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Boundary Condition for Bare Chassis Brackets of the Commercial Vehicle

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Abstract

It is common for commercial vehicles to make the top part according to the use after making the bear chassis, and to connect various devices with the bear chassis. Various brackets used in bear chassis for the development of all automobiles, including commercial vehicles, play a role of connecting the components required for driving and operating the car to the car body. In commercial vehicles, components necessary for operation are installed in the bear chassis; that is, the bear chassis of commercial vehicles is a space where the devices required for driving and operating the vehicle are installed. The devices required for the configuration of the vehicle are drive, brake, exhaust and steering, etc. These devices are basically connected to the body, the front axis, or the rear axis. The part interlinking the apparatuses required for the vehicle drive to the car body or axis is bracket. In this study, we analyzed the boundary conditions to evaluate the stability of the three brackets that connect the components of the car to the front axis of the new type of 30-seater bus in the development process. In order to analyze the boundary conditions, the boundary conditions according to the driving condition of the vehicle were classified. For stress analysis to evaluate the stability of brackets according to the driving state of the vehicle, it is reasonable to give the bracket a boundary condition of harsh conditions.

Keywords: *Bare-chassis, Bracket, Boundary condition, Stress analysis, Driving condition*

1. Introduction

Commercial vehicles manufactured by car manufacturers refer to freight trucks or buses. Unlike passenger cars, these commercial vehicles have a large body weight, and after making a bear chassis, it is common to make the top part according to the purpose and connect it with the bear chassis[1-3]. When developing all automobiles, including commercial vehicles, various brackets installed in the bear chassis play a role of connecting the components of the car to the car body. The vehicle installs the parts required for the drive and operation in the bear chassis[4-6]. The most important part required for the drive engine and mission are installed in the bear chassis. The bare chassis structure of commercial vehicles in the development stage is the same as Figure 1. The bare chassis is a space where devices required for driving and operating a vehicle are installed. Devices required for the configuration of the vehicle are made of a drive device, a brake device, an exhaust device, and a steering device. These devices are basically connected to a body or an axis, and the parts

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that connect the devices required for driving the car to the body or the axis are brackets[7-11].

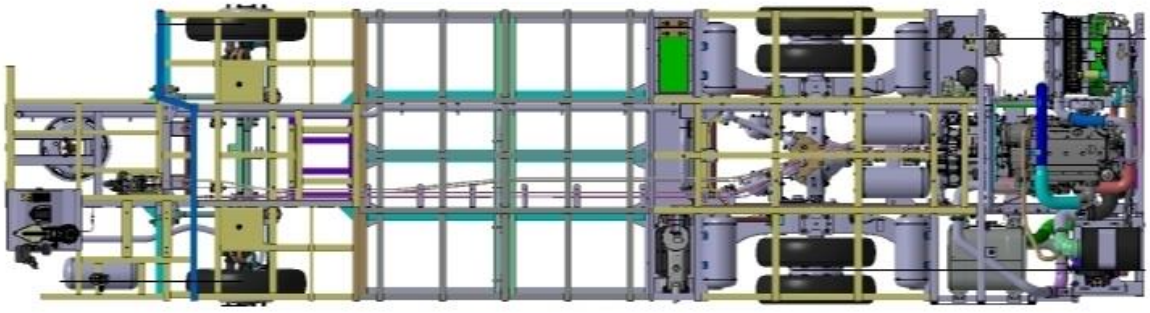


Figure 1. Bare chassis of commercial vehicle in developing

In this study, we analyzed the boundary conditions for the stability evaluation of three brackets connecting components to the front axis of a new type of 30-seater bus in the development process. The structure of brackets connected to the front axis and the body is shown in Figure 2.

