Analysis and Design of Rectangular Front Load Beam for Energy Absorption for an Automobile

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Abstract: *With the new innovation in technology energy absorption performance is the most important mark in the vehicle safety. The front rail layout must be adjusted so that more strength is absorbed. In this paper different energy absorbing materials and different criterion that is non identical rib (inside) thickness are estimate using FEA in rectangular column (loaded beam). The four front load beam under goes the path of direct load which affects the deformable barrier of the offset and the whole front. By design of rails the acceleration pulse exert influence on the passenger compartment. Effective design helps in the reduction of injury to the occupants. Whole model is simulated in LS-DYNA.*

Key words: FEA, Impact analysis, Beam structure, Dynamic crushing, Thin-walled structure, LS- Dyna.

1. Introduction:

Increasing population of world causes more manufacturing and uses of vehicles. The remarkable increment in number of vehicles creates the significant safety issue of passengers and drivers in the terms of poor road condition and negligence of driving rules. There are so many vehicle accidents happen in only the seconds in all over world.

Among them, major percentage of accident cases is due to collision of cars at front sides i.e., Frontal vehicle collisions. Anterior vehicle crash declared as the crucial type of car accident in the whole world. Customers have become highly conscious of the seriousness of vehicle security. As a result, vehicle safety becomes the primary selling feature in automobile industries in today's world. Vehicle crash-resistant is explained as the estimation of inhabitant security when vehicle is required in the RTA (road traffic accident). By the designers keep on to make the frontal of the vehicle so competent to soak up maximum part of energy for the reduction of amount acceleration of the head of occupant, also for the reduction of the immersion of the upper part and lower part of the dash. The lead part of rail of automobile plays the role of the component which absorbs maximum part of energy. This study will help to get better utilization of energy of the front rails

The crash in the front is the most familiar accidents which is on the vehicles. The impact test on the front was fundamentally drafted under the committee which is under EEV safety. This test which is done is simulated and comes out to be the most common type of road crash which is fettle. Its bottlenecks are the inability of car to resist the sudden hit in the section of traveller which causes the injuries which are deadly and serious. Since, it does not provide protection against the sudden frontal hit. In ECE regulations for Frontal crashes, the testing vehicle should pass the two basic tests, the Offset deformable Barrier 40% offset test and full Frontal 100% overlap test.

2. Structural Condition:

Immersion of energy and minimum change of energy to the rider or travellers classified into two basic design of structures in vehicles elements. The design of structure of vehicle contains the design of body and supporting frame of structure.

Figure. 1. shows that the 120kN force is taken by the front rail, around 40% of the force, taken by the other unique part of the assembly which also designed in such a way that it assembled with different parts of units of the manufacturer's vehicle

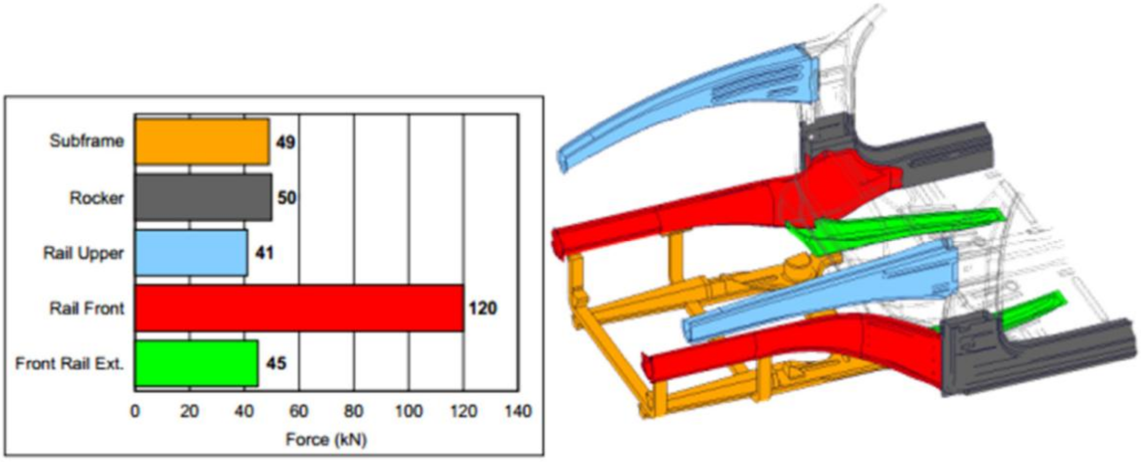

Figure1.

