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Architecture of Train Stations: Analysis of Governing Design Components - Kenitra Station, Morocco

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Abstract.

Background

The ideas and designing process of train stations had evolved to follow the several philosophies of design-led elements, such as: highlighting the cultural development of the surrounding community, space division for several activities and uses, axes planning for human gathering and the quality of the prevailing economic activity in it and divide the assembly elements and its distribution, and also keep up with the rapid evolution in rail transport technology.

The paper assumes that there are 4 main guiding station design components that affected the design process of train stations: **Spatial, technical, style, and urban.** Those 4 design components are shaped by the basic architectural design elements: of **function & form**; which express the essential spaces and volumes of any basic train.

Methodology

The methodology of the discussion is an analysis for a case study (Kenitra Station in Morocco); uses several basic elements of form and function -which are specific to the train station as a building type- for discussion about each element: its idea, purpose, and effect; leading to provide comparison factors for a comparative analysis between the station components to obtain enough results that show how the design components of a station are affected; in terms of space, technology, style, and urbanism.

Keywords: Stations, Kenitra, components, transportation, airport

1. INTRODUCTION

A new design axis was created: respecting the human dimension; in materials, and the distribution and development of spaces of which has integrated transport with shopping and tourism, energy conservation, visual and thermal comfort internally, integration of modern technology in passenger service and queries, and security; until train stations became similar to airports in demonstration of technological development, economic renaissance and planning for the future; expressing the basis of the development of civilizations is the evolution of communication and transportation.

Problem definition

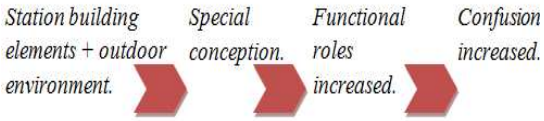
With the advancement in technology and the development of new aesthetics expressions for the architectural product, the research notices the problem of the interference of the design components with each other; blurring the lines between each component, and losing the "purity" of each component that distinguished each one; i.e. losing the ability to adequately analyse the differences and changes among each station design.

For example: Public art -an obvious aesthetic design element- is considered by operators and lawmakers (and in turn: the artists) as a function design element that is controlled by guidelines for revenue and barrier-free spaces. Commercial functions were upgraded from being peripherals to become integral parts of a station. Other qualities like environmental solutions (which in the past were part of the technical component) had become diluted in various design aspects, such as: quality of station building and platforms are related to the thermal comfort and adequate lighting; lighting itself is an aesthetic value adding to the users' experience and delight, and finally: the sustainability and energy saving; all of those should be found, not just in the machination, but in the materials, open spaces, voids in solids, and even structure.

Design Complexity & Purpose Confusion:

The importance of railway stations is with various functions –aside from accessing to trains- like a place for meeting, shopping, and urban landmarks. The functional type of the station is the factor that affects the landscape; considering many types of stations, like: Central city terminals, airport, light rail, etc. [1]

With station designing became expansive in space in volume and types, and as a result, in activities. Space functionality became more complex; an issue that turned the space from the inside into a disorienting experience; as the "red line" that separates the travel spaces from the other public ones became more blurred. [6]



As a modern interpretation as an intermodal knot, the complexity of a railway station should be both a system of space sequences, and includes reference points marking out the course. Easy access and simultaneous perception of various levels of the station result in comfort and fluidity for users. [6]

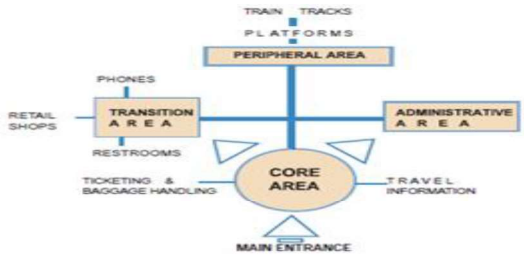


Figure 1: Flow diagram of functional element
Source: Kandee, S. (2004).