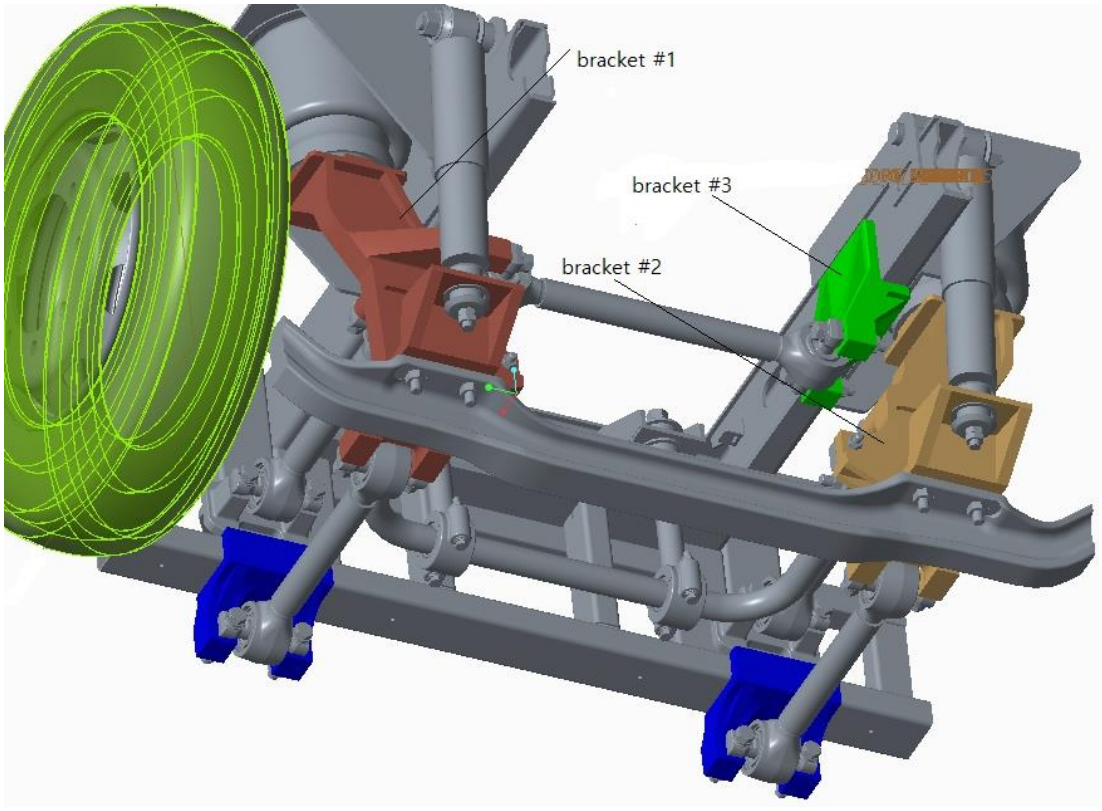
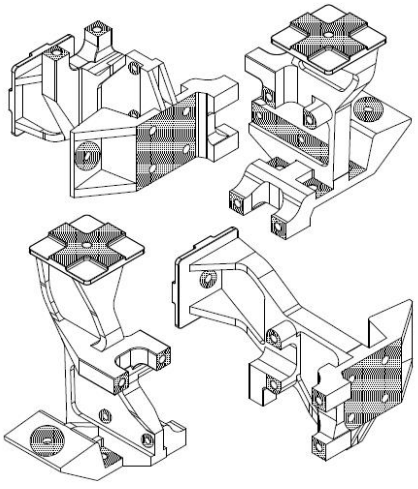


Figure 2. Brackets connected to the front axis and the body

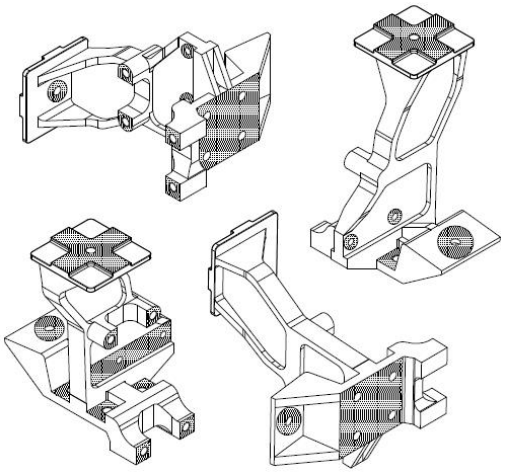
In order to perform boundary condition analysis on three types of brackets shown in Figure 2. load change according to the driving state of commercial vehicle should be considered. For stress analysis to evaluate stability of brackets according to different driving conditions, it is reasonable to give harsh conditions to the load acting on the bracket.

