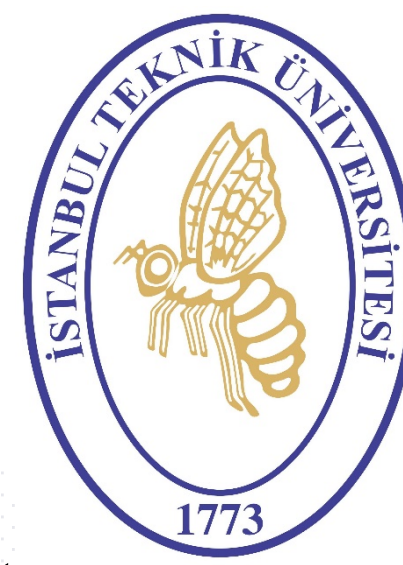


# Determination of Loads Acting on Guide Rail Fixing Under Certain Loading Condition

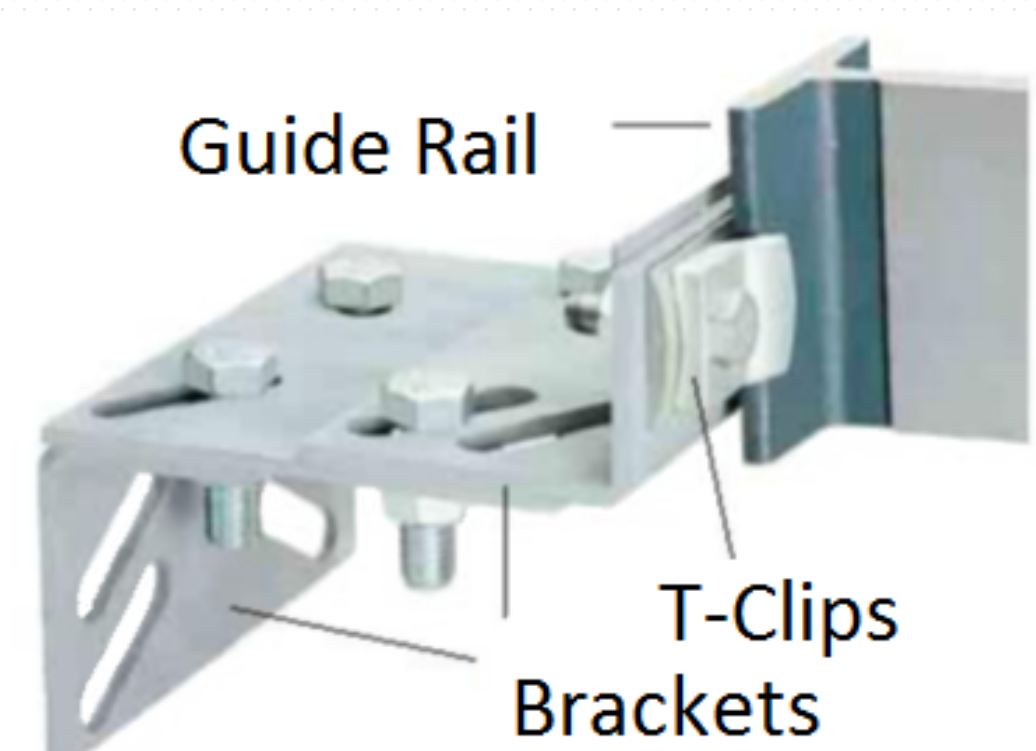
Sühan Atay, Eren Kayaoğlu, Adem Candaş  
C. Erdem İmrak, Sefa Targıt, Yusuf Ziya Kocabal

