

Development of FREED Assisted Mobility Vehicle

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ABSTRACT

This paper introduces two approaches that were applied when developing the FREED assisted mobility vehicle, and gives specific examples of each.

The first approach is to simultaneously develop an assisted mobility vehicle with various specifications from the base specification vehicle planning and layout stage. The optimum package layout for an assisted mobility vehicle was realized within that process. In addition, common parts were shared by establishing the streamlined parts design and investigating design feasibility.

The second approach consists of simultaneously producing assisted mobility vehicles within the same production line as mass production vehicles.

Applying the above development methods enhanced product appeal and productivity compared to conventional models.

1. Introduction

Research on small-scale production technology for special vehicles was previously reported in “Development of Small-scale Production Method for Large-size Exterior Plastic Parts”⁽¹⁾. Development of the FREED assisted mobility vehicle introduced in this paper aimed to enable various usage formats and enhance product appeal, while also reducing costs by minimizing investment amounts in consideration of small-scale production.

2. FREED Assisted Mobility Vehicle

The FREED package characteristics, which offer large cabin space in a compact body size, were used to provide sufficient functions as an assisted mobility vehicle with the minimum possible changes from the base vehicle. In addition, various specifications are provided to meet

diverse user needs.

Figure 1 shows the three FREED assisted mobility vehicle types.

Side lift-up seat (equipment) car is illustrated in Fig. 1(a).

This is a 4-passenger specification with two rows of captain seats for easy assistance when getting in and out of the vehicle. A sliding door with an opening width of 600 mm is included to provide sufficient space when raising and lowering the lift-up seat.

Next, assistant lift-up seat (equipment) car is shown in Fig. 1(b).

This is a 7-passenger specification with three rows of captain seats for easy communication. The door opening angle is 16.5 degrees wider than that of the base vehicle in order to provide sufficient space when getting in and out of the vehicle.

Finally, wheelchair vehicle is shown in Fig. 1(c).



Fig. 1 FREED with side and assistant lift-up seat and wheelchair vehicle (with third seat)

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Two types were set: a 5-passenger specification with two rows of captain seats, and a 7-passenger specification with three rows of captain seats. A 3-point seatbelt for the wheelchair passenger is provided, and various usage formats are supported.

3. Package Layout and Common Parts with the Base Vehicle

3.1. Simultaneous Development of Three Assisted Mobility Vehicle Types

Assisted mobility vehicles have conventionally been modified versions of mass production vehicles, so the following items are desired⁽²⁾.

- (1) Large-scale modifications should not be necessary.
- (2) It should be possible to flexibly add different equipment to suit the needs of the disabled.

In addition, development of assisted mobility vehicles easy to use for every user has also been desired from the viewpoint of universal design⁽³⁾. FREED development did not take the approach of developing separate general vehicle and modified vehicle types, but was instead conducted in a manner that includes the modified vehicle as a variation of the general vehicle. The assisted mobility vehicle with various specifications was simultaneously developed in order to effectively achieve the items specified below.

- (1) Establishment of the optimum FREED package layout that also includes assisted mobility specifications
- (2) Sharing of common parts between the FREED base vehicle and assisted mobility vehicles
- (3) Line production of assisted mobility vehicle with minimum changes to line facilities

Specific examples in the development of wheelchair vehicle are presented below.

3.2. Specific Examples of a Streamlined Package Layout

A package that can also be used as a wheelchair vehicle has been developed by making use of base vehicle package.

The layout of the exhaust pipe, fuel tank and fuel lines, rear suspension, harness, and other parts was investigated. This resulted in a better package layout with a wider slope, taller rear opening, and more expansive wheelchair passenger space compared to other compact class minivan wheelchair vehicles in the same class as the FREED. Note that values of these sections are almost the same as those for a middle class minivan wheelchair vehicle.

The main wheelchair vehicle dimensions and comparisons are set forth below and in Fig. 2.

- (1) Lateral width of the slope for getting in and out of the vehicle: 700 mm (+20 mm wider than other vehicles in the same class)
- (2) Height of wheelchair passenger space: 1 345 mm (+95 mm higher than other vehicles in the same class)
- (3) Opening height: 1 315 mm (+90 mm higher than other vehicles in the same class)

3.3. Specific Examples of Common Parts Shared with the Base Vehicle

After securing the main wheelchair vehicle dimensions described in section 3.2. above, common parts were shared with the base vehicle as shown in Fig. 3 below in order to reduce new investment.

The main common parts with the base vehicle are shown in Fig. 4.