2. Boundary condition classification

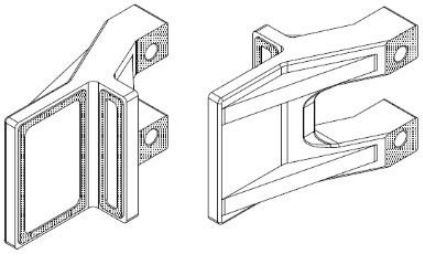
The purpose of this study is to analyze the boundary conditions of three types of brackets to evaluate the stability of the brackets used in commercial vehicles in the development stage. The shape of the three-type bracket is equal to Figure 3. Bracket #1 and Bracket #2 are subject to the load applied as the vehicle travels, depending on its own weight, deceleration, and acceleration. Bracket #3 delivers loads and is linked to Bracket #1 and link members when the vehicle turns and generates centrifugal force.



(a) Bracket #1



(b) Bracket #2



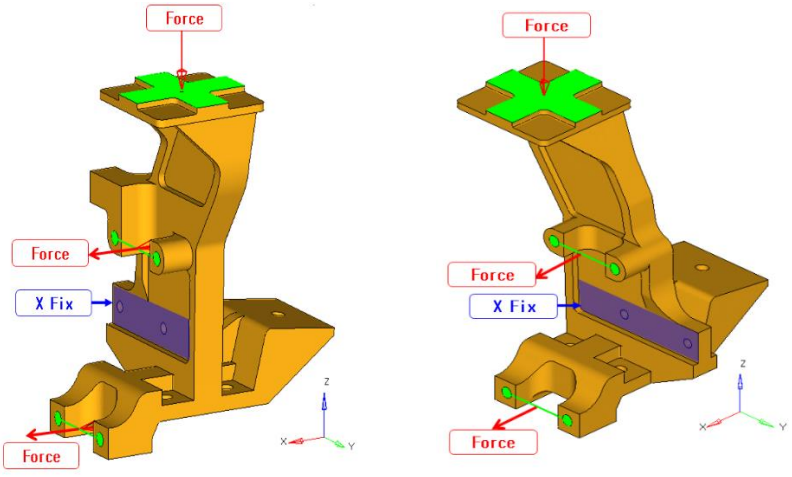
(c) Bracket #3

Figure 3. Bracket species

According to the driving state of the vehicle, the brackets are subjected to loads, and the loads applied to the brackets are classified as boundary conditions according to the driving state. In the boundary condition, the total weight of the 30-seater commercial vehicle was 11ton and the ratio of front axis was 30% of total weihgt. Also, the speed reduction and acceleration were 50km/hr, the radius of the road was 50m, and the speed of the vehicle was considered 50km/hr in the curved section. These data are the result of choosing possible harsh conditions.

2.1 Load of car body and braking

In the situation where the commercial vehicle brakes among driving, the weight of passenger and vehicles is delivered to the car body, and the inertial force by the brake actuates. The difference in speed of slowing down while braking is about 80 kN when the inertial force is calculated by 50 km/hr: this inertial force acts on four wheels, so 20 kN acts on each wheel. The load conditions acting on two brackets connected to the front axis in the braking state considering these contents are as follows.

