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## Road and Rail Infrastructure III

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## ROAD NETWORK MANAGEMENT IN CROATIA IN COMPARISON WITH OTHER EUROPEAN COUNTRIES

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### Abstract

Road network management is a systematic process of effective maintenance, improving and exploitation of constructed roads, combining engineering principles with sound business practices and cost effectiveness. Thus, creating the conditions for more organized and flexible approach to decision-making processes in order to meet current and future customer needs is needed.

Public roads management in the Republic of Croatia is based on strategic documents, Act on Roads and planning documents. Act on Roads (Official Gazette 84/11) is the basic document governing the classification of roads, planning, construction, reconstruction, maintenance, measures to protect the traffic and roads, concessions, management, financing and supervision of the road system. Although the total road network is a unique road system due to technical, traffic and economic characteristics, there are two main subsystems in Croatia: the highways (and semi-highways) and the primary road network. Primary road network consists of state, county and local roads. Public roads management is entrusted to the County Road Administration and the City of Zagreb (for county and local roads), Croatian Roads (for state roads), Croatian highways and concession companies (Rijeka-Zagreb highway, Zagreb-Macelj highway, Binalstra) for management of highway network. Rational and quality management of the road network is a real challenge nowadays, which must meet high traffic demands with available financial resources. Such an approach necessarily requires modern database, system for monitoring the condition of roads and facilities, the unique reference marking system of roads, preventive maintenance approach, adequate laws and regulations and the appropriate organization of road administrations and financing.

In this paper, besides the description of the road network management in the Republic of Croatia, road network classification will be described, modes of management in different European countries (such as Germany, Poland, Slovenia, Hungary, Austria, Belgium, etc.) and comparison of experiences from given countries and Croatia will be shown.

*Keywords: road network, management, European countries, (road) users*

### 1 Road network in Croatia – The legal framework

Transport sector plays an important role in Croatian economic development, with a share of around 4.7% of GDP and employee 5.2% of the working population – 58.635 employees [1]. The importance of transport infrastructure development is considered essential for economic and social development and promotion of inter-regional exchange.

The road network in the Republic of Croatia includes public roads and unclassified roads. Croatia now has in total 26.963,90 kilometers of public (categorized) roads. Decree on the Public Road Classification [2] classifies public roads as: motorways (total length 1.413,10 km),

state roads (total length 6.867,70 km), county roads (9.703,40 km) and local roads (total length 8.979,70 km). All public roads are under the authority of the Minister of Maritime Affairs, Transport and Infrastructure. This method of roads classification in the state, county and local roads express the roads transport functions (clearly defined in the Decree on Standards of the Public Road Classification) [3] following the state constitution in a similar manner as in other European countries. Management, construction and maintenance of public roads in the Republic of Croatia are entrusted to several companies according to the Act on roads (Official Gazette 84/11) and concession agreements. Croatian Motorways Ltd. is a company for operation, construction and maintenance of motorways. Croatian Roads Ltd. is a company for managing, constructing and maintaining of state roads. Rijeka-Zagreb Motorway Joint Stock Company is a company for managing, constructing and maintaining of motorway Rijeka-Zagreb (part of A1, A6 and A7). These companies are 100% owned by the Republic of Croatia. Zagreb-Macelj Motorway Ltd. is a company for financing, construction, operation and maintenance of the Zagreb – Macelj motorway (A2) based on concession agreement from 2003. Bina-Istra Motorway Joint Stock Company is a company for construction, maintenance and operation of motorway Istrian Epsilon (A8 and A9) based on concession agreement since 1998.

**Table 1** Key documents and planning period

Planning period	Document	Government body	Planning period
long-term	National Transport Development Strategy	Croatian Parliament	adopted in 1999
middle-term	Programme for construction and maintenance of state road network	Government of the Republic of Croatia on proposal by Ministry of Maritime affairs, Transport and Infrastructure	4 years
short-term	Construction and maintenance plan	Croatian Motorways Croatian Roads	1 year

County governments and an administrative body in the City of Zagreb are responsible for construction, operation, maintenance and protection of county and local roads. Strategy for the development of public roads, four-year programs related to construction and maintenance of roads and an annual implementation plans are key documents that define the access to road construction and maintenance (Table 1). Funds for the construction and maintenance of public roads are planned in the planning periods according to the Law on roads [4]. The basic regulation is complemented by other relevant matters – motorway designation, traffic safety, transportation in road traffic, transportation of hazardous cargo, toll tariff levels and toll collection system on motorways, calculation of the compensation fees for the use of road land and provision of motorway services, exceptional transportation, extensive use of public roads.

