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TOWARDS NEW PRINCIPLES OF ROAD CATEGORIZATION -REFLECTIONS BASED ON PRACTICES IN BELGIUM AND EASTERN EUROPE

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Abstract

One of the major instruments in road infrastructure planning is the functional categorization of the road network. In the Flanders region in Belgium, with one of the densest road networks in Europe, the principles of a new functional road categorization were introduced in 1997 within the Spatial Structure Plan for Flanders. This functional classification relates to clear spatial qualities: accessibility on the one hand and liveability of streets and areas on the other hand. After more than a decade of implementation of this categorization also new criteria are discussed: traffic safety, urban design, robustness of the network, co¬modality, freight routes and others. Within the frame of the revision of the Spatial Structure Plan for Flanders more 'dynamic' and 'multilevel' approaches of the categorization system are being proposed by researchers. Traffic management systems (ITS) allow a more intelligent and adaptive structuring of the traffic infrastructure network.
The focus of the paper is to reflect on how these new tendencies can affect network layout and road design, based on practices in Belgium and to confront it with cases in Bulgaria and Romania.
Secondly specific attention is paid in this paper to the application of traffic modelling within the categorization practice. The most important application is that traffic models allow to translate the road categorization into estimated traffic flows. On the other side, traffic models can be used to estimate which type of measures are needed in order to bring the actual use of the road network in correspondence with the desired use: which levels of speed limitation or road capacity restrictions are needed to make the route choice behaviour of drivers in line with the planned network structure.

Keywords: road networks, road categorization, road design, traffic modeling, spatial planning.

1 Introduction

The last decade functional road categorization has drawn new attention in several countries in Europe. Road categorization is often seen as the hierarchizing of roads. Though hierarchy is in common practice an important principle in road categorization it is not always the starting point. It was clearly not in the Flanders case, within the spatial structure planning process (1). Being one of the densest populated regions in Europe, the Spatial Structure Plan of Flanders (SSPF) states in the assessment of the existing line infrastructure that in Flanders as well the accessibility in the urban areas as the liveability of most part of the region are at stake because of the congested road system. 'For the categorization from a long run perspective, one starts from the desired (main) function with respect to the accessibility on the one side

and the liveability on the other side' [2]. The Spatial Structure Plan of Flanders adopted by the Flemish Government in 1997, has been a milestone in road categorization in Flanders. Given the binding status of the plan, the far-reaching impact in the spatial planning practices in Flanders but also in mobility planning and in road design is very strong.
Also in Holland new road design criteria based on an new system of road categorization was introduced during the last decade: the guiding principle there is the concept of 'sustainable road safety'(3). Design is based on the 'recognition principle', this principle must ensure that road users can know what traffic situations to expect and how they should behave at any moment (4). In Germany a similar evolution took place: the concept a 'self explaining roads' was introduced in the recently adopted new guidelines for road design 'RIN' replacing the former RAS-N (5).
In Eastern European countries the road network has to be adapted to the fast growing car traffic: trend following and hierarchic road categorization systems were introduced in these countries (6).
The focus of the paper is to reflect on how new tendencies in road categorization based on recent practices in Belgium but also on new developments in Germany and Holland as mentioned above, could affect network layout and road design, and to confront it with cases in Bulgaria and Romania.

2 The Flemish road categorization system

2.1 Road functions

The SSPF distinguishes three main functions for roads, see Fig. 1:
· connecting function (connection between origin and destination areas)
· collecting function (collecting within the origin areas and distributing within the
· destination areas)
· the function of giving access (to the adjacent parcels).
A difficulty arises because the same road fulfils several functions for several users, particularly motorists, the slow traffic, the public transport and the goods transport. A complete separation of functions and users is, given the existing situation, not feasible in practice. Anyhow for a good functioning of the road a good balance between the components function, form/layout and use characterizations is necessary.

