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THE ISSUE OF INTEGRATION OF ELEVATED TRANSPORT ROUTES  
IN THE AREAS OF HISTORIC POLISH CITIES. EXAMPLE  
OF THE MODERNIZATION OF A CROSS-CITY RAILWAY LINE  
IN THE ŚRÓDMIEŚCIE DISTRICT OF KRAKÓW

PROBLEM INTEGRACJI NADZIEMNYCH TRAS KOMUNIKACYJNYCH  
W OBSZARACH ZABYTKOWYCH POLSKICH MIAST.  
PRZYKŁAD MODERNIZACJI ŚREDNICOWEJ LINII KOLEJOWEJ  
W OBSZARZE KRAKOWSKIEGO ŚRÓDMIEŚCIA

**Abstract**

The aim of the article includes presentation and interdisciplinary analysis of design solutions proposed in the works awarded in the international urban architecture competition entitled "New life between flyovers" and concerning the area around the cross-city railway line, currently under modernization, running through the Śródmieście district in Kraków, from the area of Miodowa Street to the PKP Kraków Główny station. In the applications, possible scenarios of flyovers space development and the possibilities of integrating the transport route into the historic district have been assessed, taking into account historical urban relations and contemporary technical conditions. The analyses were aimed at optimising future investments so that they can become a starting point for public consultations, drafting a land development plan and determination of the development strategy for the studied area. The applied method may be helpful in determining the directions of a spatial policy aimed at the protection of cultural landscape endangered by overground transport routes.

**Keywords:** Kraków, integration of transport routes, public space, railway flyover, railway viaduct, modernization of infrastructure, modern architecture, adaptation

**Streszczenie**

Celem artykułu jest przedstawienie i interdyscyplinarna analiza rozwiązań projektowych zaproponowanych w pracach nagrodzonych w międzynarodowym konkursie urbanistyczno-architektonicznym „Nowe życie pomiędzy estakadami”, dotyczącym obszaru wokół modernizowanej obecnie średnicowej linii kolejowej przebiegającej przez krakowskie Śródmieście od rejonu ul. Miodowej do stacji PKP Kraków Główny. We wnioskach oceniono możliwe scenariusze zagospodarowywania przestrzeni pomostowych i możliwości integracji tras komunikacyjnych z zabytkową dzielnicą z uwzględnieniem historycznych relacji urbanistycznych i współczesnych uwarunkowań technicznych. Analizy te ukierunkowano na zoptymalizowanie programu przyszłych inwestycji, tak aby mogły stanowić zaczątek do konsultacji społecznych, opracowania MZPZ i wskazania strategii rozwoju badanego obszaru. Zastosowana metoda może być pomocna przy wytyczeniu kierunków polityki przestrzennej, służących ochronie krajobrazu kulturowego zagrożonego przez pojawianie się naziemnych tras komunikacyjnych.

**Słowa kluczowe:** Kraków, integracja tras komunikacyjnych, przestrzeń publiczna, estakada kolejowa, wiadukt kolejowy, modernizacja infrastruktury, współczesna architektura, adaptacja

## 1. Introduction

The issue of elevated transport routes in historical areas in Polish cities gains on importance especially in the face of the necessity of modernizing and restructuring the existing railway infrastructure [1]. It is accompanied by a technical discussion on the operation efficiency of specific systems and their influence on the development of agglomerations and life comfort of their inhabitants. Discussions also concern specialized issues connected with the influence of city flyovers, viaducts, and bridges on the formation of historical-cultural landscape. As a result of growing transport needs, both in the local and super-local context, railway lines are already being modernized in Kraków [2], Warszawa [3], and Gorzów Wielkopolski, where in 2019 regeneration of a 2-km stretch of a city flyover was completed [4]. Wrocław<sup>1</sup> is at the stage of feasibility analysis. The most efficient solution to the problem of elevated routes disturbing the urbanized structures includes demolishing them and replacing with tunnels what has been done for example in Rotterdam [6], Stuttgart [7] and Łódź [8]. This allows for essential improvement in the fluency of railway and city traffic, reduction of noise levels and gaining attractive investment areas. However, such solutions are extremely complex to implement and costly. Therefore, a need emerges to search for methods of reconstructing and adapting space over and under bridge structures to accommodate services and green areas there and to integrate them into the historical city tissue.

In this article, we analyse possible solution scenarios for areas in the direct vicinity of elevated transport routes at the example of concepts awarded in the international urban planning and architecture competition “New life between flyovers”. This competition closed in October 2018 and pertained to the cross-city railway line crossing the Śródmieście district in Kraków that has been in the process of modernization for a couple of years [9]. In 2019, commissioned by the Kraków City Office, we run analyses aimed at an assessment of potential variants for development of bridge areas proposed in the competition, taking into account historical urban development relations and technical conditions. We used comparative materials from experiences in the implementation of similar investments all over the world [10]. The conclusions drawn serve as a basis for social consultations, development of a city land development plan and future investment in PKP areas. They should also be helpful in determining further directions in space policy and development strategies for the Śródmieście district in Kraków.

## 2. The origin and terms of the competition

International, open, two-stage studio competition in urban design and architecture, organized by the Kraków City Office and Kraków SARP branch in May 2018, pertains to areas in the Kraków city centre related to railway embankments and flyovers from

<sup>1</sup> In June 2019, PKP PLK presented an enquiry for development of Preliminary Feasibility Study for the Wrocław Railway Junction that would apply to all the railway lines in the city of Wrocław and in the surrounding 19 communes [5].

PKP Kraków Główny Railway Station to the Vistula River (between Kopernika St. and Podgórska St.) in the Śródmieście district. The surface area subject to competition was ca. 199,300 m<sup>2</sup>, with the free space under new flyovers estimated at ca. 15,000 m<sup>2</sup>. The competition area is currently subject to dynamic changes related to PKP PLK investment started in 2012 and entitled *Works on the E30 railway line from Kraków Główny Towarowy to Rudzice, with added agglomeration railway tracks*, that includes modernization works covering many industries at a great degree of complexity. The goal of this investment, co-financed by the European Union under CEF instrument “Connecting Europe” (investment value exceeding one billion zloty) was to adapt the parameters of the city line to new standards and international AGC requirements (on major international railways lines) and AGTC (on major international combined transport lines) for transport corridors i.e. for circulation of passenger rail with classic cars, with max. speed of 160 km/h and cargo cars with a speed of 120 km/h [11].

Competition documentation was very vast and included, among others, video and photo documentation of the area, basic and cadastral maps, binding and currently proceeded city plans, as well layouts and investment schemes of PKP PLK. Historical development depicting the creation and development of cross-city railway line [12] constituted an important element of competition materials (Figs. 1 and 2).



