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ULUDAĞ ÜNİVERSİTESİ 1975

International Conference and Exhibition on

Automobile Engineering

September 01-02, 2015 Valencia, Spain

Crash behavior of telescopic crash box with aluminum foam

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2015 September 01

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Presentation Headlines

1- Beyçelik Gestamp Introduction

2- Introduction

3- Finite Element Model

4- Results

5- References

6- Questions& Remarks

History

TOOLING PLANT
&
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Beam)

Thin-walled tubular structures behind the bumpers of vehicles protect passengers and the structure during the impact.

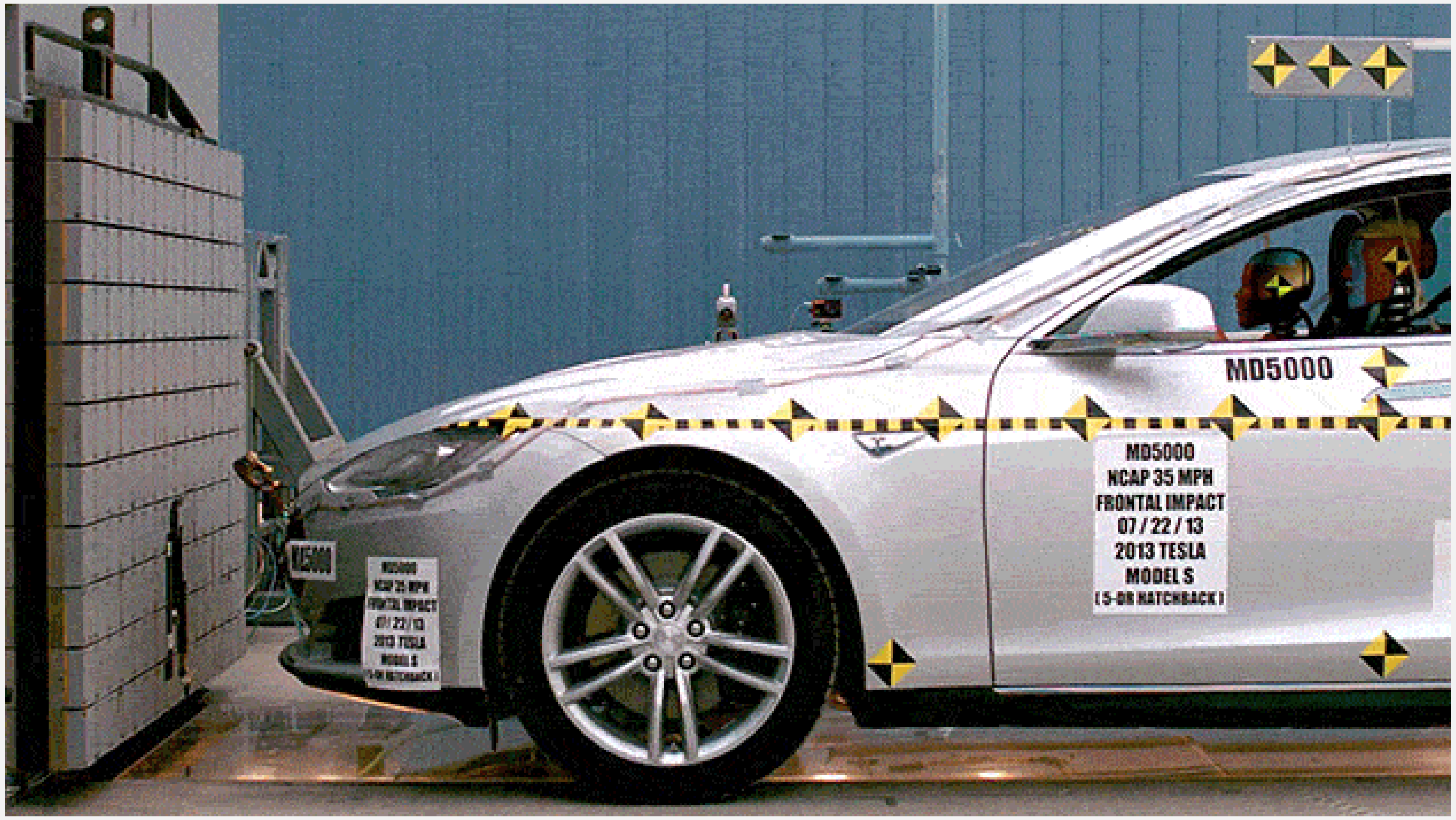


Fig.1 . Frontal Impact

The bumper deforms first, then the following component deforms until the all energy is absorbed.

