Product Introduction

Development of Light-Weight Electronically Controlled Mixer Truck "MR5040EL"

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1 Introduction

Plans for the Tokyo Olympics and redevelopment of Central Tokyo in recent years have increased the needs for products with better transportation efficiency.

"Light-weight mixer truck (Photo 1)" refers to trucks, in which the weight of the mounted mixer feature has been reduced in response to the low-floor-type chassis Note 1) (hereinafter referred to as "low-floor truck"). They can transport more ready-mixed concrete at a time due to the increased load of wet concrete.

Light-Weight Electronically Controlled Mixer Truck "MR5040EL" (hereinafter referred to as "MR5040EL"), which is introduced in this review, is made even more lightweight than the Low-floor Light-weight Mixer Truck "MR5020L" that has been in mass production since 2009. In addition, MR5040EL employs the urban-type computerized control "eMixer-II" Note 2)", which is quiet and was not installed in the conventional light-weight mixer trucks.

Note 1) The back tires are small in diameter, resulting in lower height than common large trucks. In addition, due to its medium truck-class engine, the chassis weight is lighter by approximately 1,500kg.

Note 2) Computerized hydraulic drive control for concrete mixer trucks (Refer to KYB TECHNICAL REVIEW No. 44 Model Change of the Electronic Control Concrete Mixer Truck "eMIXER")

Photo 1 Light-weight mixer truck

2 Development Background

2.1 Issue in achieving the load

The total weight of a light-weight mixer truck is 20 tons, and it had achieved the load of 11,500 kg, which was the standard specification as per the original requirement. However, the purification unit, which was installed as a result of increased exhaust gas regulations, increased the chassis weight, thus reducing the load to approximately 11,450 kg. In addition, special features to satisfy customer requests increase the weight, which further reduces the load.

In this development, we aimed to reduce the weight of the mounted mixer feature by more than 150 kg with the aim of achieving the load of 11,600 kg in the standard specifications for low-floor trucks.

2.2 Issue in reducing the assembly man-hours

As previously mentioned, demands are expected for light-weight mixer trucks. However, light-weight mixer trucks require more assembly man-hours in KYB production lines than large mixer trucks, which have more orders, preventing us from increasing the production. Light-weight mixer trucks take approximately 1.3 times more assembly man-hours compared to large mixer trucks. Therefore, our aim was to reduce the assembly man-hours of light-weight mixer trucks to the same level as large mixer trucks in order to increase the production. In addition, the assembly line requires welding when mounting the feature. However, spattering may damage the vehicle, and deteriorated atmosphere due to welding may also lead to contamination, etc. Our aim was to simultaneously improve the quality by discontinuing the welding process in the assembly line as well as reduce the assembly man-hours by changing the structure.

3 Overview of Weight Reduction

3.1 Newly developed special frame

As previously mentioned, low-floor trucks are designed so that the height is lower than large trucks. Therefore, when the mounted feature for large trucks is installed on a low-floor truck as is, it lowers the hopper (Photo 2), from which wet concrete is injected, resulting in a gap in height

with wet concrete manufacturing plants. In addition, it also lowers the chute (Photo 2), which releases wet concrete, compared to large trucks, meaning that user-friendliness is compromised for customers in terms of use with concrete pumping trucks [Note 3]. Furthermore, since low-floor trucks are medium class trucks, their chassis frame strength is weak and cannot withstand the weight of the mounted feature, which is intended to be installed on large trucks.

In order to respond to such issues, conventional light-weight mixer trucks have one "sub-frame" from the front to the back of the mounted feature under the front frame/rear frame on each side. Sub-frames enabled these trucks to have the same height as large trucks, increased the strength on the mounted feature side, and compensated for the frame strength on the chassis side, thus enabling the mounted feature to be installed on low-floor trucks (Fig. 1).

The weight of MR5040EL, which is introduced in this review, has been made light by removing these sub-frames. First, we changed the design so that the height from the ground is made the same as the conventional light-weight mixer trucks by increasing the height of the front/rear frames to address the height issue. Next, we installed a middle frame between the front frame and rear frame by using a square pipe to address the strength issue. By securing these components with bolts, we integrated them into one frame structure, increasing the strength along with the frame on the chassis side (Fig. 2). To determine the form, we used the Finite Element Method to analyze the structure in order to satisfy the strength and optimize the structure by limiting weight increase (Fig. 3). With these changes, we were able to reduce the weight by approximately 100kg without changing the user-friendliness for customers.