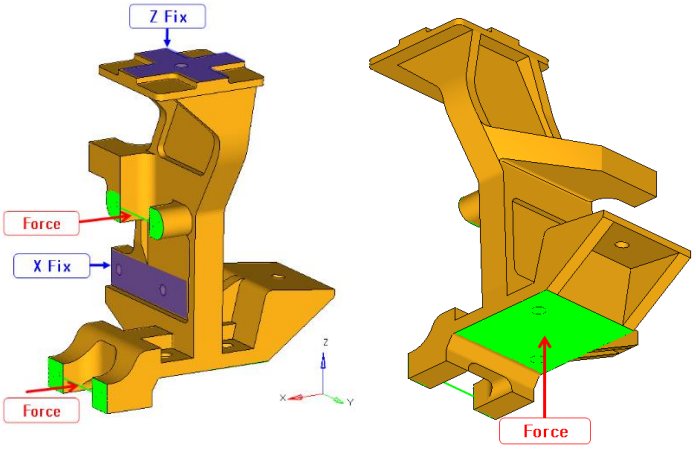


(a) Bracket #1 (b) Bracket #2

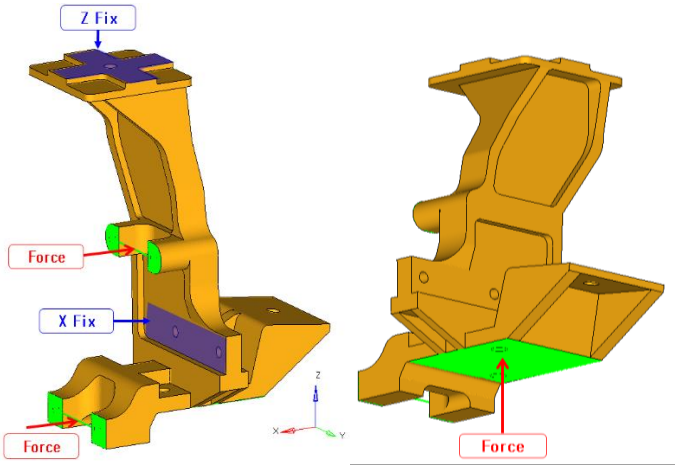
Figure 4. Boundary conditions considering weight and brake of vehicles

2.2 Unevenness and acceleration driving

The vehicle is subjected to its own weight during driving, and the driving condition that accelerates while passing through the unevenness is considered. The load by the vehicle itself is generated by reaction force while passing through the unevenness. Also, the inertia force by acceleration acts on the bracket. Considering this driving condition, the loads acting on the bracket are the same as Figure 5.



(a) Bracket #1

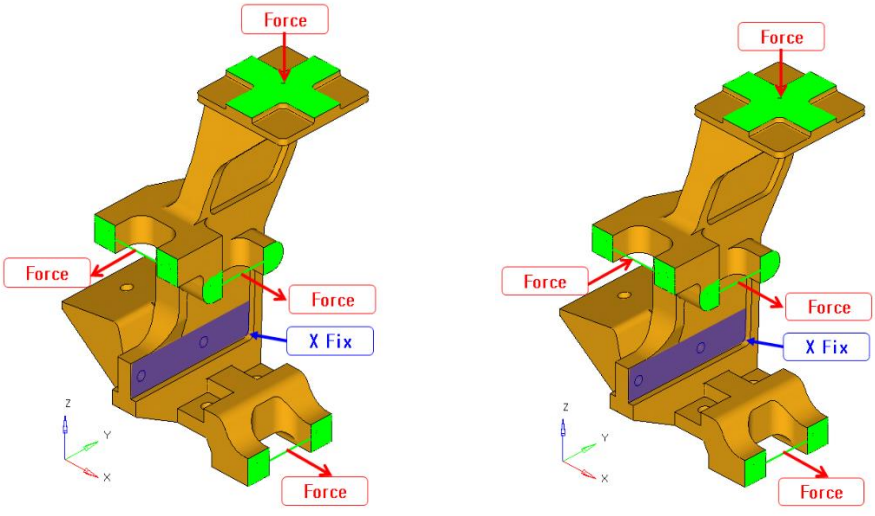


(b) Bracket #2

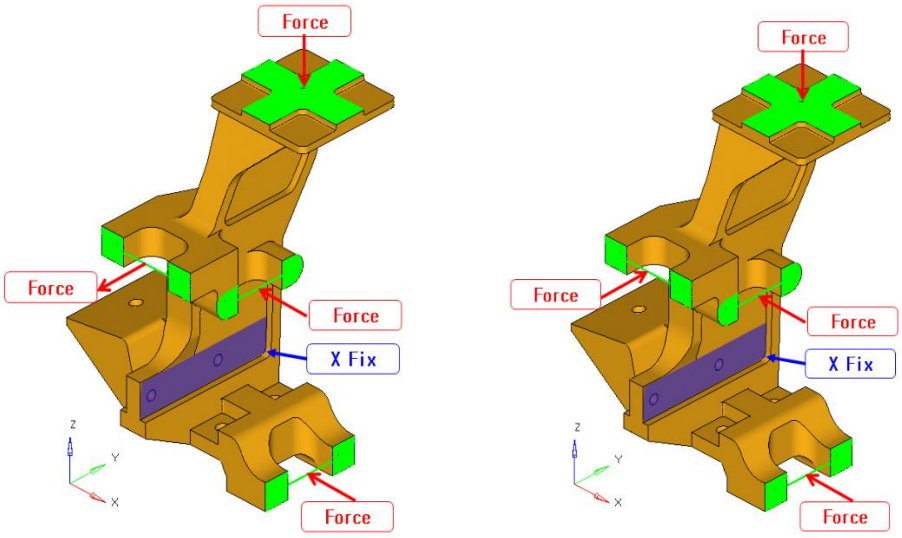
Figure 5. Boundary conditions considering weight and acceleration of vehicles