Today's stations tend to express their design concept differently from their past. Nowadays, stations are often designed in a way that makes the utmost benefit from existing buildings that are already a part of the urban design; as designers pay thorough attention to solve problems with interior planning of spaces. Most stations typically have **four main functional areas**. Figure1 shows the four functional areas and their interrelationships [7].

Those four areas represent the major physical and functional elements, along with their relationships to each other, which can be essential for establishing an intermodal station

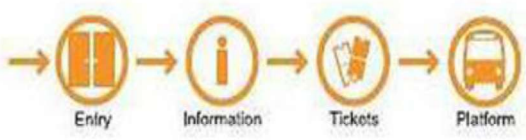


Figure 2: The basics of flow direction for passengers. Source: Fourie, C. J. (2014).

The causes and effects of the increase of spaces and practical considerations of spaces:

Table 1: Result & reasons for a disorienting experience in a station.Source: Kandee, S. (2004). Format: Author of the thesis.

Cause	Overcrowding of shops, booths, displays, etc.	- Consumption of spaces. - Poor organization of activities.	Design accommodation to existing elements only & leaving the new.
Effect	Increased confusion among users.	Complexity of functions.	The centre not serving a useful purpose.

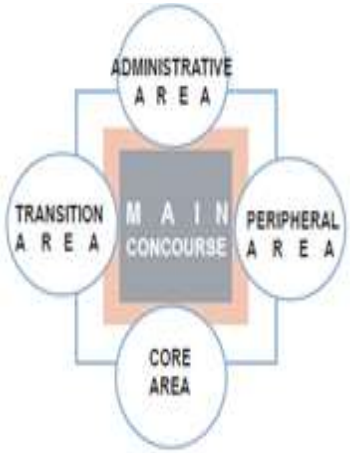


Figure 3: The interrelationships that should form an intermodal station.Source: Kandee, S. (2004).

The centre will lose its usefulness if the station building's design accommodates only existing elements without considering the new ones. With the internal circulation reinforcing the functional priorities,Figure3 should distinguish main and secondary passageways using narrower ones, the traditional main functions with their normal requirements, such as: ticket halls, waiting areas, platforms, and trains should not be the only aspects to express the functionality of a station, but there should be other supporting aspects added to meet the various needs of travelers and public during the transit. (Figure 4) explains the required circulation inside a station by passengers.

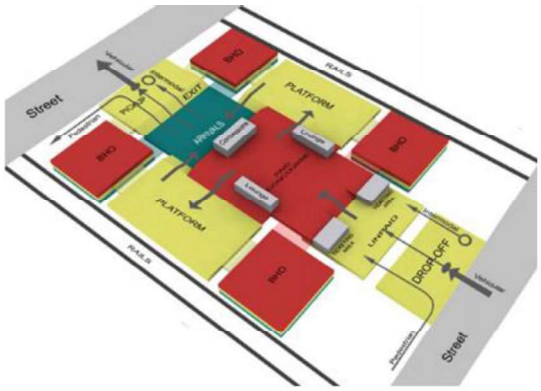


Figure 4: Design for passengers' circulation inside a station.Source: Ministry of Railways (Railway Board). (2009).

Station design components:
The paper assumes that there are 4 driving station design components: space, urban design, style, and technology.

1. Technical component:

- New structural solutions in materials, spans, and load transferring.
- The strong role of selecting a locomotive in providing requirements to be considered in providing spaces, and also sustaining the users' health and structures' lifespan.

2. Urban component:

- The component that guides the relation between the station with its surrounding urban plan; with the integration with the roads surrounding the station, the urban masses, the problem of space availability for trains' entrance into the city.
- Ease of access and clearance of approach to the station for all users.

3. Style component:

- The component used new and old materials to find new expressions of the age and the fitting style of the city as a "gate" to it.
- Finding new ways to express symbolic messages that form an artistic or a philosophical meaning to the art form of the building externally and internally.