Istanbul Technical University  
Mechanical Engineering Faculty



## Abstract

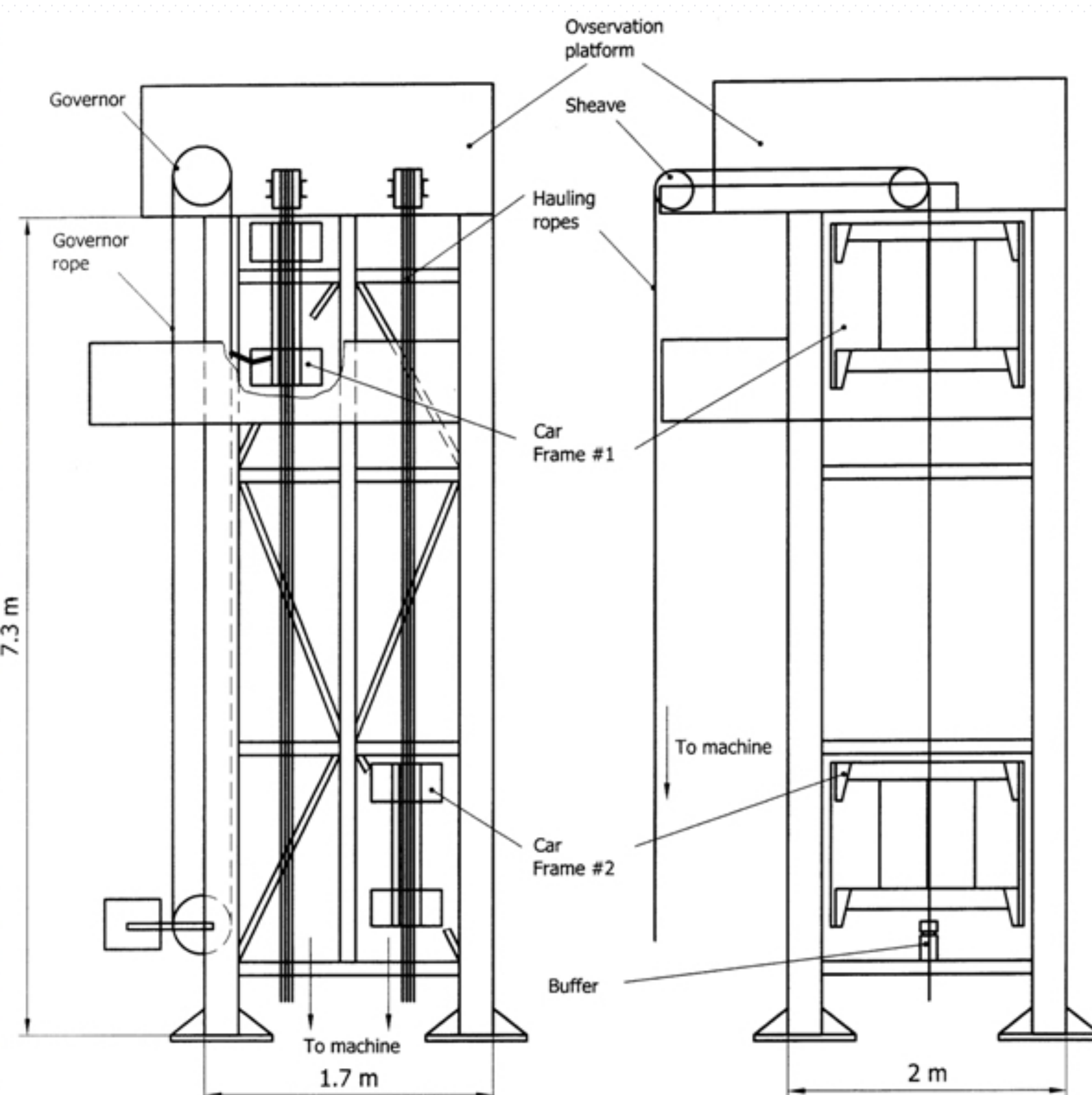
In terms of provide safety and smooth travel, guide rails and their fixing components are essential elements of the complete elevator system. Loads acting on the guide rails and fasteners occur during the elevator car normal travel lead to bending and buckling (or tensile) stresses. In this study, numerical calculations are explained according to EN 81-1 for certain loading conditions. Stress and deformations occur on the fixing components (bolts and T-clips) are examined by experimentally. Finally, the results obtained from numerical calculation and test results are compared and discussed.