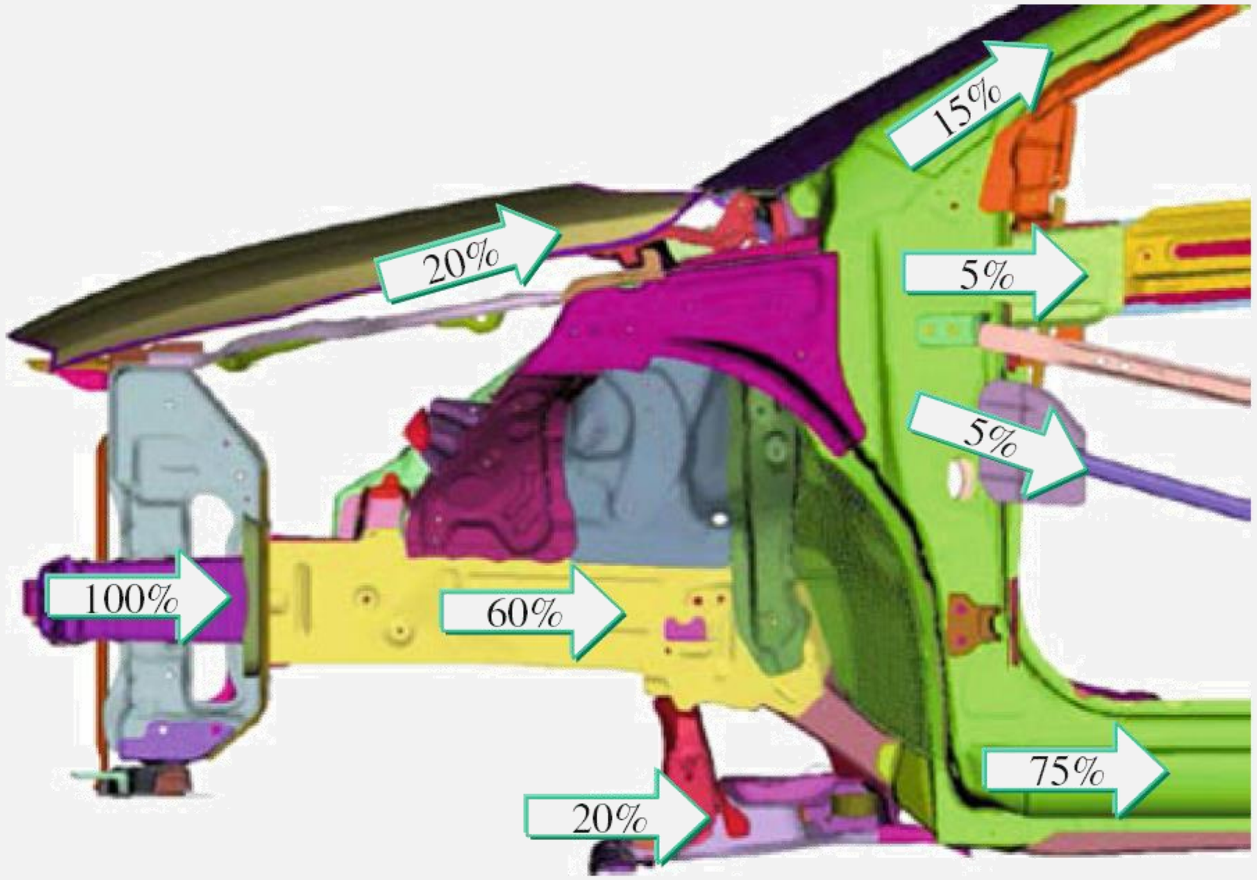


Fig. 2 Division of crash force transmission

Thin-walled structures absorb most of the crash energy with a progressive folding deformation.

