Historical and Modern Structures at the Railway Stations
「鉄道駅における歴史と現代的な構造」

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Since 1980s, railway architecture has been experiencing “station renaissance”. Along with this trend, many historical stations have been refurbished, upgraded and developed. Modern extensions need careful considerations of historical heritage and its settings. Successful renovations add additional values of modernity and attractiveness to railway stations. This paper examines refurbished stations on the example of Europe and Japan and concludes that these transport facilities with their re-born buildings improving travel by rail, are the new-generation stations that play important role as transportation hubs and urban nodes, and for their visual qualities they are often urban landmarks.

Key words: Railway station; station building; heritage architecture; refurbishment; structure.

1. Introduction

In Europe, where introduction of high-speed trains (HST) had popularized travel by rail and since 1980s, stations have experienced the most notable development since the introduction of railways in 19th century. In Japan, railways have had always strong popularity and stations were important public and commercial facilities. “Station renaissance” trend has stimulated the development of new generation of stations [1]. These stations include completely new infrastructure, such as e.g. in Europe - Lyon Gare de Saint-Exupéry TGV (1994), Gare Lille-Europe (1994), Berlin Hauptbahnhof (2006), Liège-Guillemins (2009), and in Japan, e.g. - Kyoto (1997), Nagoya (1999), Kagoshima-Chuo Station (2004), Iwamizawa Station (2009), Kochi Station (2009), Asahikawa Station (2011), Hakata Station City (2011) and Osaka Station City (2011). Many existing stations have undergone general refitting and extension by new structures, e.g. London St Pancras (2007), and Tokyo Station City (2012). Both in Europe and Japan there are examples of stations that combine heritage architecture with new one. Historical stations with new extensions are challenging, because they require unique structures that can accommodate various functions and blend in together. New extensions need to be equal to historical buildings and not superimposed, like it has been achieved at the Gare de Strasbourg.

This paper analyzes the aspects of coordination of historical and modern structures at the railway stations on the example of stations in Europe – Madrid Atocha (1985), London Waterloo (1993; 2003; 2012), Stadelhofen Bahnhof (1994), Leipzig Hauptbahnhof (1997), Paddington (1999; 2012; 2017), Gare du Nord (2001), Dresden Hauptbahnhof (2006), London St Pancras (2007), Gare de Strasbourg (2007), King’s Cross (2012), Gdynia Glowna (2012); and in Japan – Ueno Station (2002) and Tokyo Station City (2012). The conclusion is that in Europe old buildings have been refurbished based on careful historical studies and new extensions have been added with respect and after many considerations. In Japan, due to different circumstances, more often has been preserved basic style – essence of the building and less often actual old structures. Refurbished stations with their structures have a high quality of structural art.

2. “Station renaissance”

2.1 “Station renaissance” in Europe

“Station renaissance” has been a driving force resulting in total improvement of railway stations both in Europe and Japan. It was initiated for the first time by railway companies in Europe in 1980s, as their response to various challenges in railway sector and respectively, as a result of technological potential of high-speed trains, and as a factor of urban renewal, reflecting growing environmental concern. As Thorne [2] noted: “It has been commonly observed that railway architecture has been experiencing a “renaissance” since the 1980s” and as a result, station architecture has been very much improved. German Deutsche Bahn Aktien Gesellschaft (DB AG), French Societe Nationale des Chemins de fer Francais (SNCF), Network Rail (NR) in United Kingdom, and other European operators put “renaissance” of stations along with technological improvements of trains and tracks, on the top of their policies. At the current stage of re-urbanization, railway projects – particularly development of HST stations and airport stations - have been often a part of urban renewal projects. Railway planners see trains as a part of broad transportation network. Therefore railway
stations have been conceived as multimodal hubs, connected with bus stations, light rail transit (LRT), subways, parking lots and pedestrian walkways.

Current multi-modal stations, often resembling air terminals, must respond to different requirements than before. Today, according to the concept of “seamless journey”, railway stations include all facilities arranged for ticketing, waiting, transfer, shopping and even recreation. Promotion of railways incorporated a wide range of activities, and polices related not only to construction of new railway lines and stations but also to station refurbishment. Refurbished stations often combine historical architecture with new extensions, which are structurally and functionally innovative.

2.1.1 “Station renaissance” in Germany
In Germany, Deutsche Bahn AG, which was privatized in 1994, was reorganized in 2010 and divided in four companies. Among them, DB Stations & Service, belonging to DB Netze, manages passenger operations and stations. “Station renaissance” in Germany, which has been based on DB comprehensive station development program - “Emergency Program” (2002), was established on the assumption that each station is a “visiting card” of the city and responsible for conveying their identity. The program had had three goals - quality, economy and brand products. The “Emergency program” was mainly related to the renovation of railway stations, such as modernization and refurbishment of station buildings, concourses and facilities; adjustment of platforms for high-speed trains; implementation of new corporate design (in graphics, platform furniture); construction of new urban stations and new HST and airport stations. Among the most successful projects were renovation and development of Leipzig Hauptbahnhof (1997), Dresden Hauptbahnhof (2006), and construction of Berlin Hauptbahnhof (2006).

The concept of corporate design has been realized through the reliance on aesthetic features, overall unity and diversity of elements [3]. Corporate design approach replaced former non-consistent approach of the various railway brands using various individual products – with a reliable railway product as a harmonized design for all railway sections. Through the concept of a “forum station” – a station fulfilling a function of – a stage for public life and an attraction, DB emphasized the importance of aesthetic experience – something that previously was disregarded. DB provided through architecture and interior design aesthetic spaces at the station buildings, realizing their goal of “well-being feeling stations”.

2.1.2 “Station renaissance” in France
In France, railways have also gone through the process of restructuring, particularly by splitting-off infrastructure and operation [4]. French Infrastructure Authority RFF (Réseau Ferré de France), which since 1997 has been operating national infrastructure, is responsible for nationwide rail development, including construction of new TGV lines based on plans jointly programmed with SNCF. Societe Nationale des Chemins de fer Francais is the only national rail operator for intercity railways, responsible for administration and maintenance of infrastructure based on the agreement with RFF. SNCF has been divided into five main business sectors. Among them is created in 2009 SNCF Gares & Connexions, which manages 3000 stations. Groupe AREP is responsible for civil engineering.

