

Interior Design for Gran Class of E5 Tohoku Shinkansen “Hayabusa”: An Unprecedented Journey Experience

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OVERVIEW: The Gran Class is the first new grade of passenger car to be introduced since the Shinkansen began operating. Its design needed to provide not only a luxurious interior, but also an extraordinary experience that would justify the additional cost of a premium seat. Hitachi had collaborated with the East Japan Railway Company to develop the design of the new Gran Class passenger car for the E5 “Hayabusa” used on the Tohoku Shinkansen. The aim was to provide an unprecedented travel experience. The initial design work involved visualizing how passengers would use the car. This was followed by the formulation of scenarios covering different travel experiences that were then used to determine passengers’ latent requirements and subjective values. The final step was to develop the style of service and interior that would satisfy the requirements identified from the scenarios. In producing this design for an unprecedented premium passenger car, Hitachi found that it needed to trial a variety of different methodologies and to utilize manufacturing techniques with a high degree of craftsmanship.

INTRODUCTION

HITACHI and the East Japan Railway Company (JR East) have for some time been jointly engaged in the development and production of Shinkansen passenger cars for services to the new Shin-Aomori Station on the Tohoku Shinkansen.

The first of the new Gran Class Shinkansen passenger cars commenced operation as part of the E5 Shinkansen (production model) that entered service in March 2011 (see Fig. 1). Conceived as a premium passenger car that delivers an exclusive and spacious traveling service, the design of the Gran Class needed



Fig. 1—Gran Class Interior in East Japan Railway Company’s E5 Shinkansen.
The E5 Shinkansen provides a new luxury-class passenger car of a type not seen on previous Shinkansen trains.

to embody an extraordinary experience unlike any provided by previous trains.

This article describes how Hitachi went about developing its ideas and then embodying these in the Gran Class in order to create an unprecedented travel experience for the Tohoku Shinkansen E5*.

ORIGINS OF NEW DESIGN

Normally, the requirements that form the basis of a design can be obtained by considering the relevant factors, such as who will use the service and in what way, in the light of past experience. In the case of the Gran Class project, in contrast, the initial requirements were not clearly laid out. Instead, the objective was to design an exclusive passenger car of a type that had never existed on the Shinkansen in the past, and that would provide an extraordinary experience.

In response, the Design Division of Hitachi looked at studies undertaken in Japan by JR East for use in developing the E5 Shinkansen, seeking to determine what dissatisfactions and expectations customers had regarding the current Shinkansen service. This analysis found that what customers were looking for in terms of facilities and services could be split into two levels. The first comprised basic requirements shared by everyone that will lead to dissatisfaction if not provided. Examples include wider seats or having two armrests. The second were higher level expectations that make the time passengers spend on the train more pleasant, such as having relaxing seats and providing proper cutlery with meals.

While eliminating the sort of universal dissatisfactions associated with the former category of requirements is a prerequisite for all classes, the exclusive Gran Class also needs to deliver an extraordinary experience that surpasses the expectations represented by the latter category. Hitachi concluded that these two levels of needs were the keys to creating a successful design for which customers would be willing to pay a premium.

DEFINING PERSONAS AND IDENTIFYING TARGET USERS

To add realism to the work on developing an extraordinary experience, Hitachi identified scenarios for the type of person who would likely use the Gran Class.

Different types of passengers will have different expectations for the services and interior provided

by the new class. Accordingly, working on the assumption that Gran Class passengers will have a similar profile to passengers on existing Green Car services, Hitachi looked at the travel reasons and age distribution of Green Car passengers. This indicated that 70% of passengers on weekdays were traveling for business, whereas on weekends the proportions were reversed, with 70% traveling for pleasure. In terms of age, more than 60% of passengers were aged 50 or over (the "senior" category). As the Gran Class is positioned as a class above the Green Car, it was envisaged that the target passengers would be affluent people from among existing Green Car users, with the target age group being the same or slightly older. In other words, they would be discerning customers who were accustomed to high-quality environments and products, and would be a mix of people traveling for business and for pleasure.

Hitachi then went on to characterize archetypal Gran Class passengers as a way of explicitly representing the different passenger category scenarios that were to be used in the design process. The two passenger categories assumed for this purpose were: (1) executives traveling for business purposes, and (2) elderly couples traveling for pleasure.

To make the assessment of the Gran Class user experience more realistic, Hitachi defined "personas" for each of these passenger categories. For example, the business executive category was personified by a 57-year-old executive returning from a business trip in which he accompanied a customer on a visit to a production line in an Aomori factory. His job would have left him tired and looking forward to relaxing on the train, and he would be a frequent Gran Class passenger, traveling two or three times a month either in the morning or at night. In other words, the travel experience was studied with reference to these personas who were defined in terms of their age, occupation, reason for travel, how they wanted to spend their time on the train, and their travel schedule requirements.