4. Spatial component:

- The interior component that controls the safety of users in a volume with machines and crowds, the clearance of passageways and way finding.
- Establishing available spaces and utilities that witnessed upgrades in style and class to accommodate different types and classes of people; reaching new levels of ease and comfort.
- The addition of several facilities to serve the passengers like hotels, restaurants, and postal services that started to turn the train station into a central hub to the city socially and economically.

The presence of each component on any station building's design can be seen through the basic design elements of any architectural design: function & form. Each of the function and form guide several categories that are specific to the building elements that were created to form the station building. Based on simple model by Kido [1] to demonstrate the categories of function anf form for stations, which can be applied similarly to show the effects of the 4 main design componets (Figure 5).

The analysis to be conducted on Kenitra Station (Morocco); a brand new building in the early 2000's for a new railway that represents another quality of train stations in the Arab World. The key points of the paper are:

- Definition of train stations' design components.
- Function elements of train station: quality of entrances, quality of station buildings, quality of concourses, and environmental solutions.
- Form elements of train stations: aesthetical expressions and symbolism.

Comparative analysis between design elements and their effect on station components

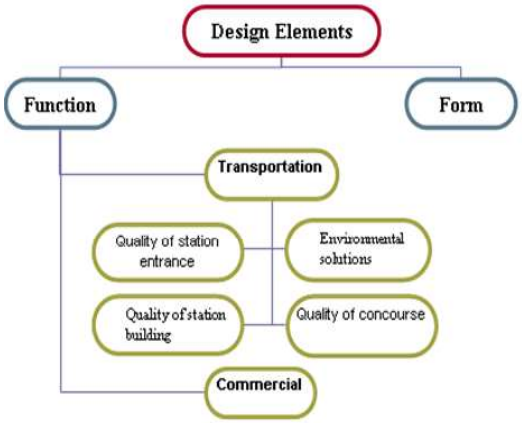


Figure 5: Design elements of railway station spaces.Source: Kido, E. M. (2013). Format: Author of the thesis.

Quality of entrance:

Accessibility should be present for all users; therefore, universal design is very important. Universal design should include aesthetic values, like: colourful glass elevators, interesting forms of ramps, etc. as glass gives a modern look. Today, stations have barrier-free circulation through **escalators**, **lifts**, helping **signs** and various verbal announcements.

In Europe, the most important notes on entrances include:

- Clear entrance.
- Name & logo are visible.
- Clear & visible design, even when it is standardized sometimes.
- Providing total concept of the function, i.e. subway lines.

In addition, entrances should be exposed and have harmony with its surroundings in the case of elevated stations. In case of subways, since there are no buildings for them, entrances become more important. Whether it is an existing station or not, there can be ways to find a solution for making any entrance distinguishing. Here are some examples [1]:

1. Some underground train stations' entrances **show the operator's logo** Figure6.
2. Others have an articulate design express for the underground lines **an overall concept of the subway lines** Figure7.
3. Some show **interesting design and subway operator's logo** Figure8.
4. Some are architecturally remarkable and **express the urban fabric as a landmark** Figure9.

Figure 6: Bank Station in Princes St., London Source: http://www.alamy.com.

Figure 7: Paris Métro entrance by Hector Guimard.Source: https://en.wikipedia.org

Figure 8: Omotensandō Station, Tokyo Source: https://en.wikipedia.org

Figure 9: Metro Bilbao, Spain Source: www.fosterandpartners.com

- Quality of station building:

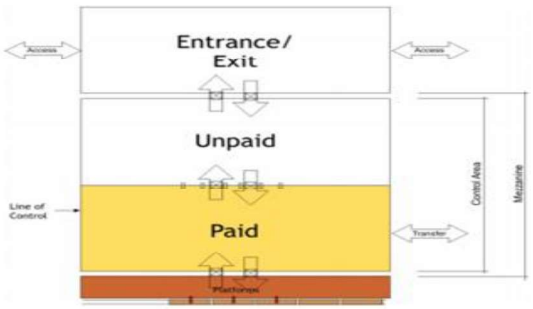


Figure 10: Typical control area between entrances. Source: Ministry of Railways (Railway Board). (2009).