Front rail absorbs around 45% of the other by the other unique part of the assembly which also designed in such a way that it assembled with different parts of units of the manufacturer's vehicle shown in figure.2

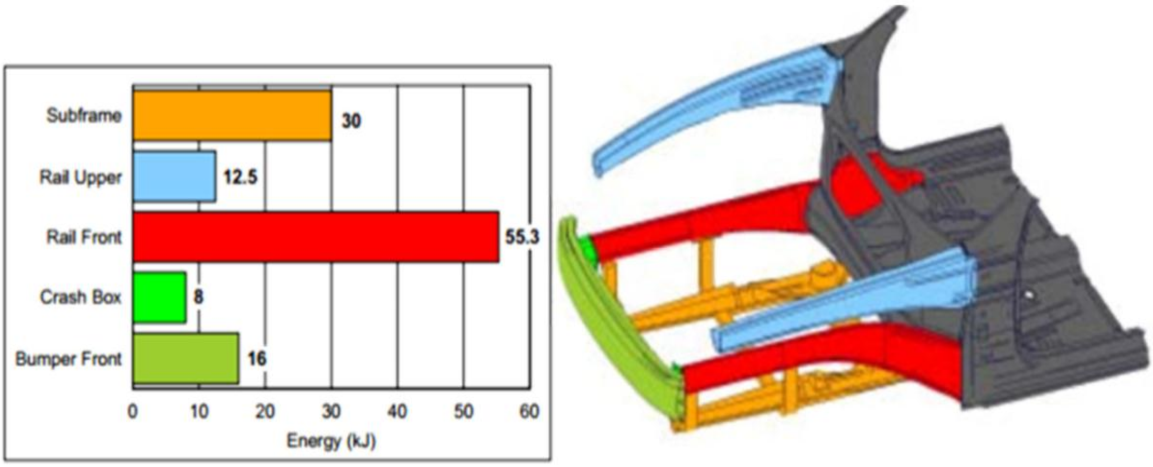

Figure2.

DESIGN METHODOLOGY

Material Selection

Energy absorption and peak force on the material depends upon the tensile strength. Advanced steel materials are developed which have the properties from low strength to high strength are of the range from low carbon steel to martensitic. The strength varies from 200 MPa to 1800 MPa.

Model Building

Average mesh size of 4mm is used for the model. The minimum size of the element is 2 mm and maximum is 5mm.A rectangular section of 60*50*1.8 mm thick is used with a length of 300mm. The component is fixed in all degrees of freedom at one at as shown in Figure,6

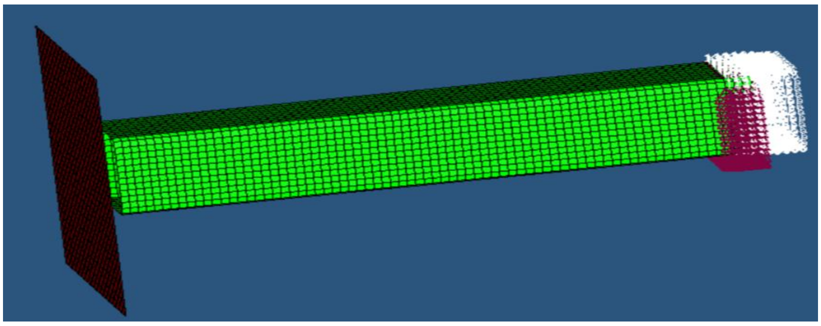

Figure 3. Boundary Condition

Mesh Quality Criteria

Shell Element warpage in Degrees	<15, Degrees
Minimum Element size for shell Elements	2 mm
Maximum Element size for shell Elements	5 mm
Shell Element quad angle	>45,<135, Degrees
Shell Element Trias	>20, <120, Degrees
Aspect Ratio of the Shell Element	<=5
Jacobian of the Shell Element	>0.6, =1
Skewness of Shell Element	<45, Degrees
Percentage of Trias	<= 7%

