City-planning transformation of the functional and planning structure of districts near a railway station in the largest megalopolises (international experience)

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Abstract. The article deals with the peculiarities of functioning, renovation and redevelopment of city districts proximately adjacent to the territories of railway stations and roads. Both decaying, degenerating districts and successfully developing ones are of interest. The functional, compositional and planning principles of these districts’ development with their consecutive inclusion into the full-fledged city life are revealed by analysing foreign and Russian experience. The issue of city districts near a railway station’s transformation becomes actual not only in Russia, but in many cities around the world as well. It is conditional upon the fact that to a greater extent railway infrastructure objects formerly situated outside a city begin to contact closely with the urban area in the process of urban sprawl. It is impossible not to consider their influence on planning, functional as well as architectural and stylistic solution of the infrastructure. The aim of the research is to detect the main compositional, planning and functional peculiarities and principles of the site development situated in city districts near a railway station. The following tasks were to be solved to achieve the abovementioned aim: to distinguish the examples of various countries’ cities, the structure of which includes railway infrastructure objects actively; to study briefly the district history that can influence the further urban development of the site; to analyse the chosen cities’ city-planning situations; to find out the main functions of buildings and housing as well as the urban realm elements present in districts near a railway station; to study the functionality of buildings, constructions and urban spaces that appeared in urban realm in different historic periods; to define planning and functional interconnections between the different elements of city tissue in districts near a railway station.

1. Introduction
On the rebound of industrial advance in many countries of the world such as Great Britain, Germany, Switzerland, Austria and others a new transport means, i.e. the railway one, appeared in the XVIIIth century. The first railway road appeared in Russia in the 1830s. It joined Saint Petersburg, Tsarskoe Selo (currently the town of Pushkin) and Pavlovsk. The active formation of the Russian Empire railway network began in the not-too-distant future, in the second half of the XIXth century. In such a way not only the new typology of public buildings, i.e. the railway station, but new city districts with their functional and planning specificity appeared. The districts that are proximately adjacent to the railway stations and road are meant. The railway road was the transportation means of large volumes of cargo and passengers’ movement; and it is characteristic for many modern cities formed in the
The main planning constraints related to the railway road and influencing the character of the adjacent site development are the easement area [4] and sanitary protection zone [5]. If the easement area includes only the objects of the railway road transport and engineering infrastructure, then sanitary protection zone allows making buildings and housing not belonging to the railway road on the territories occupied by it. However, the list of such ones is restricted by the governing documents. In particular, it is not allowed to place apartment blocks, landscape and recreation zones in the sanitary protection zone. Strict hygiene and other requirements limit the function package that the site development adjacent to the railway road can have. However, it should be noted that the regulatory environment of various states is different, that is why it is acceptable to place housing construction closely to the railway road in some of them.

The problem of the research is the civil site development stagnation of many city districts near a railway station and the lack of strict functional programme to develop them.

The aim of the present research is to reveal the main compositional, planning and functional peculiarities and principles of city districts near a railway station’s effective development.

The following tasks should be solved to reach this set aim:

- to study the examples of cities where the railway road and its infrastructure objects are actively included in the city tissue of historic downtowns;
- to study briefly the history of a district near a railway station, the facts preceding the district’s genesis, formation and development;
- to analyze the city-planning situations of the chosen cities;
- to look at the functionality of buildings and housing as well as the elements of urban realm present in districts near a railway station;
- to distinguish compositional, planning and functional interconnections of city tissue different elements in districts near a railway station.

The largest cities’ districts near the railway stations are the research objects.

The research subject is the world experience of districts near a railway station’s renovation as exemplified by large European cities.

In the course of the research the following hypothesis was developed, however, it does not pretend to be the conclusion, but it is directed at the more attentive treatment of the existing problem and the development of the logical and justified work system. The hypothesis lies in the fact that city districts near a railway station have their characteristic peculiarities of functional, compositional and planning structure formation due to various hygiene limitations that is reflected in the picture of the existing and perspective site development, that is why the core of the site development functional programme of such districts must consist of the unique public objects capable to attract investors as the capital influx and citizens as common users of the territory. In particular, public facilities, to be more precise, the research, development, production and managerial and business ones such as university campuses, technoparks, head-quarters of large industrial and entrepreneurial companies, waste recycling plants
and other objects studied in detail in the present article, are a spectacular example of the site development of the territories adjacent to the railway lines.