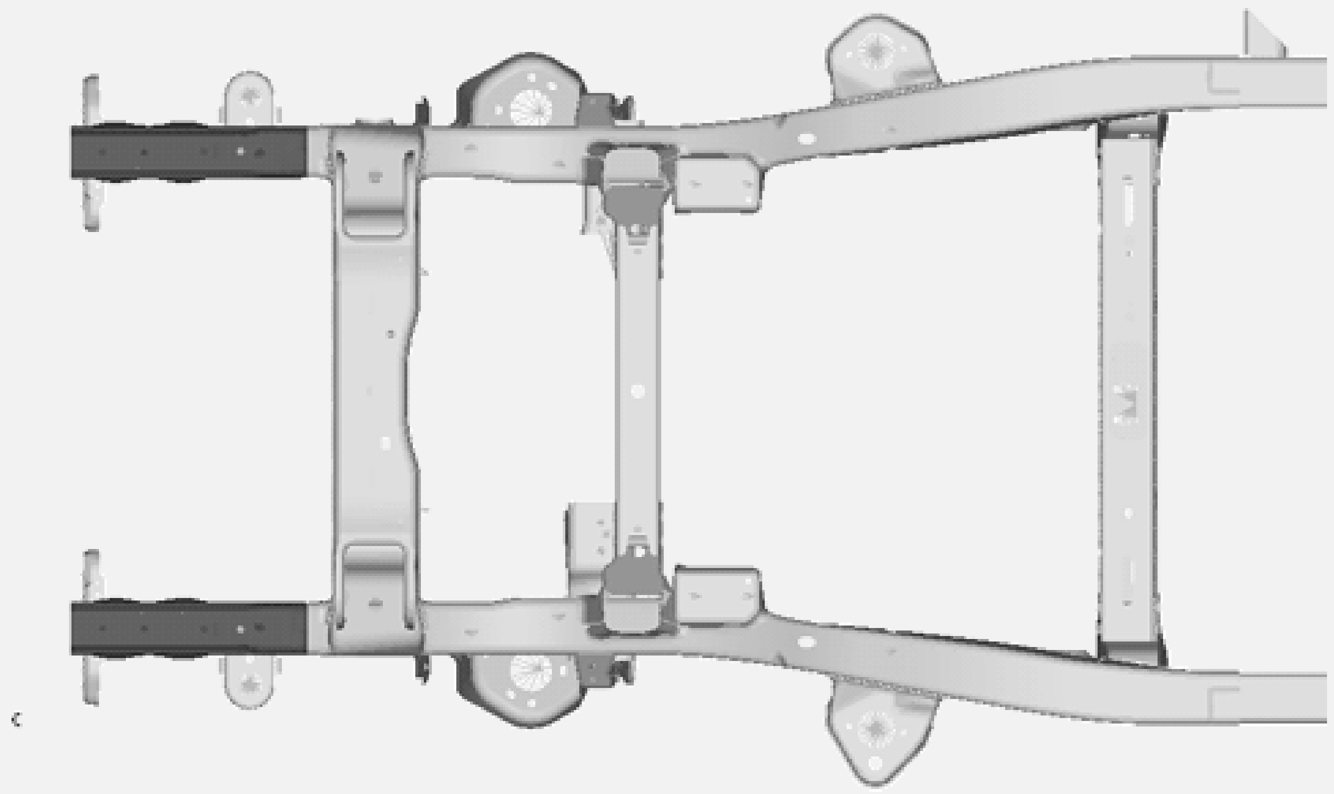


Fig. 3 Under Body Crash Force Transmission

Crash Box is a the part which is usually advanced of the rails that should collapse at relatively low force to absorb energy in a controlled way [1].