Main station components include: **indoor environment** (discussed earlier), and **outdoor environment**, like: plaza and main street in front of station buildings (or entrance for subways). Train stations (especially termini) are a representation of the urban context and corporation. An original station -with being a transportation pivot- can become important, a local landmark, a gateway, and a meeting point for the locals. Modern railway stations often resemble airport terminals. There are few points to be considered [1]:

1. Train stations have no separation between departing and arriving routes.
2. A station can represent an important urban mark in comparison to airports; especially with small stations that can serve the local communities with its visual identity and facilities, while the large stations are considered "*gateways*" [1].
3. The designer is expected to ensure that journeys are easy and less confusing. The station design has to take into account that the journey extends out of a station, i.e. the **approach** and **departure from the station** affect the travel experience. The site can have one or more transportation modes; such as: buses, taxis, personal vehicles, planes, and even bicycles [14].

Figure 11: St Pancras International, England; by Norman Foster.
Source: Kido, E. M. (2013).

Figure 12: Sloterdijk Station, Netherland;by H. Reijndersof, Holland Railconsul.
Source: http://www.simplyamsterdam.nl

- **Quality of concourse**

The circulation design can depend on: **locomotive types, rate of users at the busiest times, barrier-free accessibility, etc.** Placing commercial activities and other amenities at circulation routes can hinder the users' flow, safety, and ease [1]. Thus, **barrier-free needs** themselves can act against the basic objective [15].

1. All spaces (transit, peripheral, etc.) should be located with ease and without hindering.
2. Suitable dimensions for visibility and orientation.
3. Clear and easy definitions of the progression through all the elements for travellers. A natural flow in a specific order for functions: through facilities and timetables, ticket-selling facilities, etc.
4. Ease of movement, comfort and speed are important for circulation through the station.
5. Using furniture and other services to separate main areas of high-rate passing from other areas of a slower rate.
6. Sustaining the flow of passengers through station concourses and other public spaces and comfort in waiting areas by adding furniture, amenities and separation from main passengers' flow area [1].

- **Environmental solutions**

Sustainability study for train station help -not only with environmental behaviour- but with the economic and social effects:

- Decrease consumption of energy.
- Using suitable daylighting for more efficient production and comfort.
- Treatment of ventilation; especially with fire prevention.
- Acoustic treatment for users' guidance and comfort [14].

- **Commercial function**

Large train stations in many countries (such as USA, Japan, and UK) started to act as "*shopping districts*"; particularly for tourists. This happens by collecting several functions inside the station, like: banks, coffee shops, postal services, hotels, cinemas, etc. [7]

Example: Milano Centrale, Italy:

The station consists of 5 levels: underground, ground, mezzanine, platform, and upper level.

The front building is considered a shopping mall Figure13. & distributed mainly on the first 3 levels and includes many varieties such as: bistro, restaurants, fashion clothing, toys, appliances, etc. [13]

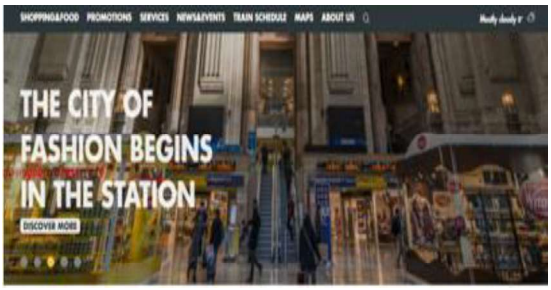


Figure 13: The shopping mall inside Milano Centrale, Italy
.Source: http://www.milanocentrale.it/en/

Form Elements

Train station buildings are considered an image or a gateway to its urban fabric. They carry a cultural and social representation of the city or town's background, and showcased with aesthetical values.