Fig. 1. Fragment of “Kraków City Cadastral Map” of 1848 with the future railway line stretch marked [12, p. 14]



Fig. 2. Fragment of the “Kraków City Cadastral Map” from 2nd half of the 19th century depicting the course of the southern stretch of the railway line [12, p. 15]



Fig. 3. Fragment of a contemporary Kraków City map depicting the course of the central cross-city railway line under modernization since 2012 (basic map of the area subject to the development, M2 appendix to competition rules [9])

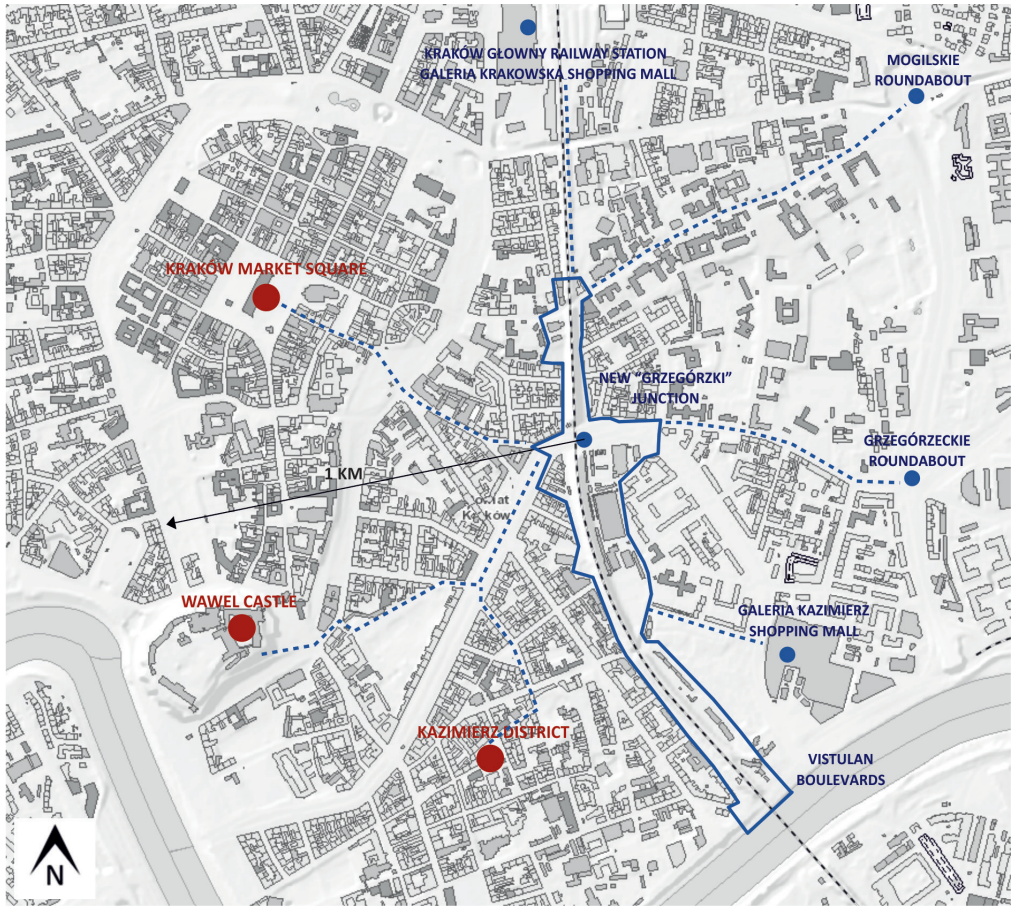


Fig. 4. Location of the modernized cross-city line, from Kraków Główny Railway Station to the other bank of the Vistula river and major transport connections for this area, and the scope of competition development (by E. Komarzyńska-Świeściak)

The point of departure for competitions concepts included “fait accompli” by PKP PLK that, without consulting it with city authorities, decided to replace the existing embankments with flyovers with a purely structural form, with the areas under them intended for car parks [13]. In the area subject to competition, between the Kraków Główny railway station and the Vistula river, the scope of PKP PLK works included among others construction of a new railway station (Kraków Grzegórzecki), 850 m of the railway line on a 4-track flyover from Kopernika St. to Miodowa St. (replacing the former embankment) (Figs. 3, 4 and 5), as well as adding two tracks (from the eastern side) to the historical railway viaduct over Grzegórzecka St. (Dietla St.) (Fig. 6)<sup>2</sup>. This investment of PKP PLK significantly changed urban, transport and social relations for the whole Kraków agglomeration. A special challenge includes the integration

<sup>2</sup> Since then, new viaducts and flyovers under the first, out of four, tracks have been created. Further, demolition of the 19<sup>th</sup> century embankment and construction of viaducts and flyovers for the remaining tracks is planned [2].

of the newly-created facilities with the historic environment, both from the point of view of architectural composition and their functional role. The analysed stretch of currently modernized railway is located in an area subject to art restorer's protection and entered on the list of historical urban layouts and having the status of Historical Monument. Moreover, two facilities (viaducts) along this railway line are subject to art restorer's protection as these are entered on the list of historical facilities. The development in the vicinity of the embankment is also protected with individual decisions on entry to the list of historical facilities or commune record of historical buildings [9]. In such a situation, the main task before competition participants was to propose a method of developing and using the space under bridge structures (in the place of former embankments) and designing a fully integrated transport junction (railway – new Kraków Grzegórzki SKA<sup>3</sup> station, tram, bus, bike) that

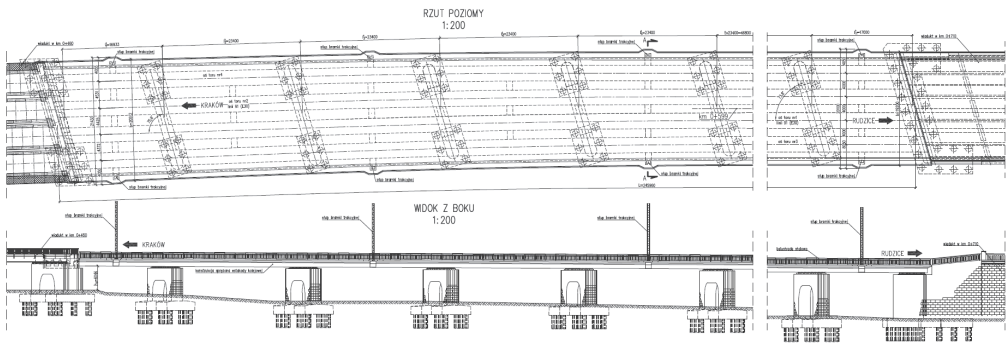


Fig. 5. Scope of modernization of the railway line between Kraków Główny Railway Station and the Vistula River: site plan – stage III [13]

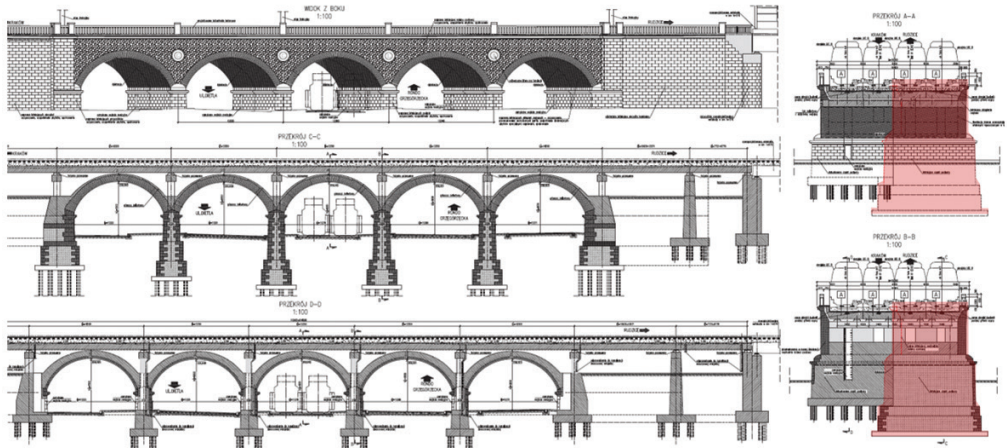


Fig. 6. Scope of modernization of the railway line between Kraków Główny Railway Station and the Vistula River: expansion by two tracks (from the eastern side) of the historical railway viaduct over Grzegórzecka St. (Dietla St.) [13]

<sup>3</sup> SKA – high-speed urban railway in the Krakow Agglomeration.

would take over a large share of passengers using the Kraków Główny railway station [9, p. 14]<sup>4</sup>. The area subject to competition included not only the space created under the built flyovers and expanded viaducts, but also areas adjoining the reconstructed railway line and pertained to the creation of frontages of surrounding streets and interrelations in space that has previously been separated by the railway embankment.