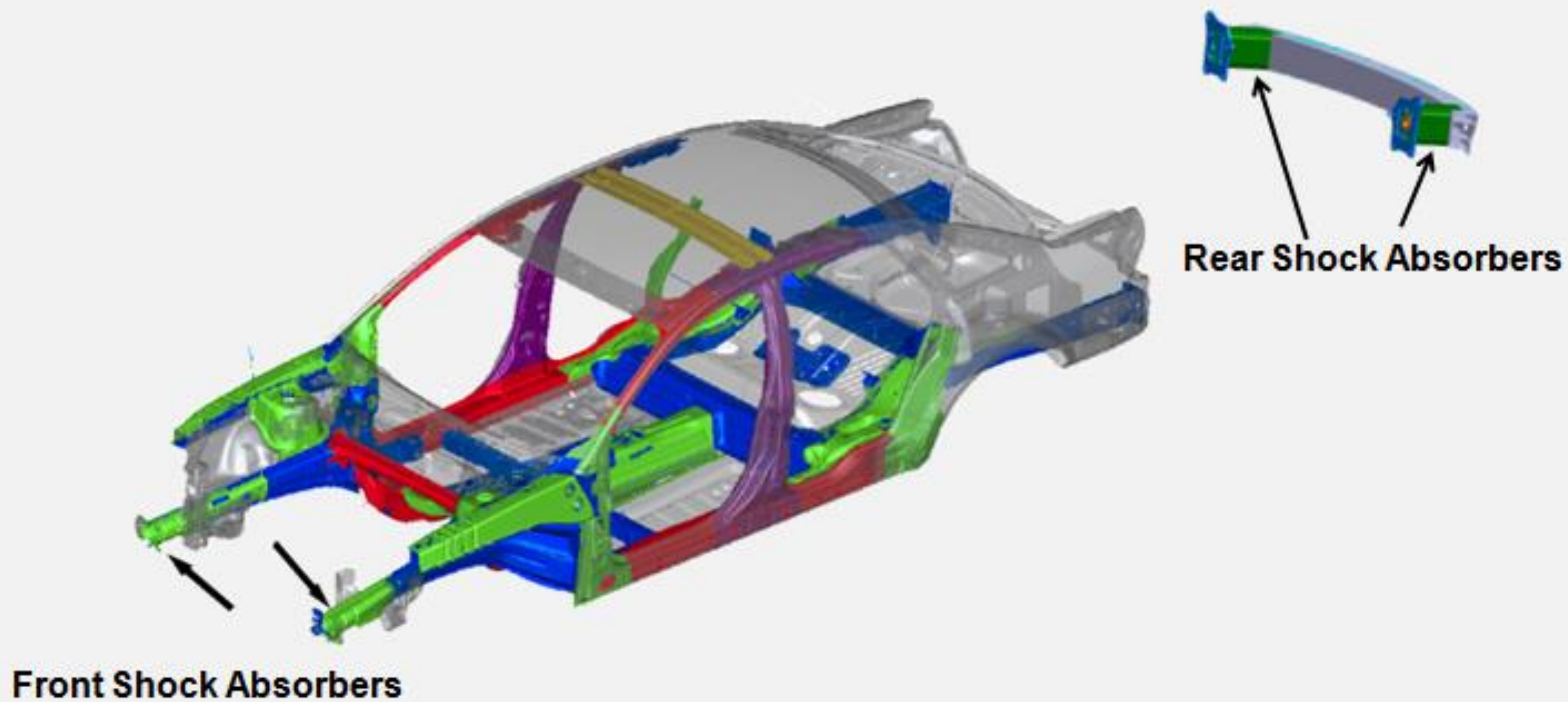


Fig.4 . Shock Absorbers (Crash Boxes)

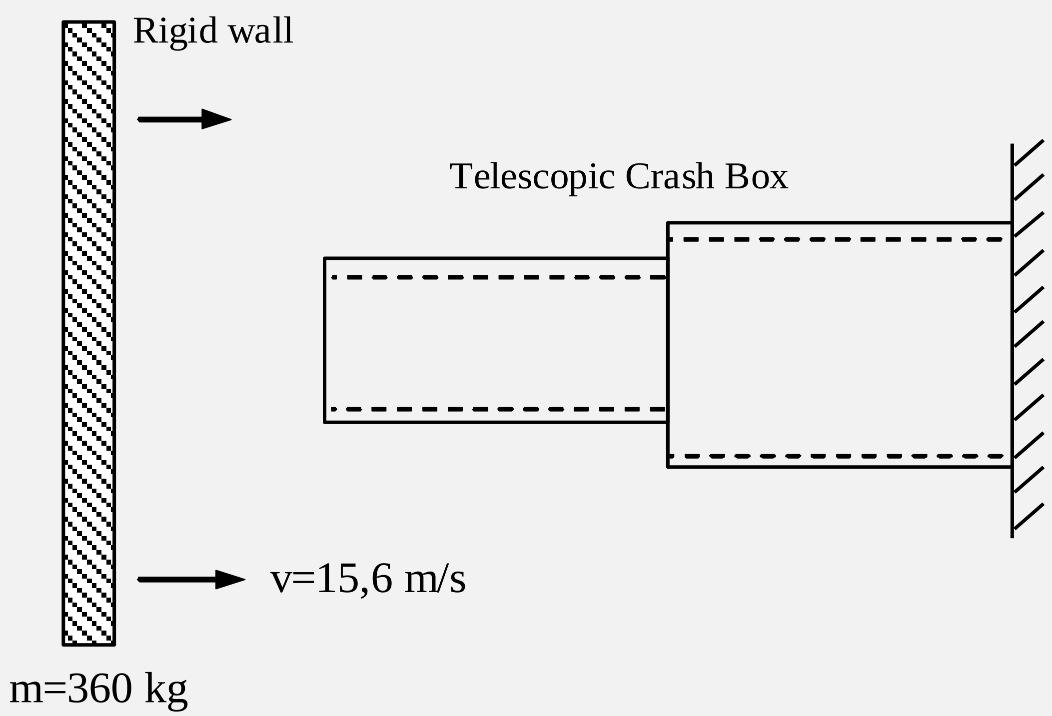
In this study, aluminum foam effect of the crashworthiness behavior analyzed on the telescopic crash box geometry.

The geometric models were modeled with CATIA.

The post processing of the FEA models were prepared Hyper Mesh.

The crash simulations were performed with LS-DYNA.

The behavior of the crash box has been studied by simulating the impact of a rigid barrier.