According to the policies of refurbishment many stations have been modernized, and among them main terminals in Paris: Gare de’l Est (1988), Gare d’Austerlitz (1989), Gare Montparnasse (1986-1990), Gare du Nord (2001), Gare de Lyon (1994) and Gare Saint-Lazare (1996), and many projects still are going on. While station renewal was based on careful studies on historical architecture, new stations, such as the Lyon Gare de Saint-Exupéry TGV (1994) or Gare Lille-Europe (1994), have been designed as innovative buildings with an airport terminal-like image due to expressive, light-weight structures. SNCF has expanded its “station renaissance” policies, through strengthened corporate design, vigorous station renewal and introduction of new type of amenity, combining transportation function with city services, such as recreation and retail. SNCF introduced certification for stations, which comprise of 45 criteria, including aesthetics. New approach based on “Station Organization Plan” (POG) (Plan d’Organisation des Gares) – is a comprehensive plan for intermodal transport and commercial development. The aim of this program is to develop special methods related to spatial positioning of transport-related fixtures and fittings and the pedestrian routes, which as result are defined and integrated into one coherent network. That program was followed by commercial development plan, which determinates the location of commercial facilities.

2.1.3 “Station renaissance” in the United Kingdom
In the United Kingdom, like in Germany, national railways have been divided and privatized in 1994. Infrastructure has been separated from operation, and since 2002, Network Rail has owned and managed railway facilities, while passenger operations have been franchised under the Private Finance Initiative (PFI) and have been operated by various Train Operating Companies (TOCs). Since privatization, “station renaissance” has been reflected in diversification and expansion of station trading and in new commercial developments in newly created station spaces. Stations also have been better prepared to match their social context – through provision of parking lots for cars and bicycles, better accessibility, provision of services in accordance to local needs, and through better quality of operations, services and design that includes such principles, as public involvement, competitions, and aesthetic guidelines.
In order to achieve new station image – safe, configured to seamless process, comfortable, enjoyable, preserving historical heritage – NR has promoted new railway station’s goals, such as: quality (improvement and renewal); operation (balanced services); and access (provision of interchanges, barriers-free). Polices boosting new image of railway have been reflected in NR guidelines, such as “Developing modern facilities at stations”, “NR heritage guidance”, “Way finding and signing guidance”, and “Advertising design strategy”. Implementation of these policies has been reflected in refurbishment of historical stations according to major stations renewal program - “Station 2000” (e.g. St Pancras, 2007; King’s Cross, 2012 - scheduled connection with St Pancras in 2013), and in realization of new ones (e.g. Stratford Regional, 1999; Manchester Piccadilly, 2002). Fourteen historical terminals in London have been modernized in collaboration with TOCs and municipal government, as a part of urban development projects. Historical terminals have been modernized to accommodate platforms for high-speed trains, larger interchanges and new facilities, including shopping and food outlets (e.g., Waterloo International, 1994; and Paddington, 1999; King’s Cross, 2012). Refurbished stations have shown integration with other public and environmentally benign transportation modes and became attractive modern additions to historical buildings.

2.2 “Station renaissance” in Japan

In 1987, based on national reform, Japan National Railways have been privatized and divided. Currently, Japan Railways Group consists of seven operating companies, including six passenger operators. Unlike in Europe, Japanese railways are divided by regions, not by operation and infrastructure - therefore they have been willing to expand and profit from related business fields. Railway companies in Japan have been promoting “station renaissance” since 1990s. Their aim is to attract more customers by improving railways through better services and attractive appearance of stations. The scope of “station renaissance” has included refurbishment of existing major terminal stations, planning and construction of new stations on existing lines - as a response to local needs, and on new lines accompanying the growth of cities, and also development of shinkansen stations.

Refurbishment has been based on amenity improvement programs. They enhanced aesthetics through barrier-free design, inclusion of amenities (new entrances, toilets), better information signs, new facilities, and commercial developments. East Japan Railway Company, known as JR East (JRE), which is operating in Tōhoku, Kantō, and Kōshin'etsu, has completed several successful renewal projects in Tokyo, such as Ueno (2002), Shinagawa (2004), Omiya (2005), Tachikawa (2007), and has been carrying out new development projects at Shinjuku, Shibuya and Tokyo stations. Some stations have been built new. Kanazawa Station, which was completely rebuilt in 1990 and developed with new shopping center in 1991, has boosted its image in 2005 by a grand Tsuzumi Gate and Motenashi Dome. Other stations with outstanding architecture include Kyoto (1997), Nagoya (1999), Iwamiwaza Station (2009), Hakata Station City (2011), and Osaka Station City (2011). These stations have new building however platforms have remained not upgraded yet.

3. Aesthetic factors of structural art and their realization in refurbished stations

3.1 Structural art

Structural art is an art accomplished in the work of structure. Art forms have developed after Industrial Revolution in late 19 century along with the introduction of new materials – iron, structural steel, reinforced concrete, prestressed concrete, and later - structural glass, composite timber, other composites and fiber reinforced plastic. New materials allowed for new structural forms, such tensile structures, shells, grid shells, space frames, etc. These forms have determined the shape of engineering structures such bridges and buildings. Billington [5] has defined three goals of structural art – efficiency, economy, and elegance. These goals correspond with the need of the conservation of environment and accountability of funds while satisfying the need of aesthetics in public life and preservation of historical monuments. Structural art - as opposed to fine architecture which seeks the beauty of pleasing shapes independent of the structural skeleton of the building – is based on engineering structure that is fully visible and aesthetically pleasing in its own right being the prime source of the beauty of the building.

