

RESEARCH

DESIGNING BANDAR ABBAS RAILWAY STATION BY SUSTAINABLE ARCHITECTURE APPROACH (CLIMATIC SUSTAINABILITY)

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ABSTRACT

Increasing growth of population together with increased modifying activities of human in surrounding environment has caused fundamental and often catastrophic impacts on the earth's habitats including uncontrolled energy consumption, forest degradation, environmental pollutions and extinction of plant and animal species. This situation has rendered sustainable development and related issues as a major concern for current societies. Compared to other types of transportation, railway is considered as one of the safest transportation ways. Participants of this industry, however, have been always concentrated on increasing safety of transportation of railway vehicles. Obviously, the environment surrounding the rails and safety of trains' transportation interact with each other. Although the main concern in designing the railways is to maximize safety, the changes occurring at surrounding environment as a result of railways establishment may compromise safety of transportation and neighboring residents. The main objective of the present study is to design Bandar Abbas railway station based on sustainable architecture approach. This is a quantitative research based on analyzing climatic principles and data. Data were collected by library and field studies to gather climatic perspectives. Data were analyzed using climate software. In library study, standards and properties of railway station were investigated. Psychological study of train travelers and investigating similar designs constitute another part of this study. Moreover, designing principles in hot and humid climate were extracted from the relevant books. Filed study includes visiting the site, visiting train stations within the country and interviewing with the travelers via questionnaire.

INTRODUCTION

After technological changes during industrial revolution, emergence of new concerns and problems, and human conflict to gain his previous calm space and necessity to exploit the emerging phenomenon of iron century, have forced the human to consider aesthetic issues while using these products. In between, emergence of railroad as a widespread and indispensable transportation way was the first attempt of human to create a humanistic and not merely functional medium to meet his demands [1].

Railway is a fundamental and undeniable principle of transportation which is widely used all over the world; the use of this facility has been growing during recent years by astonishing progress in designing and manufacturing express trains. Major railway stations are urban symbols in European metropolises; often used as a site for creating magnificent architectural works regarding their important role in people life as rail gateways of the city. The old history of such architectural works indicates the prominent role of railway in human life in developed countries and highlights the need for innovation and creativity in designing urban and intercity train stations [2].

Also Iran, despite the fact that was not in such blind development, but inevitably is forced to use the achievements of this period, since the age of communication has its own language and to create communication, which is inevitable in human life should know the language. Railroad is the longtime economic activities in Iran, which according to its importance since their arrival in Iran, including centers that be attracted to it a lot of professionals and technologists and engineers in the country and be central to train the best technical personnel in the country. But the lack of development and its all-round development in the years after the launch in Iran is stagnating. This may be resolved in accordance with policy makers and planners in the country and rail transportation become a lucrative part of the country and attract and employ the most efficient technical and engineering personnel. In smaller dimensions, one of the ways of railways flourish in Iran is encouraging people to use the train to travel inside and outside the city [3]. There are various ways to attract people towards this mode of transportation, which is detectable in various aspects of civil, economic and sociological. But from an architectural standpoint, perhaps one of most effective strategy is to provide traveler comfort conditions in train stations. This comfort can be considered in several aspects: physical comfort (proper circulation), environmental comfort (to meet the needs of climate and environmental psychology), eye-catching of space station (in terms of beauty of form), proper ventilation and so on. On the other hand, the railway with low energy consumption is highest result in the transport sector, while according to the sensitivities of today about environmental pollution will enter the minimum harm to the environment. Therefore, the researchers intends to design the train station with the attitude and approach of sustainable architecture, which honoring the environmental conditions and are intended to user comfort, achieve a model for designing these spaces [4].

KEY WORDS

Railway Station,
Sustainable
Architecture, Bandar
Abbas, Workstation
Design

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Research Hypotheses

- It seems that sustainability principles regarding climatic aspect of the bed can be designed in the context of shape.
- Sustainable designing of Bandar Abbas train station based on social and environmental issues and local and climatic properties of the city can be completely in alignment with performance of a train station.
- Presence of sustainable condition based on climatic properties in the railway station may improve travelers' satisfaction and comfort during the travel.

SUSTAINABLE ARCHITECTURE

Sustainable construction is defined as follows: "management of a clean and healthy environment based on effective use of natural resources and ecological principles"; the main objective of constructing sustainable building is to reduce its negative impact on environment, energy resources and nature following these rules [5]:

1. Reduce consumption of non-renewable resources.
2. Development of the natural environment.
3. Eliminating or reducing the use of toxic substances or harmful on nature in the construction industry.