The components of a station are complex. So, the designer should sustain the function elements while adding elegance and balance to the form [1]:

- Between inside and outside of the station: interior design, facades, corporate identity, and urban context
- Between architectural design, structural design, mechanical requirements, and transportation requirements.

Theme

It is the wholesome style component as an expression using all form elements, special arrangement, and urban characteristics. In the past, with the concept of stations was new, themes were about expressing the philosophy of welcoming the travelers to a new urban entity, and using artistic movements for that; starting with the classicism in order and features, and evolving with the special and technological progress of station building.

Later, train station renaissance overcame the problems with standardized styles using the station renaissance, and the special arrangements of the station spaces became more adaptable to other styles; whether they are for a new building, or part of a renovated building.

Figure 14: Bermingham New Street Station, UK.
Source: Mairs, J. (2016).

Figure 15: The old Bermingham New Street.
Source: https://en.wikipedia.org

The theme can express a futuristic style; even contrasting with old concepts. The **Bermingham New Street Station** Figure 14. was opened in 2015 with a futuristic, dynamic theme that expresses the dynamics of railways' nature using perception distorting and forms of motion and replaced a demolished, classical station Figure 15 [10]. **University of Naples subway station** (Figure 16) has a morphological theme; in which design forms descending to the platforms to represent as a *"metaphorical shift from the conscious brain to the spiritual mind"* [11].

Figure 16: University of Naples subway station, Italy.
Source: Etherington, R. (2011).

Figure 17: Beijing Station, China.

Source: https://en.wikipedia.org

The theme can be a traditional style; a pure vernacular, or a blend with another concept. **Beijing Station** has a style that merges traditional Chinese style with socialist classicism (Figure 17) [12].

Research significance

The effects of increasing the size and services of stations; a matter that led to the complexity of functions and confusion among users; leading to:

- An uneasy experience of travellers and visitors.
- Wasting time needed to conserve for the basic function of stations: travelling in time.

The solution to the problem of complexity can be found in:

- Classifying the main and secondary spaces within a station and the required application of rules.
- Analysing the causes and effects of the increase of spaces and practical considerations of spaces, caused by the created supporting aspects of train stations as a result of complexity; such as: internal circulation, access for the disabled, advertising, information, etc.
- The form and aesthetics of a station building -aside of providing an identity of the designer and the location- should also serve the functional aspect of a station; as a quality and as a quantity. This is shown in several "functional" elements; such as: public art, choice of materials, advertising, colours, lighting, clarity, etc.

ABOUT KENITRA STATION, MOROCCO

A design competition was held to design a new TGV station in Morocco, with Silvio d'Ascia Architecture, Omar Kobité Architecture and Eric Giudice Architects as the winners [2].

Figure 18: Map of HSR Morocco, showing Kenitra Station in the middle.
Source: HSR Casablanca – Tangier to be ready for service in 2018. (2016).

One part of an overall plan to introduce HSR to Morocco is the station in Kenitra; a port city located along the northern Atlantic Ocean, just south of the coastlines of Portugal and Spain. The station will be part of a new 350 km long HSR line that starts north of Kenitra, in Tangier, and extend south to the city of Rabat and on to Casablanca; serving trains that reach 320 km/hr. The project should speed passenger travel and decrease traffic on existing rail lines in the region, to carry more than 10 million passengers a year [4].

Figure 19: Kenitra Station, street view.
Source: Rosenfield, K. (2014, March).

FUNCTION DESIGN ELEMENTS

Quality of entrances

Whether the entrance is linked to the station building or away from it (e.g. underground stations), the entrance should provide a connection to the urban context around it, while adding clarity, visibility, and identity to the corporation in special [1]; which adds to a style identity.

Kenitra Station distinguishes between the 2 entryways, the station uses its lightweight aluminium canopy framework to emphasise the entrances in a visual expression that is united with the overall visual weight of the station[3].

Quality of station building

Figure 20: Kenitra Station, from above.
Source: Rosenfield, K. (2014, March).