2. Materials and methods

In the course of the research such methods as comparative analysis, unit factor graphoanalytical method and architectural and spatial modeling were used, due to them the set tasks were solved and the aim of the research was reached.

For the more objective view of the site development problem and city districts near a railway station’s development the world experience in solving this problem was considered.

**Basel, Switzerland.** The main part of the railway road in Basel is in the structure of restrained urban conditions. There are two main railway stations in the city. One of them, Basel Badischer Bahnhof, is situated on the right bank of the Rhine in the so called Small Basel. The other one, Bahnhof Basel SBB, is situated on the opposite bank of the river in Big Basel.

The buildings of chemical plant “Syngenta International AG”, the complex of trade and exhibition centres consisting of the Basler Weinnesse, Hall 1, Messe Basel and Hall 3, hotel Hyperion Hotel Basel, Musical Theatre Basel, multi-storeyed garage Parkhaus Badischer Bahnhof AG of 300 metres long are in the structure of the districts near railway station Basel Badischer Bahnhof.

By contrast with the previous one the district near railway station Bahnhof Basel SBB is interesting by objects situated not simply in the pedestrian proximity from the railway road, but at the distance of not more than 100 metres and sometimes proximately adjacent to the easement area of the railway road. The city zoo is to the west of the railway station. The covered market Markthalle Basel built in 1929-1930 and reconstructed in 2006-2012 when the fourteen-storeyed tower was added to it among the other objects is just at a short distance from the railway station. The conference centre Viaduktstrasse built in 1885–1994 according to the project of bureau Diener & Diener Architekten is situated on the territory between the zoo and market. The twenty-four-storeyed tower of Bank for International Settlements (BIS) built in the 1970s is in the accessibility for pedestrians from the railway station. It is planned to finish the building of the nineteen-storeyed hotel Mövenpick Hotel Basel in front of the tower. Eastward, the architectural objects, Peter Merian Haus and Jacob Burckhardt Haus, built upon the project by Swiss architect Hans Zwimpfer (bureau ffbk Architekten) are on the elongated plot of land along the railway road in the place of the former locomotive shed and other buildings belonging to the railway road. Architectural-planning and voluminous-spatial solution of these buildings are similar. They are stretched along the railway road and face it with their perpendicular blocks and its opposite side, i.e. Nauenstrasse St. The buildings occupy the offices of different companies and firms, commercial facilities as well as Hochschule für Wirtschaft FHNW in Western Switzerland and the university library of business and economics. The high-rise administrative office building Grosspeter Tower made in 2013–2018 is to the east of these constructions. Apart from the offices a hotel is there.

All the above mentioned objects are situated on the one side of the railway road. The other side contains buildings that are of interest as well. They are the following ones: office and commercial complex with nursing home for the elderly Südpark Basel, twenty-four-storeyed office and residential tower Meret Oppenheim Tower, Central Signal Box, museum Schaulager. Jacques Herzog and Pierre de Meuron who were awarded the Fritscher Architecture Prize are the authors of all the four described objects.

**Zürich, Switzerland.** The main “railway band” of Zürich is on the left bank of the river Limmat rooting down to the Lake of Zürich. It splits the city from the north-west to the south-east where on the bank of the river it ends with the city’s main railway station. The Swiss National Museum with the new flanking building erected in 2012–2015 on the project design of architect bureau Christ & Gantenbein is near the key railway hub of whole Switzerland. From the southern side the railway road limits Zürich industrial quarter confined by the river from the north. The part of this district is known as “fashionable quarter” Escher Wyss. Swiss industrial machinery manufacturing plant from which the quarter got its name was situated on this territory from the beginning of the XIXth century and up to
the middle of the XXth one. From the second half of the XXth century, after the closing of the plant, this district has been actively overbuilt by civic buildings. The theatre Schauspielhaus is in the former shipbuilding factory workshop from 2000. It neighbours the multiservice unit civic centre “Plus 5” during the building of which in 2001–2004 some elements of a foundry shop constructed in 1898 were preserved. The complex includes the showroom, business-centre with study rooms, offices of law firms as well as shops and catering enterprises. One of the faces of «Plus 5» looks at Turbinenplatz, the same square is faced with the building of Zürich technopark being one of the largest ones in Europe. It was built in 1989–1993 and became one of the first large community buildings erected in line with the redevelopment of this former industrial area. The premises of technopark have innovative structure, they are universal and suitable for the work of specialists in different areas of science, production operations and art, moreover, universities and research and development centres can lead their educational activities here. Several large hotels are in the accessibility for pedestrians. The railway road in Zürich does not have an exclusion zone as such. Large groceries, the fringe theatre “CLOSE-Theatre”, the offices of architectural and design bureaus and other companies as well as housing accommodations and recreation sites such as, for example, Pfingstweiden Park and Maaghof-Park are almost close to it. The bridges transverse to the railway road with multilevel interchanges connect the districts of the city dissected by the road and the river.

