



Railway Corridors within Croatian Cities: Obstacles or Opportunities?

Željka Jurković, Marijana Hadzima-Nyarko^(✉), and Danijela Lovoković

Faculty of Civil Engineering and Architecture Osijek, Josip Juraj Strossmayer University of
Osijek, Ulica Vladimira Preloga 3, 31000 Osijek, Croatia
mhadzima@gfos.hr

Abstract. At the time of construction, the railways were located on the outskirts of the Croatian cities or away from the city limits. Cities grew, in their expansion “skipped” the railway, and the railway became a spatial and physical barrier to the connection of the city, railway corridors became intra-city traffic corridors. Consequently, the railway has generated and is generating multiple problems in the functioning of the city and the quality of life of its citizens. The basic problems in railway corridors in Croatia are spatial, traffic, environmental, technological, proprietary, financial, management, safety, and maintenance issues. The article typifies conflict spaces within railway corridors into points (individual locations), linear (along the railway line), or territorial spaces (surfaces for different purposes). The article identifies the basic problems in the railway corridors and gives a comparative analysis of the possibility of turning problems related to railway corridors into opportunities for urban development.

Keywords: Railway corridors · Croatia · Opportunities · Urban development

1 Introduction

The era of railway prosperity in Europe began in the middle of the 19th century, when the railway, as land transport, became the initiator of industrialization and transport connections. Apart from the development of transport and the economy, the railway has significantly influenced the urban development of cities. At the time of its construction, the railway corridors were away from the city limits. Cities grew, and in their expansion, they “skipped” railway lines as spatial and physical barriers and city boundaries, that is, railway corridors became intra-city traffic corridors.

The development of cities in the 21st century is primarily based on the reconstruction and conversion of existing built parts, the construction of unbuilt parts, and increasing the density. At the level of the European Union, sustainable transport planning is set out in the Urban Mobility Action Plan, adopted in 2009 [1]. Transport systems in the 21st century can no longer be planned only sectorally (technically) but multidisciplinary, integrally with the surrounding purposes in the city and with special care for environmental protection [2, 3]. In these processes, is the railway only a barrier to connecting parts of the city or the potential for the formation of the city’s urban development corridor?

The structure of this paper is as follows. The first part defines railway corridors, discusses the main problems of railway corridors, and explains the need for an integrated approach to traffic planning in the city. In the second part, spatial and traffic problems within the railway corridors are systematized. The central part of the article discusses the problems and possibilities of railway corridors and provides conclusions and guidelines for further research. In a separate chapter, examples from the city of Osijek are presented, which show how problematic situations in railway corridors can be annulled and turned into locations of urban development.

2 Identification of Basic Problems in Railway Corridors in Croatian Cities

Corridors are spaces in which transport, economic and demographic processes are linearly articulated [4] and integrate infrastructure, urbanization, and economic development [5–7]. Previous research by various authors, including the authors of this article, included research on spatial and transport issues of railways in Croatian cities - railway hubs (Zagreb, Rijeka, Osijek, Vinkovci, Slavonski Brod), and how it affected the spatial development of cities [8–15]. The conclusion is that the same processes took place in Croatian cities: the railway was initially built away from the borders of the cities, cities grew, skipped railways, and the railway remained a spatial barrier to connecting parts of the city. Based on previous research, the basic problems in the railway corridors in Croatia are presented in Table 1.

Table 1. Basic problems in railway corridors in Croatia.

Basic problems	Detailed description of the Basic problems	Jurisdiction
Spatial	Barrier to connecting parts of the city The spaces of the railway corridors are not completely built or the space needs to be repurposed	State, City
Traffic	Conflict with other transport systems (road, tram)	State, City
Environmental	Noise pollution Risk of accident The perception of the space along the railway as dirty and untidy	State, County, City
Technological	Outdated technology	State
Proprietary	State property	State
Financial	Expensive management and maintenance (state aid)	State
Management	Inadequate management Generating financial losses	State
Safety	Traffic conflict points (crossings in one level)	State, County, City
Maintenance	Expensive and insufficient maintenance	State

The subject of the research is the space of railway corridors in cities that make up the railway (transport infrastructure) and the immediate environment (space of different purposes and different levels of completion) [15].