The subject to the first stage of the competition included urban development plans with a proposal for functional and space programme for the “recovered” space thanks to a reconstruction consisting in demolishing embankments and replacing them with “transparent” flyovers. This pertained to new urban and transport relations and also opportunities for using the adjacent areas and new opportunities in shaping city centre that will emerge once the embankment barrier disappears. The subject of the second stage of the competitions included an architectural concept for a fragment of the reconstructed railway line located between Kopernika St. and Grzegórzecka St. and including three spans together with their direct vicinity. It was required to present it both in the form of drawings in 1:500, 1:200 scale, and in the form of a model in 1:50 scale (Figs. 7, 8).



Fig. 7. Three-layer functional hybrid: model in a 1:50 scale (2<sup>nd</sup> stage of the competition), 1<sup>st</sup> prize (Ton Venhoeven c.s. Architekten B.V., the Netherlands) (by E. Komarzyńska-Świeściak)



Fig. 8. Roofed pedestrian and bike passage with extensive green areas: model in a scale 1:50 (2<sup>nd</sup> stage of the competition), 2<sup>nd</sup> prize NM architekci Z. Szpocińska and T. Marciniwicz; K. Kamieniobrodzki, J. Grochulski, G. Rejniak, Warszawa) (by E. Komarzyńska-Świeściak)

In competition conditions, it was also stressed that proposals concerning functions under the flyovers should take into account the fact that railway traffic generates vibrations and noise. Its elimination should be included in the proposed design solutions. The main goal of the competition was to obtain variant concepts and ideas for the development of the whole historical Kraków city center that would be useful in setting directions for urban development strategies and policies, for dialogue, and social consultations. As it was stressed in competition

<sup>4</sup> The Grzegórzki junction will provide attractive possibilities of changing between various public transport means, but will also become a starting point for walking for the inhabitants of this area and travellers heading to the Old Town and Kazimierz districts. Passenger traffic in this station would be only slightly smaller than in Kraków Główny railway station. Major traffic congestion is expected in the morning. Ca. 2400–3000 will get off trains per hour, with ca. 1100–1300 getting on. Nearly all of them will use the passage to Grzegórzecka St. [9, p. 14].

rules: “the ordering party expects modern land development, urban layout, architectural, technological and ecological solutions of top quality, developed with special attention paid to the spacial context: urban layout, historical, transport and social; it expects proposal of a vision of a city-friendly for its inhabitants” [9, p. 12].

### **3. State of the art**

The analyses presented in this article constitute a continuation of many years of our research in regeneration of historical public utility facilities, including railway stations and junctions [14, 15], as well as conditions and form of functional and spatial transformations for the areas under bridge facilities implemented in European cities at the turn of the 21<sup>st</sup> century [16]. Example reconstructions of railway flyovers collected and analysed during this research provided a valuable reference point for assessing the feasibility of the solutions proposed in the competition, estimating their costs and impact on the urban environment. The bibliographic analysis points to insufficient research comprehensively dealing with the integration of elevated transport routes in historical city areas. The issues concerning developing space under bridge facilities, if aborded at all in Polish scientific discourse, mostly pertains to historical issues [17–19] or are reduced to small architecture with green areas in the vicinity of transport routes [20, 21]. World literature is also scarce in overview works on investments of this type. What is mostly encountered are case studies of specific implementations [22, 23], and essays on such issues [24].

### **4. Research methodology**

The topics discussed by the authors when analysing results of the “New life between flyovers” competition border several scientific disciplines i.e. architecture and urban development, construction, and transport, as well as broadly understood environment shaping. The analyses covered solutions in urban design and city engineering, architecture connected with construction, vibro-acoustics, protection of historical facilities and cultural landscape. Sociological data obtained from social consultations was also used. The main focus was to generate conclusions relating to use plans and creation of space around the flyovers. Such conclusions will serve as a basis for further social consultations and provide some guidelines for future provisions of urban land development plans.

Post-competition analyses included the following elements:

- ▶ The character of competition works;
- ▶ Characteristics of the area subject to the development (division into zones);
- ▶ Solution scenarios and their assessment in the context of the researched areas (questionnaires, cross-industry discussions, assessment of the solutions based on reference implementation, cost estimation);
- ▶ Recommended solutions and potential directions for actions;

- ▶ Summary and conclusions;
- ▶ Problems and contemporary trends in the development of transport areas (annex).

For the purpose of precise assessment of design solutions in the competition, it was necessary to analyse the current condition of the area subject to the competition. Local inspection together with analysis of historical [9] and urban planning [25–33] documents allowed for dividing the area into four functional zones characterized by their vicinity and cross-section of the route (Fig. 9):

- ▶ **ZONE A:** the area along the flyover, between Podgórska St. and Miodowa St.;
- ▶ **ZONE B:** the area under Miodowa St. – “Grzegórzki” junction flyover;
- ▶ **ZONE C:** integrated “Grzegórzki” junction (Fig. 10);
- ▶ **ZONE D:** the area under the flyover and the adjacent green area between “Grzegórzki” junction and Kopernika St. (Fig. 10).

The main assumption for post-competition analysis was to search for scenarios without replicating the work of competition jury who already performed an in-depth assessment of

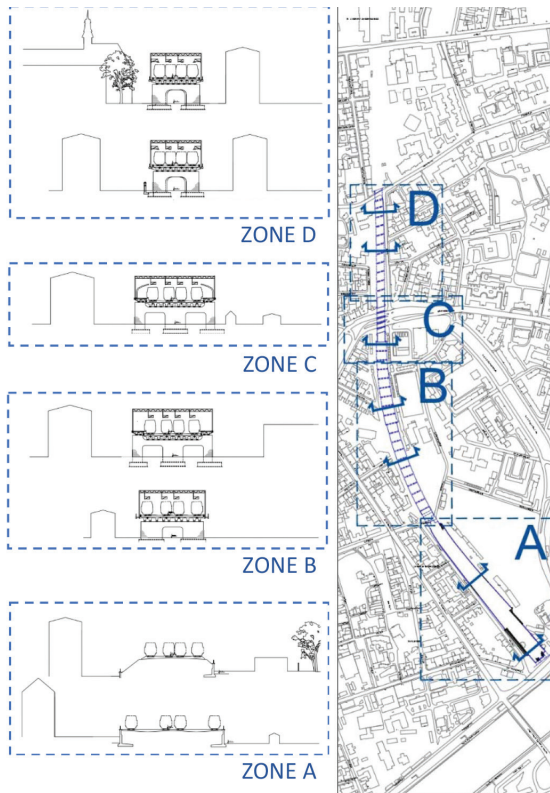


Fig. 9. Division of the area along the new cross-city line and under it into four stretches (functional zones) [10]