3.2 Aesthetic factors of structural art

Structures and buildings to achieve structural art need to fulfill particular aesthetic criteria. Aesthetics of railways can be defined as a balance between exterior and interior of station, between building architecture, engineering structure and transportation function - in consideration of its planning, layout, details and context. Transportation functions needs to be sensitively distributed and clearly distinguished from other functions. Aesthetic station has to be clear, easy approachable and easy to understand, but at the same time it needs to provide a rich environment. Aesthetic factors of station design include objective qualities, such size and scale, proportion, form and shape, space, visual weight, light, texture, color, composition, movement and rhythm, and details [6]. In subjective response to built form, there are image-based elements related to design context, representation of the image of railways, of a brand of train operators, landmarks features, and to inclusion of artistic elements. Aesthetic factors are also related to distribution of commercial role of the station and treatment of advertisements. Their explanation and relation to railway stations, is as follows.
- **Size and scale**
The size of building and its interiors affects emotional response and visual weight generated by their impression. The size of the station depends on how many passengers use it. The scale of station building is perceived in comparison to human scale. In case of large European railway terminals, like London’s St Pancras, Paddington or Victoria, they were designed not only to provide adequate space for passengers but also to impress by their large scale. Such stations like Gothic cathedrals had many meanings – political, social and urban. Smaller stations were designed more in relation to human scale. The light contributes to the perception of scale – even if the station is small, good lighting design can make station visually more spacious. Large scale of recent European stations is accompanied by human-scale elements. These stations respond to different objectives than in the past; they have been built with spacious spaces designated for various functions connected with a chain of a “seamless journey”.

- **Proportion**
Proportion is related to shape – for example slender or squat, and to scale. In the history of built forms, there have been favored proportions, such as 1.6 to 1 – the so called “golden mean”, etc., developed in ancient architecture by architects and aestheticians, or in modern times – based on the analysis of buildings which are generally considered as beautiful, such as “modulor” system by Le Corbusier [7]. Examples show that compositions made of simple geometrical figures are usually successful. In modern architecture there are also shells, tents and other modern, which, have been not analyzed like the rectilinear structures in the past. It is probably good, if the proportions of station building delivered from the geometry are based on the laws of nature.

- **Form and shape**
Form has more “solid” meaning, while shape is more outline of the object. Buildings have three-dimensional forms and there are some clues that are relevant to their perception, like distance, angle, colors, amount of textural details, etc. Complex forms can be identified through relationship to simpler forms. According to Ching, essentially, forms are built of primary elements: points, lines, planes, and volumes [8]. Superimposition of basic forms leads to “formal collision” of geometry. Forms are arranged from elements. Such arrangements can be centralized, linear, radial, clustered, or grid-like [8]. Station to be recognizable need to have forms, which can be identified and comprehend by the users.

- **Space**
According to some concepts, space exists between objects and permeates them (Plato). Ching envisages a relationship between form and space as a “unity of opposites” [8]. Sometimes may be considered that space posses “direction”, particularly when in a sequence, one space comes after another. Such sense of directionality is important at the railway stations. Space is an essential factor for a station because it must provide a room for many people using it every day. Station space serves to move through it, to wait, to purchase tickets, to prepare before embarking for a travel and after arriving at the destination. Appropriate and well-designed space provides security and well-being. Space may not need to be “defined”; rather it may be “suggested” in a subtle way, to help people to navigate through spaces. Recently glass is often used in architecture. Glass encloses spaces but leaves their visual connections. Such space can be “permeable”. Glass elevators decrease the feeling of confinement, and as a part of universal design provide convenient access for physically challenged passengers. Transparency of glass creates station more spacious and understandable. Depending on the surface design, it is possible to speak about the “degree of permeability” and the “degree of closure”. Visual clues about the nature of spaces include vision and people’s movement - motion. Among non-visual clues of the permeability of space is admission of light, weather syndrome (rain, breeze). Well-designed barrier-free space at railway station provides feelings of spaciousness, lightness, security and well-being.

- **Visual weight**
As Holgate points out, visual “weight” of areas and volumes is of major importance in the unity, balance, and composition of built forms [6]. It is influence by light, color, and texture. Modern frame and shell structures at the stations tend to look “light” and nowadays it is synonymous with “beautiful”.

- **Light**
Light with shadow helps to emphasize the nature of form. Play of light can influence the perception of texture. The quality of space is affected by changes in the angle and color of the daylight. Light is necessary for a station to perform its function. At large stations, where the role of architecture and structure is paramount, the admission of daylight can increase the expression of structure which can become a landmark feature. Daylight in daytime is preferable; therefore a provision of glazing increases the possibility of natural light’s penetration inside the station. Visual connection between platforms and concourses increases the amount of a daylight passed on the platforms. Admission of daylight through the glass walls highlights their architectural expression. It also improves the clarity of station layout because passengers can easily notice distinguished by light entrances and exits. Artificial lighting is functional as well, and can increase visual expression of the station. Top lights create secure environment and enhance architectural features of the interior. Lighting has also informative function – properly lit signs, information posters, stations names, etc., enable passengers to move in right direction easily and safely. Successful lighting depends on combination of lighting levels and types of
lighting fixtures. Design of lighting may create desirable atmosphere. With most railway stations, the combination of architecture, light and space can be achieved.

- **Texture**
  Texture is the nature of the surface – size and organization of the particles constituting a surface. The texture can be smooth or rough; can be also rich by the repetition of small design elements. Texture has a great effect on visual weight. Objects with smooth surfaces are perceived less “heavy” than those which have rough surfaces.

- **Color**
  Perception of color is subjective and influenced by size, other colors and light. Colors may have also influence on the “visual weight”. Some colors, which are “warm”, make spaces visually smaller, while “cool” colors make them visually larger. At the station, color can be created by using colorful materials and colorful artificial lighting. Bright colors visually increase space; warm colors increase the feelings of safety. Colors are also used to express the design concept. They can be also used as a guiding or safety tool – for example by emphasizing railings or elevators by particular color. Colors combined with light can be used for aesthetic and functional arrangement at the station, to underline particular functional elements or show directions.