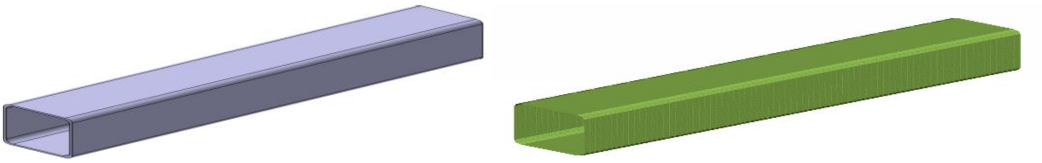

Figure 4. Section-No Mid Rib

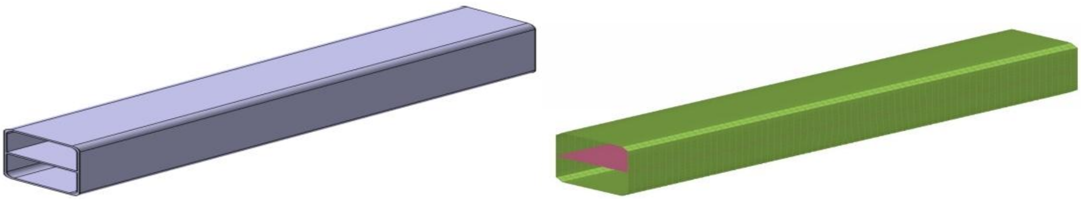

Figure 5. Section - Single Mid Rib

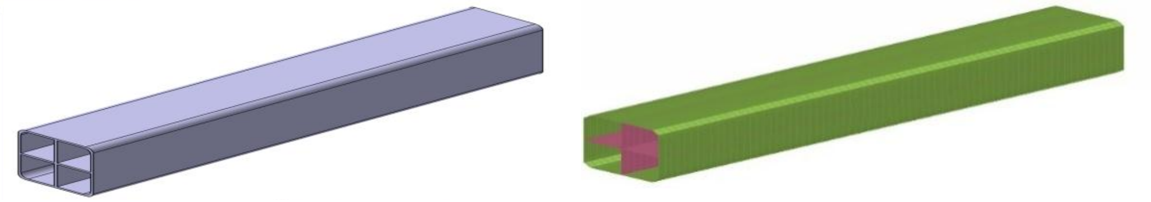

Figure 6. Section -Cross Mid Ribs (1.8 mm thick)

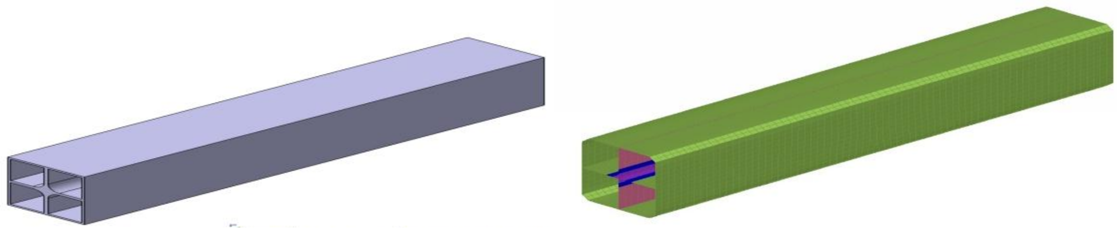

Figure 7. Section - Cross Mid Rib (5 mm fillet radius)

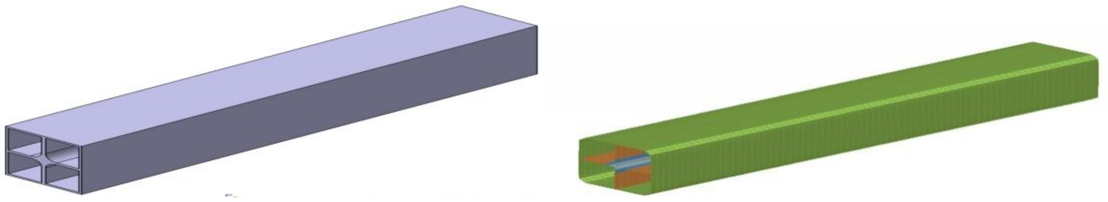

Figure 8. Section - Cross Mid Rib (7.5 mm fillet radius)