**Bern, Switzerland.** The railway road in Bern goes through its very centre. The railway station of the city being the second in size in Switzerland after Zürich is situated in the historic downtown. The University of Bern, the Church of the Holy Spirit and a bit further from it Federal Palace on Bundesplatz are in the accessibility for pedestrians from the railway station. Here the Federal Council and the Federal Assembly of Switzerland, the main governing authorities of the state, have their sittings. Further to the east Bern Minster is situated. The railway lines in the district of the central station get under the ground because of the peculiarities of local topography and town surveying. It allowed utilizing the space that could be occupied by the easement area of the railway road. Open parking areas and a bus terminal are here. The urban area closely approaches the territory occupied by the railway road as in Zürich and Basel. Along with this, the typology of site development is various: both community and residence buildings are present. In some places the buildings are separated from the railway road only by the street way and green planting zone. In some cases the buildings face the railway road directly. Most commonly, these are community buildings. The repair depot is in one and a half kilometres to the west from the central station, and one more large railway station is slightly further. The Bremgarten cemetery currently representing parkland in the densely populated area of the city is near it. The cemetery borders the territory of the railway road. The group of university hospital buildings is nearby. The medical museum of Bern faces the railway road. The Bremgarten cemetery borders Bern’s urban area. Parkland Glasbrunnen is northwards. Manufacturing and scientific companies such as recycling centre and the complex of university buildings are between the parkland and the railway road.

**Eindhoven, the Netherlands.** The factory of electric light bulbs known currently as “Philips” was opened in the Dutch city of Eindhoven in the end of the XIXth century. The company moved its headquarters to Amsterdam and its main production units to Austro-Asiatic countries in the late XXth century. After that the large industrial zones of the city present in its very centre against the background of the loss of local economic mainstay fell to desolation. Several quarters of district Strijp (Strijp-R (part of quarter Zwaanstraat, also known as Strijp-III), Strijp-S, Strijp-T (also known as Strijp-II and De Beuk) and Witte Dame are meant. All these former industrial zones are proximately adjacent to the railway road; the main railway station of the city is in quarter Stationsplein neighbouring the abovementioned quarters from the east.

District Witte Dame is the closest one to the city centre; it occupies the territory of approximately 15 hectares. The former factory building that after the reconstruction of 1995–1998 unites the design academy, public library and other various non-governmental organizations (bank departments, shops, public catering establishments, etc.) is on the territory of this district. The building of “Lichttoren” (the Tower of Light) is here as well in the heptagonal tower on the roof of which the testing of lamps
produced by “Philips” factories was performed. After the reconstruction the building was geared to housing accommodations and public duties. Mall “La Piazza” built in 1999-2004 on the project design by Massimiliano Fuxas as the broadening of the existing building of department store “Bijenkorf Building” made in 1966-1969 on the project design by Italian architect Gio Ponti and Dutch architect Theo Boosten is near Witte Dame. Quarter Strijp-S is on the fringe of Eindhoven centre and occupies 27 hectares. In 2001 the specialists of company West 8 devised the master plan of this territory’s development that meant the combination of new site development with the existing industrial buildings and housing. The central element of the planning concept became the landscaped boulevard Torenallee 60 metres wide going through the quarter in diagonal. A spacious paved square where different mass events are held and a big landscaped field also used for various public events are opposite the buildings placed along Torenallee. More than 4000 residential units were built in the course of almost 20 years of project installation in the quarter; and industrial buildings were modified to perform public duties: colleges, company offices, shopping centres, public catering establishments, museums of contemporary art. One of the buildings that catches the eye most of all is the cultural centre “Klokgebouw” (House with Watches) placed along the railway lines; different creative firms take offices on lease here.