Construction techniques in a broad zone try to provide quality integrated in terms of economic, socially and environmentally. Therefore, the rational use of natural resources and construction proper management has helped to preserve limited natural resources and reduce energy consumption (energy conservation) and will lead to improvement of environmental quality [6]. Sustainable design is architecture thoughtful collaboration with engineering of mechanical, electrical and structural. In addition to conventional design factors, such as beauty, fitness, and texture, shadow and light and the facilities that should be considered by the designer group, should pay attention to long-term factors of environmental, economic and humanitarian and consider the basics of it.

RAILWAY STATION SPACES

By examining the railway stations to conclude that different required spaces at the railway terminal is as follows [7]:

Travelers and greeters entrance: 1. Input platforms. 2. Travelers and greeters assembly hall. 3. Restroom. 4. Information. 5. Hotel reservation. 6. Warehouse gets objects for short-term. 7. Police. 8. Entry and exit gate. 9. ATM. 10. Parking.

Travelers and escort exit: 1. Parking. 2. Spaces for the establishment of porters. 3. Input and Input filters. 4. Police. 5. Room for waiting. 6. Travelers waiting hall. 7. Public relations. 8. Information. 9. Buy tickets. 10. Business sector. 11. Space for recreation. 12. Mother and child room. 13. Telecommunications, post and telephone. 14. Toilets. 15. Exhibition. 16. Output filters. 17. Exit corridors. 18. Exit platform.

Service-welfare spaces: 1. Restaurant. 2. Coffee shops. 3. Prayer room. 4. Services sector: dressing room, staff resting space, warehouse. 5. Emergency. 6. Bank. 7. Public transport stations. 8. Taxi within the city and the car parks. 9. Luggage warehouse and its side spaces.

Office spaces: 1. Supervision. 2. Assistance. 3. Conference. 4. Secretary. 5. Typing and filing. 6. Protective and night duty. 7. Procurement. 8. Public relations. 9. Center of Statistics and control. 10. Accounting. 11. Toilets. 12. Pantry. 13. Telecom.

Installation: 1. Required equipment spaces. 2. Access. 3. Department responsible. 4. Warehouse. 5. Electrical switchgear room.

MATERIALS AND METHODS

This is a quantitative research based on analyzing climatic principles and data. Data were collected by library and field studies to gather climatic perspectives. Data were analyzed using climate software. In library study, standards and properties of railway station were investigated. Psychological study of train travelers and investigating similar designs constitute another part of this study. Moreover, designing principles in hot and humid climate were extracted from the relevant books. Filed study includes visiting the site, visiting train stations within the country and interviewing with the travelers via questionnaire.

SITE

The target site is the current location of Bandar Abbas railway station.



Fig. 1: Map location of Bandar Abbas railway station, source: (wikimapia.com)