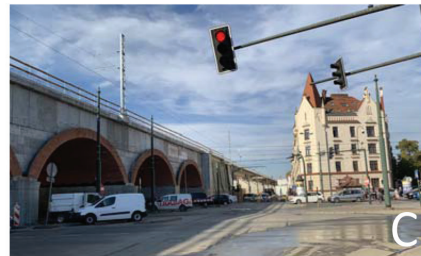


Fig. 10. Selected fragments of the area, two overview photos: zone C – historic viaduct at “Grzegórzki” junction and new-built flyover situated along existing market Unitarg, lower photo: zone D – view of the flyover along Blich St. (by E. Komarzyńska-Świeściak)



each work. Thus, the analysis was limited to short characterization of the works and pointing to their distinctive features. Then, we proceeded to indicating and characterizing the scenarios for programme and design solutions included in these works. Finally, we compared specific work zones with optimal solution scenarios for them (cf. chapter 6). Synthesis of the obtained results allowed for formulating conclusions for further perspectives and setting directions for spatial policy as well as development strategies for the analysed area.

## 5. Assumptions and characteristics of the awarded competition entries

Results of the first stage of the “New life between flyovers” competitions were announced in August 2018. Four works were qualified for the second stage. In October 2018 Competition Jury, composed of arch. Tomasz Bobrowski, arch. Jacek Ewý, arch. Marlena Happach, Piotr Lewicki, arch. Stanisław Deńko, Krzysztof Drebot and Leszek Jasiński, decided to grant three awards and one distinction (Fig. 11). Characteristics of the awarded works provided us with a set of starting scenarios for consideration for specific locations between the Vistula River and the Kraków Główny Railway Station.

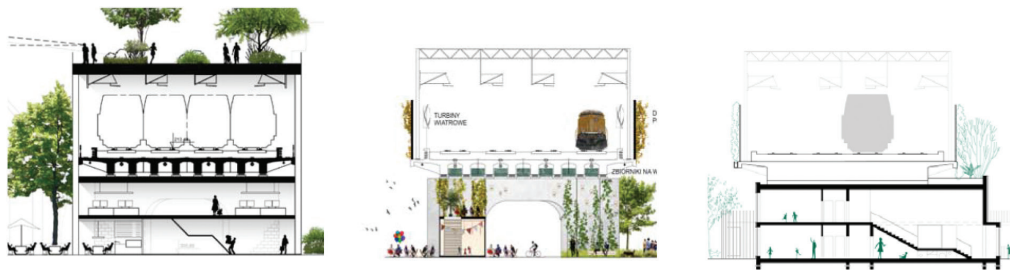


Fig. 11. Selected cross-sections of the railway flyover from Podgórska St. to Dietla St., fragments of competitions works qualified for the 2<sup>nd</sup> stage of the competition. From the left: 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., the Netherlands) [34], 2<sup>nd</sup> award (NM architekci Z. Szpocińska and T. Marciniwicz; K. Kamiembrodzki, J. Grochulski, G. Rejniak, Warszawa) [35], 3<sup>rd</sup> award (Miastopracownia Dominika Wilczyńska, Kraków) [36]

1<sup>st</sup> award: *Tri-layer functional hybrid*<sup>5</sup> is a project authored by architects E. Anthonie, J. Venhoeven, J.-W. van Oorschot, P.M. Gierek, M.A. Reinares San Martin, G. Baliński, A. Ganczarek from Ton Venhoeven c.s. Architekten B.V. from the Netherlands. This project plans recuperation of 150% of the area lost as a result of constructing the railway line (50% at ground level and 100% and tunnel roof level). The idea is to create a linear park over the flyover – the New Planty (Fig. 12) that together with Aleje Trzech Wieszców and the Vistulan Boulevards (in the future also Kalwaryjska St.) would create an attractive route with unique historical, vantage and functional values encircling the Kraków city centre (Fig. 12). Transformation of the new cross-city route into elevated green areas can be compared with the creation of a green “Boulevard Hausmann” Dietla St. in Vistula oxbow.

<sup>5</sup> Name adapted by the authors of this paper.

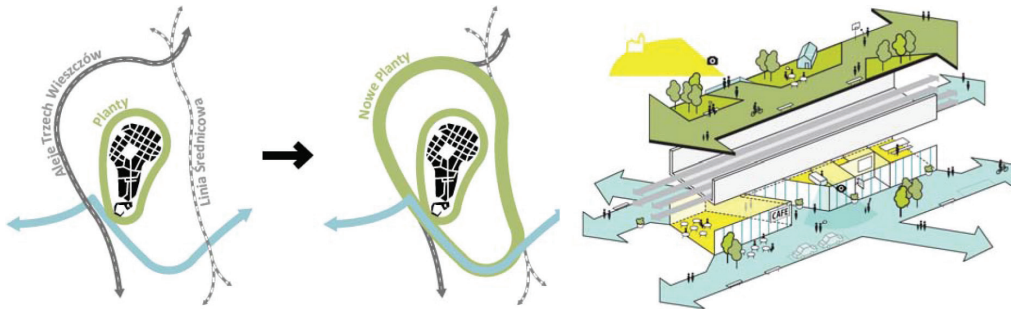


Fig. 12. On the left: Scheme illustrating the urban planning idea behind the project i.e. creation of the New Planty over the flyover and closing the green ring with a unique historical, vantage point and functional values. On the right: scheme illustrating the tri-layer functional hybrid. 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., Amsterdam) [34]

When analysing this solution in architectural scale, it must be noted that the proposed transformation of the cross-city route into a tri-layer functional hybrid (Figs. 12–14) creates attractive functional spaces at three levels:

- ▶ Under the flyover: a sequence of service points, shops, sport and recreation spots with city-forming functions and functions intended for inhabitants stimulating positive changes in the surrounding public space and partially financing the upkeep of the public park in the top layer.
- ▶ At the railway line level, there is an infrastructural tunnel intended to completely eliminate the nuisance related to the railway and increase in railway traffic.
- ▶ Over the railway, there is a public park intended to conned the Kraków Główny railway station with Market Hall and Vistulan Boulevards and to provide vantage points over the city, as well as to introduce some green areas to the densely developed central area.