RESULT & DISCUSSION

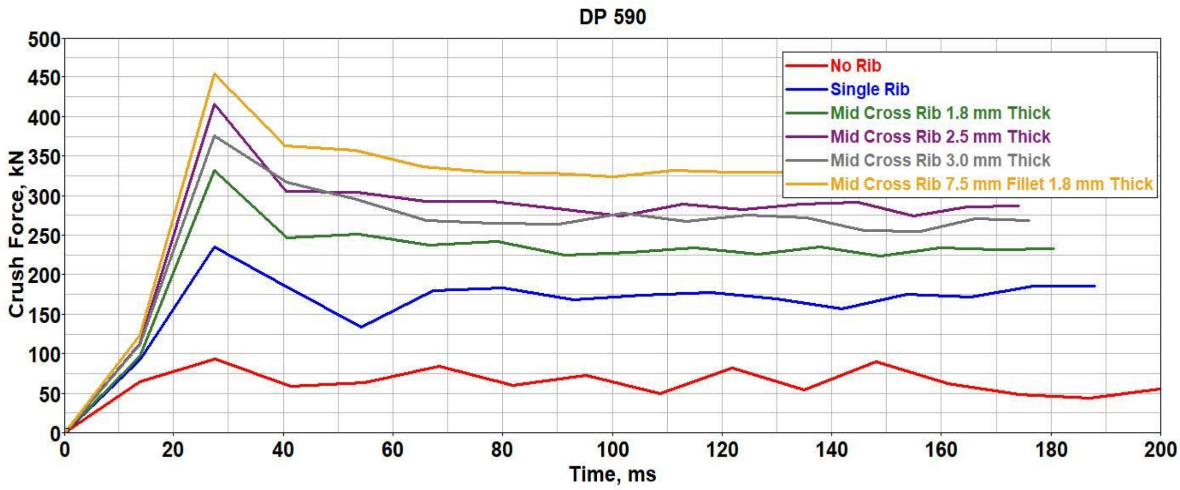

Figure 9. Result Comparison-with & without Rib– DP Material

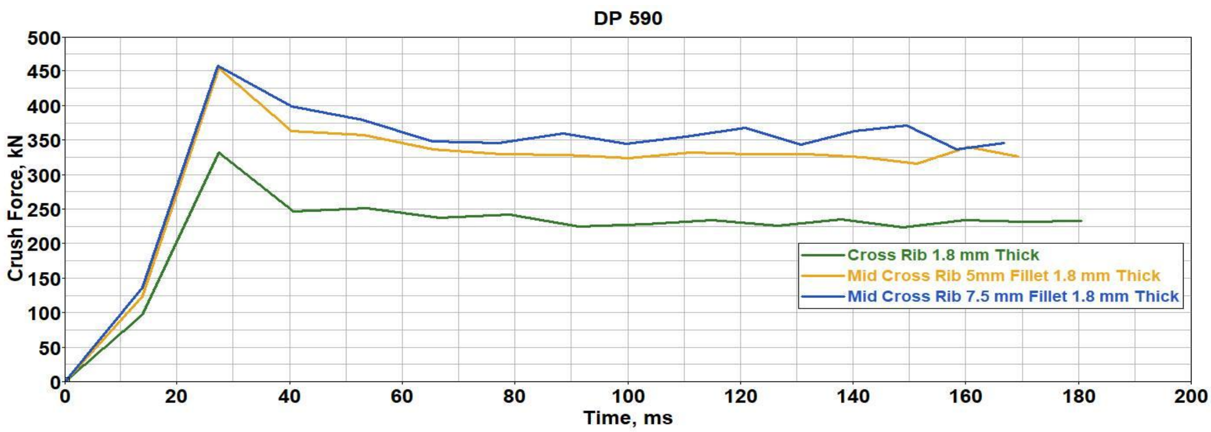

Figure 10. Result Comparison-Variation of Rib Fillet Radius–DP Material

The results show that the strength and energy absorption ability of long rectangular column increases with addition of ribs and fillet radius of the cross ribs. The incident of frontal collision, the front region at the front rail section is made up of rectangular long column. There is considerable quantity of absorption of energy if only using 3mm rib thickness as a alternative of enlarge the full front rail thickness. Dual phase steel materials has higher strength. This study can be further extended and more section options can be used to absorb more energy.

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