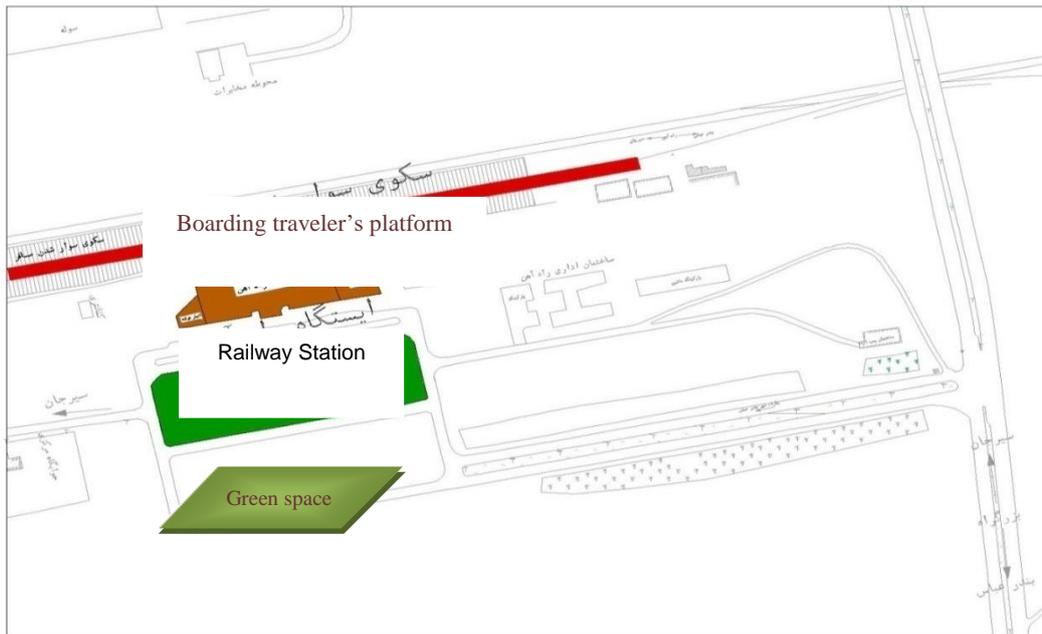


Fig. 2: Project land position, Source: (Author)

PRINCIPLES AND DESIGN CRITERIA

Criteria of Designing Railway Station

A railway station is composed of station lines, platforms, main connecting ways and terminal building. Considering planning of railway lines and location of station plan according to the network, three types of traveler stations can be used [8]: total station, terminal station, final station.

Yards and Terminal of Freight Trains

Railway yards represent workshops and facilities used for storing the materials relating to unused cars. Facilities of freight train terminal usually are composed of at least three parts: a receiving yard to which entering trains are directed from main line and stay temporarily to become classified and separated later

[2]. Classification yard in which, the wagons are separated and classified into groups with common destinations. Exit yard in which, the separated cars are connected and entrained and retained temporarily for making decision about movement to main line. In general, at least 50 feet is necessary for each freight car. There is an exception for repairmen lines that requires 55 feet for each uncoupled car and lines of special equipment in which the distance between two centers shouldn't be less than 13 feet. Exit yards should possess enough number of lines so that at least one of them is available for montage of a leaving train when necessary. The length of exit lines depends on the lengths of separated trains including locomotive. [2].

Design and Planning of the Railway Stations

From the standpoint of an engineer and designer of the railway, a station is including six main factors: 1. Rail route and signs. 2. Platforms. 3. Required spaces to facilitate the movement of travelers and pedestrians spaces. 4. Ticket sales booths and space related to retailers. 5. Parts of the trustee and the postal service. 6. The station entrance door.

To provide safety and transportation comfort for the travelers, all of these factors should be exactly defined, delimited and placed apparently near each other by applying suitable planning and signs. Suitability of connection routes among the train, platform, store and safety offices is also important for railway staff. Necessity for equipping the managers' offices with closed-circuit television systems and computer controls represents another urgent issue that should be considered in layout of railway stations. The number and length of platforms in a station are determined by position and application type of the station. The number of platforms depends to large extent on the number of trains moving through the station.

Table 1: Platform different widths

Minimum width from the edge of the platform, to the nearest obstacle	2500 mm
The minimum width of all platforms slate-discrete	4000 mm
Suggested width for a busy stations	8000 mm
Platform Set width to train the body to the extent permitted of m/h 100 (Km/h 160)	3000 mm

Table 2: Design and dimensions of the platform

Length	Higher than the maximum length of the train
End slopes	Up to 1 in 8
Cross slope	Typically 1 in 40
	At least 1 in 100
Platform height (from the top surface of the rails)	Up to 1 in 12
Wall indentation of the platform (from the platform under the level of top row)	915 mm
	300 mm
The maximum platform radial line length	360 m
The end of the platform	Top row of platform level should be coated with a resistant material and is marked by a continuous line in a bright color.

Traffic space of station hall, usually divided into the following places:

1. Information and ticket sales booths.
2. Waiting areas to see off or welcome the travelers.
3. Wait locations.
4. Restaurants, cafes, shops and book stalls.
5. Toilets.
6. Phone and office facilities.
7. Tourism information boards.

Access to light, lightness and safety are the primary considerations in designing the station, which to achieve the desired and standard levels of it, often is necessary use and application architecture tool. Stairs, escalator, lift and tilt, are tools that through them, change is possible in vertical surfaces. Incorporating the use of special materials and lighting are the main elements, which not only are used to determine the points that, will shift the angle to the direction of movement, but will be used to understand it, the diversion corridors or access staircase are leads in each episode.