Fig. 13. Visualization of the city park over the railway line with city panorama – 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., Amsterdam),

source: [https://dialogspoleczny.krakow.pl/wp-content/uploads/2018/10/1\\_Konk\\_Estakady\\_nagr\\_1.pdf](https://dialogspoleczny.krakow.pl/wp-content/uploads/2018/10/1_Konk_Estakady_nagr_1.pdf)

The park development design is based on vantage axes determining pedestrian routes and guaranteeing some intimacy feel to the inhabitant of the surrounding areas: pedestrian route at the level of residential building windows are drawn to the inside of the park or separated

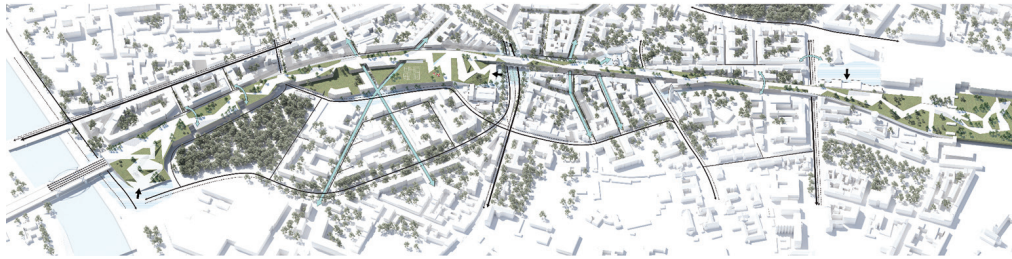


Fig. 14. Visualization of the designed development of the area around the modernized cross-city line – bird's eye view. 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., Amsterdam), source: [https://dialogospoleczny.krakow.pl/wp-content/uploads/2018/10/1\\_Konk\\_Estakady\\_nagr\\_1.pdf](https://dialogospoleczny.krakow.pl/wp-content/uploads/2018/10/1_Konk_Estakady_nagr_1.pdf)

from its edge with pot with plants. Compared to other works, this concept provides for maximum reduction of the negative impact of the railway traffic on the city. It actually consists in running the railway line in an overground tunnel (Fig. 15). According to the authors, such a tunnel should effectively reduce noise levels, air ionization, facilitate maintenance of the track and technical systems [34]. It provides for individually designed steel-structure walls with mixed filling: full (concrete prefabricated elements: boards for climbing plants and pot for plants and trees) or semi-transparent where travellers could enjoy the interesting view from the train board. Such a solution would, of course, be costly, but for example a similar Wientalterasse Park was implemented in Vienna (over a stretch of ca. 80 m), and another one, much longer of 800 m, was created on the roof of railway route running in a “tunnel” in the Sants district in Barcelona (Fig. 22). Architects assume that the height of the whole structure, together with the park, would not exceed cornices of the surrounding tenement houses and proportions in street parallel to the flyover would be similar to the surrounding, historical ones (Figs. 15, 16). Compared to other awarded works, this concept provides for

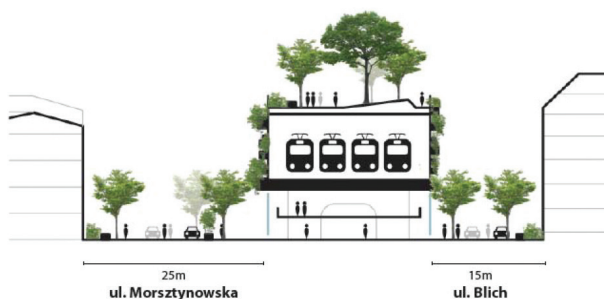


Fig. 15. Development and construction plan for the area under the new railway flyover of the modernized cross-city route; cross-section – a fragment of the competition work, 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., the Netherlands) [34]



Fig. 16. Visualization of the new development and structures under the new railway flyover of the modernized cross-city route – a fragment of the competition work, 1<sup>st</sup> award (Ton Venhoeven c.s. Architekten B.V., the Netherlands) [34]

most extensive development and commercialization of the area under the flyovers consisting of multi-functional sales and service points activating the inhabitants (the area of Blich St.) with transparent shop windows and entries of parallel streets. Such development would cover 24 out of 30 free flyover spans.

Assumptions behind the concept winning 2<sup>nd</sup> prize, authored by a design team from Warszawa (NM architekci Z. Szpocińska and T. Marciniewicz, and K. Kamieniobrodzki, J. Grochulski, as well as G. Rejniak) were similar to those of the Dutch team. This proposal included the creation of an overground pedestrian and bike route under the cross-city route that would connect Planty Dietlowskie with Planty, along Daszyńskiego St., creating the common Planty Starorzeczka that could provide an alternative to the pedestrian-bike path along the Boulevards (cf. Figs. 12, 17). Work of the Warsaw team proposes city-forming functions located exclusively under the flyover and intended for both inhabitants and visitors, with a representative, roofed pedestrian-bike passage, from Miodowa St. to Kopernika St. The passage could become a new communication route creating attractive public space. This project assumes three types of pedestrian traffic under the flyover [35]:

- ▶ Transit pedestrian – from point A to point B – finished with concrete slabs.
- ▶ Walking pedestrian – with direct access to green areas – finished in wood (Fig. 18, 19).
- ▶ Didactic footbridge – suspended under the flyover, running between vertical gardens designed on flyover supports.



Fig. 17. Layout illustrating the main idea behind this project i.e. creation of a new, overground walking and bike loop under the flyover of the new cross-city route – a fragment of the competition work, 2<sup>nd</sup> award (NM architekci Z. Szpocińska and T. Marciniewicz; K. Kamieniobrodzki, J. Grochulski, G. Rejniak, Warszawa) [35]



Fig. 18. Visualization of the structures under the flyover and green acoustic screens above – near Morsztynowska St. 2<sup>nd</sup> award (NM architekci Z. Szpocińska and T. Marciniewicz; K. Kamieniobrodzki, J. Grochulski, G. Rejniak, Warszawa) [35]

The design that won 3<sup>rd</sup> award, entitled *MARKET & RIDE concept – in search of open space*<sup>6</sup>, authored by Miastopracowna Dominika Wilczyńska from Kraków (team consisting of D. Wilczyńska, B. Nawrocka, A. Gryc, E. Szymczyk, D. Włodarczyk, J. Nawrocki), is a proposal that combines the super-local perspective with local one [36]. The structural intensity, in this case, is intermediate between the versions granted the first two awards (cf. Fig. 20).

<sup>6</sup> Name adapted by the authors of the project [36].

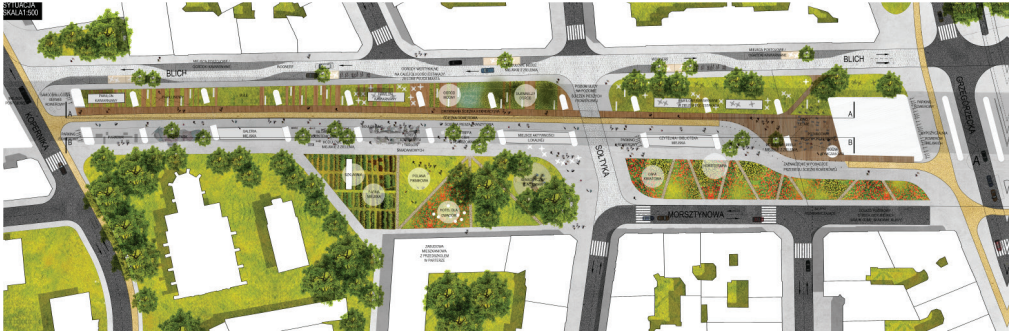


Fig. 19. Project for the development of the area between Grzegorzka St. and Kopernika St. (scope required for stage II of the competition). 2<sup>nd</sup> award (NM architekci Z. Szpocińska and T. Marciniwicz; K. Kamiembrodzki, J. Grochulski, G. Rejniak, Warszawa) [35]