TRIALS OF SCENARIO-BASED DESIGN

There are two reasons for creating a narrative describing how these constructed personas would go about catching the Shinkansen, spending their time on the train, and getting off at their destination. The first is to identify emotional expectations and latent requirements that are difficult to uncover from conventional surveys. The second is to use the storytelling process as a means for stimulating people's imaginations so as to expand their conception of the

* The E5 Shinkansen has been adopted in other trains besides "Hayabusa," such as "Hayate," "Yamabiko," and "Nasuno."

interiors and required facilities that appear in the story. In both cases, these act as a framework for giving shape to abstract concepts during the process of deciding on actual train services, what facilities these services require, and what sort of lighting and other interior fittings are needed to realize the vision for the space.

The following is an extract from a travel scenario used in the detailed design that describes a trip taken by a business executive on the Gran Class.

The scenario imagines a business executive on his way home from Shin-Aomori Station in the evening. His work day went well, leaving him in a good mood as he took his place on one of two side-by-side seats, looking forward to relaxing in the Gran Class as it carried him back to Omiya Station.

(The first part of the story is omitted.)

“Having had a few beers, I decide I would like to drink a little more. Since there is still plenty of time before we reach Omiya Station, I press the call button to ask the service attendant for a glass of whisky on the rocks. This she promptly delivers, arriving with a tray containing a large glass and some nuts which she proceeds to place on my cocktail table, serving with a smile. I’m impressed that she even brings a chaser to go with the whisky. How thoughtful! Holding the crystal glass in one hand, I start checking my schedule. But today went so well, I decide instead to spend my return trip relaxing. As I enjoy the aroma and flavor of the single malt whisky, I use my finger to circle the big round ice cube.

“When I boarded the train at Aomori, I noticed a formally dressed woman in the adjacent seat and wondered whether she was on her way to a wedding. I am glad that the partitions between seats allow us to relax freely with no chance of meeting each other’s eyes. The seat is spacious and large. The indirect lighting is slightly dim but comfortable, while a bright reading light is also provided specifically for my seat. The seat itself comes with special large armrests, and the exclusive personal space almost makes me forget I am on a train. Everything I need is within reach. The passenger who is sitting next to me does not bother me at all. This luxury space is really specially made for me.

“After drinking the whisky, I decide to take a nap before arriving at Omiya station. I lower my seat into a comfortable reclining position that provides good support and a reassuring sense of encapsulation. I am more glad than ever that I decided to travel Gran

Class. The personal service provided by the attendant is delightful and thoughtful, and having this space to myself gives a sense of exclusivity. A pleasant break from my usual routine, it is almost like taking a room at a luxury hotel, giving me time to relax. I will definitely choose Gran Class again the next time I travel. While thinking this, I drift off to sleep.”

The highlight experiences for the passenger in this high-end train scenario were the sorts of things that could not possibly be obtained from conventional surveys. Examples include the smiling and attentive attendant, the unexpected and thoughtful provision of a chaser, the exclusivity and spaciousness of the seating, and the satisfaction of being given adequate personal space without intruding on that of other people. These images also provided key pointers for designing the actual services and facilities.

Hitachi identified the experience provided by these “attitudes” (*furumai*) and “facilities” (*shitsurae*) with their attendant emotional values as being important elements in providing an extraordinary travel experience for targeted customers who would be prepared to pay for a premium seat. In producing a design capable of bringing these elements to life, Hitachi would be creating an unprecedented premium car.

Creating these detailed scenarios for different categories of target passenger served to clarify the various requirements that the Gran Class would need to meet. Based on these, Hitachi condensed the world view represented by the Gran Class experience into an overall design concept: “Exclusive dream: An unprecedented journey experience.”

ACTUAL INTERIOR DESIGN

The next step was to use these scenarios as a basis for creating a specific visual design for each of the different situations. This process gave visual form to the space that would provide the business executive with this special experience, and the facilities needed to deliver the accompanying level of service (see Fig. 2).

To deepen the link between the visual images derived from the scenarios and the actual car interiors, Hitachi surveyed the interiors at five prestigious foreign-owned hotels in Tokyo to act as a benchmark for the level of luxury and hospitality needed to surpass everyday expectations. The reason for using these hotels as a reference was because they were seen as representing a commonly accepted standard for quality and service.



Fig. 2—Design Study of Space and Facility Requirements. Travel scenarios for target users were represented as visual images and used to consider what spaces would provide this special experience, and what facilities would be needed to deliver the accompanying service.