Note 3) Vehicle used to pressure-feed wet concrete to a far location or high location via a boom.

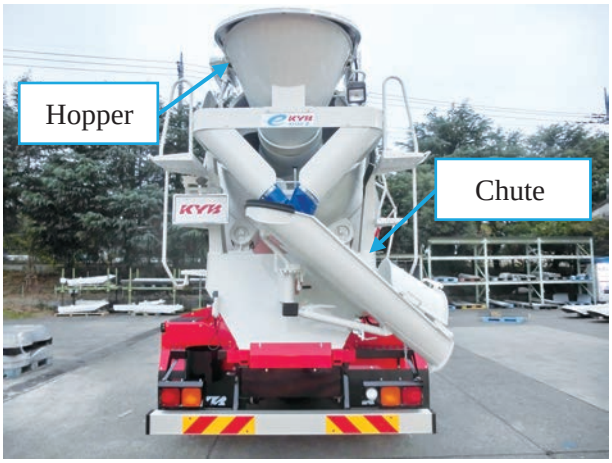


Photo 2 Hopper and chute

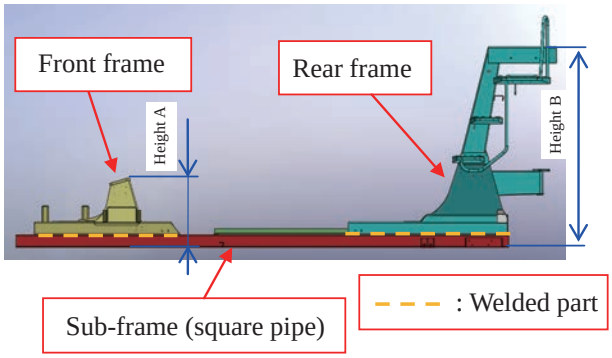


Fig. 1 Conventional mixer frame

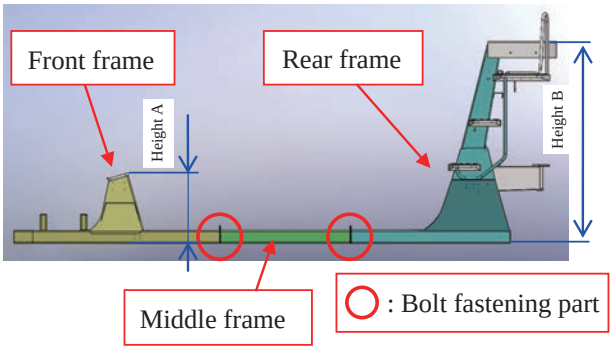


Fig. 2 Newly developed special mixer frame

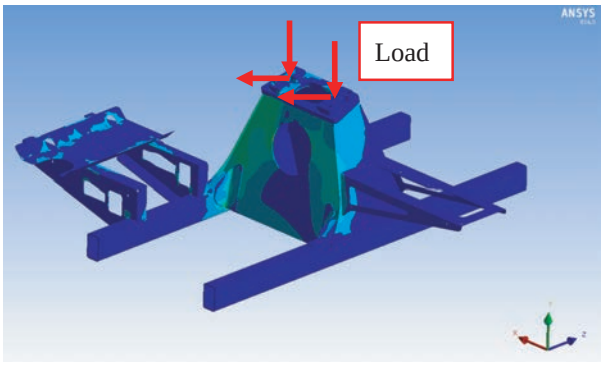


Fig. 3 Mixer frame FEM analysis

3.2 Reducing the thickness of the roller ring

Roller ring touches the drum roller, which rolls the drum (Fig. 3), and it integrates with the drum along the rolling plane. The drum touches the roller ring in 2 places in the back, so the roller uses a reinforced material due to the fact that it bears the load when wet concrete is loaded.

Strength, conductivity, and durability are aspects to consider when reducing the thickness. Therefore, we performed analyses and experiments for each consideration step and aimed to achieve the limit design. Due to this, we were successfully able to reduce the weight by approximately 20 kg.

3.3 Using the oil cooler

KYB's mixer trucks use hydraulic pump/hydraulic motor. Hydraulic drive rolls the drum, but an oil tank is originally installed to maintain the heat balance.