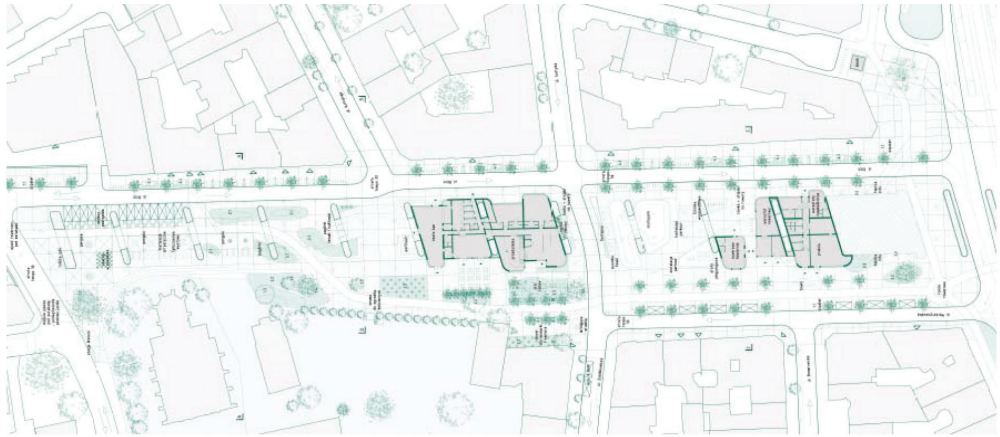
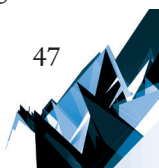


Fig. 20. Project for the development of the area between Grzegorzka St. and Kopernika St. (stage II of the competition). 3<sup>rd</sup> award (Miastopracownia Dominika Wilczyńska, Kraków) [36]

This project balances structural elements and open public grounds in the area under the flyover, at the same time giving individual stretches some local character (in response to fears of the inhabitants of excessive commercialization of this area, formulated at the social consultation stage [37]). The main concept is based on two pillars.

- ▶ MARKET, represented by a two-level market, new local centre, woonerves and squares with sport and recreation functions,
- ▶ RIDE which in this case is a combination of transit function and transfer place within the Grzegorzki junction, and intensification of public city transport, pedestrian and bike traffic with a simultaneous reduction in car traffic levels.

The concept, studio competition “New life between the flyovers” allowed the architects, inhabitants, and decision-makers to visualize a whole variety of ideas, including innovative and original solutions. Results of this competition are not equivalent to the city implementing a given project, as it was not the goal of this competition [38]. As the jury verdict justification reads: “All the submitted competition project constitute very valuable materials allowing



for a comprehensive look at the development of Kraków city centre and they include many valuable proposals for solving these issues. Therefore, the knowledge gained as a result of the competition should be used for further works on setting the directions for development strategies, and then for planning and designing” [39, p. 1].

## 6. Proposed typology of design solutions

As already mentioned above, because of the need to obtain objective assessments of usability of specific solutions, in the analysis of competition results, we renounced comprehensive analysis and assessment of the awarded works. Instead, we proposed indicating and characterizing the programme and design solutions proposed there as scenarios adequate for individual areas (Fig. 21).

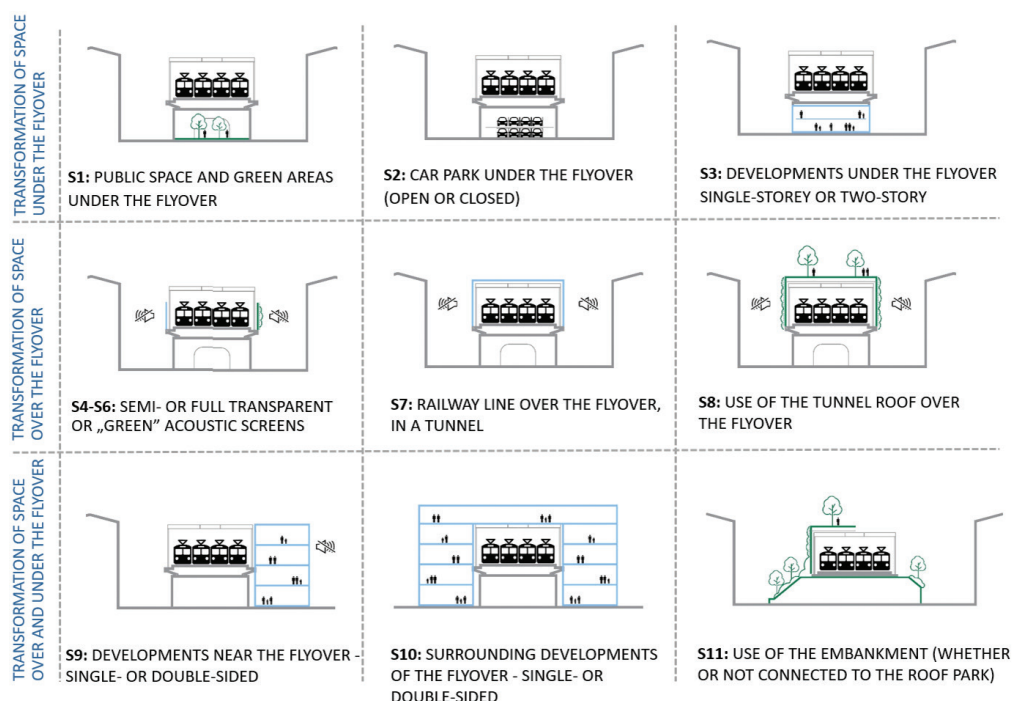
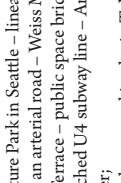


Fig. 21. Comparison of scenarios encountered in competitions works isolated in the post-competition analysis [10]

These solutions have been classified according to:

- ▶ Transformation of space under the flyover
  - ▷ Scenario 1: public space and green areas under the flyover,
  - ▷ Scenario 2: open car park (single-storey) or two-storey (open or closed) under the flyover,
  - ▷ Scenario 3: developments under the flyover – single-storey (free standing) or two-storey (freestanding or covering the whole space) shopping facilities;

Table 1. Fragment of a table with characteristics of scenarios encountered in competition works isolated in the post-competition analysis [10]. Scenario 8 i.e. use of the tunnel roof over the flyover. Scope of description: pictogram, description of the solution (basic data, complexity level, estimated costs), reference implementations, indication of competition works which proposed a given scenario, advantages and disadvantages of the variant in the context of the analysed area [10]

