

AESTHETIC APPROACH TO GREEN TRANSPORTATION PLANNING IN TOURISM WITH DESIGN FACTORS

J. Ko^{1,*}, E. Kim¹, D. W. Jeong¹, D. K. Kim²

¹Ms student, Department of Civil and Environment Engineering, Seoul National University,
South Korea

²Assistant professor, Department of Civil and Environmental Engineering, Seoul National
University, South Korea

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ABSTRACT

Green transportation technology has become a new paradigm in transportation engineering fields over the whole world. Most attention, however, has been paid to mitigate greenhouse gases or energy consumption, seldom reported pro-environment design in aesthetic aspect. It is well known that a proper design of train enhances traveler satisfaction and contributes to demand increase in public transportation. Hence, aesthetic factors should be considered significantly. However, a difficult problem for reflecting aesthetic aspect is that there is no clear design standard for railway to reflect aesthetic features. This paper aims to suggest aesthetic factors to be guidance of rail transit planning in tourist attractions. We begin by defining a term ‘aesthetic in railway system’ based on literature and empirical review. In this paper, the definition is divided into two complementary views: (I) Sight-seeing mechanism from inside to outside. (II) Vehicle exterior design harmonized with surrounding environment. Based on the definitions, design factors are suggested: window size, speed, routes, type of track, color, and size of train system. Each factor is explained with its standard.

Author Correspondence, e-mail: jiwonko@snu.ac.kr

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A result of evaluating rail transit with the factors shows that wireless tram is the most suitable transit for tourism. Limitations and improvements of the study are also suggested.

Keywords: Green transportation technology; Public transportation; Aesthetic factor; Tourism

1. INTRODUCTION

As we step into the 21st century, green technology has become widespread worldwide. Abundant studies and policies for reducing greenhouse gases as well as energy saving were done. These actions have impacted transportation planning as we might notice from the advent of pro-environment CNG buses and highly increased number of bicycle users [1].

Nevertheless, most attention naturally has been paid to gas emissions and energy sectors, seldom reported pro-environment explanations in aesthetic aspect. It is widely known that properly designed transit enhances user satisfaction and contributes to demand increases in public transportation especially in tourism. Switzerland Mobility is a good example [2]. Mode change from private cars to public transportation is one of main issues that society has been faced. As a result, a new approach with consideration of aesthetic value to public transportation is helpful to fulfill green transportation system.

We can see that society's positive attitude to sustainable transportation is changing a paradigm of transport appraisal practice. Transport appraisal practice is mandatory when government implements a new planning for railway construction which needs huge budget. Benefit cost ratio is a common way to calculate whether the project should be executed or not. Here, benefits are important content which contains utility of users. Travel time saving is the most basic components of user's utility. However, reliability, comfort and environment issues are some new arising considerations [3] as related with sustainability. These components are tried to be monetized so to be calculated to BCR (Benefit Cost Ratio) and there is an effort to improve appraisal process as those importance is increasing [3].

However, aesthetic aspect, which is represented as 'Environmental capital' containing landscape, biodiversity and heritage, has no clear standard to be monetized. The judgement is usually depended on decision a maker [3] which means nothing is guaranteed. Then, it would be hard to reflect aesthetic consideration to cultural heritage sites or any tourist attractions resulting in fastest train is the best as usual.

One of the main reasons is that aesthetic tends to be qualitative and subjective. To solve this problem, we need to suggest a unified definition of aesthetic among experts and quantified design factors. Hence, this paper aims to suggest aesthetic factors to be guidance for rail transit planning in tourist attractions.

Studies about design criteria in aesthetic perspective had shown in industrial design rather than transportation engineering, yet focused on private car market. Even though some policies seemed to consider the aesthetic design, that was limited on exterior components such as coloring along particular hierarchy of the system. A few papers asserted non-physical options in design perspective. Kim [4] proposed harmonization, color, identity and communication as design factors for light rail transit. Kim [4] emphasized that user satisfaction aspect should be considered with technical aspect for sustainability.

It was common sense that transportation system is closely related with tourism [5][6]. Yet, for which component of transportation system leads to successful tourism was not suggest in most papers. Some suggested ecosystem impact from transportation infrastructure construction [7], however, ecosystem or biological perspective is not the theme to be pointed in this paper.

Few paper mentioned specific components of transportation in tourism perspective. Jung, [8] focused that tourist transport with railway frequently across mountain. In that, it was recommended to manage landscape around railway. Interesting point was that the paper analyzed the relationship between observer's view point and landscape. Kim [9] defined a 'scenic road' as a road where passes a landscape view point or has cultural heritage meaning.

