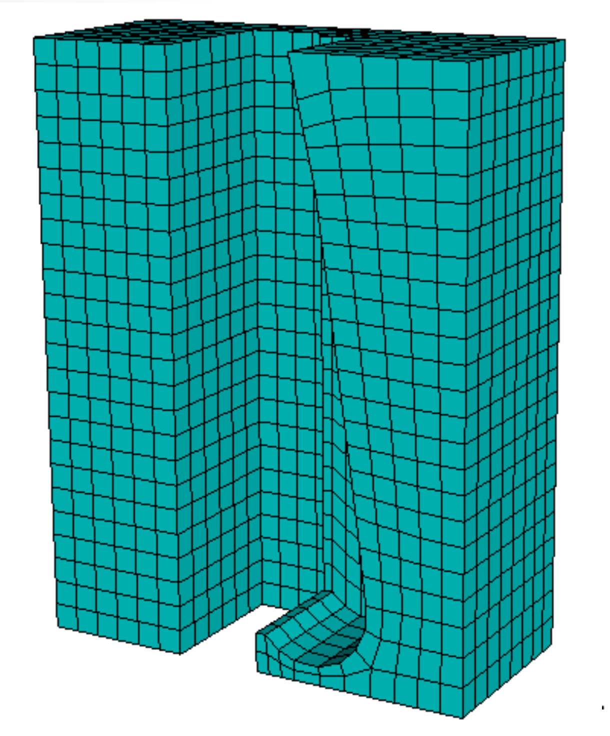
Experimental Stress Analysis of Guide Rails, *Elevator Technology 16, Proc. of ELEVCON'2006*

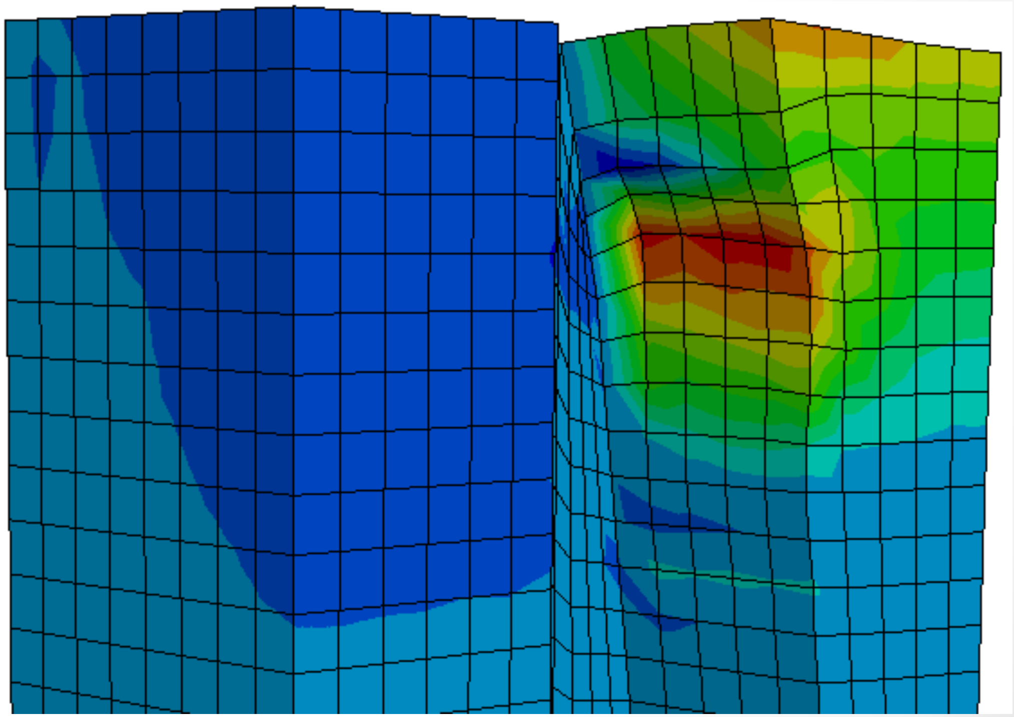




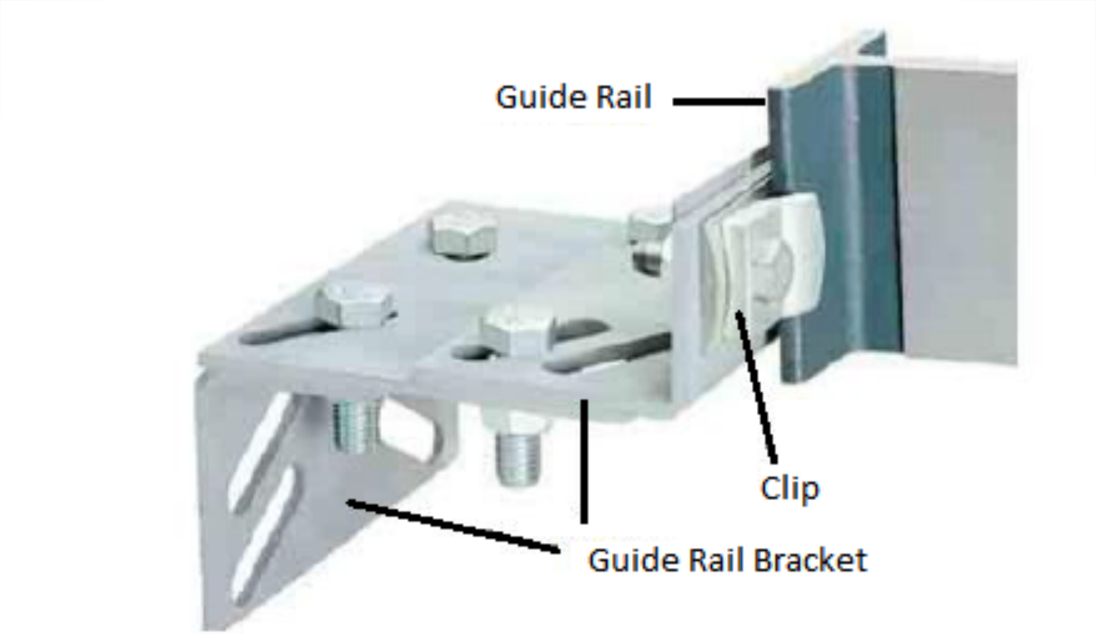
Studies on Guide Railing Equipment

Investigation of Stresses on Guide Rails and Safety Gears,
Elevator Technology 17, Proc. of ELEVCON'2008





Introduction

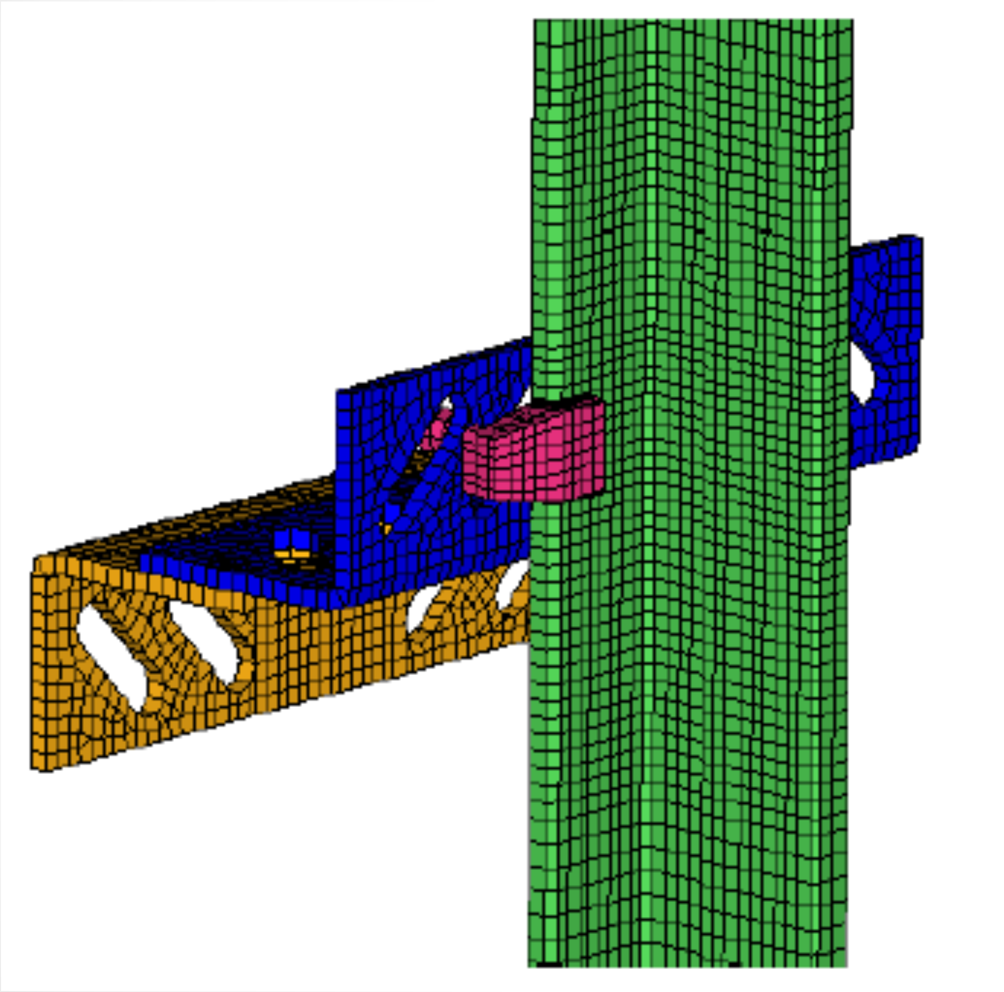


During elevator travel, the forces will be comparatively low, especially if the car is well balanced and the load is well distributed.

The other loads exerted on the rails will be from safety gear operation under emergency conditions.

The exerted loads can be very high, depending on safety gear type.