- **Composition**
  Composition may provide balance, unity, and harmony. Three-dimensional balance in built forms provides comprehensive equilibrium between visual forces. “Unity” is sometimes equaled with “beauty” of built form. In complex composition it can be referred to situation when all elements are grouped together or descend in some direction, or are integrated through broader outlines, through texture, colors and details. Composition is a very important factor of railways stations, where it helps to solve functional issues and provides easy to understand station.

- **Movement and rhythm**
  It is affected by human eye-sight and brain. Impression of “movement”, for example by use of columns, can help to direct flow of passengers. At the stations, rhythm of some facades can underline main entrance and main station hall and distinguish them from other spaces.

- **Details**
  Details include various aesthetic qualities, such as listed above. At the railway stations details should be designed with particular purpose in mind – to provide direction, information, guidance, barrier-free access and to fulfill numerous other station functions. Such well coordinated and recognizable details should be integrated with the form (structure), space and light, and distinguished by textures and colors (materials). Details should be carefully designed in case of information signs. All the information should be readable for visually impaired people and easy to understand by domestic and foreign travelers. The quality of design at such stations, e.g., Berlin Hauptbahnhof or St Pancras, has a big impact on well-being of passengers and their safety. Aesthetic design helps also to control flow of passengers – by employing guiding lights at platforms and concourses. If elements like elevators are colorful and modern, they can be well visible as well. Thus aesthetic design can improve the efficiency of a station – passengers can leave the platform more quickly and in more comfortable way, if they are provided with attractive and clear guiding information, escalators and elevators.

- **Image-based elements**
  Image can be expressed through the design. Very often built forms express their association with their particular location – “sense of place” (genius loci). In case of railway stations, which are gateways to particular cities, they might express the image of their locations as well. Stations represent rail companies and it is also reflected in aesthetic design that contains a particular image of railways. Image-based elements include design expressing the image the railways or the image of train operators. Image of railways can be created for example through marking station entrances. The company logo, which is a part of a corporate design concept, has been redefined by many European operators and applied at the station entrances as an informative, decorative and signature element.

- **Landmarks**
  Stations are perceived as landmarks, if their image-based elements are strongly related to their urban, historical, cultural, and social context and if they are harmonized with urban surrounding. Image-based elements give the station the value of an urban landmark. Historically, main railway stations in Europe were distinguished by their elaborated large forms and by a prominent location, since they were often facing the main street and had a plaza in front of the main entrance.

- **Public art**
  Public art plays a significant role in enhancing image of railways. Railway companies understand the importance of introducing a design and culture into the stations. Art has become a part of cultural value of the rail brand design. It has been acknowledged that customers’ satisfaction increases with better designed stations, with comfortable waiting areas, with clear information signs, and additionally – with public artworks, cultural and community events and with other
activities that can enrich the modern concept of the experience of travel. In Europe, some transport agencies have introduced a “percent for the art” policy, based on a fixed percentage (from 0.5% to about 1%) of all budgets for new developments allocated to the purposes of art. The issue of the art and design at public transportation has been discussed for the first time at the International Union of Public Transport (Union Internationale des Transport Publics - UITP) Congress in 2001. In Newcastle, in the effect of collaboration with private sector, the city developed a “percent for art” policy which gives up to 1% of their annual capital construction program on arts projects. In the course of the program which has been running for 26 years, at the beginning mostly permanent art works were installed at the stations but later more often temporary works such as lighting installations and live art events were installed and organized. In Europe, public art projects are often financed by government; for example the art program run in Brussels is financed by a government body set up in 1990 by the Public Works Ministry and it is related to artworks at all transit facilities. In Japan art is also applied at many stations – for example at station halls of renovated stations, conceived by local artists (like stained-glass artworks at the Ueno Station), and at the new shinkansen stations.

- **Commercial function**
  Distribution of commercial function at the stations and clear arrangement of station space in regard to its function is important factor of relation between form and function. Along with the process of evolution of railway stations, more functions have been added, such as retail, hotels, restaurants, leisure, etc. Ross [9] has listed forms of retail that include: small shops, small size walk-in units, kiosks often located at the platforms, trade stands, vending machines, public telephones, auto-teller machines (ATMs), promotional activities and internet facilities. Intermodal stations became interchanges providing access for air, other rails, bus, underground and LRT services, and a part of a new urban and commercial center accommodating businesses, hotels, and shopping centers. Shopping malls and convenience stores have been often installed around stations concourses. Stations have become transportation nodes offering many attractions and experiences as a part of efforts of changing railway companies trying to improve their products to reflect their corporate prestige. The development of many functions at railway stations caused problems with their proper arrangement. In Japan, more functions have led to confusion at some stations, where the priority was put on commercial facilities over rail travel activities. Retail is important but secondary function at the railway stations. It attracts passengers and makes station multifunctional but it also needs to be properly distributed to prevent the station to become a “department store” or a maze through which passengers cannot easily find their ways. The problem of separation of transportation and commercial function and at the same time making commercial facilities easily available is very difficult, particularly at historical stations, which need to be modernized to nowadays standards.

Commercial developments can be designed as “concentrated shopping malls” integrated with public areas of the station and distinguished from other services for passengers or as “lines of shops” usually developed in the form of corridors of retail surrounding the main operation areas. If a separate mall approach is impossible, shops line in the areas bordering the platforms. In Japan at large stations, retail is often located in the main operational areas (e.g. Ikebukuro Station) filling the station spaces as much as possible. The piecemeal approach is incoherent, resulting in adverse affect of commercialization of stations. These adverse effects of retail that may occur at any ill-conceived stations include clutter and congestion, clashing with architectural style and interior design, and obstruction in passenger operation. When installed at the main concourse, the retail has to be balanced and to include many kinds of services, such as small shops and restaurants.