Quarter Strijp-R is situated slightly further from the centre than all the above described quarters. The working-out of master plan on the transformation of the former industrial quarter into the residential quarters was done by architect bureau Diederen Dirrix and Buro Lubbers. In the new project the desire to preserve the identity of the place was taken into consideration. The old foot bridge, elevated platform, pump work for pipe bridge and security booth were preserved. The complex of the former workshop producing radio and television details is occupied by the company of the Dutch designer Piet Hein Eek. Workshops, a showroom, a restaurant and many other things are present here. This building was the first one to be geared to modern usage on this territory that played its positive role in the popularization of the quarter.

Vienna, Austria. The railway road goes along the historic districts in Vienna as in many European cities. The district of Althangrund and the ones adjacent to it give outstanding interest. Wien Spittelau Bahnhof that is a large multilevel commuting hub is situated here. Combustion plant Spittelau built in 1988-1997 on the project design by architect and artist Friedensreich Hundertwasser is near it. The federal bureau of criminal police is near. Further south the large university complex of the University of Vienna and the Vienna University of Technology is, Kurt Gödel Research Centre for Mathematical Logic (KGRC), pharmaceutical centre, geocentre, institute of regional planning and other structural scientific-research and training units of universities are here. The edifice by Dame Zaha Mohammad Hadid – residential compound Spittelau Viaducts the work over which was run from 1994 to 2006 is on the narrow plot of lands along the Donaukanal (Danube Canal). The object is situated on the currently non-functioning viaduct which was used for the overhead line of the city subway. The plot is lodged between the working overhead line of the city subway and canal front. The Jewish Cemetery in Währing (Jüdischer Friedhof Währing) neighbouring Währing park and the territory of the train shed are in 200 metres westwards the described district. The station of the above-ground subway is further south.

Oslo, Norway. The central railway station of Oslo is placed in the geometric downtown of the city, almost on the shore of the Oslofjord inlet that makes almost the whole historic, social and business centre of the city the district near the railway station. From the coastline and the station it is separated by the narrow strip of social and business site development and sea port. The underground station, tram stops are nearby. The southern part of district Gamle-Oslo including the waterside and the district of Sentrum adjacent to it from the north-west are of interest. The railway road is crossed by the highway and foot bridges, the most interesting of them is the bicycle and foot bridge “Acrobat” (in Norwegian “Akrobaten”) built on project design L2 Arkitekter and opened in 2011 and automobile and foot bridge Nordenga opened the same year.

Two most high-rise buildings of the city stand from the northern part of the railway road: thirty-seven-storeyed building of the hotel “Radisson Blu Plaza Hotel”, opposite which is multi-purpose
indoor arena “Oslo Spektrum” and the twenty-six-storeyed office building “Biskop Gunnerus Gate 14”. These buildings were made in the second half of the XIXth century.

The former sea port urban areas began to be settled comparatively recently from the southern side of the railway road in the district of Bjørvika (“Bjørvika” in Norman). In this way, for example, the cultural and business centre “Barcode Project” began to be formed in the 2000s along the railway road separated from it only by automobile and foot street. Architect bureaus A-Lab, MVRDV, DARK Architects, Snohetta and Solheim + Jacobsen Arkitekter were engaged in the work on designing the quarters. All the buildings of the complex are the office and business ones. The first floors face the street with trading space and one of the buildings has housing accommodations. This is the KLP Building built upon the project Solheim + Jacobsen Arkitekter (currently AART Architects), where the last 10 storeys are occupied by 53 flats with balconies and access to the outdoor patio. All the buildings in the complex are at ground level and united between themselves by public space.

Apart from the quarter “Barcode Project” the waterside zone separated by the railway road is being developed with other modern objects. The opera theatre erected in 2003-2007 upon the project of bureau Snohetta is distinguished particularly.

To the south-east from the described district in the immediate proximity from the railway road historic monuments in the ruined condition are: St. Mary’s Church, the Church of Saint Clement and St. Hallvard’s Cathedral. The old city cemetery is to the south.

3. Results
As can be seen from the active processes of engineering and construction in city districts near a railway station, the theme of land use planning and these territories’ management is interesting to different participants of the construction procedure: citizens, builders, architects. This shows the topicality of the current theme, but at the same time it sets many tasks before the specialists to be solved, so that the districts under consideration (i.e. city districts near a railway station) functioned harmonically in the city system. The value of these territories is understood to a great extent; however, renovation brings its results most commonly only in big and the biggest cities, moreover, mainly in the European, American and Asian ones.