1.1 Definition of Aesthetic in Railway System

As shown in the previous studies, transportation related with tourism has not a unique term yet. Even tourism has various meaning such as places that heritage site or urban cities famous for tourists. In this paper, 'transportation in tourism' covers all the meanings of transportation system which may be used for tourism with a common sense. Yet, the meaning of aesthetic is more worthy to be defined.

We begin by defining a term 'aesthetic in railway system' based on researches and empirical review.

A research conducted by Kwon [10] suggested 7 roles of transportation in tourism. In the

paper, a term of ‘tourism transportation’ was used as movement with economic, social and cultural behavior where tourists find some attractions apart from their daily life. “Table 1” shows the 7 roles of tourism transportation.

Table 1. 7 roles of tourism transportation

Number	Definition
1	Connection between tourist attractions
2	Tourist attraction itself
3	Transportation system as scenery and viewpoint of tourist attractions
4	Increasing convenience
5	Control demand in tour place
6	Control land use in tourism
7	Basic usage as traffic mode for resident

Among these 7 roles, contents related with aesthetic aspect were selected. The third role which is transportation as scenery and viewpoint of tourist attractions explains that sight-seeing behavior in the vehicle provides users a feeling of joy and excitement. Also, the second role which is tourist attraction itself proposes that transportation mode is actually able to be a landmark.

From empirical consideration, we can easily understand those characteristics were naturally existed. Several countries possess symbolized transportation representing the famous cities. New York has yellow taxi while London has red bus. Experience of riding unique transportation also gives special mood. Gondola in Italy and dog sled in Norway enhance the landscape view.

Another approach to define tourism transportation could be found in the paper of [11]. It

clearly pointed out the feature of transportation: movement. By using a term ‘travel glance’, the study highlighted that landscape view through window of train is a part of journey.

Based on the studies and empirical review of transportation in tourism, this paper defined aesthetic in railway system. The definition is divided into two complementary views:

- (I) Sight-seeing mechanism from inside to outside.
- (II) Vehicle exterior design harmonized with surrounding environment.

The first definition is more focused on the fact that train is running through the journey and its impact on outside scene. The second definition is closed to usual perspective given that design of train itself. However, harmonization with environment and systemic consideration is difference with former studies.

“Fig. 1” and “Fig. 2” helps intuitive understanding of the concepts.

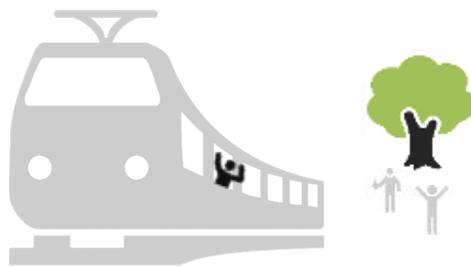


Fig.1. Sight-seeing mechanism

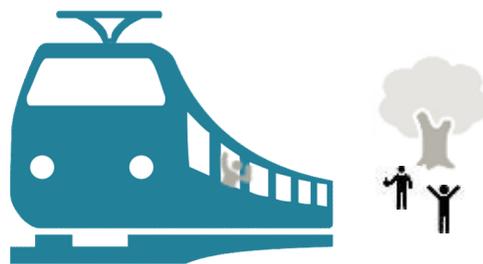


Fig.2. Vehicle exterior design

In “Fig. 1”, a person inside the train is looking outside view through window. On the contrary, people in “Fig. 2” are watching the train passing by. Observer is different between two concepts but both of them are expected to feel pleasure because of aesthetically designed train.

The elements of design factors would be provided in the next section.

1.2 Design Factors

As explained in Introduction, transport appraisal practice contains consideration of aesthetic aspect in qualitative and descriptive way. To select suitable type of train or monitor construction process, a quantitative standard is needed. Suggestion of design factors in this paper will help to appoint an adapted standard to each country.

Design factors based on the definitions will be provided in the following sections with its impact on aesthetic. The factors are: window size, speed, route, type of track, color, and size of train system.

The factors are not separated precisely, but window size, speed and route are derived from the sight-seeing mechanism whereas type of track, color and size of vehicle system are closely related with vehicle exterior.

1.3 Window Size

Most train have window but the size of window is completely different. It is intuitive that wider window is easier to see outside.

However, noticeable fact is wider window increase Field of View; this makes observers feel like they are inside the scenery. An examination with different field of view was conducted to identify how urban landscape or patterns changed. The broader field of view gave people more feeling of object's presence, and the concept could be utilized for developing a wide television [12].



Fig.3. Panoramic train(left) and KTX(right)

“Fig. 3” shows comparison of Switzerland’s panoramic train and KTX of South Korea. Panoramic train is specially designed to see beautiful scenery and only the first class has that big window almost stretching to ceiling. In contrast, KTX has much smaller window. This is

because KTX was not developed as tourism car, mostly for commuting trip. However, even commuters tend to prefer window seat to enjoy outside scenery. We could find fairly many opinions appealing inconvenience due to window frame of KTX from google. Therefore, decision maker needs to notice that tourism railway should have bigger window as possible and it is based on scientific fact which is reasonable.