- **Advertisements**
  Treatment of advertisement reflects approach to aesthetics in public spaces. Currently a wide range of advertising media is available, such as various kinds of posters – traditional, illuminated, back-lit posters in illuminated casing, which are often applied at the subway platforms. It also includes moving displays, TV and plasma displays, other displays at the stair cases and along escalators, on the train bodies, inside the trains, branding the entire stations to one advertiser, various sales and campaigns installations. The advertisement can be a part of aesthetic design, if it is a part of the design concept. In such design, it is important to maintain the balance between the size of the station and the amount and sizes of advertisements. Advertisements should be associated, if possible, with the context of the station environment, may have a reference to healthy lifestyle products, culture, etc. – to enhance the value of the station image. Particularly sensitively should be handled the advertisements at historical stations, where they should be well integrated with station architecture.

In Japan the trend to place many advertisements is stronger than in Europe. It is maybe because the recognition of aesthetics of public facilities has been weak here since the post-war economic development, followed by the destruction of landscape since 1970s, when stations displayed lack of architecture, and “despite their public character, station buildings are literally covered with so much commercial advertising that it is often difficult to tell whether they are station facilities or commercial buildings” [10]. Railway stations have been often virtually covered by advertisements. Even modernized elevation of Shibuya Station, designed by arch. Kengo Kuma (2003), has been covered with large advertisement panels.

Currently the implementation of aesthetics is being realized by railway companies - through their policies, including
amenity improvement programs, through new concepts of corporate design, and modern architectural design. Aesthetic railway stations have been successfully achieved through involvement of well-known architects. There is always a question of cost of aesthetics. Aesthetics and economy have been often seen, as contradicting each other. Since the separation of architectural and engineering professions, some engineers thought that satisfying of aesthetic requirements involves additional cost. However there are many examples of structures and buildings being beautiful and economical at the same time. Implementation of aesthetics has been carried out in renewal projects as well as in new projects. European stations, which have been more than one hundred years old, were in a need for modernization and refurbishment. Historical European stations had reputation for design excellence and recent past has seen renaissance of station architecture reflected in new stations design and in renovation of old ones. Particularly in Europe, renewal of railway stations focused on enhancement of cultural values and on brand design of particular railway operators. Design features tended to link stations with local communities through collaboration with local residents, promotion of cultural activities - organizing various events, concerts and through design competitions, and linking current stations with rich historical heritage. Also in Japan, railway companies have been making many efforts to advertise its brand name through attractive stations.

3.3  Refurbished stations in Europe

Many of refurbished European stations are large terminals that consist of historical buildings and new extensions. Splendid new railway stations resembling air terminals, are often connected with airports, and serving high-speed trains. European stations have such a common feature, that modern developments are respectfully connected with preserved historical buildings into “integrated stations”. These stations express structural art of the past and present.

3.3.1  Madrid Atocha (1985)
The original station of 1851 was largely destroyed by fire some 10 years after its construction. In 1892 it was replaced by a larger station with a wrought-iron vault. It was designed in a wrought iron renewal style by Martín Alberto Palacio Elissagüe who collaborated with Gustave Eiffel. As part of a large infrastructure project, the Atocha Station was expanded in 1985 with a new structure designed by architect Rafael Moneo. The train tracks were moved from the original structure to the new terminal while the “old” Atocha Station was completely renovated and turned into a large rest area featuring a tropical garden, shops and eateries (Fig. 1). Another part of the project replaced the bridges on the square in front of the station - the Plaza del Emperador Carlos V - by tunnels. As a result the passers-by can now enjoy an open view of the beautiful train station. Glass roof looks light, while separation of commercial function from transportation makes station easy to navigate.

3.3.2  London Waterloo (1993; 2003; 2012)
Waterloo Station, known also as London Waterloo, is a historical London terminal. Present building was originally built in 1822 and part of it is listed as heritage. The station has undergone renovation and extension, to become international terminal to serve as the Eurostar terminal from 1994 to 2007. New extension for Eurostar including train shed (1993) designed by Nicholas Grimshaw & Partners was developed in the manner of air terminal (Fig. 2). New structure of a flattened asymmetrical three-hinge bowstring arch blended well into historical setting. The roof follows the curve of the railway and increases in span down the length of the station. Each arch and the related cladding are different as the roof changes width along the curved tracks. The cladding on the trusses on one side is made of glass, and another side of stainless steel. The next train shed refurbishment was carried out between 2001 and 2003, when a new roof over the other platforms was constructed. The train sheds at Waterloo are reminiscent of the great 19th century railway architecture and engineering. From one side, the old building was preserved as much as possible including historical details, and from another new outstanding structures have been added with careful considerations and using similar materials. Glass was used for new shed similar to the roof over the concourse. Later on, retail was removed from the concourse and first floor offices were converted into retail space – the “Waterloo Balcony”, which was completed in 2012. New balcony has glass, light lit floor and transparent railings. It has well balanced proportions, looks modern and not obstructive. London Waterloo is an example of good combination of historical and modern structures that are engineering works of art.

3.3.3  Stadelhofen Bahnhof (1994)
Stadelhofen Bahnhof, built in 1894, is an important local station in Zurich. The station was remodeled in 1984. Later, Spanish engineer-architect Santiago Calatrava was commissioned to accommodate a new third track. The architect's challenge was to accommodate a third track in an existing train station built for 300 meters along a curved railway line running round a hillside in the town center. Calatrava's design has excavated the hillside to add the track, and then built the hillside back with a multilevel structure that restores the walkways and bank above, while providing an open, naturally lit platform underneath for the new track (1994). He adopted structures of steel frames and glass, including a graceful curving glass-roofed canopy developed with counterpoised steel. Walkways extend along the length of the track at four levels: the platforms themselves, an underground arcade beneath them, a cantilevered concrete promenade re-forming the hillside above the new platform, and the original hillside above that. Original elegant station building was preserved. The station successfully expresses the balance between “static” historical architecture and “dynamic"
modern structure (Fig. 3).