Main station components include: **indoor environment** (space), and **outdoor environment** (urban), like: plaza and a main street in front of station buildings (or entrance for subways). Railway terminals are important

expression of national and corporate prestige. An original station -with being a transportation pivot- can become important, a local landmark, a gateway, and a meeting point for the locals. Modern railway stations often resemble airport terminals [1], for the following reasons:

1. Railway stations have no separation between arrival and departure levels [1].
2. Similar security measures and the need for fluid transitions from "controlled" to "uncontrolled" zones [4].
3. A railway station has all the means for becoming a stronger urban space than an airport [1].

Kenitra Station uses the public commercial zone of the station has the purpose of providing a naturally-secured buffer zone. The commercial zone occupies 2,200 m^2 of area, plus 10,000 m^2 of the main area that includes common facilities for passengers and workers, is designed for public and commercial spaces; including shops, restaurants, kiosks, and a food court, with the access to them should be by users (80% of total users) who are either city residents or non-transit travellers [4]. The station's design from an urban point of view has the purpose of being a pivotal point for a new urban district for the city, and linking several Eastern and Western neighborhoods currently divided by railway lines, in other words: the station should be a unifying element between its elements, the university district, and the neighborhoods, in its circulation and urban weight [5]. The lightweight aluminium canopy framework acts as both train sheds and as a boundary to the station that covers the interior volumes of the station and appears to float above the ground dynamically [4].

Kenitra Station strengthens the role of an airport; where barrier-free passages, security buffer zones, and travelling services are almost the same. The station's exterior design gives the building an aesthetical value for the cultural side of the city, and also helps with the layout organization in strengthening the value of the station as an urban pivotal point in meeting, travelling, or trading.

Quality of concourse

The circulation design usually depends upon number factors: **density of use, type of trains, fluctuation during peak hours, barrier-free access, etc.** The location of commercial facilities at circulation areas is often against the efficient flow of passengers which can cause problems of safety and orientation. Except retail, there are other facilities located at the station, such as, cafes, bars, bookstalls, toilets [1]. The greatest factor that has changed stations and concourses in recent years is the legal requirement to become **barrier free** [11]; which are generally all elements of station, such as station building with entrance, station ticket halls and concourses, platforms, and station plaza should be located without obstruction or ambiguity, and by adding comfort elements in waiting areas by adding furniture, amenities and separation from main passengers flow area.

Kenitra Station has the design of its layout as a combination between U and L-shaped types gives the station a stronger connection between the concourse, and the platforms. The connection is further strengthened by the formation of the canopy that is both a shed and an enveloping plane that unites the areas of station.

The layout configuration is based on creating 2-L shapes; with one side is for amenities and services, and the other is a bridge that crosses the tracks. Passenger can enter into secured areas from any of the two sides of the station using the pedestrian bridge, and a secured footbridge on the opposite side of the station. The length of each "leg" of the layout is designed with respect to the integration of the TGV model used for the line; where the form of the building covers the entire stopped train [4].

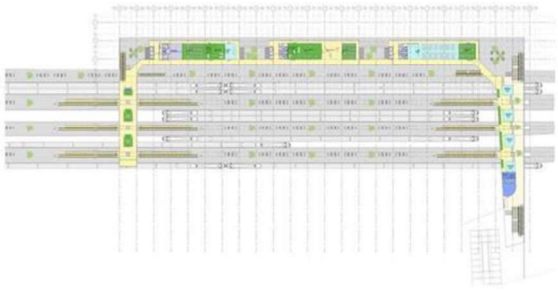


Figure 21: Plan for Kenitra Station, showing both the platforms and elevated floor
Source: Zimmer, L. (2014, March).

Environmental solutions

Train Stations nowadays tend to conserve energy, decrease its consumption rates, and provide a safe environment to its urban fabric. Train stations tend to sustain themselves in terms of heat comfort, daylighting, and power generations. The solutions are in either technological methods, and also with passive methods.