1.4 Speed

Many trains with low speed are popular for tourism since it gives tourists much time to enjoy outside view and take picture.

Actually, speed and types of view has close relationship. Brain needs specific time to sense something, filter, recognize pattern and then select things go to short term memory or long term memory. Fast speed naturally gives short time to observers so only pattern recognizing is conducted. But low speed which is enough to create imaginary gives connection to memory from recognition.

As Jung [8] conducted an experiment, a person's sight through window in a moving train became narrow with increased speed. For example, Mountain Baek-Du tour train is recommended to run with 40km/h in order to enjoy the view of mountain.

Consequently, speed can be adjusted depend on type of view that a train is showing. As we can see in "Fig. 4", a distant view such as mountain and huge plain is fine with fast speed because it does not need deep interpretation. Meanwhile, a close view in urban landscape is better with low speed to provide observer to imagine.



Fig.4. Distant view (left) and close view (right)

1.5 Route

Some people might think direct train is the best. It may be true for commuter. For tourist, however, fastest route is not an answer every time. Route may follow other ways to show more attractive landscape.

Public train from Sapporo to Otaru in Japan runs along the ocean. Bernina express from Tirano to Saint Moritz is famous for scenic train route in Switzerland [13]. “Fig. 5” shows that the railway runs different route in comparison with direct one. It follows more winding path crossing bridges and lakes. Technical aspect of round radius and max slope for each type of train shall be checked for winding path.

To sum up, not only decision of origin and destination, but also specific route is important to design railway system.

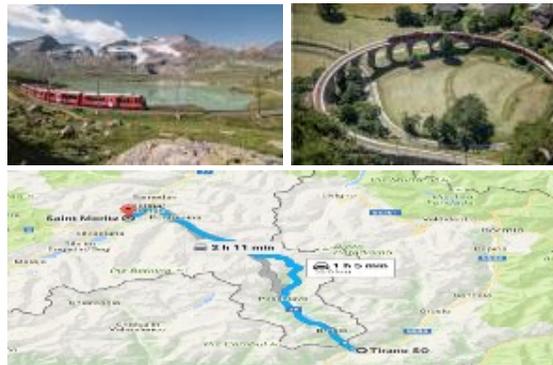


Fig.5. Bernina express route in Switzerland

1.6 Type of Track

Track is basic facility for train to run over. Once a track is facilitated, it is fixed to the location. Hence, the structure largely affects urban aesthetic.

Track is composed with ballast and sleeper. When ballast is exposed to outside, it is called as open track. If not, it is an embedded track [14].

Elevated construction with steel and cement would not be pleasurable. In case of a tramway, the existing sleeper-ballast track gives negative impact on urban aesthetic. Grass track would be a good alternative when it comes to urban aesthetic [14].



Fig. 6: Grass track

Maintenance fee is expensive but it is believed to greatly improve urban aesthetic.

1.7 Color

Some cases proof that color symbolizes a place: New York taxi and London bus as mentioned above. Also, Lisbon has yellow old tram number 28 which is landmark of Lisbon. Trams are easily found in many European countries. “Fig. 7” is a train design of Alstom in France. This blue tram with white bird is specially designed for Montpellier, famous tourist attraction in France.



Fig.7. Montpellier tram in France

Color can reflect a place’s characteristic. Some types of train such as monorail and tram are easy to advertise its color since they runs on the road. Yet, heavy transit is limited because it is usually expected to run in the basement.

1.9 Size of Train System

Behavior of people is affected by built environment [15].

An expression ‘human scale’ is commonly used in urban design and architecture. Though it was not academically defined, it means a scale fits with human body in size, texture or any physical components. Human scale can be applied to walking speed, street tree and height of building in sense of built environment. Human feels comfortable and friendly in human scaled structure.

In “Fig. 8”, a light rail transit and a heavy rail transit is introduced. Both of them companies huge structure due to systemic characteristics. Monorail needs elevated structure while HRT needs power line and huge track.



Fig. 8: Monorail(left) and Heavy rail transit(right)

Monorail is considered effective in that it runs upper ground and it is not affected by road congestion. HRT is very common type due to its merit of carrying many passengers or freights. However, these elevated structure and electricity lines are in huge scale disharmonizing people. Meanwhile, tramways are known to possibly make people-friendly streets because its structure is relatively simple. Especially, a wireless tram is spotlighted in Europe and Asia countries due to its pro-environment and friendly characteristic.

2. RESULTS AND DISCUSSION

In this section, comparison between previous and new decision making process will be discussed. Also, evaluation based on provided design factors will be suggested.