## 2 Sources of funding

Main sources of funding for construction and maintenance activities on public roads are defined by the Law on roads [4]:

- fee of fuel, tolls paid for the use of highways and other charges related to the use of highways;
- toll to be paid for the use of highways under concession;
- charges from fuel and other charges related to the use of state roads;
- annual road charges to be paid upon registration of motor vehicles, and other fees related to the use of regional and local roads.

Since the January 1<sup>st</sup> 2014 fee charged on fuel has been redistributed: amount of from HRK 0.60 to HRK 0.20 in favor of Croatian Motorways and from HRK 0.60 to HRK 0.80 in favor of Croatian Roads expressing the investments policy in the next four-year period (Table 2).

**Table 2** Plan and structure of investments according to Programs of constructing and maintaining the state road network for the period of 2009 to 2016 (in 000 HRK) [5, 6]

	Description	Motorways	State roads	County and Local roads
		plan	plan	plan
2013-2016	construction	6.896.761	5.959.880	125.680
	investment maintenance	790.125	3.194.877	1.435.299
	regular maintenance	1.034.873	1.740.000	1.955.108
2009-2012	construction	9.271.141	4.589.570	769.985
	investment maintenance	1.167.288	1.676.000	1.335.808
	regular maintenance	1.276.102	1.200.000	1.937.350

### 3 Road network management in the European countries

The density of the road network of high quality service in Croatia is several times higher compared with other transition countries, while in comparison with the countries of the European Union is at about at the same level.

#### 3.1 Denmark

Denmark is a relatively small country of 42.916 km<sup>2</sup> including more than 400 islands. A well connected transport system in Denmark is therefore dependent on several types of infrastructure solutions in order to achieve a high level of mobility that integrates all regions. Total Danish road network includes motorways, main or national roads, secondary or regional roads and all other roads in a country. According to data from the Ministry of Transport [7], the Danish road network is length 73.574 km, of which 1.143 km are motorways, 379 km dual carriageways and 72.065 km all other roads. Approximately 5% of all roads are state roads while the remaining 95% are owned primarily by local municipalities. The vast majority of Danish roads and bridges are free of charge for the individual user; however, there are a few exceptions: the Great Belt Bridge joining Zealand and Funen and the Øresund Bridge linking Copenhagen to Malomö in Sweden. Several bridges connect the various islands with the Danish mainland. These bridges are essential to an integrated Danish transport system, as well as they link Scandinavia together with Continental Europe. Road Administration Structure in Denmark exists in three levels: State (1), Counties (16) and Municipalities (271). The Danish Road Directorate (Vejdirektoratet) [8] constructs, operates and maintains the state-owned road network, which comprises motorways, a number of main roads and many of the country's bridges – approximately 4.000 km.

#### 3.2 Sweden

Sweden with area of 450.295 km<sup>2</sup> is divided into 21 counties. The length of the road network is 423.055 km and density decreases from the south to the north of Sweden [9]. Sweden has a fairly limited system of motorways. The motorways' primary purpose is connecting major cities to their surrounding areas. There are also a number of semi-motorways – roads with only 2 or 3 lanes but to which the same conditions apply as to motorways (i.e. grade-separated crossings, no slow traffic). The Swedish road numbering scheme does not distinguish

between motorways and other types of roads. Sweden like, Denmark, has integrated the E-road numbers into their networks, meaning that the roads usually have no other national number. Swedish road network consist from national roads and county roads. National roads are roads of high quality and sometimes pass through several counties. Roads with lower numbers are in southern Sweden, and roads with higher numbers are in northern Sweden. The network of national roads covers all of Sweden, and has a total length of 8.769 km (not including E-roads). The national roads are public roads owned by the Government of Sweden and administered by the Swedish Transport Administration. They get a high priority for snow plowing during the winter. As of February 2008, Sweden has 59 national roads. The county roads are divided into primary, secondary and tertiary roads, of which the primary roads have the most important transport function. The Swedish Transport Administration (Trafikverket) is the Government agency responsible for the long-term planning of the transport system for road traffic and responsible for construction, operation and maintenance of the state road network and national railway network. Since 1990 the National Road Administration has been responsible for road maintenance on trunk roads and some primary county roads, including those that pass through towns. Previously it was the municipalities that were responsible for these parts of road.