3.3.4 Leipzig Hauptbahnhof (1997)
Leipzig Hauptbahnhof was designed by architects W. Lossow and M.H. Kühne, who were chosen in design competition organized in 1906. The renewal of Leipzig Hbf was realized in 1997 through the collaboration between DB, private investors and local government. Design concept relied on the combination of tradition with modern architecture, openness of station hall and provision of daylight - all in the manner of airport terminals. With the respect for the cultural heritage, the stations structure was not modified but the original design idea was extended by a new vertical development of the transverse platform hall. The modernization of station included also the renewal of building façade, historical train shed of 1915, and renovation of train platforms.

Station hall was modernized and developed according to the competition winning project by ECE Projektmanagement. The design idea was to open up the ceiling of the transverse platform and to create a new vertical development - a 3-floor market place “Promenaden Hauptbahnhof Leipzig”, with lively shopping and entertainment zone comprising of around 140 specialist stores on approximately 30,000 m² (Fig. 4). New shops have been integrated into the protected historical structure without interfering with transportation function. Station halls, large train shed and platforms have been renovated as well. Leipzig is currently Europe's largest railway station by floor area (83,460 m²; 24 platforms). The station has revitalized the surrounding area. The “Promenaden” at the Leipzig Hauptbahnhof was granted in 2004 in Madrid for the first time the “ULI1 Award for Excellence”, as a trend-setting pilot example of the revitalization of train stations. The successes prompted DB to renovate the longitudinal platform halls at a cost of about 200 million DM. Tenner [11] observed that the station became the center of attraction in the heart of the Saxon metropolis and is visited by an average of 150,000 people every day, while before renovation 70,000 passengers per day were counted at the station.

3.3.5 Paddington Station (1999; 2012; 2017)
Paddington Station, known also as London Paddington, is one of central London terminals connected also with underground, which serves as the portal from Heathrow into the rest of the city. Current building, originally designed by engineer Isambard K. Brunel and architect Sir Matthew D. Wyatt was built in 1854 and undergone renovations. The spectacular train shed was cast-iron with arabesque details at the large windows. Today, Paddington has 14 terminal platforms; platforms 1 to 8 are below the original three spans of Brunel's train shed and platforms 9 to 12 are beneath the later fourth span. The station concourse stretches across the head of platforms 1 to 12, underneath the London end of the four main train sheds. The area between the rear of the Great Western Hotel and the station concourse is traditionally called “The Lawn”. It was originally unroofed, but was later built up to form part of the station's first pedestrian concourse.

The improvements carried out between 1996 and 1998 involved the refurbishment of platforms 6, 7 and 8, electrification of platforms 3 to 12, reconstruction of the footbridge between platforms 6 and 10 and the concourse area (“The Lawn”), extension of the station concourse and London Underground ticket offices, and improvement of signage and customer information systems. The station has also received a facelift as part of an improvement program. The improvement was designed by Nicholas Grimshaw and Partners in association with Rodney Fitch. It added a new customer information system and retail, food and drink outlets on “The Lawn”. The renovation included the re-roofing of “The Lawn”, and its separation from the concourse by a glass screen wall. It is now surrounded by shops and cafés on several levels (1999; Fig. 5). The design expresses historical heritage and “sense of place”. Renovated structure looks light and elegant. New developments are coordinated with historical building.

The fourth span was renovated in 2011, involving repair and restoration of the original Edwardian glazed roof. So that

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1 Urban Land Institute (ULI) founded in 1936 in Washington D.C. is a non-profit organization for scientific research and education
platforms 9 to 12 can once again have daylight. Currently, the station is undergoing the most significant redevelopment since the historic station was completed. Local firm Weston Williamson is in charge of the renovation, which calls for a number of new sections to be constructed as well as retrofitting the older ones to accommodate increased ridership and new London Crossrail line, which now under construction. The Grade I listed station is located on a potential UNESCO World Heritage Site and the design balances many issues, like heritage, conservation, transport integration, way-finding, orientation, servicing and security. The renovation will create a new great space that responds to Brunel’s original concept of a “great interior”. New ticket hall will have a glass canopy. Renovations are currently underway and are expected to be complete in 2015 and by 2018 the new London Crossrail line should be in operation. The project known as the Paddington Integrated Project (PIP), involves construction of a new station. The station will be built by Crossrail, a subsidiary of Transport for London (TfL), which was set up to develop a new infrastructure to address congestion and capacity improvement on London's existing railway network. New Crossrail stations, designed by renowned architects will be constructed along the central route at Paddington, Tottenham Court Road, Bond Street, Farringdon, Liverpool Street, Whitechapel and Canary Wharf. The project of rebuilding the Paddington Station has a target completion date of 2017.

![Fig. 5 Paddington Station – „The Lawn“, London, 1998](image1.png)
![Fig. 6 Gare du Nord extension, Paris 2001](image2.png)

3.3.6 **Gare du Nord (2001)**
The station was originally built in 1865 by Jacques Hittorf and in years it had accumulated many additions. The modernization of the Gare du Nord was undertaken in order to prepare it for the commissioning of the TGV Nord. The project included the layout and roofing for the Eurostar TGV service, extension of the Eurostar terminal, the reconstruction of all main line tracks and platforms, as well as creation of new underground interchange with parking lot and approaches to RER (Réseau Express Regional) and subway line. Original structure of the station was restored. The project was based on careful studies and respectful approach of modern intervention in old structure, which was reflected in choice of materials (stone, wood, metal and glass) and the coherence that extends to every aspect of the restoration program. The design complies with the SNCF policies in regard to historical restoration included in “POG” and provides barrier-free access through escalators and transparent elevators with glass walls. New interchange (1992-2001) has been composed of a double-roof hall that blends with the roofing of a historical building (Fig. 6). The hall constructed of glass and metal is completely transparent and accommodates well-lit space that is centered around central access to various transportation modes on five levels, including high-speed trains, local trains and subways. Entrances to each transportation mode have been distinguished in style: white tiling is applied for accessing the Paris Transport Authority RATP (Regie Autonome des Transports Parisiens), red coating is used on the beams and columns for accessing the regional express trains RER. Transparency of the building provides daylight in the interior and visual link with the street and heritage station architecture. The station is still under the development – a new connecting hallway between Gare du Nord and Gare de l'Est is scheduled to be opened when the new LGV Est begins serving the station.