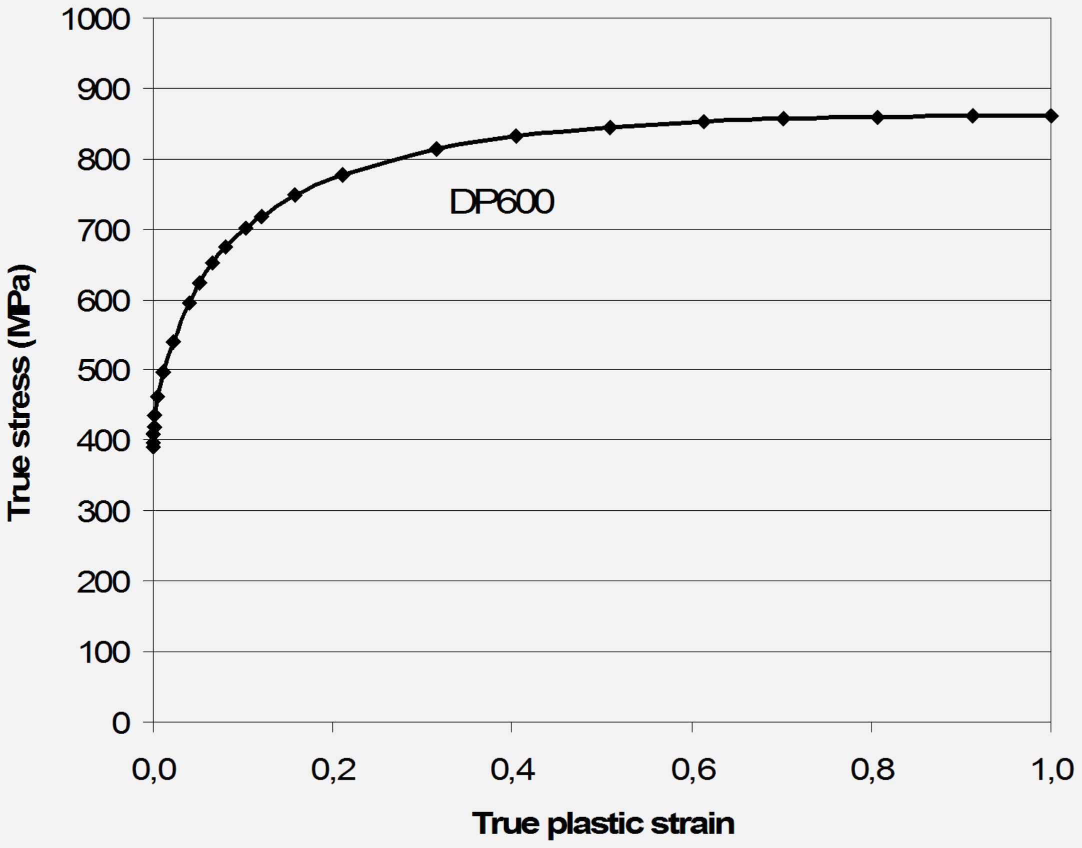


Fig.5 . Impact model and true stress-strain diagram of material

3. Finite Element Model

Parameter	Abbreviation	Value	Unit
Rigid Barrier Velocity	v	15600	mm/s
Rigid Barrier Mass	m	0,36	t
Dynamic Friction Coefficient	F_D	0,1	
Static Friction Coefficient	F_S	0,1	

Table 1. Rigid Barrier Properties

Parameter	Abbreviation	Value	Unit
Density	ρ	$7.85x10^{-9}$	g/m^3
Yield Stress	$σ_{ak}$	390	MPa
Young's Modulus	E	210000	MPa
Poisson's Ratio	Nu	0.3	
Thickness	t	1.5	mm

Table 2. DP600 Properties

Parameter	Abbreviation	Value	Unit
Density	ρ	$1.11x10^{-9}$	g/m^3
Young's Modulus	E	1100	MPa
Poisson's Ratio	Nu	0.0	
Yield Stress	SIGP	0.777	

Table 3. Al-Foam Properties

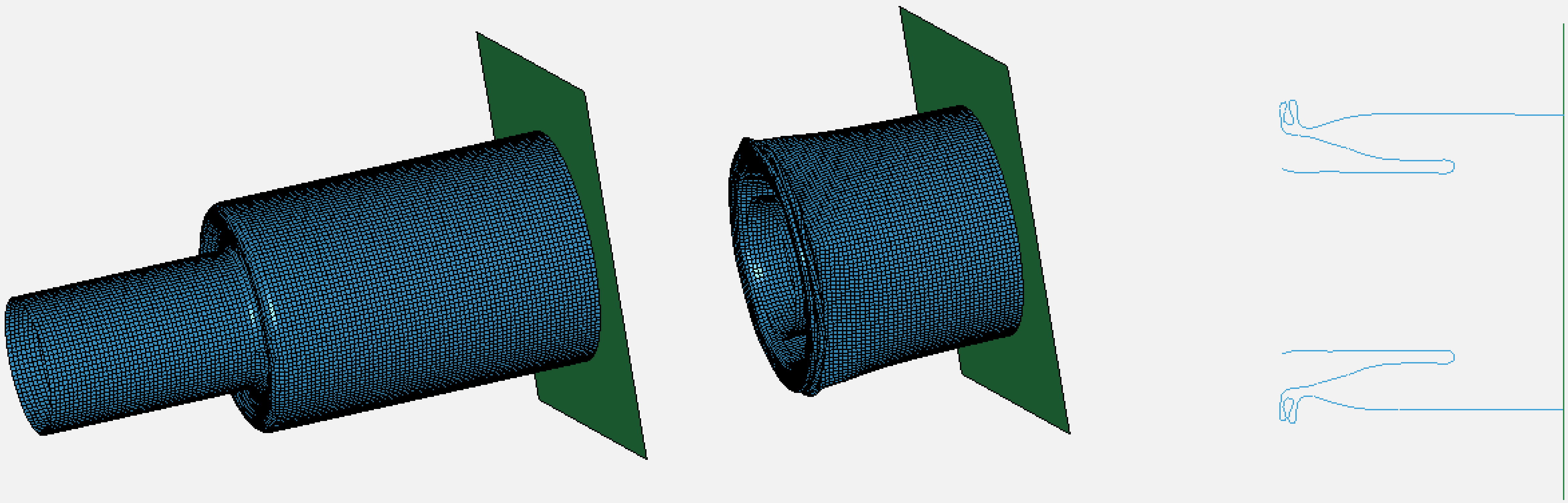


Fig.5. Undeformed, deformation characteristics and section view for empty telescopic crash box (deformed time=10 ms)