### 3.3 Belgium

Since 1962, infrastructure construction in Belgium has been divided into three distinct zones: Flanders, Wallonia, and Brussels. Each region has different standards and construction methods when constructing roads and bridges. The road network in Belgium is made of highways, national (or regional) roads (the secondary network) and communal roads (or streets). There are also a number of orbital roads in Belgium around major cities. According data from 2010, total road network in Belgium is 154.012 km, among which there are 1.747 km of highways (both Flanders and Wallonia have approximately 900 km of highway each), 13.892 km of national (regional) roads and rest of other roads. Belgium road network has A-roads, B-roads, R-roads, N-roads, T-roads, and secondary N-roads or Provincial Routes. A-roads are motorways which connect major cities and international destinations. These are not always built as limited access facilities, and may include traffic lights and grade crossings. B-roads usually are expressway quality, and are short link routes between other points. R-roads are rings around major cities, the most famous of which being the R0 Brussels Ring. N-roads can have motorway characteristics and grade-separated interchanges but for the most part are 2 lane roads connecting secondary cities and towns. Provincial Routes are very rarely signposted, and connect smaller towns and villages [10]. The road network in Belgium is managed by regional authorities, meaning that a road section in Flanders is managed by the Flemish Government, a road section in Brussels by the Brussels government and a road section in Wallonia by the Walloon Government. Communal roads are managed at the municipal level.

### 3.4 France

Transportation in France relies on one of the densest networks in the world with 146 km of road and per 100 km<sup>2</sup>, there are 1,000.960 km of roads. The French highway network consists largely of toll roads, except around large cities and in parts of the north. It is a network totaling 11.392 km of highways [11], operated by different private companies. French highway network is seventh largest highway network in the world, and, after Spain and Germany, third network in Europe. France currently counts 30.500 km of major trunk roads (routes nationales) and state-owned motorways. The county roads (routes départementales) cover a total distance of 365.000 km. The main trunk road network reflects the centralizing tradition of France: the majority of them leave the gates of Paris; trunk roads begin on the parish of Notre-Dame of Paris at Kilometer Zero. To ensure an effective road network, new roads not serving Paris were created.

### 3.5 Slovenia

The Republic of Slovenia a total area of 20.273 km<sup>2</sup>, is located on the transport route linking Central Europe and the Adriatic Sea. It has a network of roads and railways that are recently renovated with the help of the European Union. The total length of the public road network of the Republic of Slovenia is more than 38.900 km. The entire road network of the Republic of Slovenia includes national roads that are owned by the Republic of Slovenia and local roads which are owned by the municipality. The total length of national roads is approximately 6.500 km. State roads include motorways, expressways, main roads (first and second rows), and regional roads (I, II and III of the order). The categorization of public roads was based on the criteria for categorization of public roads [14]. Categorization of state roads is established by the Regulation on the classification of state roads. Management, maintenance and development of the national road network – regional and main roads authorized by the Board of the Republic of Slovenia for Roads. This body conducts vocational – technical, developmental, organizational and administrative tasks for the construction, maintenance and protection of main and regional roads. Management includes several sectors. Management Division has the establishment of regional offices in major cities, while the sector headquarters in Ljubljana. Management, maintenance and development of motorways and expressways are responsible Motorway Company of the Republic of Slovenia, Inc. (DARS). DARS is a company whose founder and owner is the Republic of Slovenia. In 1995 Slovenia passed the first planning document – the National Programme of highway construction in the Republic of Slovenia, which determines the strategic, organizational and financial basis for the realization of the construction of a highway which is part of the European road network.