Three elements were identified from this analysis. Firstly, the hotel rooms were furnished in a consistent simple and contemporary style. Secondly, a rich textured feel was achieved through the use of rustic wooden materials and glossy fabrics. The third element was that a high-end atmosphere was created through skillful color coordination in the arrangement of these high-quality materials. This approach of expressing a sense of quality through a simple basic design together with rich materials and finely balanced color combinations is called the “authentic modern” style, and it was designated as the benchmark for the interior design of the cars (see Fig. 3).

The hotel study also identified lighting design as another factor in creating a high-quality impression. The approach taken is to use multiple sources of indirect lighting that combine to provide a subdued atmosphere, with some areas left purposely dark while others are elegantly highlighted with spotlighting. This lighting method is called “task and ambient lighting.” It creates a calm and relaxing mood in a room by using standing lamps to provide indirect lighting for overall illumination, with localized lighting provided where needed for specific tasks such as reading. This is a well-established approach to creating a sophisticated lighting environment in which the darkness emphasizes the brightness.

Hitachi saw the application of this design methodology for creating high-quality hotel rooms to the Gran Class as a means of creating an interior space that conveys an impression of quality the moment the passenger enters the car.

Specifically, to create a design in keeping with this “authentic modern” style of color and finish, a loop pile carpet in a Bordeaux wine color was combined with the matte white-beige finish of illuminated



Fig. 3—Selection of Materials for Achieving “Authentic Modern” Style.

The style is simple and contemporary. An atmosphere of luxury is created from a color-coordinated combination of high-quality materials, including rustic woods and glossy fabrics.

surfaces and seats of high-quality leather in a matching shade of beige, with the overall effect being accented by dark-brown wood with a clear grain pattern. The lighting also drew on techniques used in hotels, with a design that used multiple sources of indirect lighting to create elegant pools of light against a darker background, including cross-car-mounted ceiling lights, window frame lighting, and lights mounted under the overhead rack and in foot wells. This is called “multi-ambient lighting,” and is intended to create a heightened sense of personal space and exclusive luxury through careful integration with the design of the area around the seat.

METICULOUS CAR DESIGN THAT DELIVERS “EXPERIENCE”

Incorporating a sophisticated design into the finished car has a vital role in achieving a richness of “experience”. In designing the Gran Class, Hitachi faced a number of new challenges. In particular, if the intended effect was not achieved, the service would fail to inspire the discerning customers who were its target market. The way to leave passengers with a sense of having gained a special “experience value” was to build a level of facilities that could create an

environment where such an experience could be had. In this, the seat design and the multi-ambient lighting were recognized as being the key factors to consider. It was these factors that would determine how successfully the design achieved its aim of delivering “experiences” such as the sense of superiority that comes from being in an exclusive space with a level of luxury akin to that of a top hotel, or the satisfaction of occupying your own personal space.

Lighting

Light-emitting diode (LED) lighting was selected for use throughout the Gran Class cars, from the seating compartment to the private deck. This took advantage of the characteristics of LED lights, which provide an even distribution of light in a compact device, creating an innovative lighting method suitable for the limited spaces available, such as window frames, ceiling lighting, and lighting in the deck supporting rails. Close attention was paid to the lighting effects provided by the window frame lights. Specifically, the design was able to incorporate lighting into the limited space available in the window frames while keeping the light source itself invisible, something that was not possible using previous types of light fitting. Careful consideration was also given to the orientation and positions of LED lights to ensure a pleasant and even distribution of light across the side walls, which acted as a reflective surface for dispersing illumination. In selecting these side wall panels, the design team conducted a thorough investigation to identify ways of keeping joints and inspection covers hidden while also ensuring that they satisfied the requirements for cleaning and maintenance. Furthermore, the delicate nature of the indirect reflected light meant that any shadows or lack of uniformity in the illumination would be seen as a design flaw. To achieve an elegant gradation of light, the team made frequent visits to the factory for prototyping and testing, looking at factors such as the shape of reflective surfaces and the degree of sheen in surface coatings, until they were able to create a level of finish with which they could be satisfied (see Fig. 4).

For the private deck (entry lobby), it was recognized that this space needed to act as an entrance to an extraordinary experience that symbolically represented the beginning of the trip. Taking account of the path that passengers would follow, its design used indirect lights at the entrance door and supporting rail lighting to draw in the passenger in a way that expressed its role as a welcoming space. Spatial requirements meant

that the service attendant room was located between the seating area and bathroom. An exceptional design was used for the region in front of the service attendant room. This created a high-quality space that conveyed the impression of a lobby area leading into the seating compartment, with materials, colors, and furnishings that coordinated with the passenger area, and an indirect overhead lighting system that turned the entire ceiling into a source of illumination (see Fig. 5).