Scenarios encountered in competitions works isolated in the post-competition analysis	Description of the solution / basic data / Complexity level	Reference implementations	Indication of competition works which proposed a given variant
<p>No</p>  <p>Transformation of space over the flyover, scenario 8: use of the tunnel roof over the flyover</p>	<p>Functional and spatial variants</p> <p>Linear parks connected with transport routes are mainly organised in downtown, off-road or railway flyovers, such as the High Line in New York, Viaduct des Arts in Paris or Seoulllo 7017 promenade in Seoul. Linear parks are also being created over active railway flyovers, such as Rambla de Santis in Barcelona. Such a solution – a park located on the roof of the “tunnel” enclosing the existing embankments and flyover - was proposed in the winning competition work. The park stretches over a distance of two kilometers above the entire railway route from Vistulan Boulevards to Krakow Główny Railway Station. The pedestrian passageway-garden implemented on the roof of the “tunnel” is attractive and varied. It connects with the adjacent areas by means of stairs and lifts, and large slipways (roof decks). In many places it is an excellent viewing platform. The scale of the project is unprecedented, which would make such a structure extremely attractive, but would also entail huge technical problems and costs.</p> <p>In sections where the flyover runs close to buildings (from Podgórska St. to Grzegorzki junction and north of Kopernika St.) such a 15-metre high structure would obscure the view from windows. Therefore, it seems that the implementation of such a development would be justified only on a part of the route.</p>	<ul style="list-style-type: none"> <li>▶ Olympic Sculpture Park in Seattle – linear park over train tracks and an arterial road – Weiss Manfredi;</li> <li>▶ Vienna Valley Terrace – public space bridging over the entrenched U4 subway line – Architekten Tillner Willinger;</li> <li>▶ Miyashita Park above a parking lot in Tokio – Atelier Bow-Wow;</li> <li>▶ High Line – linear park on a closed railway flyover – Field Operations and architects Diller Scofidio + Renfro (New York);</li> <li>▶ Rambla de Santis in Barcelona – city park covering the railway line – Sergi Godia, Ana Molino, arquitectos Esteyco Ingeniería;</li> <li>▶ Seoulllo 7017 in Seoul – park on a closed road flyover – MVRDV;</li> <li>▶ Promenade plantée in Paris – linear park on a closed railway flyover – Jacques Vergely and architect Philippe Mathieux;</li> <li>▶ Madrid Río in Madrid – linear park over burried city’s Ring Road – West8;</li> <li>▶ all kinds of wildlife bridges over highways (estimated cost: ca. 19mln PLN/100 running m).</li> </ul>	<p>Project with 1st award (a linear public park designed to connect the main railway station with Unitarg Fair Hall and Vistulan Boulevards, as well as to highlight the city’s scenic values and introduce greenery into the densely built-up area of the city centre).</p> <p>Project with 2nd award (no tunnel with a park).</p> <p>Project with 3rd award (no tunnel with a park).</p>
8	<p><b>ASSESSMENT OF FEASIBILITY:</b> The implementation of a linear park on the roof of the “tunnel” enclosing the railway flyover can be rational within the Grzegorzki station (ZONE C) and on the section between the station and St. Nicholas church (ZONE D). In the remaining sections, due to the size of such a structure and small distances from tenement houses, the view from all windows would be obscured, which undermines the purpose of this solution.</p> <p><b>ESTIMATED COSTS:</b> The cost of constructing a linear park on the roof of the tunnel enclosing the railway flyover would be extremely high. Additional increase of costs would be necessary to ensure safe access (lifts, escalators) and evacuation of users and appropriate systems enabling vegetation of greenery. The whole “tunnel” with a line park would cost about 1 million PLN per 1 running meter of the structure.</p> <p><b>TECHNICAL SOLUTIONS:</b> The construction of a “heavy” linear park slab would have to be supported by the construction of a “tunnel”, which can only have supports beyond the outline of the flyover. Due to its large width (from 20 to 30m) and loads of about 10 kN/m<sup>2</sup>, such a structure would have to have large cross-sections (in the winning work it was shown symbolically without any indication of dimensions).</p> <p><b>ADVANTAGES:</b> A unique architectural structure would provide a new accent in the cultural landscape of Krakow. The greenery of the park would compensate for the cutting down of several hundred trees removed during the construction of the flyover. Excellent views of the panorama of Krakow from the level of the park would be possible.</p> <p><b>DISADVANTAGES</b> Cultural landscape change in a historic district. Huge costs of construction and maintenance of the object.</p>		

- ▶ Transformation of space over the flyover
  - ▷ Scenario 4: semi-transparent acoustic screens,
  - ▷ Scenario 5: fully transparent acoustic screens,
  - ▷ Scenario 6: “green” acoustic screens,
  - ▷ Scenario 7: railway line over the flyover, in a tunnel,
  - ▷ Scenario 8: use of the tunnel roof over the flyover;
- ▶ Transformation of space over and under the flyover
  - ▷ Scenario 9: developments near the flyover – single- or double-sided,
  - ▷ Scenario 10: surrounding developments of the flyover – single- or double-sided,
  - ▷ Scenario 11: use of the embankment (whether or not connected to the roof park).

Additional scenarios (e.g. scenario 10 with surrounding developments around the flyover) were added to the scenarios proposed in the awarded works to create a broader spectrum of transformation possibilities for the cross-city line (Fig. 21). Each of these scenarios was described in detail and symbolically represented in the table whose selected fragments can be seen in the table (Tab. 1). This breakdown informs which of the awarded works proposed a given transformation and references implementations were also provided (cf. Figs. 22–25) where such a solution was realized (some of these investments were also discussed in a vast appendix to the analyses).

The analyses included assessment of implementation feasibility for a given transformation form in the area of the new cross-city route with an indication of optimal location for a given structure. Costs and technical complexity level for implementation of each of the scenarios were also estimated. Advantages and disadvantages of specific solutions in the context of applying them in a selected fragment of the area under analysis were also indicated. Such conclusions from the analysis allow for indicating recommended solutions and determining potential directions for actions in the area of the new cross-city route.



Fig. 22. Implementation of scenario S8: the JARDINES ELEVADOS DE SANTS project – surrounding structures and covering the railway line (a stretch of ca. 800 m, surface area of 48,400 m<sup>2</sup>) with a city park in Rambla de Sants district in Barcelona, designed by Sergi Godia, A. Molino, arquitectos Esteyco Ingenieria (<https://www.plataformaarquitectura.cl/cl/801124/jardines-elevados-de-sants-en-barcelona-sergi-godia-plus-ana-molino-architects>)



Fig. 23. Implementation of scenarios S9 and S10: design of an office and service building over a decommissioned flyover in Vienna (13,700 m<sup>2</sup>, length ca. 180 m), designed by Tillner und Willinger ZT GmbH, 2008 ([https://www.b2match.eu/system/building2017/files/01\\_TILLNER\\_ONLINEVERSION.pdf?1495443960](https://www.b2match.eu/system/building2017/files/01_TILLNER_ONLINEVERSION.pdf?1495443960))





Fig. 24. Implementation of scenario S1: the VIA VERDE project – vertical gardens covering pillars of the flyover for Mexico City ring road (the gardens are intended to cover eventually 1000 pillars), designed by VerdMX (<https://www.thecivilengineer.org/news-center/latest-news/item/1157-vertical-gardens-in-mexico-city-to-combat-pollution>)



Fig. 25. Implementation of scenario S3: market hall Im Viadukt under Wipkinger Viadukt and Lettenviadukt in Zurich (9008 m<sup>2</sup>, stretch length ca. 600 m), designed by EM2N, 2010 (<https://www.im-viadukt.ch/en/home/?lang=set>)

## 7. Conclusions

The awarded competition works can above all show the Kraków inhabitants, that in spite of the destructive influence of the elevated, expanded and modernized railway line, the recovered spaced under and over the flyovers can also play a constructive role. These areas may be included in the network of public space and the feeling of a transport route as a physical and mental barrier in the city may be minimized. A significant number of works took up the challenge to search for a new formula for the space around the new cross-city route, mostly interpreted as multifunctional public space integrated into the surrounding space and adapted to its context and the needs of local communities. This linear, adapting functional structure may be a warranty of high-quality combination of urban design solutions after the demolition of the railway embankment.