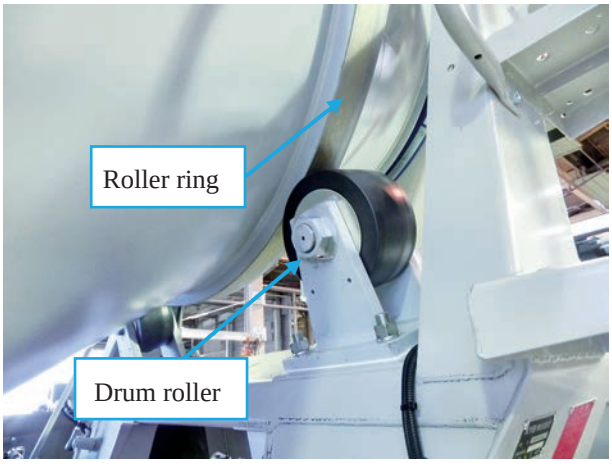


Photo 3 Drum roller and roller ring

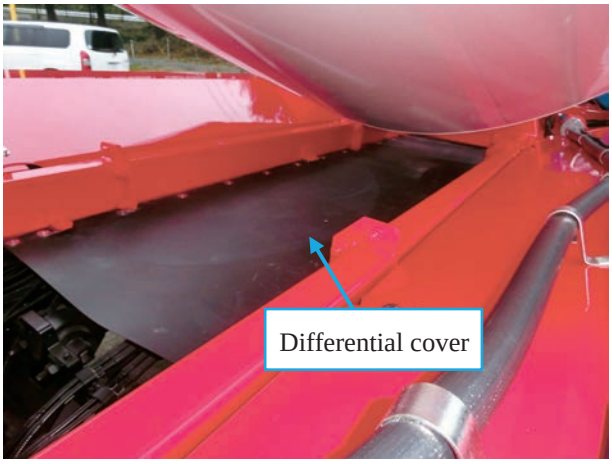


Photo 5 Resin material differential cover

We used an oil cooler, with which the oil tank is integrated, for MR5040EL. This is the first time for this oil cooler to be used for domestically manufactured mixer trucks. The oil cooler (Photo 4) has a fan for forced cooling, which can efficiently cool down with a small amount of hydraulic oil. In addition, reducing the used hydraulic oil amount also leads to weight reduction.

Due to this, we reduced the used hydraulic oil amount by 80% without reducing the cooling efficiency and successfully reduced the weight by approximately 30kg.

Photo 4 Oil cooler

3.4 Using resin for the differential cover

The differential cover is used to prevent the grease, which sprays from the differential gear on the chassis side, from spattering on the drum.

The differential cover used in KYB's mixer trucks, which are manufactured in Japan, is made with iron. We aimed to reduce the weight of MR5040EL by changing the material for the differential cover to resin (Photo 5). This is used for KYB's overseas mixer trucks, and it performs sufficient functions as a cover. Due to this, we were successfully able to reduce the weight by approximately 10kg.

3.5 Using aluminum material

We used aluminum exterior parts, which are also used as standard parts for the conventional light-weight mixer trucks, on MR5040EL as standard parts in order to also reduce the weight. Some of the exterior parts using the aluminum material are side guard to prevent people from getting caught, fender/splash board to prevent spattering of mud during traveling, and rear cover to prevent wet concrete from spattering over the rear part of the vehicle (Photo 6).