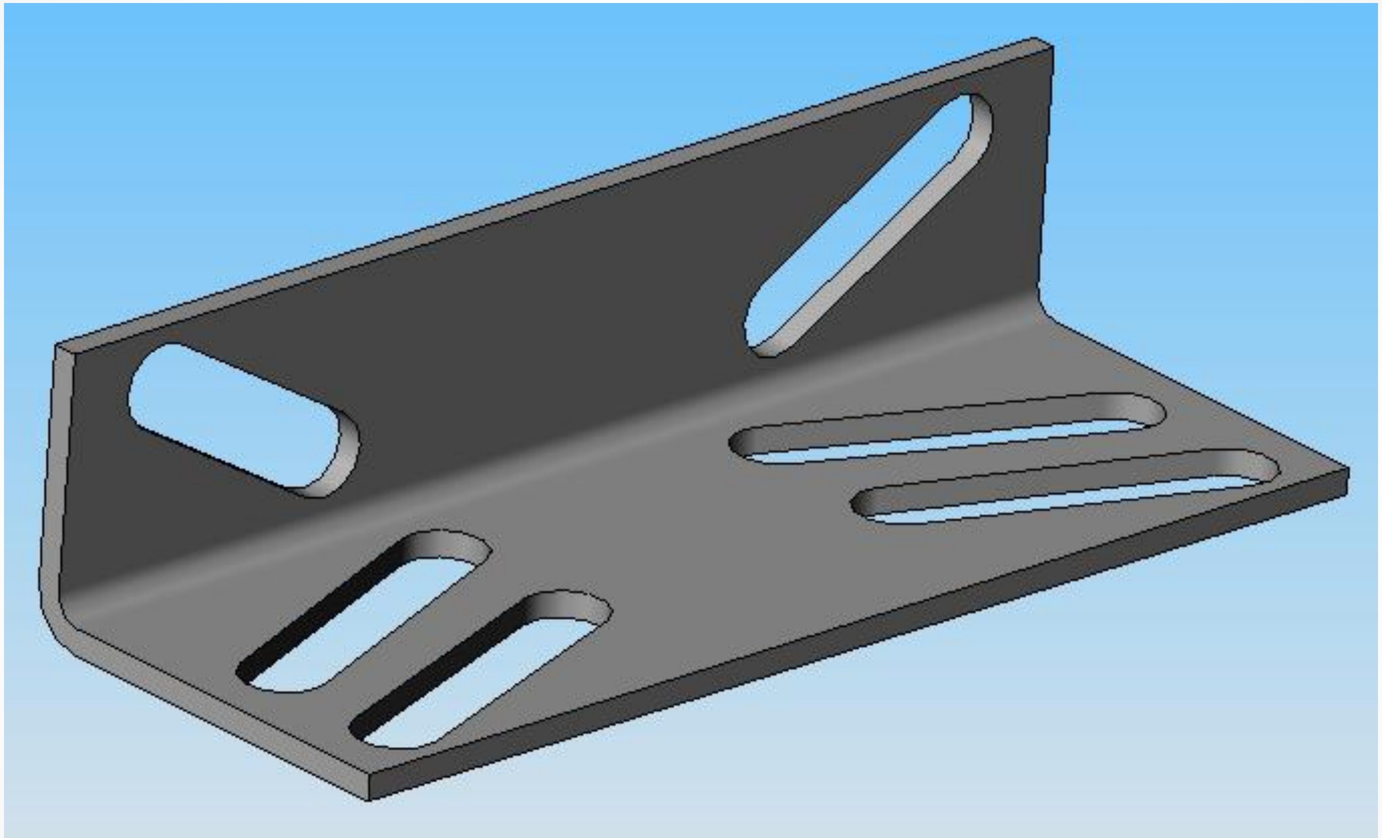
Introduction



The stress and deformation calculations of guide rail (T90) have been performed according to EN-81-1:1998 standard during safety gear operation.

Guide rail, rail brackets and clips were modeled and finite element model of guide rail assembly was performed.

Guide Rail Bracket



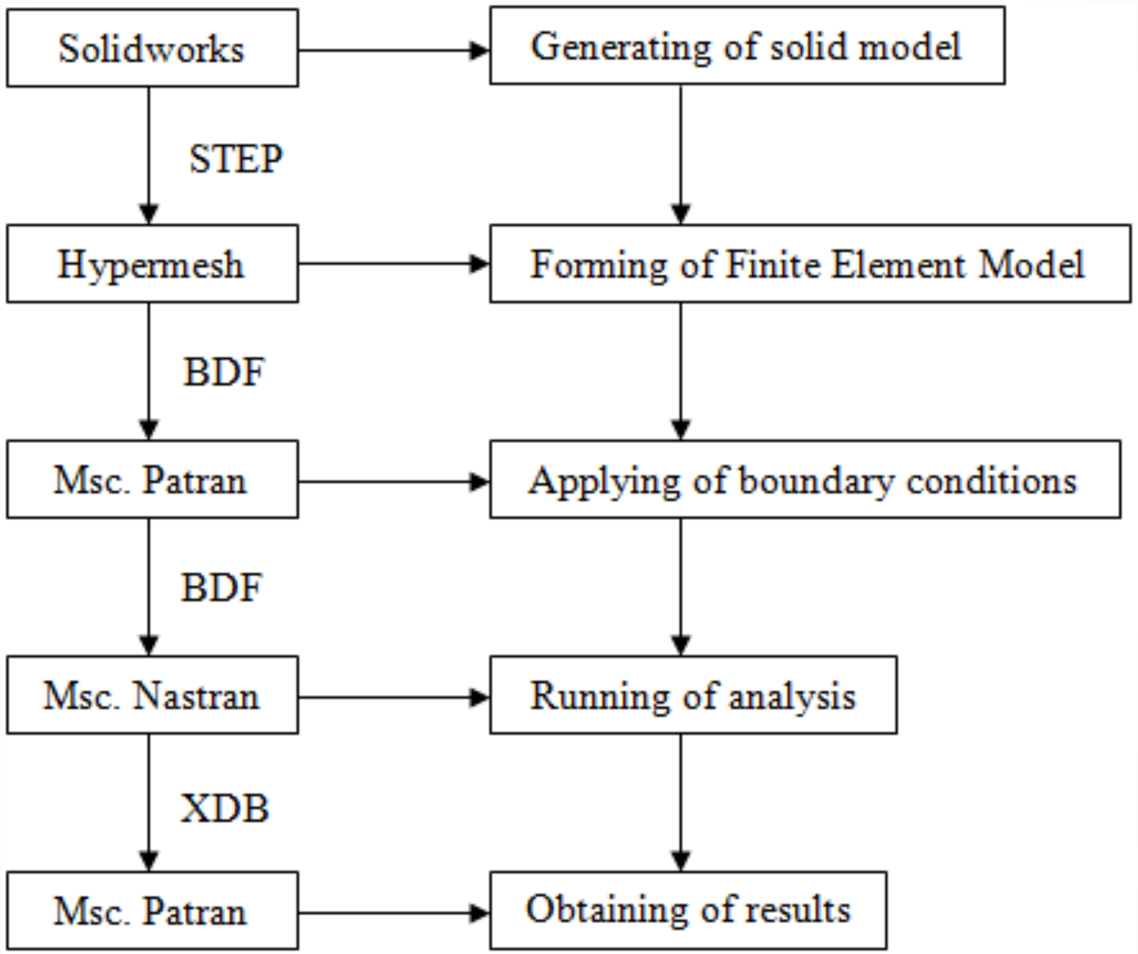
For a safe, smooth and comfortable travel, guide rail brackets are the most important components along with guide rails.

Modelling and design parameters

In order to analyse the statical behaviour of the guide rails and the rail brackets during the introduction of safety gear, assembly parameters related to the cabin and the guide rail were given in Table 1.

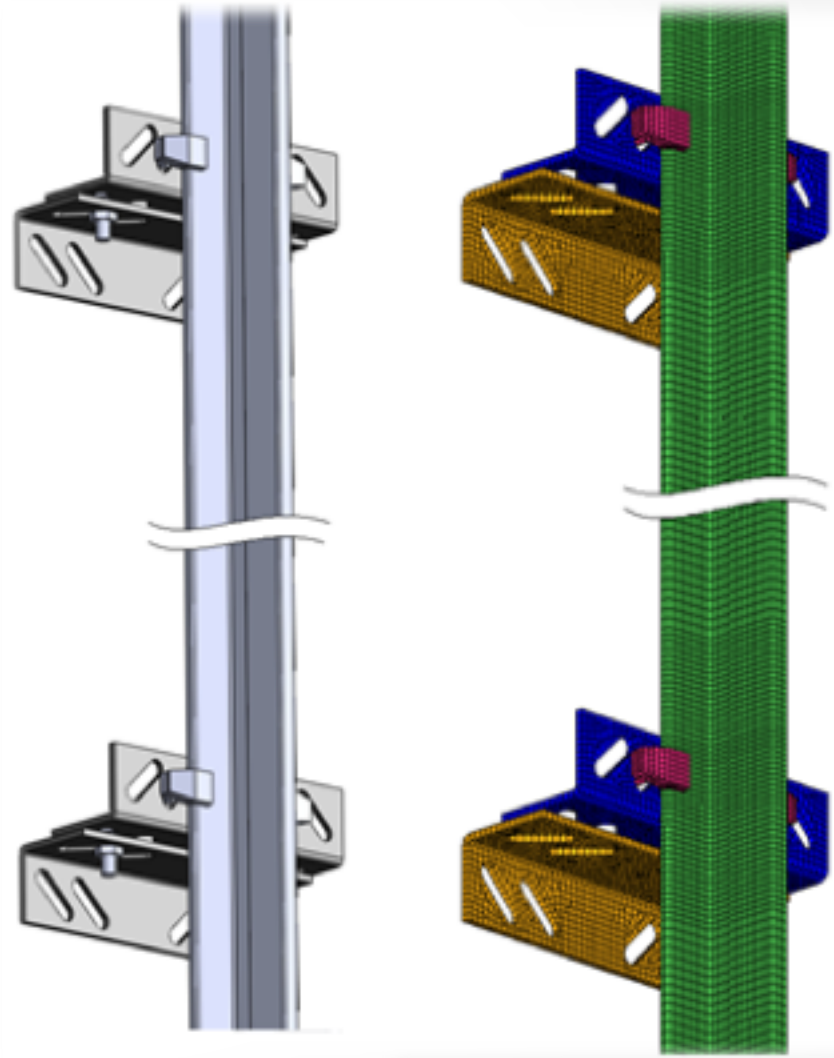
Elevator car rated load (Q)	800 kg
Elevator car load (P)	1500 kg
Car dimensions (Dx, Dy)	1600, 1400 mm
Selected guide rail	T90/B
Guidance between the guide shoes (h)	2950 mm
Guidance between the guide rail brackets (l)	2000 mm

Flow chart for design & stress analysis of rail bracket



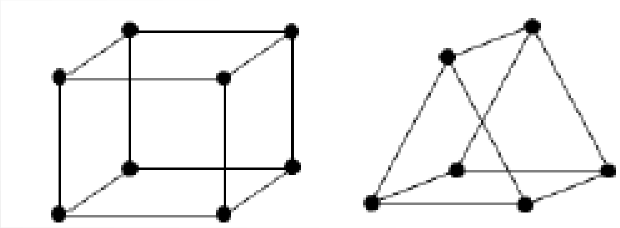
Solid model and finite element model of the system

The total length of the rail is 5000 mm and the distance between the rail brackets is 2000 mm. The full model (both the top and the bottom brackets) was used instead of the half model (only the top or the bottom brackets) in comparison with previous studies.