Of the listed problems in Table 1, the most comprehensive are spatial problems [15]. They are the most comprehensive because they often include several types of problems (traffic, environmental, inadequate use of space). Schematically, they can be divided into three types depending on the size and impact on the surrounding space: individual location - conflict point, linear spatial problem – linear conflict, and territorial problem.

Individual location - conflict points (Fig. 1) include traffic conflict points and conversion or renovation of individual buildings (eg. Reconstruction of existing railway buildings) for other purposes. Conflict points include intersections (hubs) with other transport systems, where the traffic flow is interrupted and traffic takes place at a reduced speed and is regulated by light and sound signals, traffic jams, or the like (Fig. 2). Intersected areas include intersections on one level where several types of traffic take place at the same. Resolving individual conflicting traffic points involves building uneven intersections, underpasses, or overpasses.

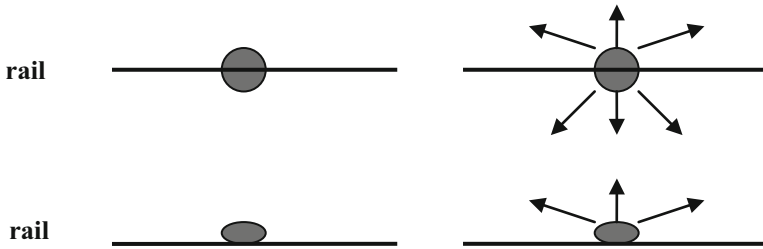


Fig. 1. Scheme of individual location - conflict point and its impact on the surrounding space.



Fig. 2. Conflict point (Osijek): interrupted traffic flow.

In linear conflict spaces (Fig. 3) belong strokes where the railway is a spatial and functional barrier to connecting parts of the city [15]. Linear spatial conflicts are the

biggest spatial, traffic, and functional obstacles to the connection of parts of the city separated by a railway (Fig. 4). Resolving linear conflict spaces implies conversion and arrangement of a part of space, change of purpose of a part of space, construction of a missing or replacement building, etc. (Fig. 5).

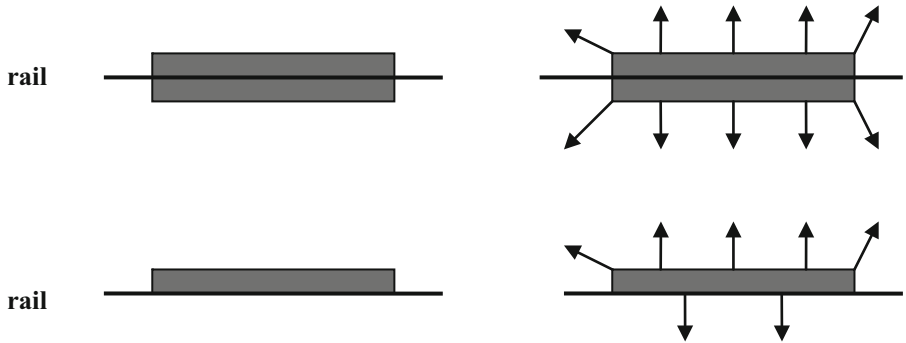


Fig. 3. Scheme of a linear spatial problem (linear conflict) and its impact on the surrounding space.



Fig. 4. Linear conflict (Osijek): parts of the city separated by a railway line.

Territorial conflict areas refer mainly to the existence of abandoned areas (zones) of former railway or industrial facilities (Fig. 6).