With respect to the search for new forms of transforming elevated transport routes, the selected works (1<sup>st</sup> and 2<sup>nd</sup> award) went beyond the competition assumptions and related the concept to the whole city, future changes in this area and possibilities of dividing the investment in railway areas into stages. This allowed for opening the discussion on the future of these areas. The above-mentioned competition works present two drastically different strategies for adaptation of transport routes to new functions. The work awarded 1<sup>st</sup> prize presents a broader, urban perspective as it proposes a new structure adapting the elevated route in harmony with the city. The concept of “Tri-layer functional hybrid” is a zero compromise proposal influencing urban structures in a given area with momentum. Such a revolutionary change was duly compared by the authors to drying the Vistula basin in the place of the present Dietla St. What is interesting, as the report on social consultations in the form of questionnaires [40] reads, this work also met with the greatest approval of

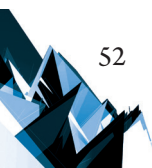
Kraków inhabitants<sup>7</sup>. In opposition to it, the work awarded 2<sup>nd</sup> prize proposes interesting gardens and service points under the flyovers only, maximally limits interventions in the bridge structures of SKA route, thus not requiring great investment expenditures and deep changes in the structure of both the flyovers and city infrastructure. This shows, that the concepts acquired as a result of the competition may provide partial, but not total guidelines for future works intended for implementation of both fragments and finally the whole investment, and for planning to divide it into stages.

This selection of awarded and distinguished works constitutes a voice in a discussion, so much needed in Poland, on the model of solutions interfering with historical spacial structures of the city, both at urban planning and architectural level, with foreign, linear shapes of elevated transport routes. Especially the winning project illustrates the opportunity lost a couple of years ago for PKP designing a multifunctional, hybrid facility integrating the flyovers with local architecture and landscape in cooperation with the city. As part of conclusions from analyses draw by us, we proposed a selection of previously described scenarios (cf. chapter 6) for the assumed functional zones in the railway line area, from the Vistulan Boulevards to Kopernika St. (cf. chapter 4) – Tab. 2.

Table 2. Breakdown of the designated functional zones in the development area with scenarios proposed for them

Zone in the development area	Proposed scenarios
<p style="text-align: center;">ZONE A</p> <p>The area along the flyover between Podgórska St. and Miodowa St.</p>	<p><b>S1</b> – public space and green areas under the flyover;  <b>S4/S4+S5+S6</b> – semi-transparent or mixed acoustic screens (from the west, the stretch from Przemyska St. to Miodowa St.) – coupled with other safeguards;  <b>S11</b> – development of the embankment (attractive green solutions);</p>
<p style="text-align: center;">ZONE B</p> <p>The area under the flyover Miodowa St. – “Grzegórzki” junction</p>	<p><b>S2</b> – single-story open or two-story car park ;  <b>S3</b> – single-story shopping facilities (free standing);  <b>S4/S4+S5+S6</b> – semi-transparent or mixed acoustic screens (from the west, the stretch from Miodowa St. to Joselewicza St.) – couples with other safeguards;  <b>S10</b> – developments at the flyover, single-sided (adjoining the Cracovia skating ring);</p>
<p style="text-align: center;">ZONE C</p> <p>Integrated “Grzegórzki” junction</p>	<p><b>S3</b> – two-story (open or closed) car park under the flyover;  two-story (free-standing of covering the whole space) shopping facilities;  <b>S4</b> – semi-transparent acoustic screens coupled with other safeguards;  <b>S7±S8</b> – railway line over the flyover, in a “tunnel”, optionally with development of a park on the “tunnel” roof;  <b>S10</b> – single-sided development at the flyover (at the south-eastern side of the Grzegórzki station);</p>

<sup>7</sup> At the consultation stage, Kraków inhabitants and all the stakeholders were asked to assess the awarded and distinguished works and point to which out of the four concepts should be implemented and which elements from the remaining ones could be additionally included. In a closed question asking for selection of a single concept most closely corresponding to their expectations concerning development of the areas under the flyover, the vast majority of respondents pointed to the project authored by Ton Venhoeccn c.d. Architekten B.V. (73% of respondents) [40].



<b>ZONE D</b> The area under the flyover and the adjacent green area between “Grzegórzki” junction and Kopernika St.	<b>S1</b> – public space and green areas under the flyover (for fragments); <b>S3</b> – two-storey (free-standing or covering the whole space) shopping facilities; <b>S7±S8</b> – railway line over the flyover, in a “tunnel”, optionally with development of a park on the “tunnel” roof;
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Taking into account conclusions from the analyses, we formulated the following postulates and directions for further actions:

- ▶ To give the city appropriate time horizon for actions preceding the actual implementation in the SKA route area, it is recommended that the Kraków City Commune immediately applies to the Ministry for a permit to open the closed railway areas.
- ▶ To increase efficiency of use the areas under the SKA route, improve it functional, spatial, visual and aesthetic values as well as to determine their relations with the surrounding public space, we propose introduction in the target urban development plan for this area a rule for assigning individual intended use to the elevated transport route and the areas under it, and also making a division into temporary and target developments in this area (provisions providing for operation of the area in the transition phase i.e. until the area gets developed in a way provided for in the law; reference example: project of the land development plan for the areas surrounding the ks. J. Poniatowski viaduct in Warsaw [41]). Moreover, it is recommended to define the parameters of the developments located under the flyovers (i.e. maximum surface area, height, and building alignment) together with guidelines concerning the shape of frontage on the side of public space (e.g. provisions requiring the use of high-quality finishing and equipment materials).
- ▶ To optimize the selection of functional programmes for this area, we postulate including in the designing process the so-called non-statutory urban planning tools (i.e. public discussions, participation workshops) and competences of local communities<sup>8</sup>.
- ▶ To boost the interest of private investors in the grounds under the SKA route, we propose developing a catalogue of model protection solutions together with administrative and organizational strategies for a given type of environmental transient conditions. Such a catalogue should be linked to databases and the maps of city real state of Kraków.
- ▶ Before starting development of a city urban development plan and later, before starting the investment project, in-depth analysis if the area under the SKA route is needed. It should be based on the results of interdisciplinary research spanning urban engineering, architecture, urban planning, construction, environment protection, vibro-acoustics, and sociology (social consultations).

<sup>8</sup> Another round of social consultations related to the project consisting in participation workshops entitled “Development of areas under the railway flyover under construction between Miodowa St. and Kopernika St.” took place in September and October 2019.

## 8. Summary

The development process for the area of the new agglomeration route in Kraków constitutes a great organizational and design challenge. These actions may be difficult because of the complexity of issues (status of closed areas, limitations in City's disposing of the areas managed by PKP, difficulties in obtaining financing for investment of this type, inhabitants' being unconvinced of the potential of these areas) and the number of questions requiring analysis (unfavourable environmental conditions, possible collisions with the operation of the railway route, social needs). However, with appropriate planning, cooperation, and coordination, it may contribute to the creation of a new, unique public space, enriching the functional and spatial structure of the city and general improvement in the perception of this area. To conclude, we would like to stress the great value of the initiative consisting in organization of such a competition by the Kraków branch of SARP as it opened very important discussion on transport-related space and expressed appreciation of reliable and complete input materials for the competition, which translated into clear and detailed solutions presented in the competition works. Knowledge gained as a result of the competition and conclusions from the analysis should be taken into account in developing legal regulations determining the rules for urban design policy in this respect. These rules should be determined together with actions in the formal and legal sphere, especially with respect to changes in the status of existing "closed" PKP areas and City's disposal of the area under and in the direct vicinity of the SKA route.

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