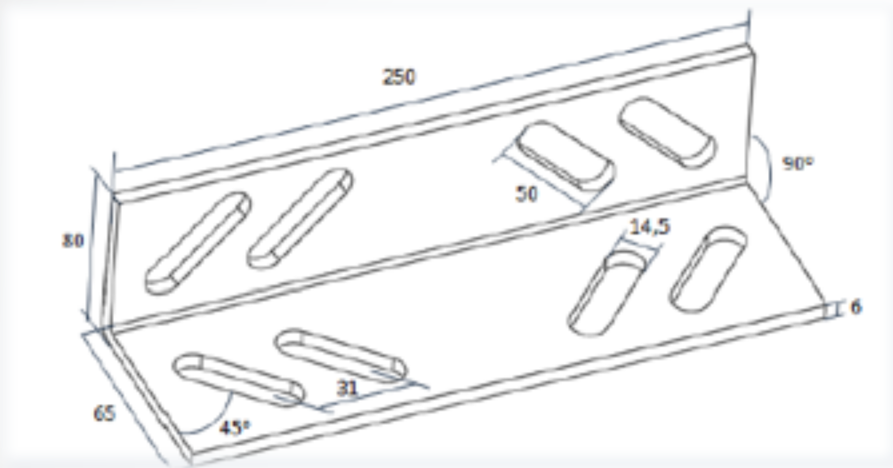
Element types and number in finite element model

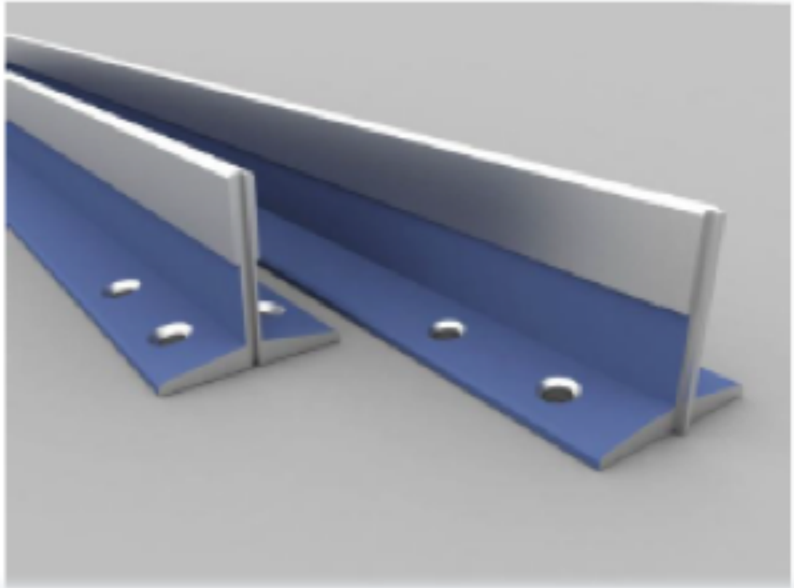
Assembly Parts	Guide Rail	Brackets	Clips
Quadrangular Prism Element Number	65992	4148	688
Triangular Prism Element Number	2872	592	48
Total Element Number	68864	4740	736



Rectangular prism elements with 8 node points and triangle prism elements with 6 node.

Modeling Parameters





The material of the guide rail and guide rail bracket selected as **St37** steel.

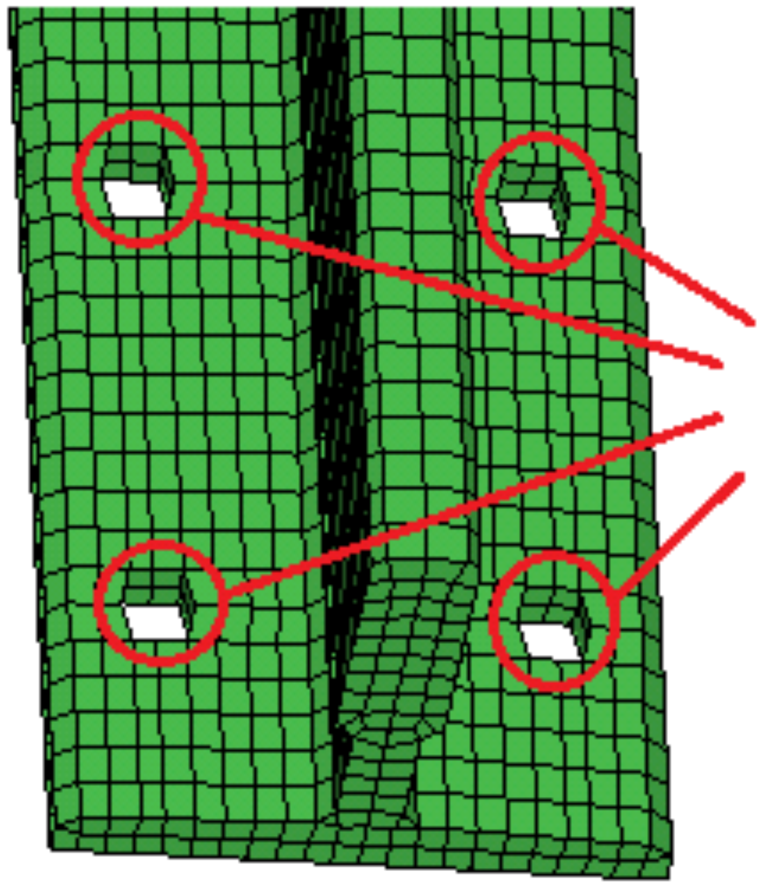
Material characteristics: Linear isotropic

Elasticity modulus: 2.1 x 10^5 N/mm^2

Poisson rate: 0.3

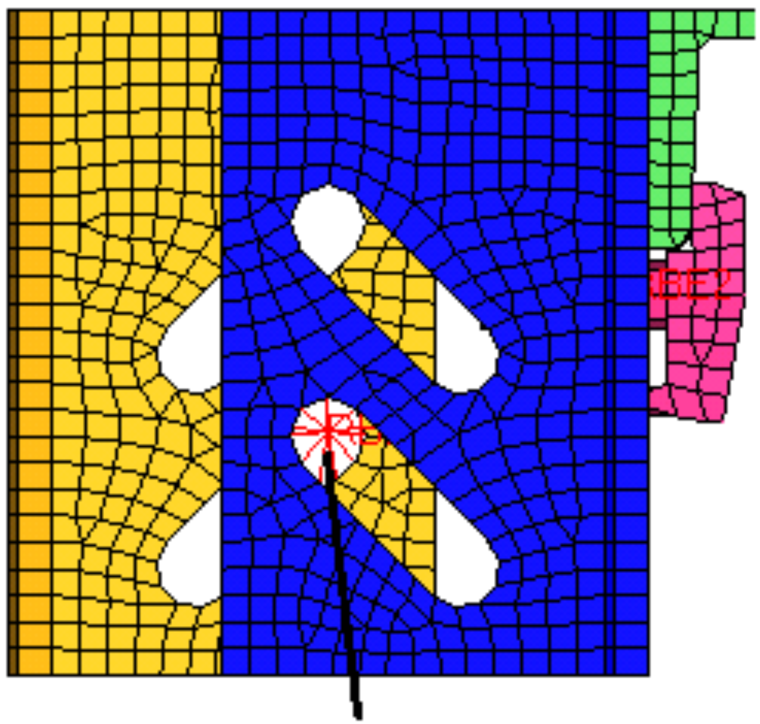
Boundary Conditions

3 different boundary conditions were applied:

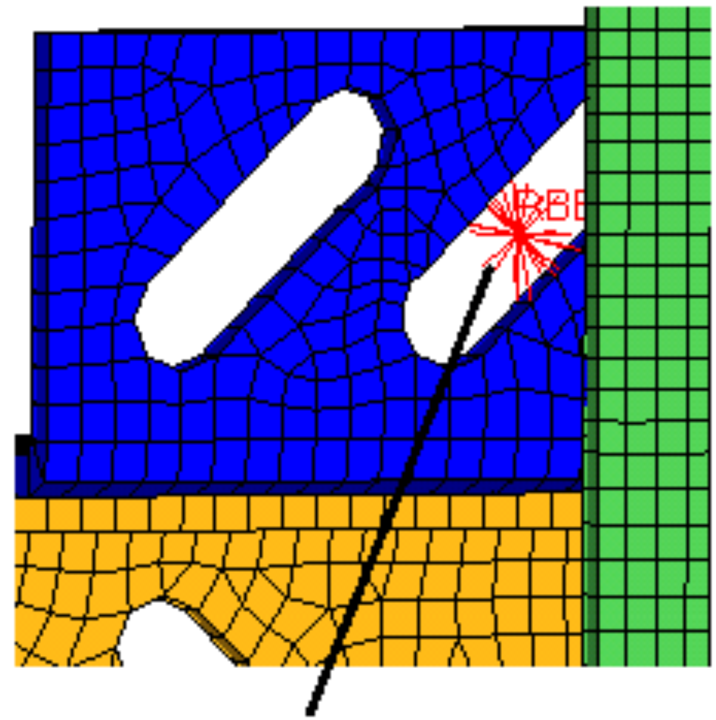


a) Connection nodes between rail and brackets

Boundary Conditions

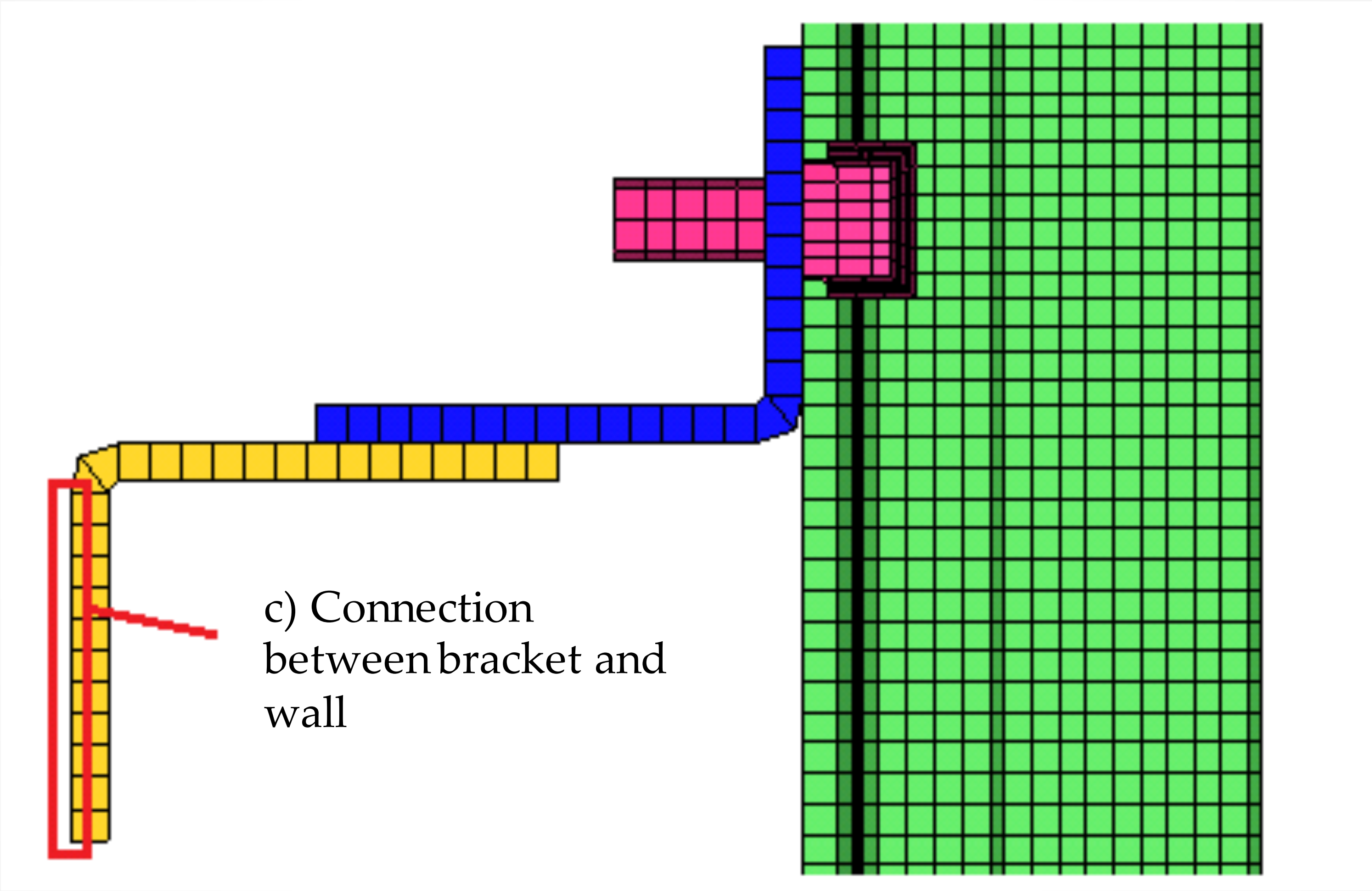


b) Bolt connection
between brackets (rigid)



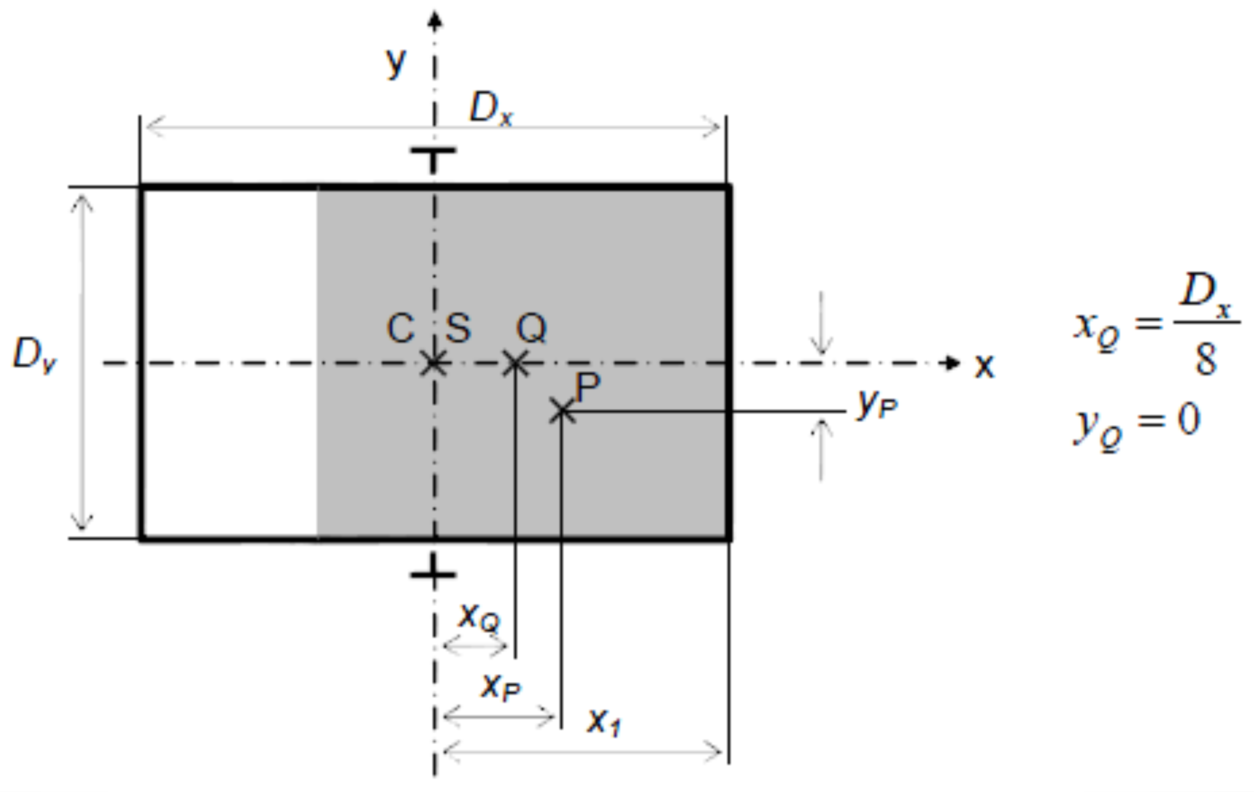
b) Bolt connection
between brackets and
tabs (rigid)

Boundary Conditions



Load distribution and related dimensions

An elevator system with a capacity of 10 passengers in a 16-story building

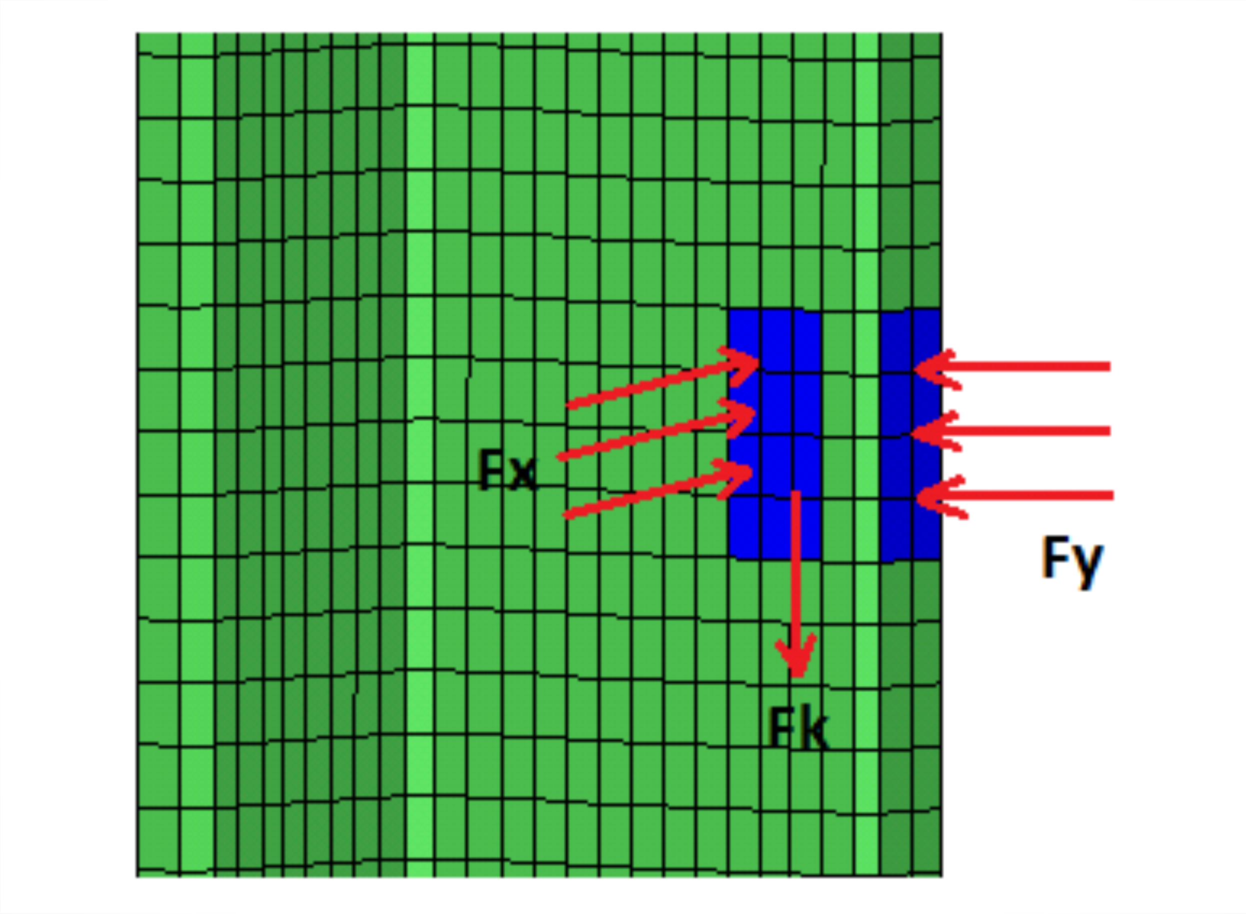


$$x_Q = \frac{D_x}{8}$$

$$y_Q = 0$$

Rail calculations were made for work status of the parachute assembly for a centrally guided and hanging cabin situation.