- (1) Exhaust pipe in front of the low floor section
- (2) Fuel tank in front of the low floor section

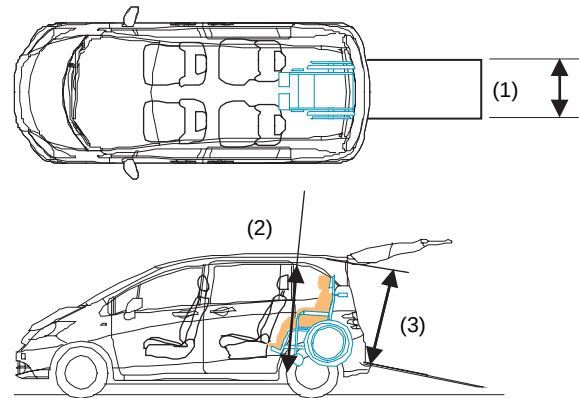


Fig. 2 Main dimensions of FREED wheelchair vehicle

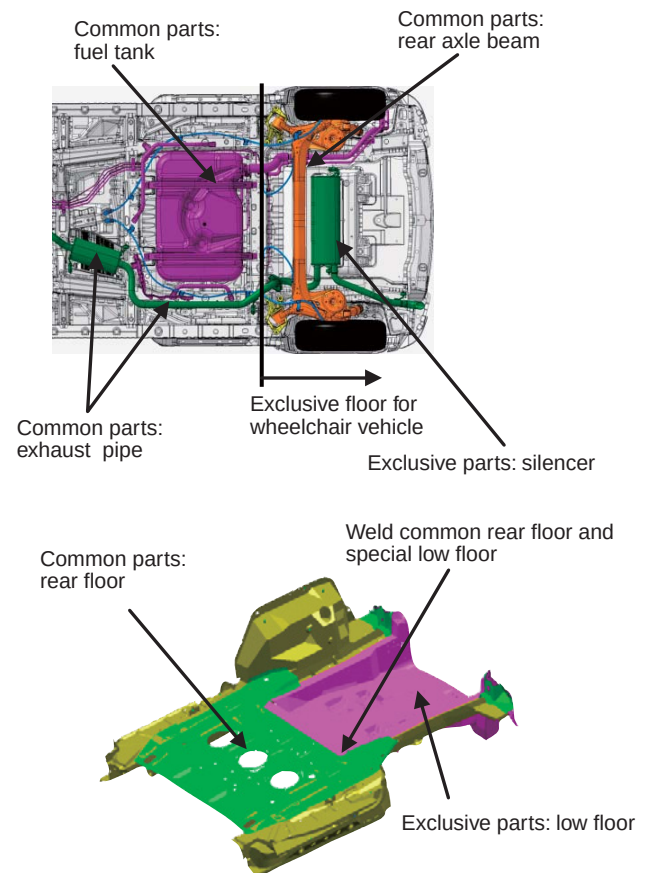


Fig. 3 Structure of FREED wheelchair vehicle

- (3) Rear axle beam
- (4) Floor (structural portion) in front of the low floor section

The above parts contribute greatly to basic vehicle performance, and the use of common parts enables the development process time to be streamlined.

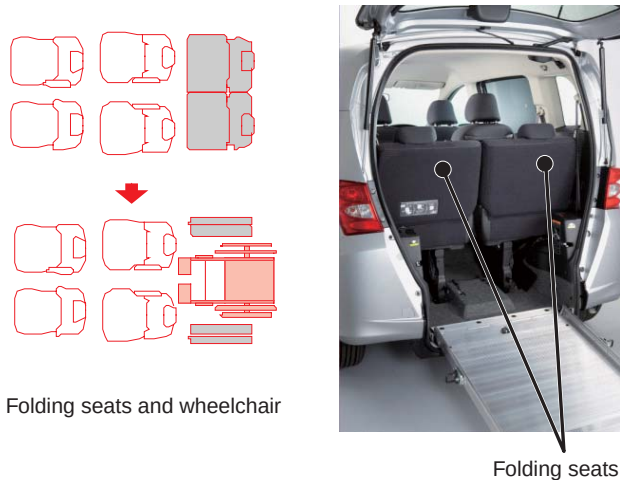


Fig. 4 FREED wheelchair vehicle (with third seat)

3.4. Compact Size Wheelchair Vehicle that also Enables Use of a Third Seating Row

Investigations were also conducted to enable the FREED wheelchair vehicle to make the use of the 7/5-passenger package layout of the base vehicle. This resulted in a compact size minivan vehicle with a 3-row seating specification that can accommodate seven adult passengers when not using a wheelchair, and a 2-row seating specification that can accommodate five adult passengers when using a wheelchair. This enabled the support of various usage formats.

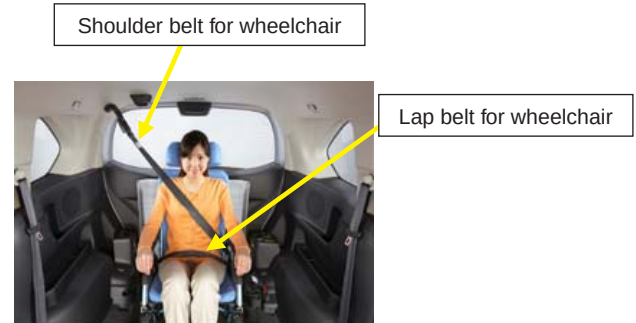


Fig. 5 Photograph of FREED wheelchair vehicle (with 3-point seatbelt for wheelchair)