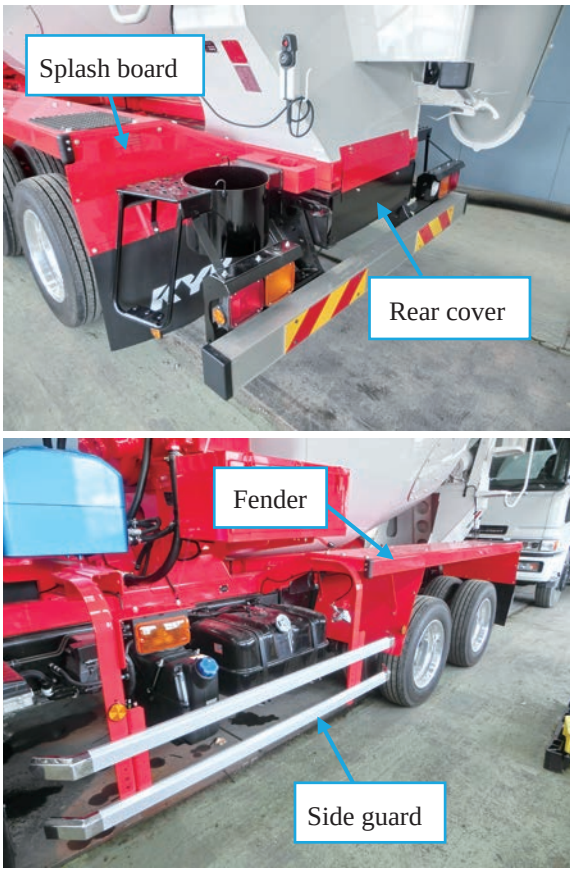


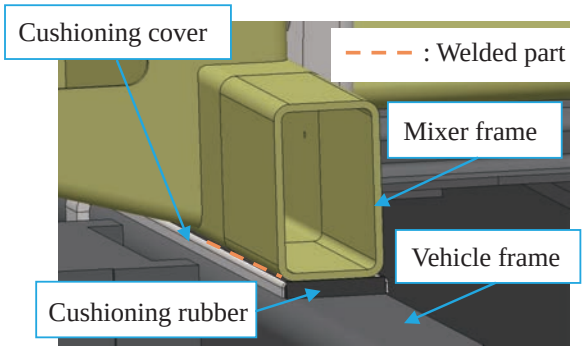
Photo 6 Aluminum exterior parts

4 Simplifying Assembly

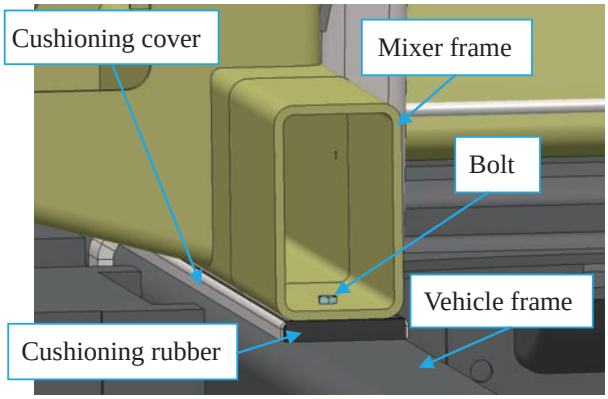
In this development, we considered the design so that we could discontinue the welding process in the assembly line and reduce the assembly man-hours on the mounted feature side.

4.1 Reducing assembly man-hours with the newly developed special frame

As previously mentioned, sub-frames were installed on the conventional light-weight mixer trucks. With MR5040EL, we discontinued the sub-frames and secured middle frames with bolts, thus successfully discontinuing the welding process in the line and drastically reducing the assembly man-hours.



(a) Conventional mixer



(b) MR5040EL

Fig. 4 Cushioning cover bolt fastening

4.2 Discontinuing the welding process to prevent the mounted feature and the cushioning material for vehicle from falling out of place

Rivets are installed on top of the vehicle frame. If the mounted feature is installed directly on the vehicle, it would sit on the rivets. Therefore, we install cushioning rubber in between as a cushioning material. Furthermore, we install a cover on the cushioning rubber so that it would not fall out of place while traveling. The cushioning cover is welded onto the mixer frame in the assembly line (Fig. 4-a). However, with MR5040EL, we tapped the mixer frame and secured the cushioning cover and the cushioning rubber with bolts with the aim of preventing them from falling out of place and discontinuing the welding process (Fig. 4-b).

5 Conclusion

We have reduced the weight of the mounted mixer feature by more than 150 kg in this development and succeeded in achieving the load of over 11,600kg in the standard specifications.

The assembly man-hours have drastically reduced and have become the same number of man-hours as large trucks, which has enabled us to increase production. Furthermore, we have also been able to discontinue the welding process within production lines.

6 In Closing

This was exhibited in the Tokyo Motor Show, which was held in October of 2015, as part of our development activities. It was well-received by many visitors.

Our plan for the future is to have customers perform monitor assessment and develop this into a mixer truck, which is even more user-friendly.

Finally, I would like to express my deepest gratitude for everyone involved in this development who has provided great support, within and outside of the company.

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