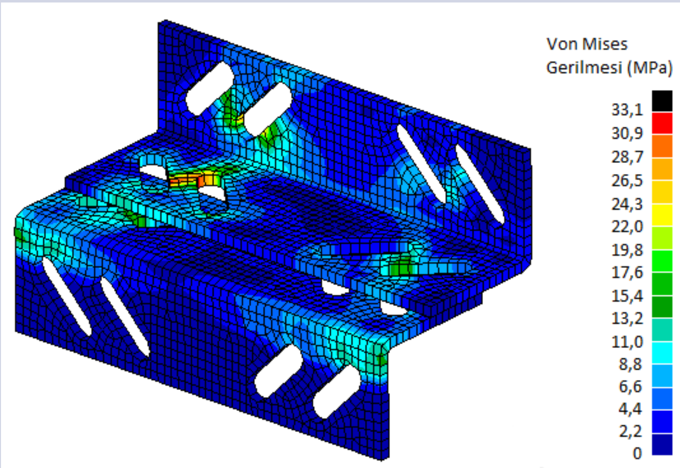
Applying forces



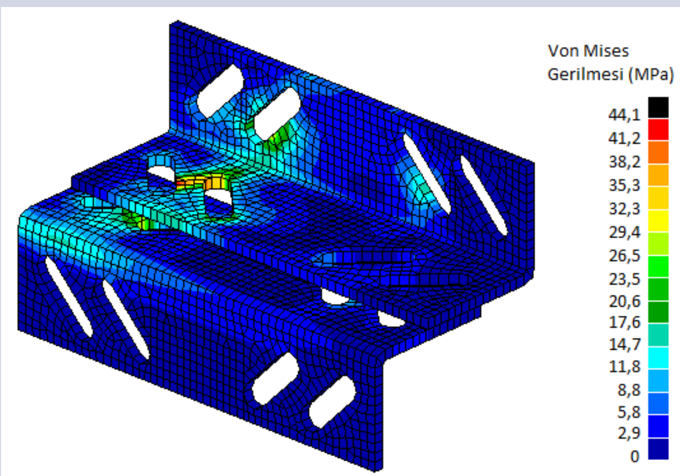
Results

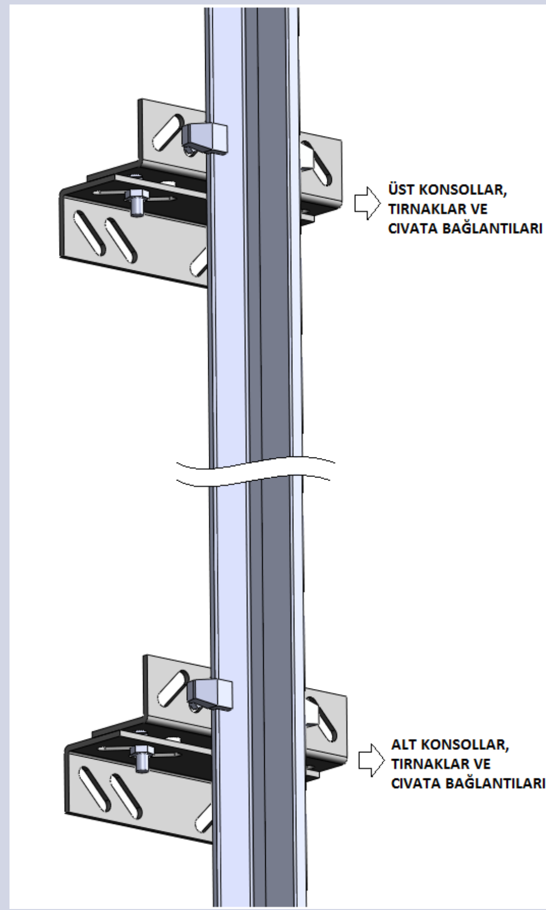
Stress distribution

upper bracket



lower bracket





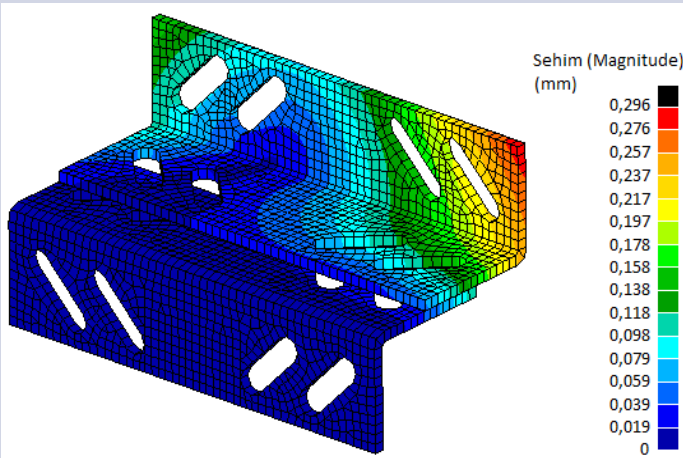
Stress distribution on the guide rail brackets

For 800 kg cabin load register, 200 mm distance between centre of gravity of the load register and rail axis, mid-point impact of safety gear on the rail situation

