



Rear bumper design and structural analysis study in compliance with ECE R58.03 regulation

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Abstract

In this study, it is aimed to construct and equip rear bumpers to provide effective protection against the rear entry of vehicles with the updated regulation on rear protection equipment of motor vehicles and their trailers. Structural analysis was carried out with the help of Ansys program to the bumper designed for an N category vehicle, and forces of 100 kN and 180 kN, which are the regulation conditions, were applied. Design verification has been made and the study has been commissioned.

Introduction

Recently, there has been a serious increase in the number of vehicles in the traffic, and as a result, it is seen that traffic accidents have increased at the same rate. Although this situation is not only related to the number of vehicles but also to the road condition, it is possible to say that there is an increase in the number of traffic accidents all over the world.

It is known that with the increase of safety technologies in the automotive sector, deaths can be significantly reduced. One of these measures is undoubtedly the bumpers on the back of the trucks and it can be said that these bumpers are durable. In the event that a car hits the truck from behind, this system prevents people from getting under the truck, and fatalities can be prevented to a great extent. Figure 1 shows the impact of a truck without a rear bumper and a car crashing into another truck with a rear bumper.



Figure 1. Crush Test [1]

The regulation with the code R58.03 has been published by the European Economic Commission (ECE) in order to standardize the required strength in these units [2].

Truck rear bumpers, which have been produced for a long time, are seen as the most important solution to prevent deaths in rear-end collisions. Picture 2 shows the rear bumper designed for the truck with the Koluman brand concrete pump superstructure.

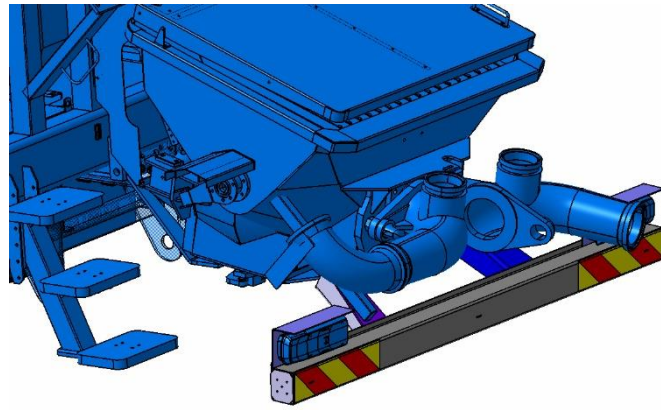


Figure 2. Rear Bumper of Concrete Pump

Results and discussions

As a result of the regulations determined by the European Economic Commission (ECE), the protective equipment that must be mounted on the back of the truck must meet some conditions. Under these conditions, the durability of the material is tested by applying forces to the areas determined on the bumper. The regulation with the code R58.03 has been published by the European Economic Commission (ECE) in order to standardize the required strength in these units. The values included in the regulation are shown on the bumper in Figure 3.

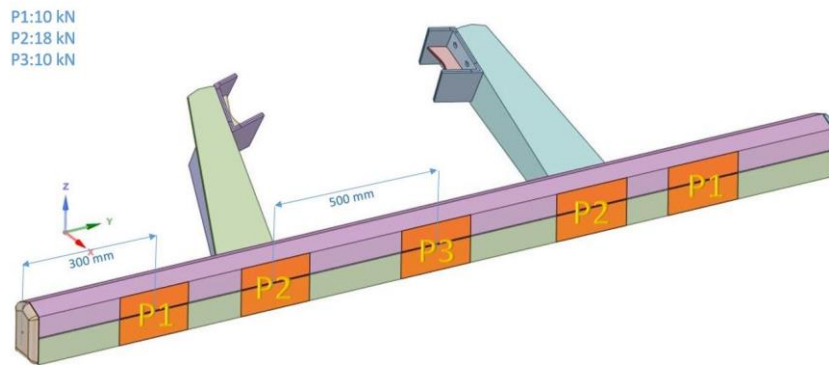


Figure 3. Rear Bumper of Concrete Pump

In the designed rear bumper, the material has been prepared for static analysis in Ansys program. The visual of the prepared material is shown in Figure 4.

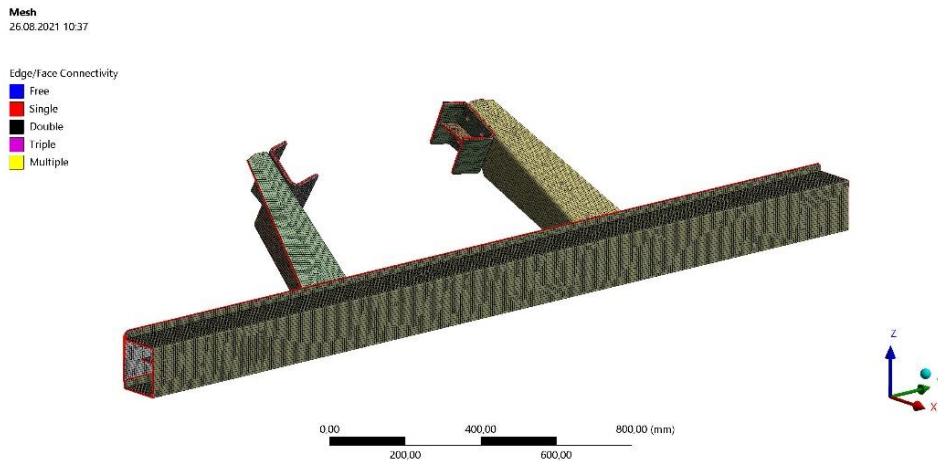


Figure 4. Mesh Structure of Rear Bumper

In the designed rear bumper, 10 kN of P1 load was applied to the material. The result of the tension in the material after the application is shown in Figure 5.