We shall see how decision process would change after adaption of design factors. This is a case study of South Korea. “Fig. 9” presents decision method of selecting vehicle types to be installed in South Korea.

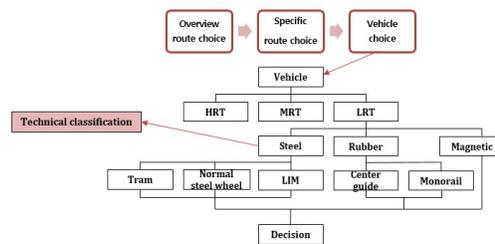


Fig.9. Present decision method to decide type of vehicle

Origin and destination is selected as first step, and then specific route will be determined as next step. Later, type of vehicle is selected depends on capacity and technical classification which is almost meaningless in case of tourism. Also, route choice only changes by economic consideration.

New decision method is suggested in “Fig. 10”. Assume that we want to choose vehicle within LRT, five types of LRT were presented in the left side of the figure. Then, design factors are vertically ordered. Type of track is hard to be changed since all types of LRT have its inherent facilitated track. In contrast, color can be changed easily. This feature of flexibility will be used for scoring in “Table 3”. No order of priority among the factors, however, decision makers should consider those factors integrally.

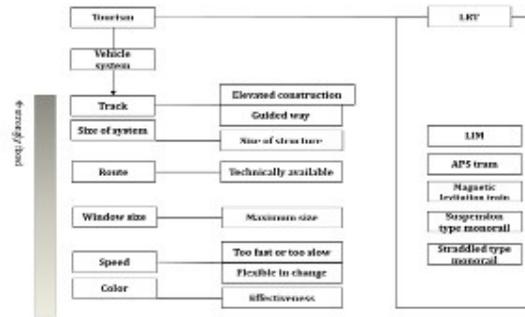


Fig.10. New decision method

Standard of each factor based on “Fig. 10” was summed up in “Table 2”. In case of track, grass track of tram is more desirable rather than elevated structure of monorail or guided way of LIM and Magnetic levitation train. Smaller size of system and wider window size is better. All types of LRT are possible to make big window like panoramic train except suspension monorail (the ceiling is obstructed by its guided way track). High flexibility in route and speed is desirable. Regarding route, technical possibility shall be considered as mentioned in above chapter. LIM and suspension monorail are known to have small scope of round radius and max slope. In regard to speed, all LRT except LIM are able to run in 60km/h, but have problem with running over 100km/h due to energy efficiency. Rather, LIM was inefficient when it runs in 60km/h. Color changes easily for all types, however, since LIM usually expected to run in basement, colored exterior cannot be seen to observers which means LIM may be inefficient in color factor.

Table 2. Standard of each factor

Factor	Standard
Track	Grass type
Size of system	Smaller
Route	Flexibility
Window Size	Wider
Speed	Flexibility
Color	Efficiency

“Table 3” presents evaluation result. It would be better to suggest a sketched design suits

for tourism. However, this table intended to calculate possibility of transformation from existing vehicle for comparison. Score ranges from 1 to 4. (1: impossible to be changed. 2: possible to change but difficult. 3: it can be changed but inefficient. 4: possible and efficient.)

As a result, wireless tram is the most suitable transit for tourism.

Table 3: Assessment table

Factor	Wireless Tram	Linear Induction Motor	Straddled monorail	Magnetic levitation	Suspension monorail
Color	4	3	4	4	4
Speed	2	4	2	2	1
Window	4	4	4	4	2
Route	4	3	4	4	2
Track	4	2	2	2	2
Size of System	4	2	2	2	2
Score	22	18	18	18	13

3. CONCLUSION

As green transportation technology has been widespread in our daily lives, importance of public transportation is also on the rise.

Transportation is key element of success in tourism. Proper design of railway system that satisfies users' interest leads to success in the travel industry.

Specific design guidance of public transit in tourism is essential in order to promote public transportation rather than private cars.

Various attempts to put aesthetic consideration in transportation appraisal have been conducted among some countries, yet with limitation. Since a feeling of beauty is subjective, it was important to build integrated definition and qualified factors.

Two complementary definitions were suggested based on several previous studies and empirical cases studies. One is sight-seeing mechanism and the other is vehicle exterior

design.

Assessment needed factors and standards. Each factor was tried to have standard so to be evaluated. When it comes to LRT, wireless tram got the highest score considering general case. It should be noticed that decision maker should take into account all factors integrally depends on the situation.

However, comparison of some standards was fine, but some of them were still somehow descriptive. It is recommended to research each type of LRT more specifically in the further research.

Consequently, this paper recommends decision makers to refer these factors and choose the most suitable vehicle type depending on the features of tourist attractions. For instance, if the decision maker needs to connect attractions with dozens of kilometers, it might be better to choose LIM instead of tram.

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