Seats

As the items of interior furniture with which passengers come into direct bodily contact, seats are the most important and effective factors in delivering the experience of exclusive space provided by the Gran Class. In putting together the seat design, Hitachi sought to have the seats convey both a sense of quality and a relaxing appearance, while also maintaining



Fig. 4—LED Window Frame Lighting.

Repeated prototyping and testing were conducted prior to achieving the finished product, looking at factors such as where to locate LED lights, which wall shapes were most effective, and the best choice of surface sheen.



Fig. 5—Gran Class Private Deck.

The private deck (entrance lobby) on the Gran Class (left) uses lighting to draw passengers into the interior, and the passage to the bathroom (right) uses indirect ceiling lighting to create a high-quality space.

the optimum ergonomic form as recommended by the seat manufacturer. A further consideration was to design the seating in a way that integrated with the car interior. The seats are electrically operated with a single button for setting the most relaxing position, including the position of the foot-rest and leg-rest. A particular focus of the design was to give passengers the sense of a spacious personal area that provided enveloping support for their entire body. The seat pitch was increased to 1,300 mm and a design with a slim back shell was selected to maximize the space for each passenger while also satisfying the requirement, specific to trains, that the seats be able to rotate 180°. The design also ensured that the rear of the seats had an elegant flawless line, this being the part of the interior design that would spend the most time in the passenger's line of sight.

Other special features for enhancing seat comfort include partitions that separate people in adjacent seats from each other's view, flexible reading lights, movable headrests, folding tables, and magazine pockets (see Fig. 6).

Design for Sensory Stimulation

In addition to providing a quality visual experience, the design also sought to stimulate the other senses. Noise is one example, an issue that becomes more of a problem as trains get faster. The Gran Class, however, succeeded in significantly reducing noise levels compared to other classes through the use of thicker acoustic absorbents, wool carpet with a long loop size, and overhead storage compartments.

Use of carpet with a long loop size complements the properties of wool, being soft to the tread. Considerable testing was carried out to find the best combination of loop lengths and densities, with

numerous samples being tested before deciding on the final specifications. This included stepping on samples directly to assess the differences. A bright beige was chosen as the seat color to emphasize this high quality, the color being selected as one that would soon appear dirty unless frequently cleaned. The idea was to give passengers a sense of satisfaction that would come from being in a high-end car furnished using genuine materials that they could touch for themselves.

That is, as soon as the passenger entered the car, the furnishings presented their senses with an immediate impression of being in a special place. This was used as a way to give the passenger an experience of exclusivity, inducing a feeling of satisfaction that would make them glad they chose to take the train and want to do the same again in the future.

As the final stage of the development, a full-size interior mock-up was built to assess the actual experience created by the space, with its unprecedented interior layout and lighting effects. This was used to evaluate the interior design, verify that the intended lighting effects were in fact achieved, and confirm



Fig. 6—Gran Class Seats.

The seats provide an exclusive personal space designed for optimal seating comfort with enveloping support for the entire body.



Fig. 7—Full-size Interior Mock-up Used to Evaluate Design. The mock-up was used to conduct an overall evaluation and verification of the interior design, lighting effects, compatibility between interior materials and the seating, and the sense of high quality conveyed by the space.

the compatibility between the interior materials and the seating. It was also used to assess and verify that these elements all worked together to convey the high quality of the space. The design team worked as a group to eliminate one by one any specific problems that were identified. The end result was a production model car that featured a level of exclusivity, quality, and finish that went beyond any existing train (see Fig. 7).

CONCLUSIONS

This article has described how Hitachi went about developing its ideas and then embodying these in the Gran Class in order to create an unprecedented travel experience for the Tohoku Shinkansen E5.

The E5 “Hayabusa” has already been in operation for several months, during which time it has received considerable positive feedback from passengers, with its exclusivity also featuring in a number of media reports.

While numerous ideas for the service were suggested in the early stages of the development, the need to consider operational implications made it difficult to make a detailed examination of their potential. Meanwhile, the key factors for further enhancing the passenger experience included not only special facilities or features that enhance passenger convenience, but also aspects of human behavior such as having service attendants who provide friendly and attentive service. Accordingly, the concept behind the Gran Class design included providing in-car facilities that would help service attendants provide better service. For example, providing adequate galley space to facilitate the preparation of meals and drinks will make the service attendants’ job easier and less stressful, freeing them to concentrate more on providing a better service to their customers.

Drawing on ideas such as this, Hitachi intends to continue working on design proposals that deliver a richer and more sophisticated railway travel experience.

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