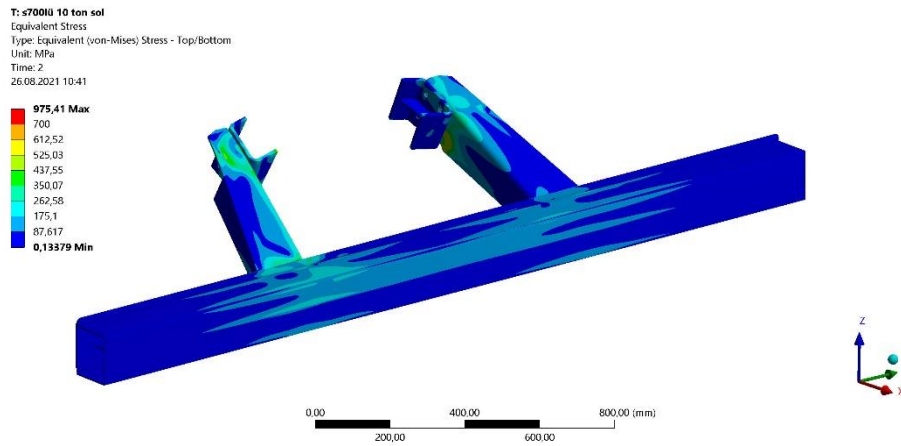


Figure 5. P1 Force Application

In the designed rear bumper, 18 kN of P2 load was applied to the material. The result of the tension in the material after the application is shown in Figure 6.

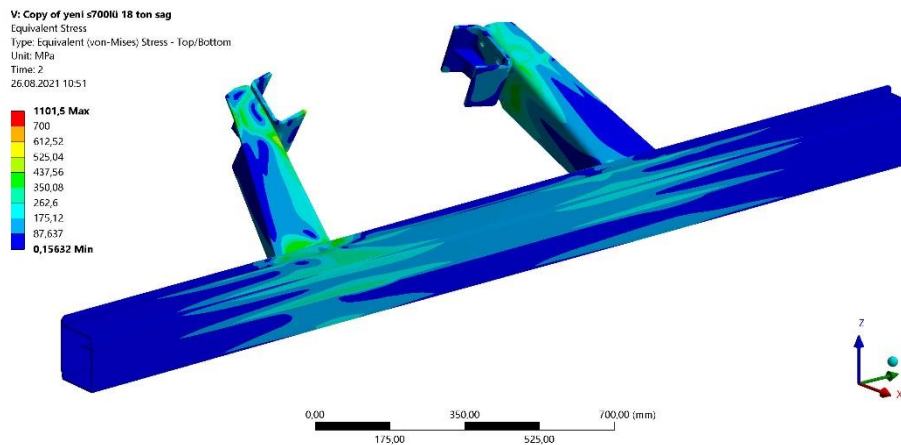


Figure 6. P2 Force Application

In the designed rear bumper, 10 kN of P3 load was applied to the material. The result of the tension in the material after the application is shown in Figure 7.

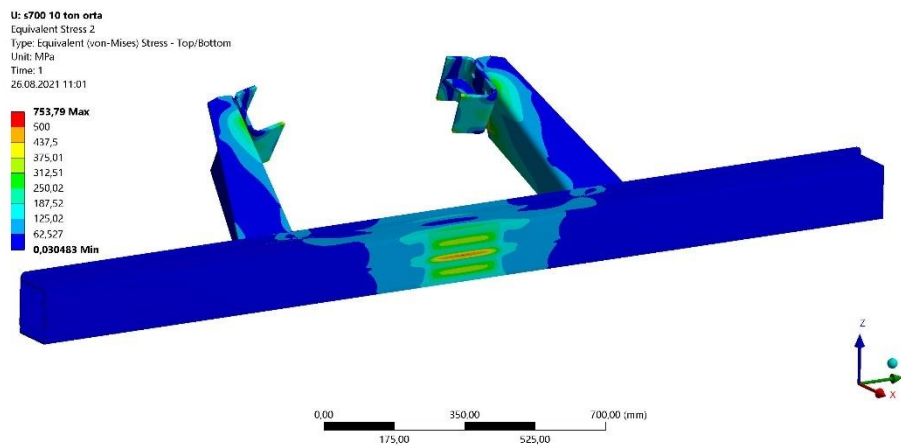


Figure 7. P3 Force Application

Conclusion

Recently, the regulation on rear protection equipment of motor vehicles and their trailers has been updated. In this case study, a structure equipped with a rear bumper to increase effective safety against accidents at the rear of the vehicles was designed and tested under 100kN and 180kN forces. As a result of this study, minimum strength values have been reached for the material to be used while designing the bumper.

References

- [1] Sekizsilindir, (2017). Retrieved from , <https://www.sekizsilindir.com/2017/03/kamyon-arka-koruma-cercevesi.html>
- [2]Regulation, (2017). Retrieved from <https://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2017/R058r3e.pdf>