The first travelers contact in station hall is at the ticket office. The other main site is related to service activities and postal and integrity in the distances between selling tickets locations and the platform railing. As well as shops and restaurants, which tend toward the phone booth and the location of the toilet are more traveler's visibility. Congestion associated with the packaging and cargo integrity, frequently occurs due to a covered wagons and multiple carts. Because of collisions that may occur with the in motion traveler, it is necessary the station designer to reduce collisions and motion friction is divided office space and pedestrians space. The station entrance door provides can be accessed directly to the private vehicles and other forms of public transport, and in order to convey different types of travelers and especially travelers, who come to the station as walking.

Station Design: Practical Considerations

External Traffic Space

Establishing problem-free connections, both within and out of the station, is an important factor for attracting customers' satisfaction. There should be apparent routes for travelers' access to side walk, main street, car parking, taxi stands, bus station and so forth. These routes should undoubtedly have ceiling, enough light and safety. External signs and routing maps according to their size, design and location and priorities are of great importance. Station layout should be in such a way that ensures vision routes in main traffic parts are not blocked by barriers. Separation between transportation and movement routes is very important. The travelers who enter or exit the station shouldn't use a narrow entrance at the same time.

Designing sidewalks and planting trees, both are a major factor. Paved sidewalks and parking section is better by asphalt, as well as tree planting in the lawn area is better than planting dense and luxuriant plants. Providing light, in terms of providing comfort and in terms of safety is one of the most important considerations. In this category are needed a combination of lighting equipment from the construction of electricity poles for lighting pathways and sidewalks, until lighting system around the input station area and street lighting and directions to the station.

Table 3: Access to the platform: Stairs

Width of stairs	mm 300
Height	150 mm
Width	1200 mm (min)
Length of end space (the junction of the last stair to the platform)	1800 mm (maximum, without intermediate railings) 1850 mm (normally up to the edge of the platform)
Number of stair	Max 16 Min 3
Stairs relating to persons with disabilities	Maximum the stairs between landing: 8
Railing	On both sides, continues to the 850 mm height and 50 mm diameter

Table 4: Access to the platform: sloping surfaces

Necessary slope	For all the levels, maximum 500 mm
Necessary slope	For all the levels more than 500 mm in conjunction with stairs Max 1 in 2
Slopes	1 in 20 preferably Maximum 10 m
Length	1800 mm
Landing (between Sloping surface)	1200 mm (min)
Width	1450 mm (preferably)
(The end part of the slope)	Resistant to slip

Internal Traffic Space

Within the station, travelers should be able to find their way easily from ticket kiosk to getting on the train without facing any barrier, confusion and desperation. The way of passing the four major parts of the station including entrance, information and ticket kiosk, waiting saloon and platform and trains should be exactly defined and more important parts such as ticket sale office should have a stronger architectural form. Width of movement routes in saloon should not only be proportional to traffic rate, but also represents function and symbolic role of each rout. Traffic within the station saloon should be accompanied with movement comfort, calmness and speed, because all people don't move in the same direction, some have children with themselves and move slowly; thus it is necessary that movement be possible in all levels of speed. Providing comfort and calmness depends on availability of shelter, protection and suitable temperature in the station. It is necessary to establish indoor routs and application of glass enables the designer to use sunlight for supplying the required temperature without any cost.

Table 5: The station main parts

Entrance: A smooth flow with paths and clearly defined areas for pedestrians and displacement	Parking, arrival and entrance, selling tickets and information, waiting section and business services, platforms and trains	Exit: Providing a quick exit from the train up to station entrance doors
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Study enough proper intervals in space hall should help to determine the priority of each section. Method of floor work doing and the type of used materials on the floor work should also contribute to determine the path and psychomotor motion and pedestrians between main station hall area.

Ticket Offices

Purchasing tickets customers should be able to easily find their own way to parts of ticket sales. In this section took place the money business, and in fact is where travelers and employees are in direct contact with each other. Environmental quality, comfortable double to talk and design on the ticket all must create good image and reassuring. Normally, station management office to pursue and effective oversight of the work and the behavior of the established relationship between employees and customers is overlooking and dominant on the sale hall. Staff offices, which are located behind the ticket sales booth, they should not be able to view from the sale and must be hidden by installing blinds from the customer viewpoint.

Business Sector

Shops, stores and restaurants inside the station meet customer service needs and to a large extent add to earnings railway. It is important that without compromising the current operation of the station provide the optimal balance in trade facilitation. It is better the phone, mailboxes and automatic machines must be placed near the paths of movement, rather than be installed individually and separately put on integrated together, so travelers do not have to prevent of collision be careful with them.