2.3 Corner driving

The centrifugal force which generates while vehicle passes by the curve section is mv^2/r. Where v is the linear speed, and the tangential speed generated by the vehicle turning the curved section. We assume that in the curved section the speed of the vehicle is 50 km/hr, and the radius of curvature is 50 m. Therefore, the centrifugal force is 43,000N at the time. Since this centrifugal force is connected to two brackets installed in front and rear of the vehicle, the centrifugal force transmitted to one Bracket #1 is about 12,900N. The turning occurring the centrifugal force is created in left and right turning. Therefore, the direction of the centrifugal force actuating on bracket actuates on the respective reverse direction. The boundary conditions considering these centrifugal forces are the same as Figure 6. In the Figure 6. (a) and (c) are the form of delivering centrifugal force generated by the vehicle turning to the right, and (b) and (d) are the centrifugal forces generated by turning to the left, acting on Bracket #1. Figure 6.'s (d) is the best harsh condition given to Bracket #1.



(a) (b)



(c) (d)

Figure 6. Boundary conditions of Bracket #1 in turning driving

Bracket #3 located on the opposite side of Bracket #1 delivers centrifugal force by Bracket #1 to the car body when the vehicle is turned, and the boundary condition is the same as Figure 7.

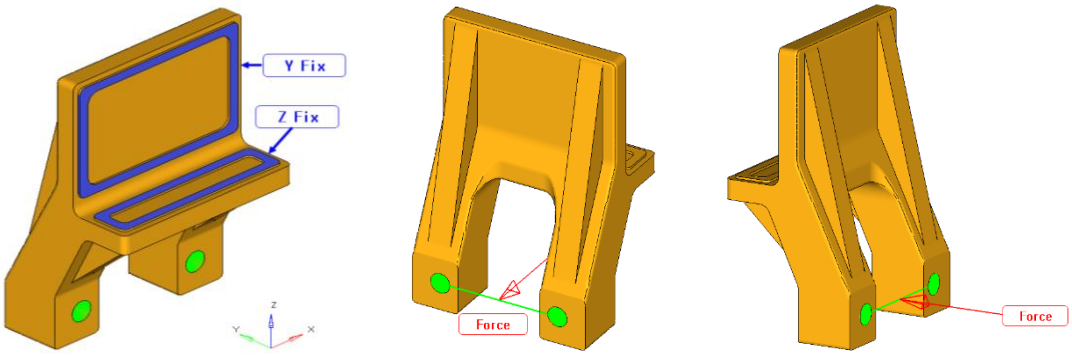


Figure 7. Boundary conditions of Bracket #3 in turning driving

3. Conclusion

In this study, we analyzed the boundary conditions for stress analysis to verify the safety of brackets applied to bare chassis in the early stage of commercial vehicle development. In the bare chassis of commercial vehicles, boundary conditions indicating load change according to the driving state of commercial vehicles for three types of brackets connected to the front axis and the car body were classified and analyzed. The following conclusions were obtained by classifying boundary conditions according to the driving state of the vehicle and performing analysis.

1) Boundary conditions should be classified according to the driving state of the vehicle in order to analyze the load change acting on the brackets included in the bare chassis.

2) The driving condition classification of the vehicles should consider the car body load application,

deceleration, acceleration and corner driving.

3) It is reasonable to give the boundary condition of the harsh condition to the load acting on bracket.

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