The Russian experience of districts near a railway station’s renovation as well as former industrial, communal and warehouse and general-use territories is less successful than the foreign one. Community objects and urban open spaces having potential to attract citizens and developers there and revive these territories appear on such plots as occasional spots not very frequently.

On the basis of the analysed material it is clear that most commonly districts near a railway station are built with unique objects capable to attract citizens there, to make them socially important and interesting both for the rest of citizens and investments. These can be large research and development complexes and technoparks, university academic campuses and libraries, trade and exhibition centres and theatres as well as large administrative and office and business objects such as, for example, federal ministries, courts and company headquarters. All the above mentioned functions can be included in the abstract model of city districts near a railway station’s development. Moreover, while designing on the territories adjacent to the railway lines it is necessary to adhere to the principles of transport security, environmental protection and landscape-aesthetic harmonization [6].

4. Discussion
The theme of city districts near a railway station’s development is interesting to many architects. This is proved both by theoretical manuscripts and applied work, i.e. numerous designing and construction.

In that way Le Corbusier says in his article “The New Spirit in Architecture” written in 1924: “… a human being reveals themselves through the order; what unveils in front of your eyes when you leave Paris by railway road if not the largest reduction of things to order and not the fight with nature? Fight to submit it to themselves, to classify, to bring comfort to themselves, in brief to establish themselves in the human world different from the hostile natural environment, in our world where geometry reigns? The human being works way through only by geometry. The rails are absolute parallels, the
railroad embankment is the realisation of geometrical drawing; bridges, viaducts, sluices, channels, all this city and near-city creation developing in a separate countryside shows that when a person acts when he/she wants to show his/her will, he/she unavoidably becomes a geometrion and creates with geometry” [7, p. 28]. The genius of modernism not only allows to understand the city-planning value of territories near a railway station, but shows the aesthetic importance of the railway road which in this or that form can be transmitted into architecture (Table 1).

Table 1 (beginning). The analysis of functional and planning structure of city districts near a railway station (as exemplified by foreign experience)
Table 1 (end). The analysis of functional and planning structure of city districts near a railway station (as exemplified by foreign experience)

This theme continues to be topical a hundred years later at the beginning of the XXIst century. The researchers of city planning and architecture consider it in their scientific works. Mikhail Nikolaevich Kanunnikov reviews the problem of “site development and rational use of the territories adjacent to railway roads in large cities” [8] in his thesis for a candidate degree in architecture.

Moreover, many modern famous architect bureaus in their practical activity come across designing
districts near a railway station. In this way in 2019 the project of architect bureau OMA on the reconstruction of the Belgian national railroad company’s headquarters building was published [9]. The multistoried building on the very narrow plot along the railway road will include conference hall, classrooms, assembly hall and gym, restaurant, office and engineering equipment premises. In the end of 2019 Japanese architect bureau Nikken Sekkei was announced the winner in the competition in the designing of the architectural and city-planning concept of the site development on the territory of Riga goods yard in Moscow [10]. On the territory with the total area of more than 20 hectares the architects suggested to place large public complex accommodating the headquarters of the company “Russian Railways” and other office premises, sales premises, academic and medical organisations as well as housing accommodations open to the city. The complex is positioned by the authors as the key social and business object of this district which will allow developing further the adjacent city territories, attracting entrepreneurs, citizens and tourists there.

5. Conclusion

In such a way, districts near a railway station are important in the structure of the cities having appeared there on the cusp of the XXth and XXIst centuries and from that time having strategically important communicative functions.

![Abstract model of the city-planning formation of districts near the railway station](image)

**Figure 1.** Abstract model of the city-planning formation of the districts near the railway station
The character of the site development of such districts has always had its peculiarities among which is chaotic site development without city development plans, the disbalance of functional programme and the lack of community buildings including the objects of social infrastructure, breaking-ups in the city tissue and the absence of transport links with the central districts of the city and others (Fig. 1). These and various other problems are being solved successfully in Russian cities including the ones with a population of 1 million or more such as Samara, the railway road in which appeared in 1875–1877 that cut the dwelling zone of the city from the river bank [11].

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