Waiting Areas

Waiting areas should provide the travelers with place, comfort, security and information. Such places should be located near the food and drink selling places or should be independent and self-sufficient spaces. Waiting saloons are often carpeted and equipped with heating system and furniture. The floor of waiting saloon is carpeted with fluffy cotton floorings, forest sturdy wood, carpet, rubber flooring and stainless steel. When travelers wait for the trains, they should be protected against natural factors and workplace of the employees should be sheltered appropriately. Station parasol should be stretched as long as the platform margin and view field permit. An important factor for securing the station is prevention from water penetration. Pavement of the station shouldn't be slippery when saturated with water.

Health Services

Although many trains have their own toilets. Construction of toilets at stations is an important factor in customer satisfaction. In places, where existed this possible should be using natural light and air conditioning. Equipped with toilets for disabled people with specific fences, extra width and complete washing facilities should be considered as an important issue.

Traveler's Specific Bridges

Construction of bridges generally preferred to traffic tunnels as a vehicle for passing on the rails and the transition from one platform to another platform. Bridges to avoid issues, such as throwing rocks and suicide are usually covered and roofed. Travelers crossing bridges are usually installed near the central part of the platform and near the entrance door to ticket offices, and usually are equipped slope surfaces and elevator.

Facilities for Disabled People

Station should be designed in such a way that people with disabilities can travel by train comfortably. Providing facilities for disabled persons is an important propaganda for railway firms and create a good image in customers' mind.

Information Signs

In Travel by train, it often happens that travelers to destination are changed several train. Information on timelines, expected time of arrival of trains, etc., must be displayed with a logical continuation and organized to inform travelers.

Information Announced by Using Audio and Sound Facilities

Information pages, illuminated displays and audio devices advised waiting travelers on the platforms from the time of arrival and exit of trains. Many travelers, such information derive from the ticket sales and information booth. Main display boards usually are more complete by electronic smaller screens that have been installed at the entries platform and close to eating places.

Workstation Design Dimensions

Site Selection

Stations should be located in areas with connection to other urban and regional infrastructures. It is better to establish the station in a region enriched by spectacular scenery. Thus, the main issue in site selection is availability of operational relation and landscape and scenery.

Internal and Subsidiary Parts of the Station

Both large and small stations include internal parts (internal-core) where ticket sale office and similar services reside and subsidiary parts including platforms, bridges and minor roads. Internal parts are often regarded as station center. This part includes ticket sale office, newspaper sale kiosk, departure time controllers and staff office. Applying simple shapes in the form of circle, polygonal, or triangular to indicate internal part is a suitable way to show the duties that should be considered. Offices, ticket sale kiosk, toilets, shops and cafeterias can be predicted as subsidiary parts that share a general space.

Providing Protection and Public Safety

One of workstation design goals was to create a feeling of security and peace in travelers. To achieve this goal, there are four main methods. Paying careful attention to design and details, design type, which is encouraging people to accept defense methods and care actions, They are providing adequate lighting and the use of facilities, such as closed-circuit television. The design of such parts, must in traveler create feels existed a safe area. Waiting areas is a guard in stations without operator, a potential line for travelers. To make sure that such places from all sides are in sight can be reduced this risk. In general, travelers feel that in a bright area faced with fewer risks than a dark field with low light and it can be regarded as station designer to increase the density lights in inner safe space.

Table 6: Platform lighting

Percentage of uniformity	1 to 25
Percentage of uniformity (Between minimum and medium exposure value) Recommended amount	Tiny station 100 lux Main station 150 lux Underground station 150 lux

Information about the Travel

Information about the travel by electronic display devices and install signs traditional time tables, usually presented in the internal, almost near the sites of ticket sales to travelers. In the case of installed electronic signs must be taken into account two factors: firstly, to ensure that all travelers around the station receiving information, and secondly, the installation of this equipment does not impact danger for indiscriminately trains that do not stopping at the station.

Environmental Standards

Providing warm and pleasing air is an important necessity to welcome the travelers at entrance, waiting saloon and ticket sale kiosks. Mechanical air conditioning system equipped with cooling system in summer and warming system in winter is of great importance.