3.3.7 **Dresden Hauptbahnhof (2006)**
Dresden Hauptbahnhof is one of two main inter-city transit hubs in Dresden. Originally one of the most impressive late-nineteenth-century railway stations in Europe designed by Ernst Giese and Paul Weidner and built in 1897. The station has three halls; the biggest central hall covers the terminating tracks. Parts of the tracks are terminal. The arrivals hall is situated in front of the terminating tracks giving the station the character of a terminal station. The station was in poor condition and required renovation.

Renovation and expansion of the station was part of a wider masterplan to revive the surrounding area. The station redevelopment removes various additions and alterations made to the building over the last hundred years in order to restore the integrity of the original design. Circulation within and through the station has been rationalized and the
design allows for the future expansion of the station by extending the barrel-vaulted roof over the outer platforms by 200 meters, providing a cover for the new high-speed trains, which are almost twice the length of the old platforms. For that purpose, the refurbishment included new 30,000 m² roof, covered by a canopy made from Teflon-coated fibre glass, which was designed by Sir Norman Foster (Foster and Partners) with lightweight fabric roof design by Sir Edmund Happold (Buro Happold; Fig. 7). Refurbishment included redevelopment of an entrance building and reconstruction and glazing of dome and arches. Restored structural elements fit well to new structures that use new materials. Details and colors contribute to the total image of the modernized historical station.

3.3.8 London St Pancras (2007)
St Pancras Station, often termed in history as the “cathedral of the railways”, is located in central London near King’s Cross Station. Magnificent historical station and hotel (Midland Grand Hotel) designed by an architect Sir George Gilbert Scott were completed in 1868 and 1876 respectively. A single-span iron-and-glass train shed with beautiful and biggest of its kind for decades arch roof was designed by William Henry Barlow and Rowland Mason Ordish. When the station was first opened in 1868, a 74 m-wide train shed was a spectacular structure that held the world record for the largest enclosed space.

St Pancras unused for decades was successfully refurbished and developed and still remains one of the greatest Victorian buildings in London. The master plan for the extension was created by Sir Norman Foster and modified by Alistar Lanley and Arup. After a decade-long project the station was officially re-opened as the St Pancras International in 2007. It serves as a final destination for Eurostar and high-speed rail in the UK. After opening of the station, the number of Eurostar passengers increased for about 20%; annually 45 million passengers pass through the station.

3.3.9 Gare de Strasbourg (2007)
Gare de Strasbourg is a main station in Strasbourg, and the second largest train station in France, which was originally opened in 1846 and rebuilt in 1883. It was designed in 1883 by an architect Johann Jacobsthal. It serves also TGV lines, since 2012 – Frankfurt - Strasbourg – Marseille. To adjust station quality to TGV services, in 2007 the station has metamorphosed into an intermodal transportation hub. In this renovation, historical building was framed by a 120 m long glass shell designed by Jean-Marie Duthilleul, the architect for the SNCF (Fig. 10). The four hectares of a square in front of historical station, edged by a series of imposing buildings with the pink sandstone station facade and its long enclosing glass gallery serving as the main backdrop, have been transformed into a garden. The 25-metre high “winter garden” serves as the entrance building and as the link between train tracks and trains, trams, buses, taxis as well as the underground. In this project by AREP, landscape design was done by an architect Michel Desvigne. The extension won the Brunel Award in 2008. Outstanding aesthetic design features structure that is light and expressive but does not
overshadows historical architecture. The balance has been achieved between new intervention and old valuable heritage.

### 3.3.10 King’s Cross Station (2012)

King’s Cross Station completed in 1852, is a major London terminal designed by an architect Lewis Cubitt for Great Northern Railway, who also designed a nearby Great Northern Hotel. The restoration project started in the 1980s, with a plan by Foster & Partners, which strengthened connections with neighboring St Pancras International. In an effort to return the station to former glory and provide comfortable environment for 47 million annual passengers, Network Rail undertook in 1990s a conservation and redevelopment project by architect John McAslan & Partners. Around 60 % passengers at King’s Cross, change trains between train and Tube, or between King’s Cross and St Pancras.

Transformation of King’s Cross Station combined three different styles of architecture: re-use, restoration and new build. The train shed and range buildings have been adapted and re-used. The station’s obscured Grade I listed façade has been very precisely restored. To deliver an efficient space, the new development included the insertion of a grand semicircular building – Western Concourse – that provided better environment for the purpose of an interchange (Fig. 11). The project including also re-glazing of the arched roof and various repair works, was opened in 2012. The area between St Pancras and King’s Cross stations was covered by new structure with a stunning roof that McAslan says is the largest single-span station structure in Europe, measuring 54 m from centre to circumference [12]. The architectural expression of the structure was described as “some kind of reverse waterfall, a white steel grid that swoops up from the ground and cascades over your head towards 16 perimeter columns in a flurry of 1,200 solid and 1,012 glass triangular panels...Like the 1852 train sheds, this is a structure that is at the limit of what’s possible, and the components are celebrated” [12]. Historical heritage architecture has been exposed and ticket office retained its original decorations. The space is modern, bright and with an array of food and retail outlets has an image of an airport rather than a conventional station facility. It is spacious and easy to understand. The refurbishment of the historic station is in final phase; it will end in 2013 with the creation of a new public square and open-air plaza facing Euston Road (the landscape design for which is being carried out by Stanton Williams Architects).

### 3.3.11 Gdynia Główna (2012)

Gdynia Główna is one of the largest stations in Poland, with five tracks serving also international trains ICE. Originally it was built in 1870. It was demolished during the WWII and rebuilt in 1950-54 by an architect Wacław Tomaszewski in a stylistic combination of Socialist Realism and Modernism. It was quite handsome and functional building with large ticket hall, information and waiting room, etc. The building was simple and proportional, with well executed details. The building was registered as national heritage in 2008. The restoration of the building was supervised by the Historical Heritage Conservator and like it is usually in Poland, everything was approved from the preservation point of view.