Kenitra Station uses a more passive approach, while adding to the cultural identity of the building within its urban context. The station's design is inspired by its local context in providing passive design strategies to naturally ventilate a large part of its interior [3]. The passive design uses the "floating" canopy of the station. While the structure of canopy itself carries several rows of rooftop photovoltaic panels, it also provides shade, wind directing, and collection of rain water during rainy seasons [4]. The elevated station, in addition to its natural ventilation and water recovery systems, includes other energy efficient measures to reduce pressure on the grid; turning the station into a hub for green transportation, and a sustainable site for locals the best experience and comfort for users [3].

Figure 22: Kenitra Station's platforms.
Source: Zimmer, L. (2014, March)

FORM DESIGN ELEMENTS

Form and function for train station design became over time more integrated with each other to the point of reaching some difficulty in some cases to separate their effects on the station design components: How can the necessities of travelling modes contribute to an experience for the user? What are the tools needed to shape a concept or deliver a message through designing a station? What message / expression should be used in the first place?

Theme is the wholesome expression using all form elements, special arrangement, and urban characteristics. In the past, with the concept of stations was new, themes were about expressing the philosophy of welcoming the travelers to a new urban entity, and using artistic movements for that; starting with the classicism in order and features, and evolving with the special and technological progress of station building.

Traditionalism is not just about duplicating old vernacular elements from history. It is about the adaptation of old cultural reference that characterizes the urban surroundings, and adding modern qualities and expressions to them. Kenitra Station is inspired by the traditional art and culture of the city; an inspiration that created its canopy lattice work that has function for the station and has a strong aesthetical expression in movement, rhythm, and composition. The lights and shadows from the latticework give the users a special experience that is unique to the city and its history.

RESULTS

In general, the 4 design components are influenced by the basic design elements (function & form) which are specific to the design of train stations. Each of function & form has its own set of sub-categories; where each of these sub-categories varies in presence, value, and effect throughout time period.

The function and form elements as products of the new design paradigms of train stations of today; following the development of transport modes, integration of several social activities; the adapting of the train station to the new circumstances of urban constraints (planning, society, economy)-whether the train station is a new building in a new urban space.

Table 2: Comparative analysis between principal design components of case studies.
Source: Author of the paper.

Design Elements		Station Design Components			
		Technical	*Urban*	*Spatial*	*Style*
Function	Quality of station building	●	●		
	Environmental solutions	●	●	●	●
	Quality of concourse	●		●	●
Form	Aesthetical expression	●			●
	Theme		●		●

The paper conducts a comparative analysis between the station design components and the previously-discussed design elements of function and form; that finds several results which should bring a proposal for the possible design direction

that is currently ongoing with the new train station buildings, and how it could affect the designers' approach to the design operation of said building type, in the current era.

CONCLUSIONS

The research finds the following results:

1. **Design components**, due to the development of cultural, social, and technological matters, can serve many functional purposes (e.g. materials can serve both environmental issues and spatial functionality), and also form and aesthetics; adding new vocabulary in visual and sensory expressions.

2. **The form of a station** and its aesthetical values becomes more expressive to the city's identity, even if the exterior design can be a representative of an international style at first glance. This is shown clearly in Kenitra Station (modern traditionalism, but not a vernacular treatment). Therefore, aesthetics is not bound to representing a specific art movement, but rather symbolizing an identity to its environment. Style has a more controlling value on the overall architectural product of train stations by deciding a theme; which is now not limited to only a classical representation of an art movement, but serves a function purpose in enhancing the special and urban components using the advancements in technical components.

3. **The major zones of a train station building:** becoming more important and integral to the station building and the linking between all zones became clearer in their commanding rules: hierarchy, individualism, integration, clarity, easiness for all users especially the handicapped and elderly, etc.). Starting with entrances that are related more with the urban connections, and its expressed values can vary between corporate identity, urban identity, or an international identity. Station halls (concourses) are designed as open spaces, and include buffer areas for security and crowd control; mainly inspired by airports. To eliminate confusions and delays, amenities and shops are organized to help in determining routes, clear information methods, and even aesthetical treatments.