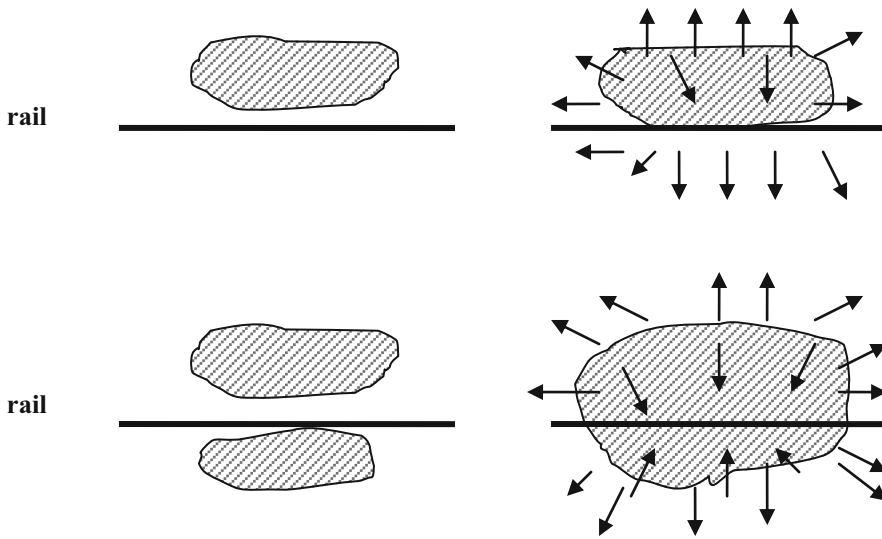


Fig. 5. Scheme of a territorial spatial problem (spatial conflict) and its impact on the surrounding space.



Fig. 6. Territorial conflict (Osijek): spatial problem.

3 Correlation of the Relationship of Problems in the Areas of Railway Corridors and Opportunities for Improvement

Corridors, whether natural (river, canal) or artificial (road, railway), throughout history spontaneously, and later planned, become the backbone of the economic and urban

development of many cities. In the 21st century, the planning of the transport system within cities is inextricably linked to spatial planning, where the precondition for sustainable development of the public transport system (railway) is the development of public intra-urban and inter-urban transport.

Arguments in favor of the corridor as a planning concept emphasize the traffic, spatial, institutional, economic, and ecological (environmental) aspects of the corridor [7, 15, 16]. Thus planned corridors can re-form the spatial structure of the city and shape the city [15, 18].

The transformation possibilities of railways and railway corridors are:

- encouraging the mobility of the population by establishing public inner-city railway and suburban railway transport (inter-city railway) and public intercity transport, which contributes to the reduction of road (motor) traffic and CO² emissions
- variety of possible sizes, shapes, and scales of interventions
- diversity of urban and traffic interventions within the railway corridors
- railway stations can become new points of centrality and urbanity, and form the identity and development of certain parts of the city
- along with the space of the corridor, it is possible to form a new urban landscape (cityscape), change the image of the city, or create a new identity of the city [8, 15, 18].

The transformation opportunities arise from the spatial specifics and characteristics of the space of railway corridors in the city, as presented in Table 2:

- linear or radial provision of railway corridors in the city structure, including locating in the central areas of the city
- connecting different parts of the city and the outskirts with the center
- improvements in the technological conditions of the railway, which consequently frees up these spaces for a new purpose
- the areas along the railway, from its construction until today, have never been completely urban or architecturally completed [15, 18].

Based on our previous research, in previous chapters, we presented the most important problems in the railway corridors in Croatia (Table 1.) In previous chapters, we also identified three types of major problems in the railway corridors. In Table 2. we present the correlation between the basic problems in the railway corridors and identify the opportunities that are provided to solve this problem, i.e. we suggested how to transform the problems within the railway corridors into opportunities for urban development.

Table 2. Correlation of basic problems and basic opportunities.

Basic problems →	Basic opportunities
Spatial	<p>The railway is an infrastructure network that has spatial geometry within the city structure which can be used for multipurpose use, including its location in central urban areas</p> <p>The specificity of the transformation of railway corridors in relation to other types of urban transformations is in their linear or radial provision in the city structure, from the center to the edges, connecting different parts of the city, connecting the city periphery with the center</p> <p>The transformation of the space of railway corridors can take place in stages and polycentrically</p> <p>Railway stations can become new points of centrality and urbanity, and form the identity and development of certain parts of the city</p>
Traffic	<p>The radial or linear location of the railway within the city is the possibility to quickly connect parts of the city (by inner-city railway)</p> <p>Fast, safe, economically and environmentally friendly transport system</p> <p>High capacity rail transport system</p> <p>Weather-independent transport system</p>
Environmental	<p>The inner-city railway is an environmentally friendly means of transport for sustainable urban mobility (electromobility)</p>
Technological	<p>The use of EU funds is an opportunity for technological improvements (increasing the speed and safety of traffic and the purchase of new trains)</p>
Proprietary	<p>Involvement of private investors, granting concessions, public-private partnership</p>
Financial	<p>The use of EU funds and private investors</p> <p>Opportunity to complete the construction of undeveloped spaces within the railway corridors and investment</p>
Management	<p>Involvement of private investors and management</p>
Safety	<p>Increasing the quality of life in the city</p>
Maintenance	<p>The use of EU funds and private investors</p> <p>Involvement of private investors and management</p>