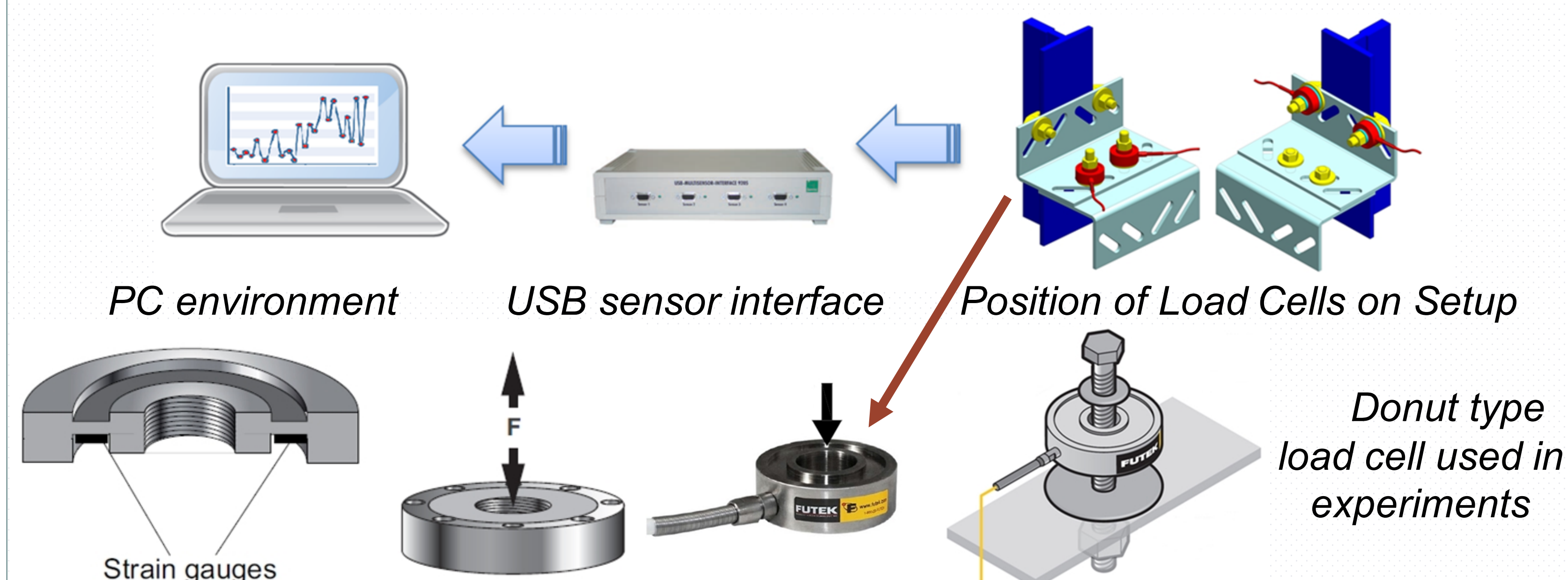
The brackets are mounted with pre-stressed bolts. Wherein by the application of transverse forces between the parts, a  $\mu F_{pre}$  friction force, ( $F_{fric}$ ) occurs. The theoretical principles of fasteners are given for making the mechanical joint effective.

$$F_{fric} = \mu F_{pre} \geq F/i \quad \text{or} \quad \mu F_{pre} = c_0 F/i$$

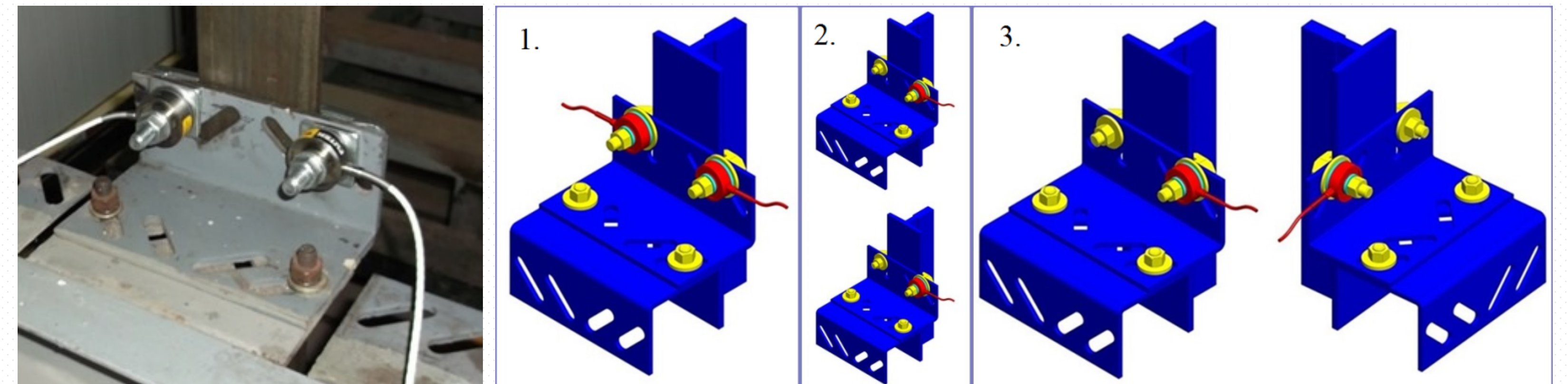
Where  $i$  is the number of bolts and  $c_0 = 1.1 - 1.5$  is the safety factor against sliding. From this equation, the force necessary to provide the joint can be found. M12 bolts and T3 type T-bolts are suitable for T-90 guide rails in accordance to the standards.