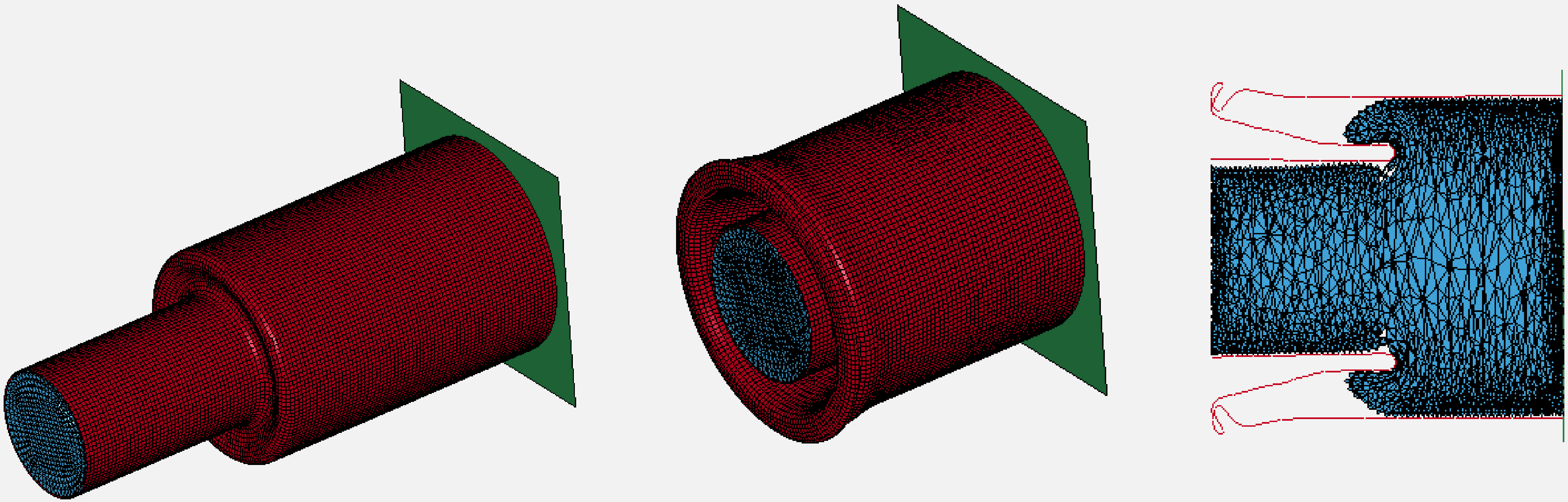


Fig.5. Undeformed, deformation characteristics and section view for aluminum foam filled crash box (deformed time=10 ms)