Among details were frescoes in waiting room on the walls and ceiling, done by an artist Juliusz Gizbert-Studnicki in 1957. These frescos, which have been discovered during renovation, were restored to their original shape, as well as sculptures, mosaics, and many details in wood and stone (Fig. 12). The renovation included also refurbishment of the station hall, canopies at the platforms and new signalizing system. Original colors of the facade and interior walls have been reconstructed, as well as all wooden and stone details, wooden panelling, old lamps, etc. New functional and commercial spaces have been developed on the ground floor and in newly constructed basement. Refurbishment of Gdynia Główna succeeded in good coordination of modernity with preservation of architectural heritage of a building and its interiors. The station with its heritage serves not only as a transportation hub but also plays cultural role, housing many cultural events, such as experimental theatres, music and multimedia festival - “Transvizualia”, etc.

### 3.4 Refurbished Stations in Japan

Two types can be distinguished in recent stations in Japan. “Station tower” is characterized by high-rise station building. “Station city” – has a large block-type multifunctional station building. Even smaller stations, for example Tokyo metropolitan stations, have often high-rise station buildings, which include stations and hotels, offices, and shops. One of such newest building is Hikarie (2012) at Shibuya Station. The second type - “station city” has many facilities like a
city, above the ground and underground, and other urban functions accommodated in large station complex, with station squares on both sides. Both types include renovated historical buildings - preserved or rebuilt, with consideration of their structure and the need to satisfy seismic standards. Many historical stations are being rebuilt from the beginning and their preservation is related to their essence or elements rather, than a whole.

3.4.1 Ueno Station (2002)
Ueno is a main intercity terminal in Tokyo and the eighth busiest stations in Japan. About 380,000 commuters and visitors pass through the station every day. Ueno Station has been subjected to a successful refurbishment project under the JRE. Historical modernist building of 1932 was preserved; station hall was refurbished, added glass roof and connected with concourses with food and retail (Fig. 5). New structure fits well to historical building and makes it more convenient and attractive. Many elements, emphasizing the location and history, including art, have been installed. At the gallery has been created space for concerts. The accomplishment of refurbishment and adding new aesthetic structures has been a bright and more convenient station related to local community and harmonized with surrounding area. The balance between historical part and modern interventions has been kept and due to the modernization station became more attractive and more popular among users than before.

3.4.2 Tokyo Station City (2012)
Tokyo Station is the main intercity terminal in Tokyo and the eighth busiest stations in Japan. About 180,000 commuters and visitors pass through the station every day. Annually, the station is used by more about 14 mln passengers. It has two sides with different symbolic: Marunouchi side with historical neo-renaissance Marunouchi Building (1914), designed by architect Kingo Tatsuno; and – symbolizing future Yaesu side with new office towers and new entrance portion with a roof, now under construction. JRE, along with four other companies including Mitsui Fudosan, have been redeveloping Tokyo Station since the 2004, as a part of efforts to revitalize the heart of the capital. The new Tokyo Station realizes a new concept of a conglomerate “station city”. Tokyo Station City consists of historical and modern buildings developed on both sides of the railway track. On Yaesu side, the “Sapia Tower” with offices, Hotel Metropolitan Marunouchi and conference facilities, and the “GranTokyo” twin south and north 200-meters high-rise towers designed by Helmuth Jahn, housing the Daimaru department store, were completed in 2007. Central part on Yaesu side will be replaced by a lower than before structure, with a 240-meter-long pedestrian deck under large dynamic and airy canopy covering outdoor and loading areas and of 10,700 m² plaza (scheduled for completion in 2013). The deck designed by Helmuth Jahn will be covered by a huge white roof – “GranRoof” - that resembles a sail. Shops will be positioned along the deck overlooking the spacious plaza. On the Marunouchi side, a red brick Marunouchi building has been demolished and restored again to its original shape from before wartime damage and in consideration of seismic standards (Fig. 6). Original bricks and stones have been re-used. Third story was added and octagonal domes have been rebuilt into original form. In the interiors, relief decoration was restored and existing structure was utilized (Fig. 7). The surrounding area will be converted into w station square giving more space for pedestrians and extending towards wide walkway to Imperial Palace (scheduled for completion in 2013). It will be seen how this important place in the heart of Tokyo will be designed.

The beauty of engineering has been directly delivered from the concept of “crystal towers” – glass structures for high-rise towers and from the concept of “a sail of light” for the “GranRoof”s” membrane structure. Aside from the modernization of historical building and new building construction, among modernized spaces are newly developed underground interiors – “Tokyo Station Media Court” (2000), “Silver Bell” (2002) – a recreation space designed by an architect Edward Suzuki, “Kitchen Street” (2004) - a mall with restaurants, and a “GranSta” (2009) - “a stage” created for people to rest and enjoy various facilities that has been opened on the first basement. Aesthetics of Tokyo Station has been expressed through the combination of old and new – reconstructed historical building on the Marunouchi side, and new part with expressive structures on the Yaesu side. Tokyo station with its prominent location, large volume, dynamic forms and high-tech structures has the aesthetic qualities of a landmark station.
CONCLUSIONS
Combination of historical buildings and modern structures needs careful approach. All aesthetic factors should be considered in such project. It requires consideration for the heritage, particularly if station is large and listed as a heritage building (e.g. St Pancras and Tokyo Station). The outcome – architecturally rich and structurally innovative station - can be rewording. Insertion of new outstanding structures can transform station into better environment, like in the case of King’s Cross Station, when new canopy was designed against structural constraints. Renovated stations are the new-generation transport facilities, which have the image of air terminals because of their high quality. These new stations are urban landmarks, with their central location, grand visual architecture, unique structures, and multifunctional facilities.

References