Table 7: Environmental standards about the ticket offices

Heat	C 20, with the use of central heating local system
Ventilation	At least two air change or 28 m per hour, whichever is greater, in cases where heat exceeds that of 25 c, shall apply cooling system.
Light	Standard lighting services at levels overall 500 lux Workshop station 750 lux
Sound insulation	Noise levels at work stations should not exceed than 60 dbA. Noise level due to ventilation equipment in near work stations must be less than 50 dbA. Ticket office floor should be carpeted and also roof is sound attenuator.

Fire Protection

The design for fire protection should be considered the requirements and needs of every aspect and the resulting strategies based on them.

Announcement Systems

Graphical display devices, both traditional and electronic billboard and audio systems provide tools by them, are informed travelers that in which platform and at what time should be board the train. Information distributed through public information audio systems should clearly be audible and purely conceptual.

DESIGN

Schedule Table of Physics Project

Travelers Exit

Row	Description of space	Unit level (m2)	Number of units	Total area (m2)	Considerations
1	Purchase free shops	40	20	800	
2	Travelers waiting halls (monitoring)	4000	2	8000	
3	Coffee shop and coffee house	200	1	200	
4	Restaurant	500	1	500	
5	Prayer room	300	1	300	
6	Security and law enforcement	100	1	100	
7	Warehouses	20	7	140	
8	Toilet	30	8	240	Men and women
9	Clinic	120	1	120	
10	Quarantine	120	1	120	
11	Vip formalities	200	1	200	
12	Exhibition and reading rooms	400	1	400	
13	Communication spaces			4000	
14	Essential information	200	1	200	
15	Rail transport institutions booths	100	10	1000	
16	Control spaces and final page views	10	8	80	
17	Installations	100	1	100	
	The total area of the second part			16420	

Entrance Travelers

Row	Description of space	Unit level (m2)	Number of units	Total area (m2)	Considerations
1	Entrance	4300	2	8600	
2	Goods delivery and temporary storage	550	8	4400	For 8 platforms
3	Greeters waiting room	4500	1	4500	
4	Cafeteria	200	1	200	
5	Parking	25	200	5000	
6	Travelers and administration information	300	1	300	
7	Greeters information	50	1	50	
8	Warehouses	30	1	30	
9	Staff spaces	50	1	50	
10	Mechanical installations	800	1	800	
11	Electrical installations	1000	1	1000	
12	Communication spaces	3000	1	3000	
	Total public sector infrastructure, travelers entrance			24930	

Administrative Section

Row	Description of space	Unit level (m2)	Number of units	Total area (m2)	Considerations
1	Management space	100	-	100	
2	Deputy space	50	-	50	
3	Personnel offices	60	6	360	
4	Restaurant	300	-	300	For 100 employees
5	Conference hall	360	-	360	
6	Toilet	80	-	80	Men and women
7	Warehouses	25	-	25	

8	Archive	30	-	30	
9	Telecommunications new lines control	300	-	300	
10	Propagation space	20	-	20	
11	Support spaces	75	-	75	
12	Communication spaces			1150	
13	Computer site	150	-	150	
	Total area of the fourth main offices			3000	

Service-welfare

Row	Description of space	Unit level (m2)	Number of units	Total area (m2)	Considerations
1	Library	200	-	200	
2	Selling books booths	25	10	250	
3	Post, telegraph, telephone	100	-	100	
4	Children's entertainment space	240	-	240	
5	Computer games site	300	-	300	
6	Internet hall	240	-	240	
7	E-mail hall	120	-	120	
8	Toilet	6	15	90	
9	Communication spaces	500	-	500	
	Total			2040	

CONCLUSION

Extension of information in new era and limitation of study time have made it necessary to propose technical and scientific methods. Undoubtedly, a major hurdle for economic growth of the country is defects and weakness of transportation systems especially railway. Although the cost of establishing a two-line railway is equal to that of constructing a six-line street, the railway is still cost effective considering exploitation and retention issues. Railway is now the best transportation way and the most effective way for development of agriculture and business affairs. It has a critical economic role in Iran as well. Regarding geographical situation of Iran located at the junction of three continents of Asia, Africa and Europe, the country can play a unique role in goods transportation. Considering the fact that each region has its own climatic condition, most of the architectures believe that by understanding climate of a geographical region, the same designs can be used for similar regions. The results indicated that by considering all criteria of railway station design, sustainable design of Bandar Abbas train station according to social, environmental, local and climatic issues can be performed in accordance with functions of a train station.

CONFLICT OF INTEREST

There is no conflict of interest.

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None.

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None.

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