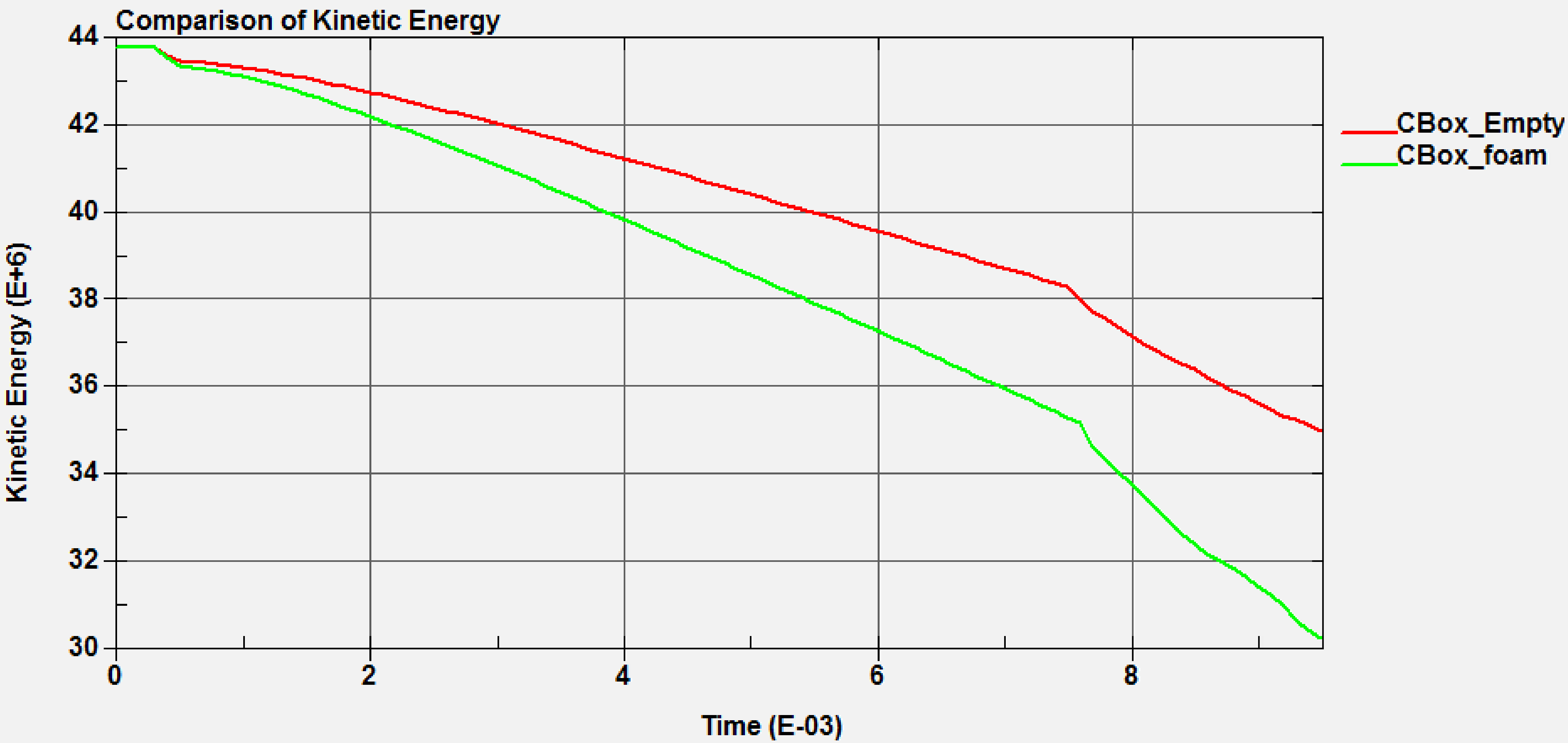


Fig.11. Comparison of Kinetic Energy for with and without aluminum foam

- In order to maximize the absorbed energy, new telescopic box geometry with aluminum foam-filled is analyzed.
- It is revealed that aluminum foam filled crash box energy absorption capability is % 47 higher than the empty one.

Profile	Total Absorbed Energy	Unit
Empty Crash Box	8,81	kJ
Aluminum Foam Filled Crash Box	13,57	kJ