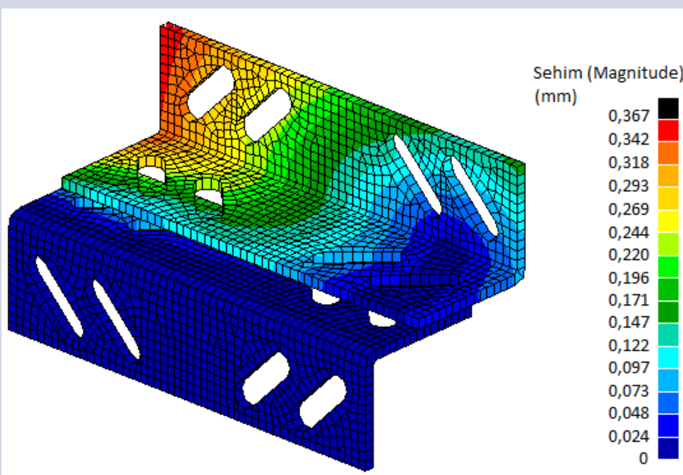
Results

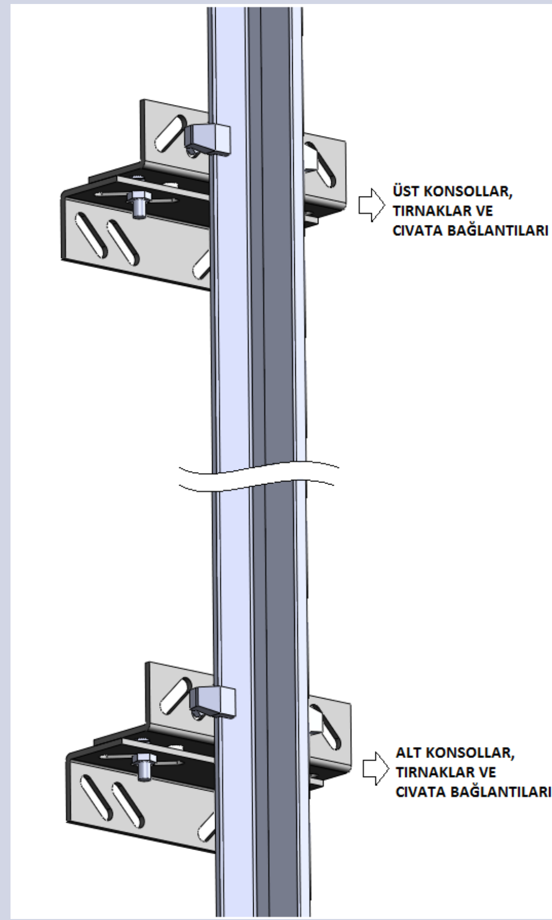
Deflection distribution

upper bracket



lower bracket

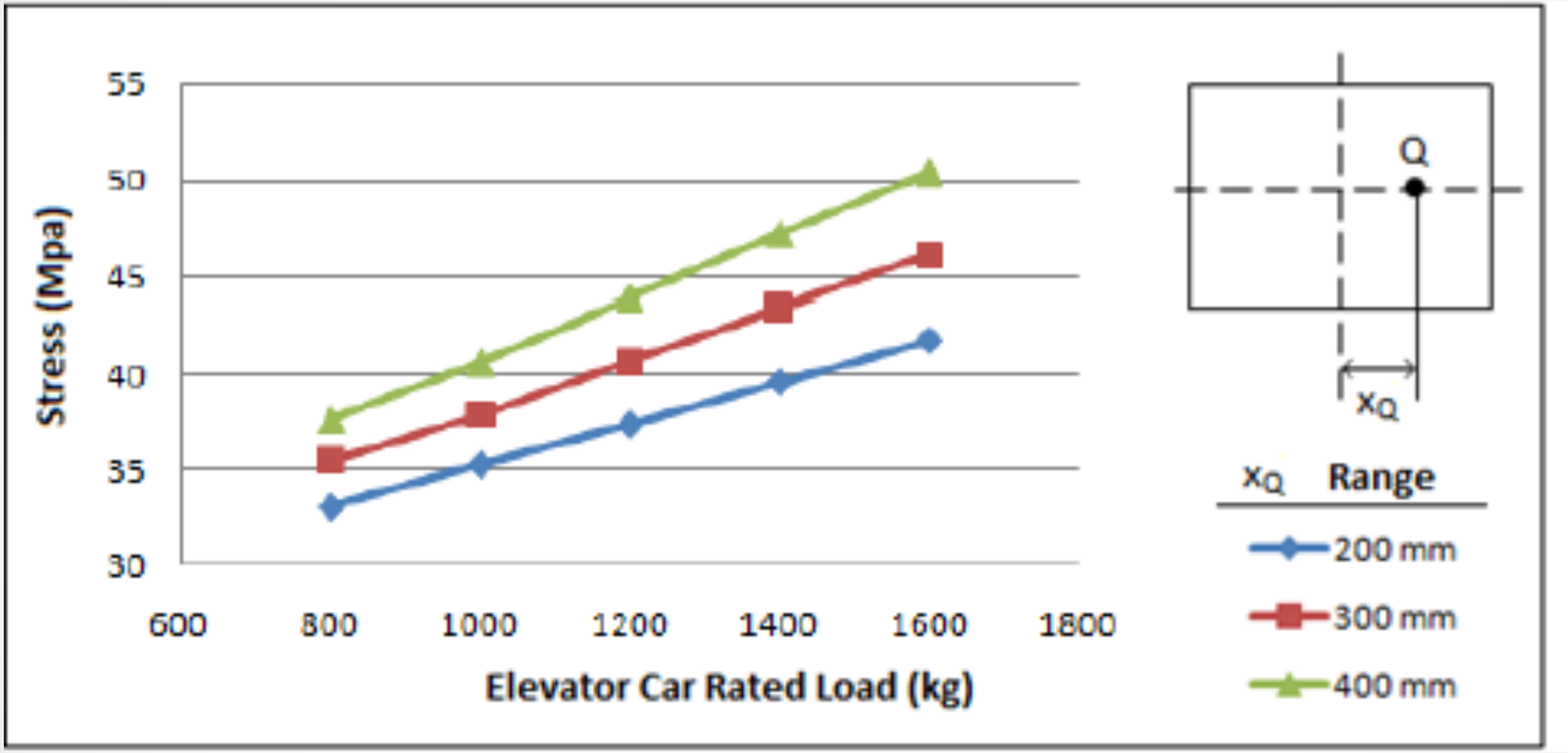




Deflection distribution on the guide rail brackets

Results

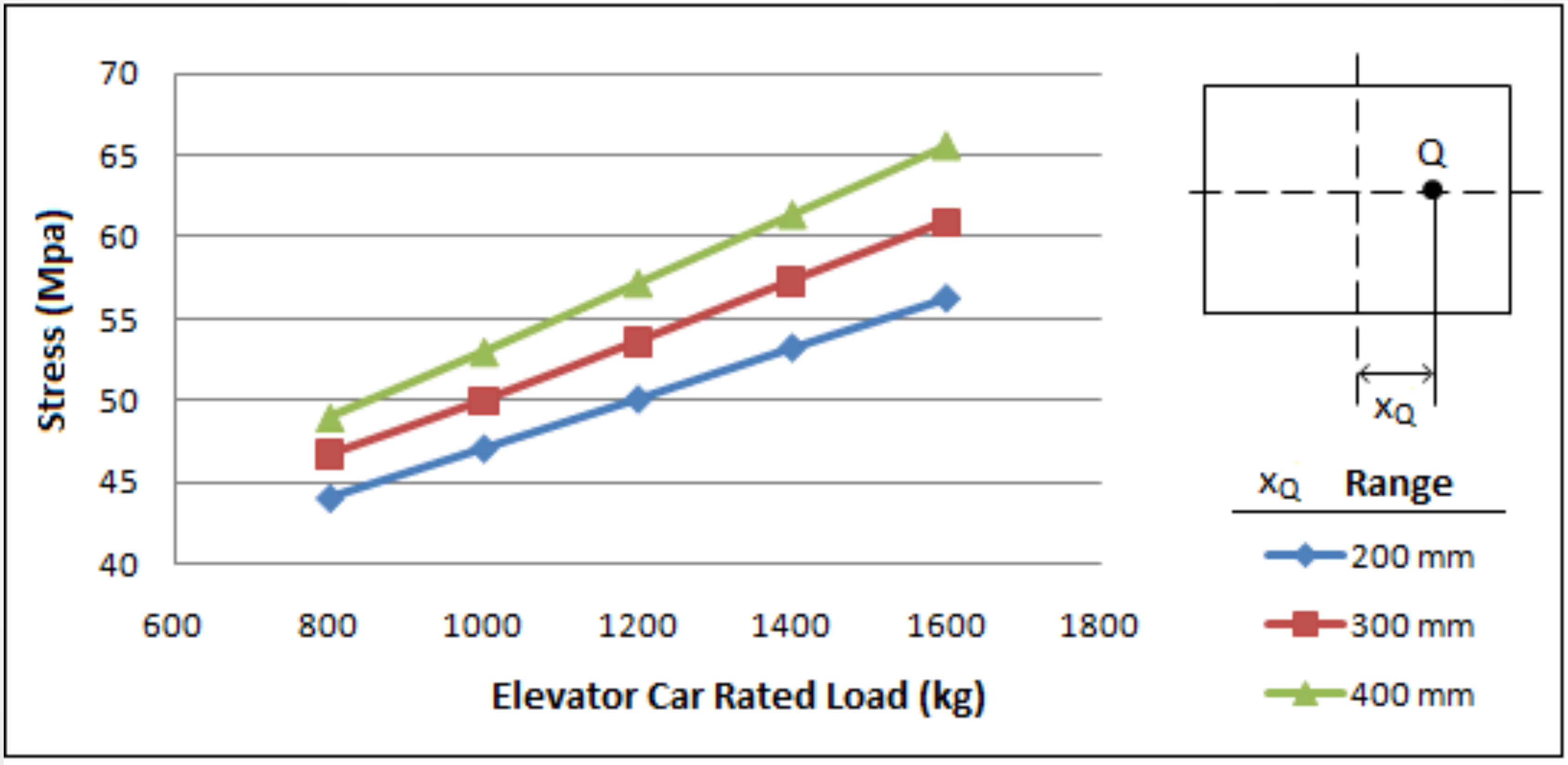
According to axis offset (x_Q), distribution of **maximum stress** of top bracket at different loads.



Maximum stress values increase while x_Q increasing.

Results

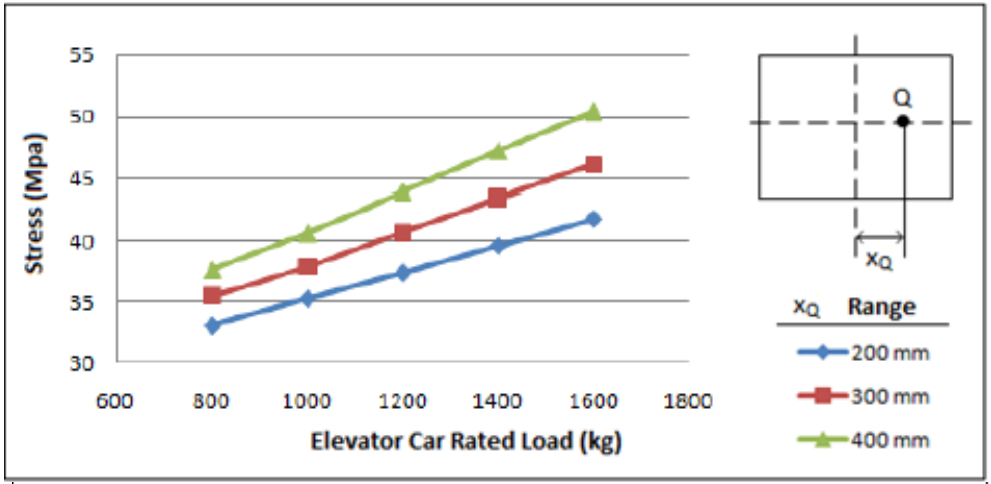
According to axis offset (x_Q), distribution of **maximum stress** of bottom bracket at different loads.



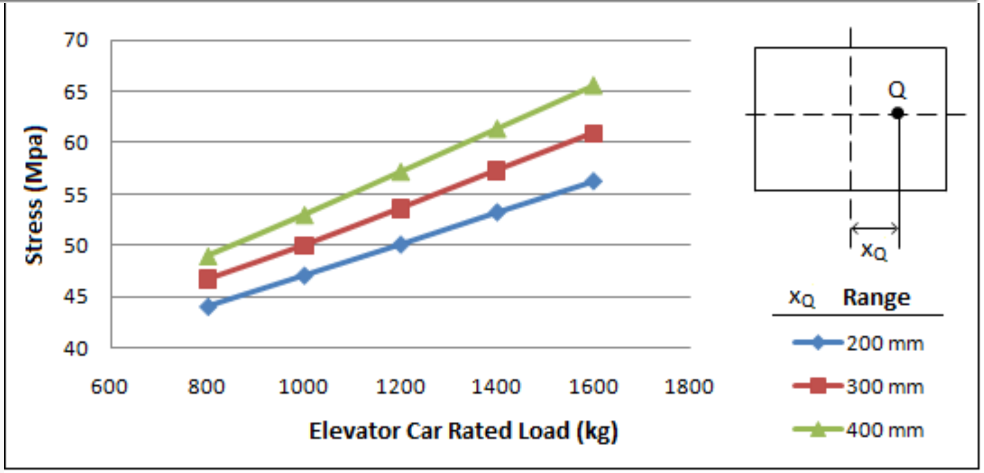
Maximum stress values increase while x_Q increasing.