4 Railway Corridors in Osijek: Examples of Opportunities

The traffic solution of the Osijek railway junction is determined in the valid spatial plans: The Spatial Development Plan of the City of Osijek and the General Urban Plan of Osijek. In these plans, individual interventions are planned to resolve conflict traffic points, but larger territorial interventions are also planned to relocate the freight line outside the city and build a new freight station. In the past two decades, only two interventions were built: two new pedestrian bridges (overpasses), which resolved two conflicting traffic points. The construction of two overpasses, one in the Upper Town (Fig. 7) and the other in the Lower Town (Fig. 8) can be considered a solution to the individual conflict traffic problem (railway traffic and pedestrian traffic).



Fig. 7. Pedestrian bridge at the railway station, Osijek, Croatia, architects: Branimir Kljajić and Goran Jagić, 2009.



Fig. 8. Pedestrian bridge over a railway corridor at the Sugar factory, Osijek, Croatia, architect: Assoc. Prof. Željko Koški, PhD, other authors: Prof. Zvonimir Marić, PhD, Prof. Damir Markulak, PhD, and Prof. Damir Varevac, PhD, 2005.

An example of a possible territorial change in Osijek is the dismantling of the railway towards the eastern industrial zone (Fig. 4, Fig. 9) since a new railway is planned instead, south of the city. In this way, significant areas that can be used for public purposes would be freed up (Fig. 10), as the authors of this article proposed.



Fig. 9. Railway towards the Osijek eastern industrial zone – current situation.



Fig. 10. Territorial situation after dismantling the railway towards the Osijek eastern industrial zone – one of the possible usage scenarios for public purposes.

5 Discussion and Findings

The railway is institutionally connected to the state, and to this day the solution to the railway issue is superior to the spatial or development interests of cities. In recent times, the Croatian state transport policy [19, 20] must also satisfy the interests of the EU.

The specific objectives of the transformation of railway corridors relate to ensuring the permeability of railway corridors, whereby the transport corridor space becomes the development corridor of the city and the space of mobility for city residents. Of particular importance is the new role of railway stations, which should become central places of urban planning.

The research identified the types of the most important problems in the railway corridors in Croatian cities – railway hubs and suggested how to transform the problems within the railway corridors into opportunities for urban development. A correlation between each problem has been established and given the opportunity to achieve a solution to the problem. It is in this radial and linear extension (network) through the central parts of the city that the greatest potential for the transformation of railway corridors lies and solving the spatial and traffic problems. By merging the separated parts of the city, sustainable transport and spatial development would be achieved and the quality of life in the city would be increased. In the example of the city of Osijek, examples of individual, linear and territorial problems are shown and opportunities for their transformation that would contribute to urban development are presented.

6 Conclusion

In Croatian cities, there is a possibility of quality application of corridor planning since it includes an integrated approach: simultaneous planning of the railway transport system and the surrounding area. Urban transformation of railway corridors is needed in those cities where the railway restricts the expansion or integration of parts of the city, in cities where railway traffic is relocated, and in cities where the railway is or will become a public urban transport system. Consequently, by compressing or relocating the railway, spaces for new conversion are freed up within cities. Such territorial changes are the greatest opportunity for urban development of the Croatian cities which are also railway hubs.

Railway transport as an environmentally and economically acceptable means of transport is becoming stronger, and at the inner-city level, this will impose the need to transform railway corridors by individual, linear or territorial transformations and solve basic problems within the corridors. The specificity of the transformation of railway corridors in relation to other types of urban transformations is their linear or radial provision in the city structure, from the center to the edges, connecting different parts of the city, connecting the city periphery with the center, improving railway technological conditions. The new role of railway stations in the revitalization of railway transport in the 21st century is not sufficiently emphasized and researched in the domestic professional and scientific literature dealing with issues of sustainable transport and spatial development of cities.

Further research on the concept of corridor planning as an approach to the spatial planning of 21st-century cities and research on the relationship between the railway and the shape of the city are proposed.

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