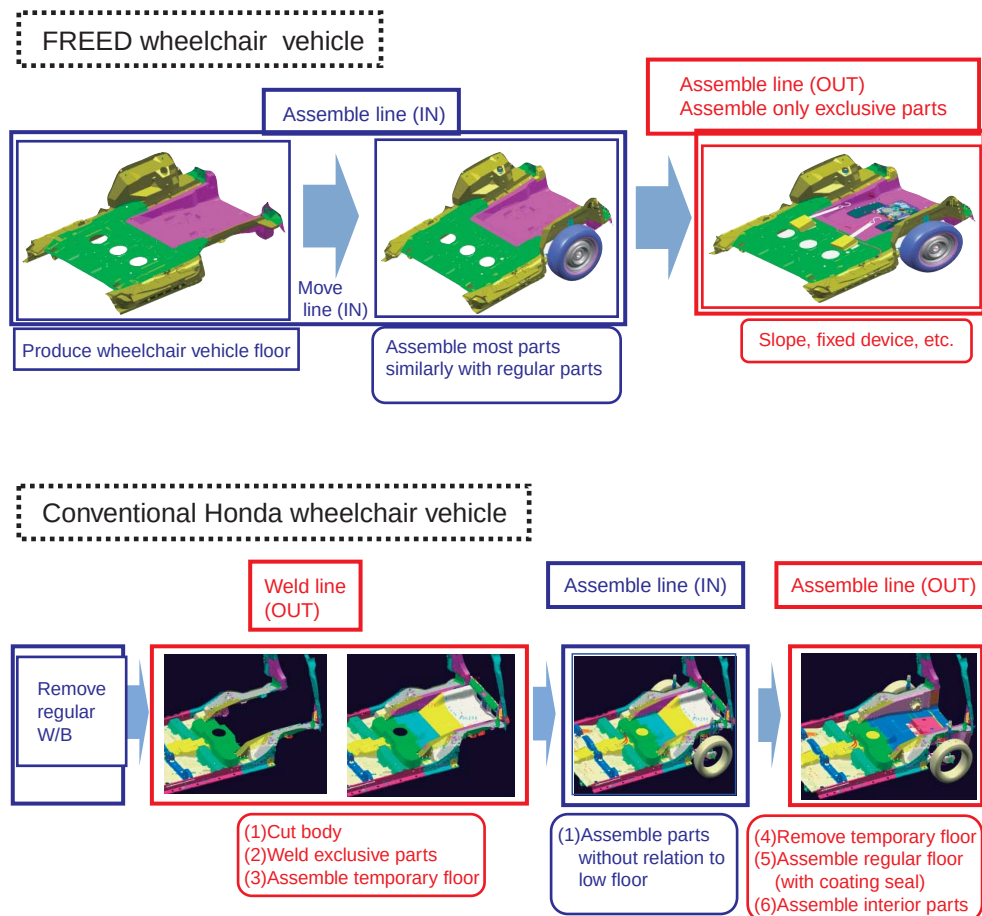


Fig. 6 Manufacturing outline of FREED and conventional wheelchair vehicles

3.5. Three-point Seatbelt and Other Features for Wheelchair Passenger

The FREED wheelchair vehicle has a 3-point ELR seatbelt for the wheelchair passenger that consists of a shoulder belt and a lap belt as shown in Fig. 5. The locations where this seatbelt is attached to the chassis share common parts with the base specifications. In addition, the two belts are separate in consideration of different usage formats. Assist grips are also provided on the backs of the second row seats, enabling the wheelchair passenger to more easily maintain position and posture.

4. Common Manufacturing Processes with the Base Vehicle

Figure 6 shows the process outline diagrams for the FREED wheelchair vehicle and the conventional Honda wheelchair vehicle. Processes enclosed by blue frames in the figure are processes in the mass production vehicle manufacturing line, and those enclosed by red frames are processes outside the mass production vehicle manufacturing line. In addition, the upper level shows the process outline for the FREED wheelchair vehicle and the lower level shows the process outline for the conventional vehicle. The conventional vehicle shown on the lower level has many processes that are performed outside the manufacturing line, such as cutting the body, welding exclusive parts, assembling and then removing a temporary floor, bolting to the floor of the base vehicle (including sealing), and assembling exclusive interior parts. In contrast, for the FREED wheelchair vehicle shown on the upper level, the only processes performed outside the manufacturing line are assembly of some parts such as the slope and wheelchair fixing devices.

5. Conclusion

This development applied the two development methods of:

- (1) Developing assisted mobility vehicles simultaneously with the base specification vehicle
- (2) Producing assisted mobility vehicles within the same production line as mass production vehicles

This enabled the use of the characteristics of the FREED package, which offers high utility in a compact size, and solidified the FREED assisted mobility vehicle concept, while also giving consideration to the viewpoints of conservation of resources and energy.

It is thought that the social need for assisted mobility vehicles and other assistance measures will increase further as Japan moves towards an aging society. However, production volumes will still be small, and it is important that assisted mobility vehicle development enables the support of additional usage formats and increases product appeal further, and those steps be taken to advance rational vehicle creation as small-scale

production vehicles.

Numerous opinions and advice were received during the course of this development from people on the front lines at care facilities, and the authors would like to take this opportunity to express their deepest thanks to everyone for their cooperation.

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