Results

According to axis offset (xQ), distribution of maximum stress of top and bottom bracket at different loads in comporison



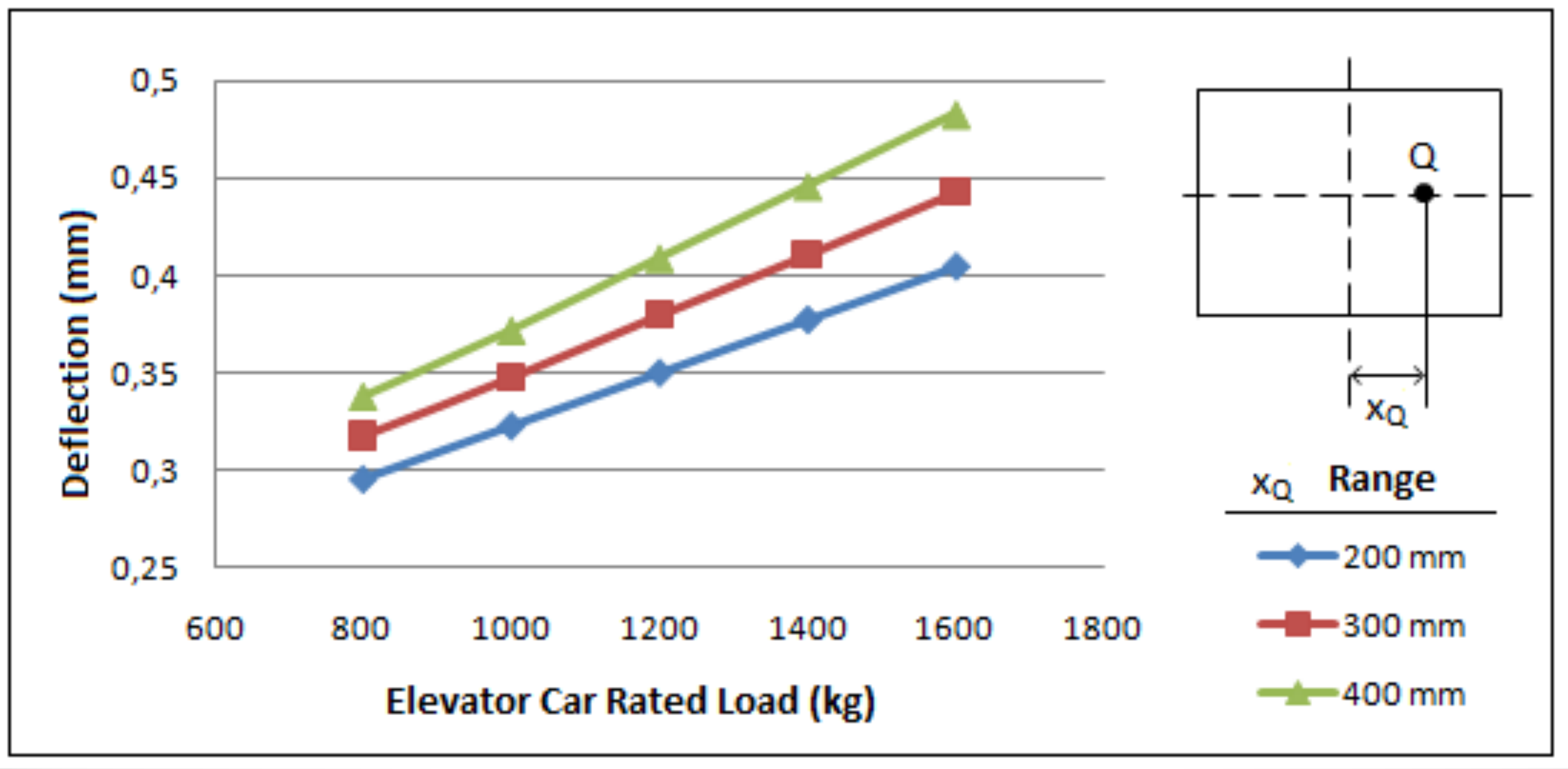
Top bracket



Bottom bracket

Results

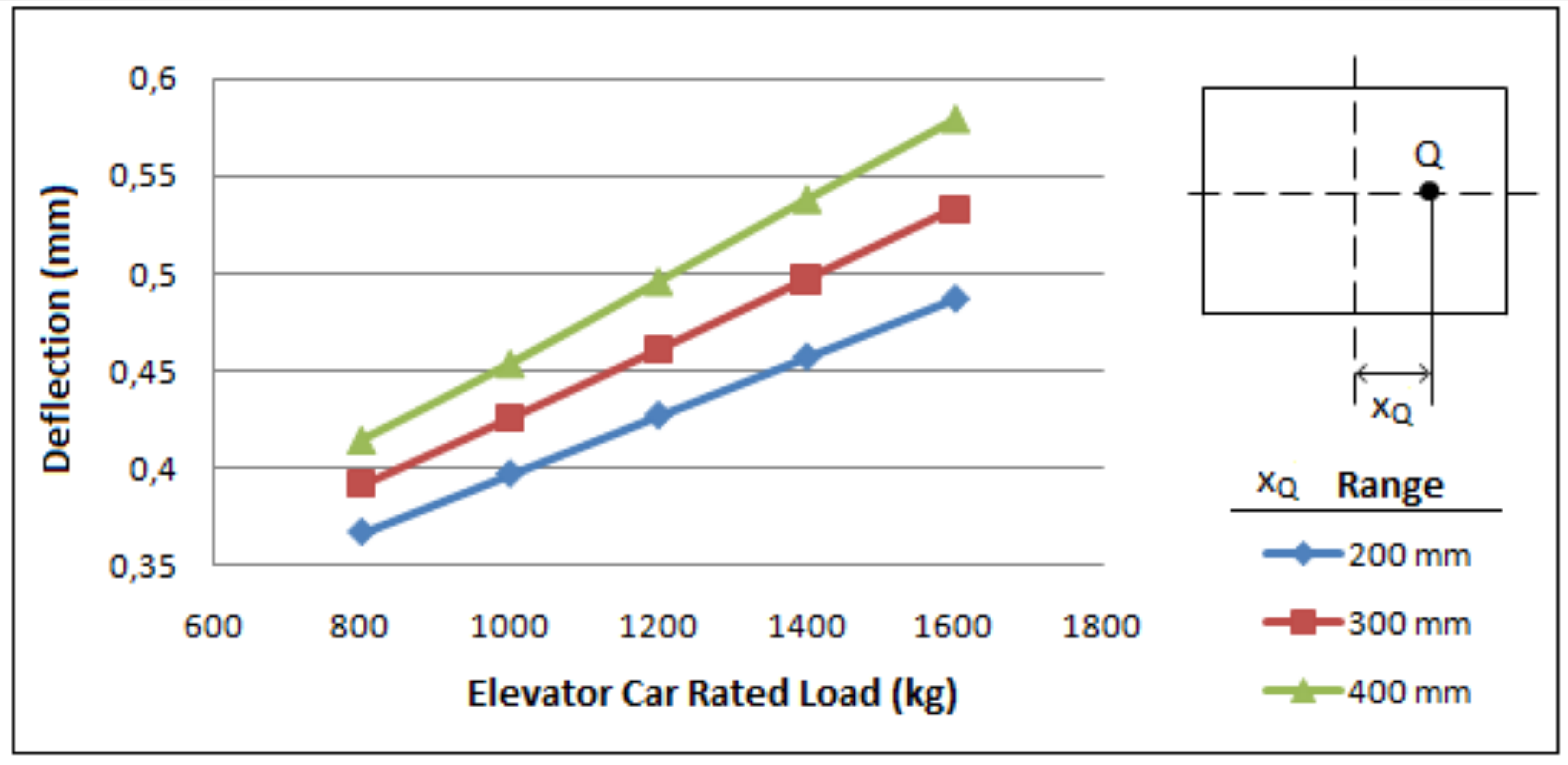
According to axis offset (x_Q), distribution of **maximum deflection** of top bracket at different loads.



Maximum deflection values increase while x_Q increasing.

Results

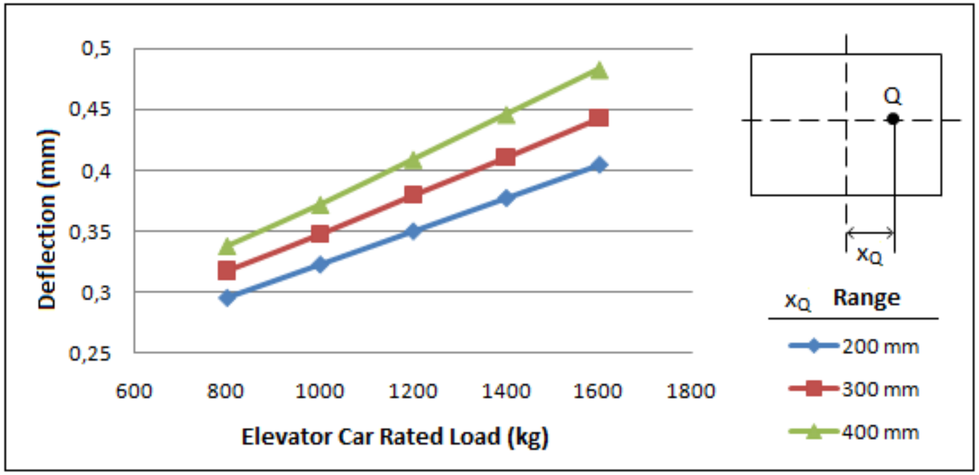
According to axis offset (x_Q), distribution of **maximum deflection** of bottom bracket at different loads.