The test tower in ITU Elevator Technology Laboratory

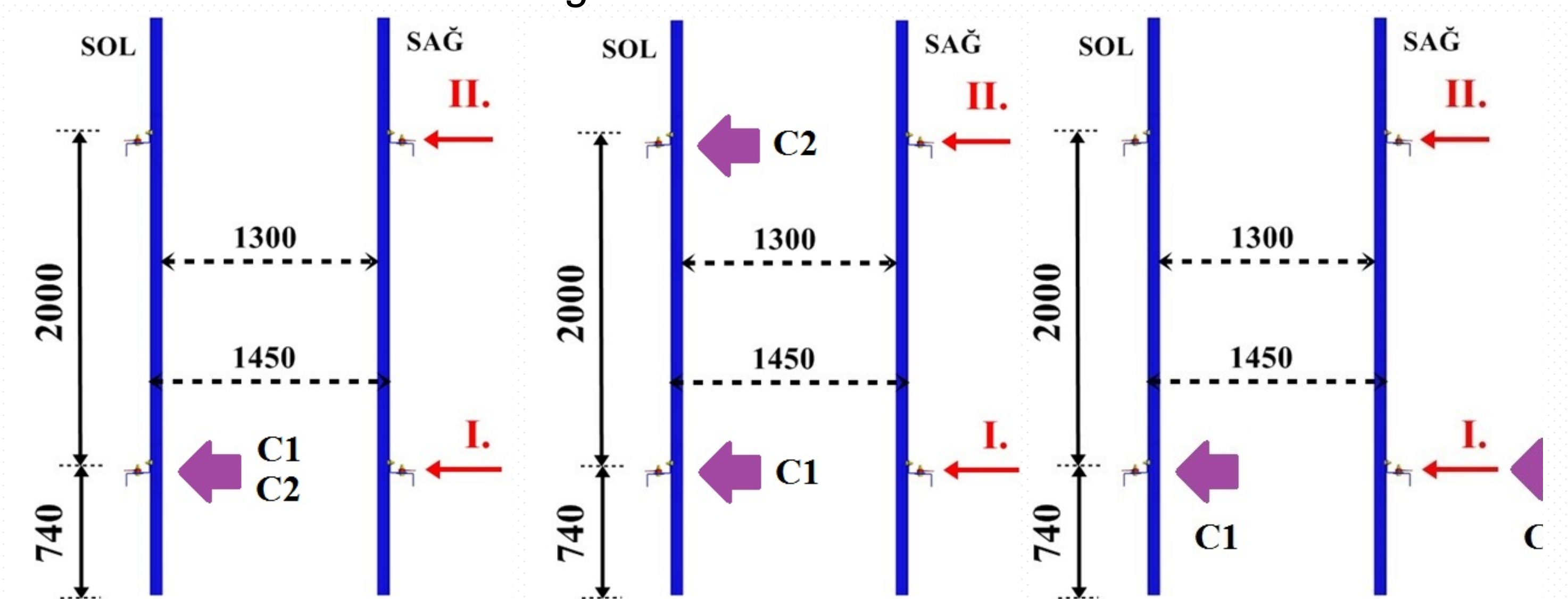


During the experiment, 8-person elevator cabin with empty and loaded (100% full) cases were investigated. Steel casting weights, each weighing 17.3 kg, were used in the elevator cabin frame to ensure empty and full status.



Brackets elements, made of St37 material, and were utilized at the test tower. Test results were taken from the ring type (donut) load cells placed on guide rail fasteners (steel clips). T90/B type standard guide rail was used. Guide rails were fitted to the base with four bearings and there is 2000 mm distance between the guide rail mounting brackets.

Configurations of 3 different test cases



Load Cell	Pre Loaded	Test-1		Test-2		Test-3	
		Min	Max	Min	Max	Min	Max
C1	2000	-47.3	42.4	-28.6	75.9	-91.1	42.0
	2500	-58.5	38.4	-77.3	13.4	-131.8	37.9
	3000	-63.0	113.9	-102.3	-11.1	-59.4	78.6
C2	2000	-105.2	91.4	-192.2	3.1	-162.8	70.0
	2500	-120.4	79.4	-135.1	71.8	-197.5	57.5
	3000	-180.2	41.5	-106.6	97.7	-110.6	142.3
Load Cell	Pre Loaded	Test-1		Test-2		Test-3	
		Min	Max	Min	Max	Min	Max
C1	2000	-332.0	78.6	-179.2	94.3	-43.8	208.2
	2500	-186.3	103.2	-339.6	127.3	-133.6	221.2
	3000	-223.4	55.4	-292.7	4.4	-470.6	172.0
C2	2000	-229.2	72.2	-135.1	127.1	-68.7	179.3
	2500	-230.5	55.3	-186.0	125.8	-75.4	189.1
	3000	-197.1	168.1	-116.8	151.2	-169.9	111.9

Forces occurred on the bolts in empty car case [N]

Forces occurred on the bolts in loaded car case [N]

The maximum load occurred on bolts is -470.6 N at Test-3 in 3000 N pre-load condition from C1 load cell. The force to untie this connection must be more than 7549-8088 N due to the standards (BS EN ISO 898-1:1999). Comparison of these two values shows that safety factor is approximately 16.

The matter of seismic activities on the elevator systems is not a new discussion but it has come into question especially after Van Earthquake 2011 in Turkey. The improved safety aspect must be underlined in respect to structural safety and reliability during seismic activities.

## Acknowledgement

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