4. **Ecological solutions** becomes more integral to the function of the station building; in saving energy, conserve resources, and providing comfort to the users in a more passive ways. Passive solutions can be found in integrating the form to the environmental solutions.

5. **Urban components:** Vertical planning becomes more important. The continuation of the strategy of vertical planning efficiently; for technical, and civil functions, and also for land use, inclusivity of functions, and even creating landmarks. Structure also started to play a role in aesthetics with rhythm, straight or organic motion, etc. Stations over time became closer to a social, commercial, and cultural centre; whether those activities are inside the station, adjacent to it, or in a link with the station with clear routes.

REFERENCES

[1] Kido, E. M. (2013). Stations for People: Recent Developments in Railway Station Design. Tokyo: Construction Technology Research Institute Ltd. National Cultural Research Institute, p58-66.

[2] Rosenfield, K. (2014, March). Silvio d'Ascia Wins Competition to Design Morocco Rail Station. Retrieved June 2019, from Archdaily: https://www.archdaily.com/485716/silvio-d-ascia-wins-competition-to-design-morocco-rail-station

[3] Zimmer, L. (2014, March). Silvio d'Ascia Unveils Gorgeous Lace-Like High Speed Rail Station for Morocco. Retrieved June 2019, from Inhabitat: https://inhabitat.com/silvio-dascia-designs-a-gorgeous-lace-like-high-speed-rail-station-for-morocco/

[4] Cardno, C. A. (2014, March). Floating Canopy Defines Morocco HSR Station. Retrieved June 2019, from American Society of Civil Engineers: https://www.asce.org/magazine/20140401-floating-canopy-defines-morocco-hsr-station/

[5] KENITRA TGV: High-speed rail station and transit hub. (n.d.). Retrieved June 2019, from Silvio d'Ascia Architecture: https://www.dascia.com/kenitra-tgv-eng

[6] Smith, M., Juul-Sorensen, N., & Worsfold, T. (2017). *Stations in the City – How are Transport Hubs Evolving to Meet Local Needs?* Retrieved July 2018, from ARUP: https://www.arup.com/perspectives/cities-and-stations

[7] Kandee, S. (2004). *Intermodal Concept in Railway Station Design.* BU Academic Review, volume 3, issue 1.

[8] Fourie, C. J. (2014). Facility Planning and Layout Design of a Railway Station. *Conference On Railway Excellence (CORE).* Adelaide: Conference On Railway Excellence.

[9] Ministry of Railways (Railway Board). (2009). *Manual for Standards and Specifications for Railway Stations.* Retrieved 2019: http://www.indianrailways.gov.in/railwayboard/uploads/directorate/land_amen/downloads/Manual%20for%20WCS%20%28Vol%201-%20Main%20Report%29.pdf

[10] Mairs, J. (2016). *AZPML's Birmingham New Street Station renovation revealed in new images.* Retrieved 2019, from Dezeen.com: https://www.dezeen.com/2016/01/19/azpml-architects-birmingham-new-street-station-renovation-photographs/

[11] Etherington, R. (2011). *University of Naples Metro Station by Karim Rashid.* Retrieved 2019, from Dezeen.com: https://www.dezeen.com/2011/04/01/university-of-naples-metro-station-by-karim-rashid/

[12] *Beijing railway station.* (n.d.). Retrieved 2019, from Wikipedia.org: https://en.wikipedia.org/wiki/Beijing_railway_station

[13] *Milano Station - Shopping Gallery*. (2016). Retrieved December 2017, from Milano Centrale: http://www.milanocentrale.it/en/

[14] Wilson, T., & Yariv, B. (2015). *Station Design Principles for Network Rail.* Network Rail, Document no. BLDG-SP80-002