Table 4. Total Absorbed Energies

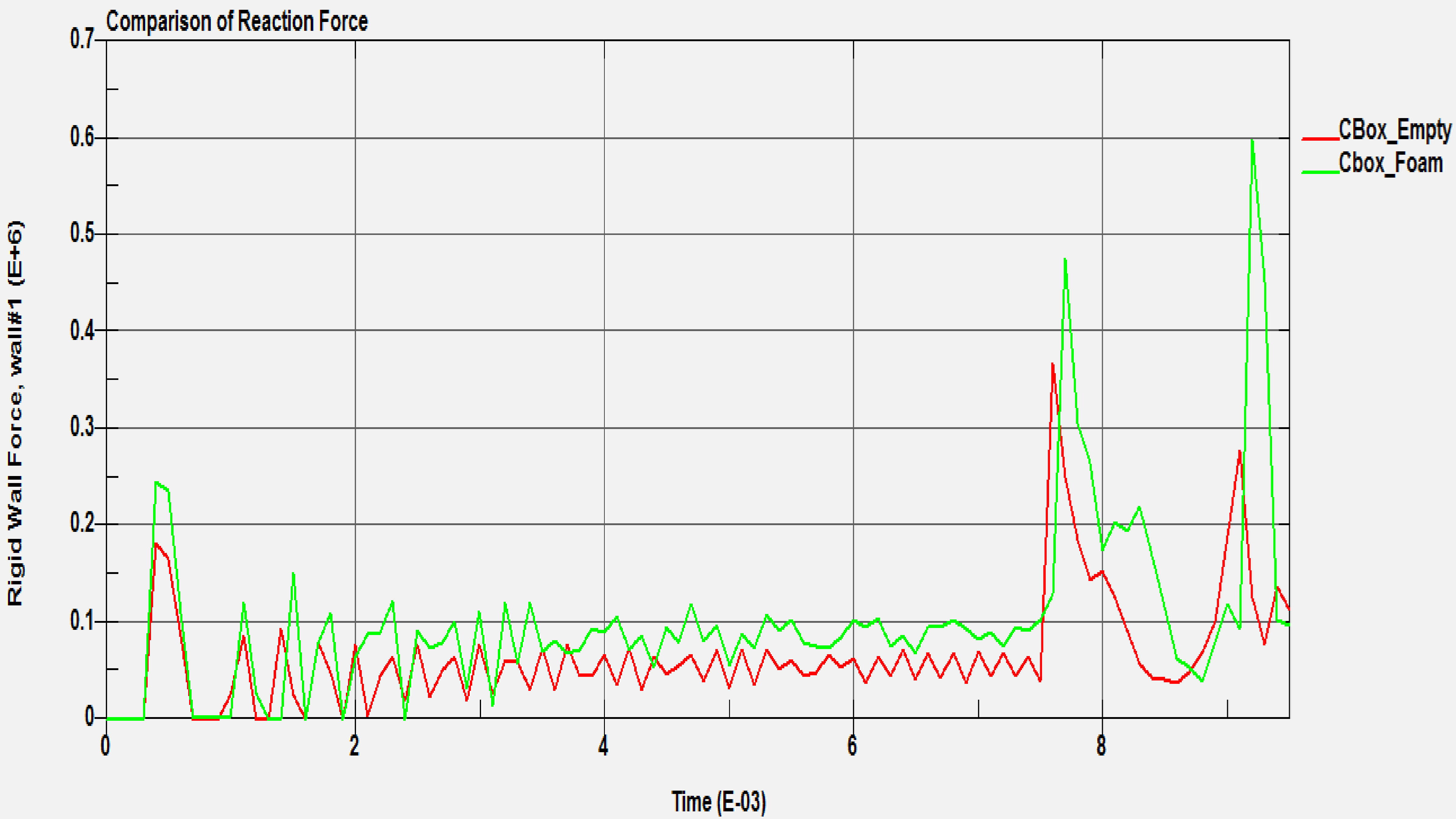


Fig.10. Comparison of Reaction Force for with and without aluminum foam

The initial reaction force of the aluminum foam filled telescopic crash box profile %34 higher than the empty telescopic crash box profile.

Profile	Initial Reaction Force	Unit
Empty Crash Box	183	kN
Aluminum Foam Filled Crash Box	245	kN

Table 4. Initial Reaction Forces

Numerical simulation’s show that in terms of achieving maximum energy absorption, telescopic crash geometry and filling the box with aluminum foam can be preferable to thickening the box wall.

7. References

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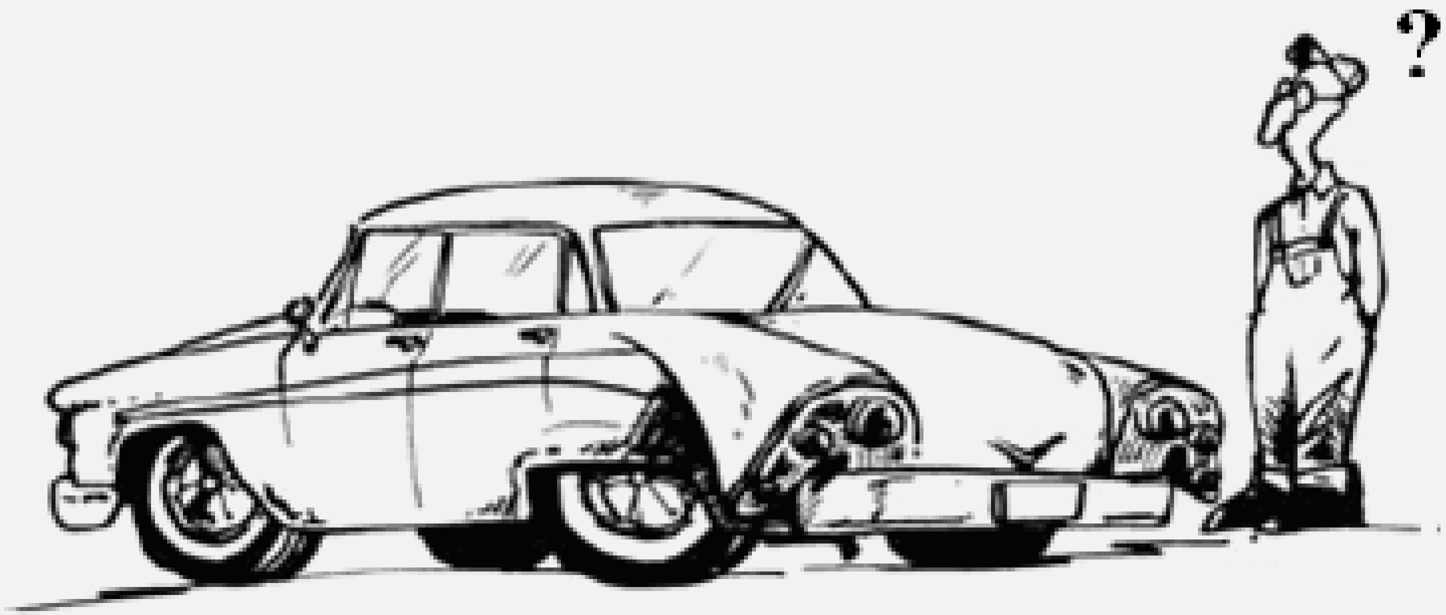

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