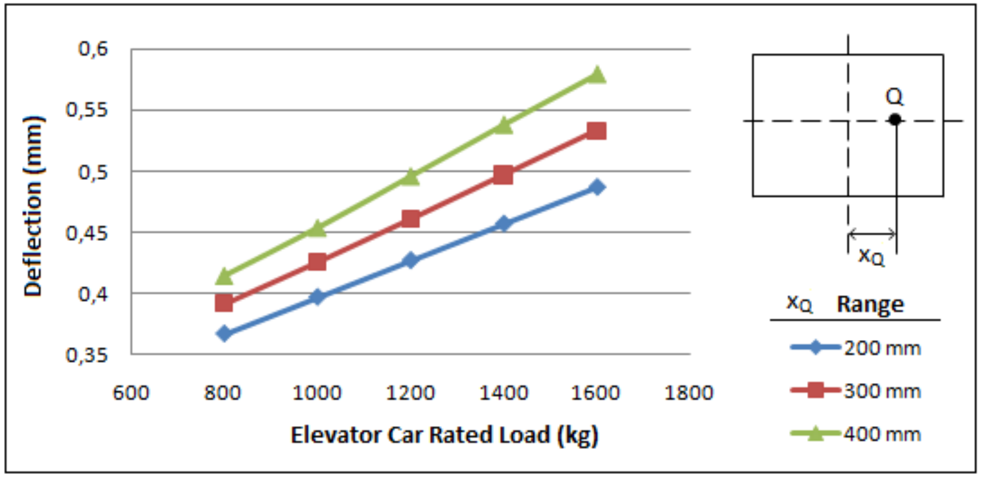
Maximum deflection values increase while x_Q increasing.

Results

According to axis offset (xQ), distribution of maximum deflection of top and bottom bracket at different loads in comporison



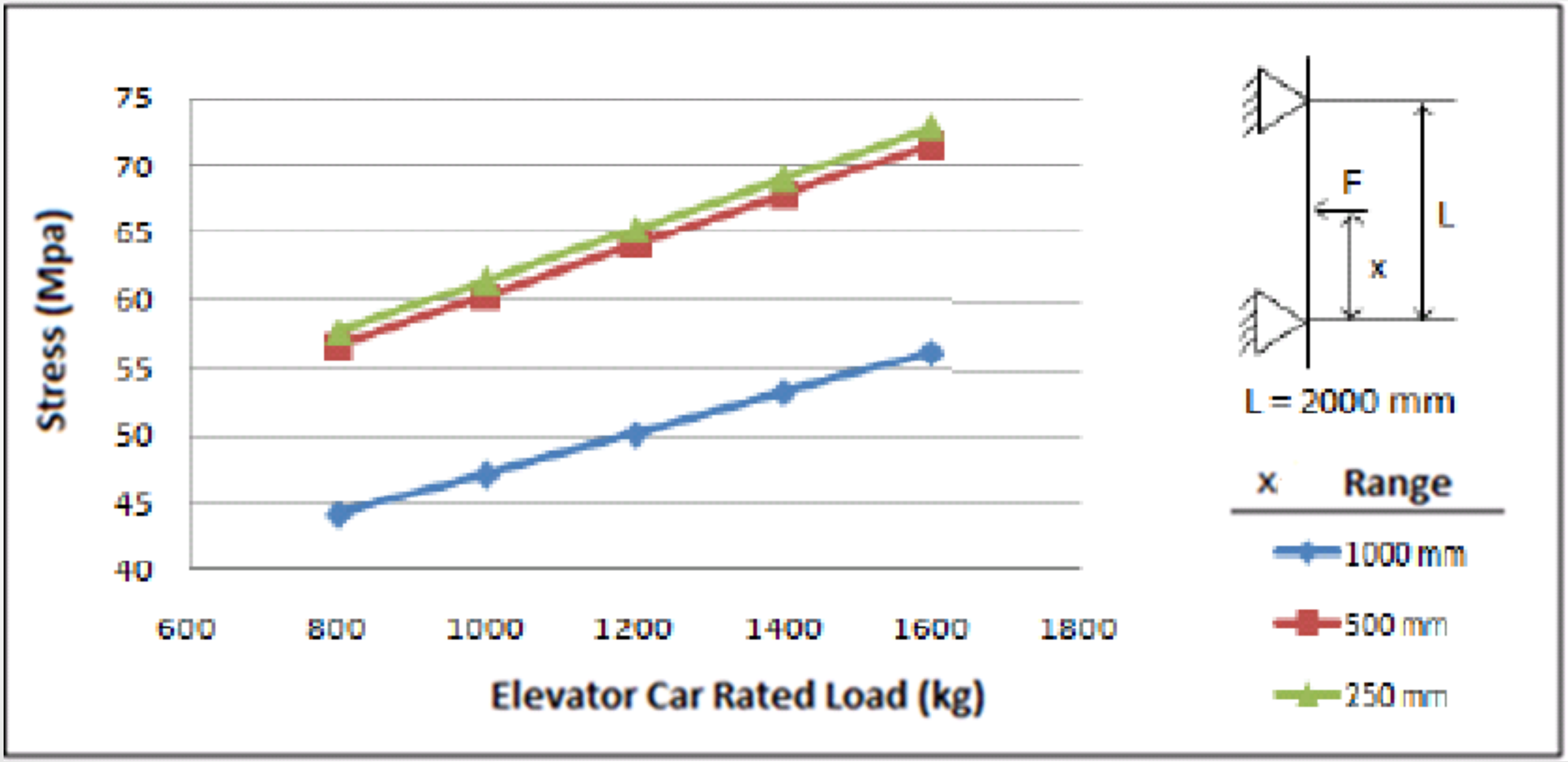
Top bracket



Bottom bracket

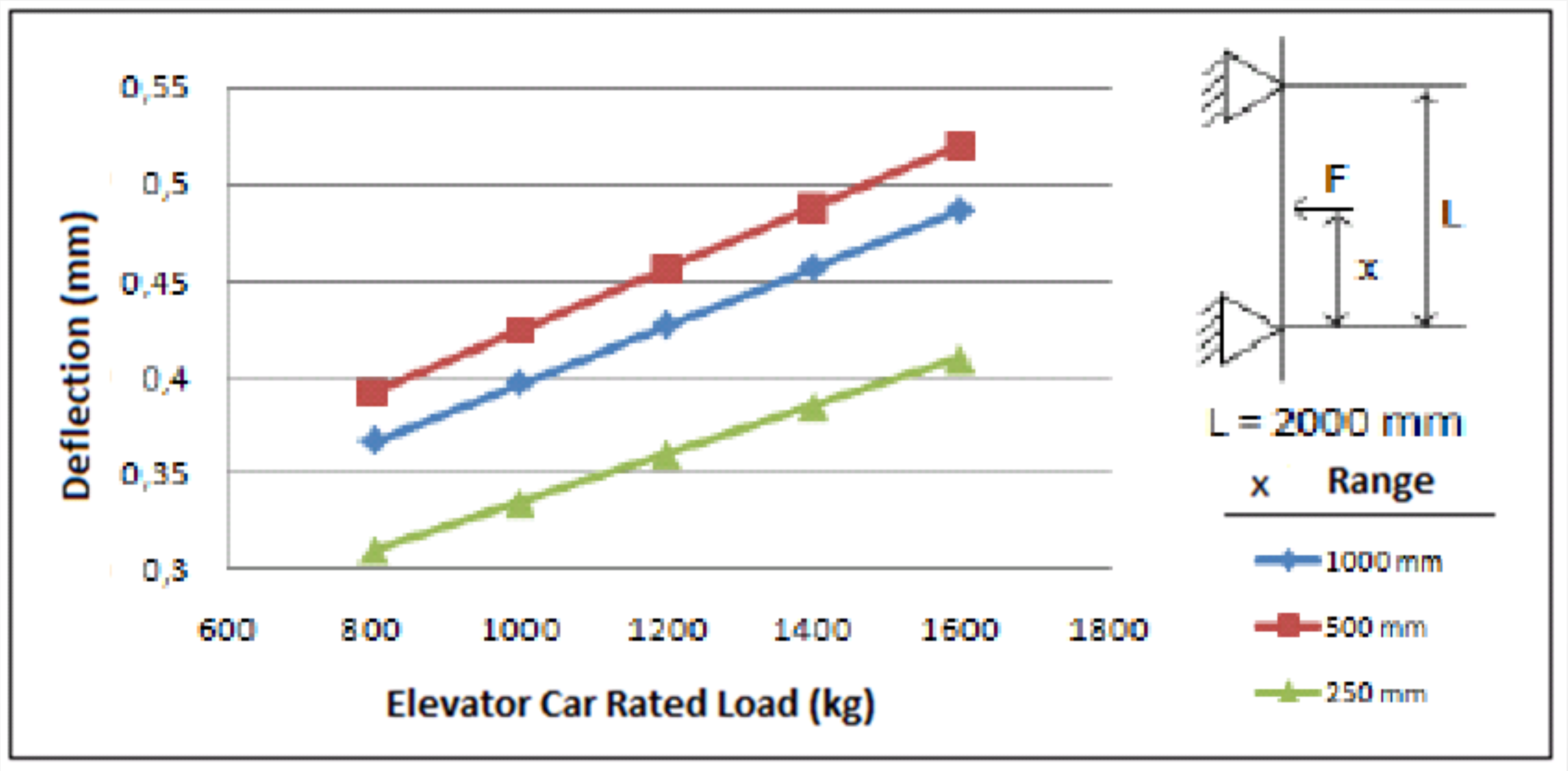
Results

According to x distance (bottom of the rail to center of the load), distribution of **maximum stress** of bottom bracket at different loads.



Results

According to x distance, distribution of **maximum deflection** of bottom bracket at different loads.



When x value is changed from 1000 mm to 500 mm, maximum deflection values increase 0.060 mm. At 250 mm deflections are smaller than others.

Conclusions

The stresses and deflections of rail brackets which are used to support rails to wall are examined by finite element method.

In order to show the effects of axis offset an example is given. In this case 2000 mm of vertical distance between guide rail brackets in T70/B guide rail is examined for comparison, finite element method results as given different axis offsets in the figures.

The values of stresses and deflections obtained from Nastran are increased with increasing range (x_Q). Besides this, high stresses were seen at point of bolt mounts.

Maximum deflection points on the bottom and top brackets were not at the same points; but they were symmetric. Because reaction forces on the brackets as a result of rail buckling and rail bending are opposite.

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