### 3.6 Poland

The Republic of Poland as a Central European country with total area of 312.679 km<sup>2</sup>, has a well-developed network of roads, waterways, railways and air transport. As a country in the “crossroads” of Europe developing economies, Poland is becoming a modern network of transport infrastructure. Public transportation is available in most cities across the country. The national road network is adapted to the administrative division of the country, covering 412.035 km of roads and is divided into the following categories: state road, a distance of 19.182 km, the regional roads with a length of 28.423 km, the county road, a distance of 125.779 km and local roads with a length of 238.651 km. Parts of the national road network are the highways and motorways. National roads are owned by the state, while the regional, county and local roads owned by regional, county and local governments. Directorate General of state roads and highways (GDDKiA – General Dyrekcja Drog Krajowych and Autostrade) is the central government body set up to manage the national roads in Poland. In addition to managing the state roads, GDDKiA collect data and information on the public road network, road works with other governments and international organizations, is working with local governments in developing and maintaining road infrastructure. GDDKiA consists of 16 regional subsidiaries that manage the roads in their area. Headquarters GDDKiA is in Warsaw.

### 3.7 Germany

As a densely populated country Germany has a modern transport infrastructure. High-speed traffic has a long tradition in Germany. Germany has about 650.000 km of roads. Road network consists 12,800 km of motorways (Bundesautobahnen), 39.637 km of federal roads (Bundesstraßen), 86.474 km of state roads (Landesstraßen), 91.710 km of district roads (Kreisstraßen) and 458.000 km of municipal/local roads (Gemeindestraßen). Federal roads, like motorways, are maintained by the federal agency of the Transport Ministry. In the German highway system they are ranked below motorways, but above the Landesstraßen and Kreisstraßen maintained

by the federal states and the districts respectively. A Bundesstraße is often referred to as “B” followed by its number. More important routes have lower numbers. Odd numbers are usually applied to north-south oriented roads, and even numbers for east-west routes. The federal roads alone handle 30% of the total traffic load, although their share of the road network is only 2%. State roads are roads that are the responsibility of the respective federal state. They cross the boundary of a rural or urban district (Landkreis or Kreisfreie Stadt). District roads or county roads (Kreisstraßen) carry traffic between the towns and villages within a district or between two neighboring districts. District roads are usually dual-lane roads but, in a few cases, can be built as limited-access dual carriageways in densely populated areas. County roads entrusted to the counties. Local roads are the responsibility of the municipality, parish or town. District roads are usually the responsibility of the respective rural district or urban district. Local roads are roads that are the responsibility of the municipality or of the town to build and/or maintain.

### 3.8 Czech Republic

Road and rail infrastructure in the Czech Republic is well branched across the country, while the motorway network expands and develops. National road network of the Czech Republic under the road communications includes the following categories: highways, roads, local roads and special communications. Highways are marked with the letter “D”. In the Czech Republic there are six highways. The total length of highways is 738.40 km. The oldest and most important highway that connects is the D1 Brno and Prague. According to the purpose and importance of road transport in the Czech Republic is divided into: a) Class I roads – roads designed for long-distance and international transport and those involving the so-called fast road. Fast road used for quick interstate and international transport. Marked with the letter “R”, and the total length of them, is 439.10 km b) Class II roads – roads intended for transport between districts c) class III roads – roads that provide connections between individual towns or villages. Roads II and III grades are indicated by the letter “S”. Local roads are used for local transportation within the municipality. Highways and roads and grades (including highways) are state-owned, while the roads were second and third grade in the property of a particular region [14]. Local roads are owned by the municipality. Highways and roads and grades managed by the roads and highways of the Czech Republic (RSD). Roads and highways is an organization established by the Ministry of Transport and Communications. RSD is currently managed with 726.90 km of motorways and express roads 391.20 km. RSD operates highways and roads and grades, cooperating with state authorities, is responsible for the maintenance of roads under its jurisdiction including facilities, participates in the development of technical regulations and road maps.

## 4 Conclusion

In most European countries different public organizations manage different road networks. State road authorities manage the state road network. State road network consists of corridors that connect the national administrative, economic and cultural centers of the country. Usually the state roads run through several provinces. The county road authority manages the county road network. The roads of the county road network usually connect the administrative, economic and cultural centers of the counties. It usually also connects and make use of some national roads. The local authorities are responsible for the local road network. This road network connects the administrative, economic and cultural centers in the county. Local roads usually run within the municipal borders. This method of roads classification in the state, county and local roads express the roads transport functions following the state constitution in European countries. Such strong vertical structuring is important in addressing the coordination of activities in the different layers and assures that all functions care of the widest interests of the population and the economy development.

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