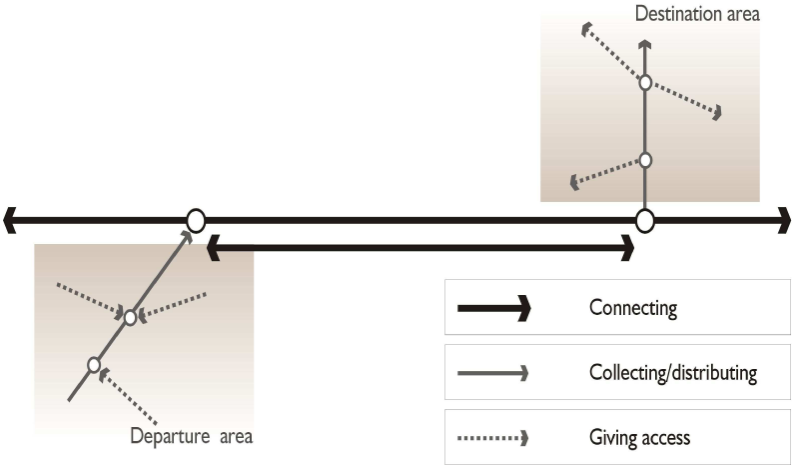

Figure 1 Road functions, distinguished in the Spatial Structure Plan Flanders

2.2 Road hierarchy

A distinction is made between four hierarchical levels according to the importance of the road infrastructure: particularly the international level, the Flemish level, the regional level and the (supra)local level. Roads, nodes and linking points are distinguished. In a node roads of the same level join and the possibility of changing road exists; these are for example interchanges on the motorway net. In a linking point roads of different level join and there is not only the possibility of changing road, at the same time also of changing level. These are for example interchanges (entrance and exit) of a motorway with other roads.
Related to the hierarchy the following principles are put forward as important in the SSPF for the development of the road network:

- Linking points always function between successive levels, so it is not opted to connect a secondary and/or local road to the main road network. -The road network of the highest level, this is the main road network (= international motorway network), must be coherent
- Roads on Flemish level and on supra-local and local level need not form a coherent network on their respective level. They must form, however, a coherent network in combination with roads on a higher level to which they have been connected by means of linking points.
- The traffic winding-off on the different levels must be in proportion to the underlying road network, so that it is not charged by through traffic and so that the road network of higher level is not charged by the traffic on a subordinate relation.

In fact these principles are a certain interpretation of the principle of hierarchy with far reaching consequences, which will be dealt with later on in this paper.

2.3 Road types and layout

In total 9 categories and 4 main categories (main, primary, secondary and local roads) are distinguished. Each road category has some specific development perspectives as a ground for the traffic policy for these roads. However there are no strict design standards (number of lanes, lane width, speed limitation, …). The development perspectives for the main roads have been aimed at the bundling of the traffic on a well-equipped main road network. The level of service must lie higher there than on the primary and secondary net. The main roads are carried out as motorways with European level design standards. The design speed has to be higher than 100 km/h and the chance on traffic-jams for the long distance traffic has to be smaller than 5 percent. Those main roads, which also serve as major transport routes, may have a traffic-jam chance for the lorry traffic of up to 2 percent. The number of intersections has to be kept limited; the distance between intersections is at least 8 to 10 km.
The development perspectives for the Primary Roads I and II both start from the principle of separating traffic flows. Given their connecting function the requirements for traffic flow conditions lie higher on the Primary Roads I: only for these roads the maximum traffic-jam chances (particularly 5 percent) and minimum distances between the nodes are indicated (particularly 3 up to 5km).
The development perspectives for the secondary roads do not only start from traffic requirements but also explicitly from the requirements of liveability and spatial accordance. In general they consist of mixed traffic flows and a passage concept within the built-up area, design speed within the built-up area is 50km/h or less.

2.4 Network layout

The mesh width and the cutting through of the meshes by line infrastructures have not been explicitly treated by Spatial Structure Plan of Flanders. However in proposed as the basic concept to build up the road network (7). The underlying principle to promote these tree structures, directed towards the main roads, is however to avoid the cutting through of the

meshes of the main road network by roads that would be functioning on the national level. Though the mesh width within the main road network in Flanders is mostly rather large in proportion to the high density of functions in those areas, reducing of the mesh width is not seen as a good solution. By reducing the mesh width spatial dynamics come about which support spatial spreading out of activities.

Table 1 Overview of the different functional road categories in Flanders

CATEGORY	MAIN FUNCTION	SUPPLEMENTARY FUNCTION	LAYOUT
MAIN ROAD	CONNECT on the international level	Connect on Flemish level	Highway according European standards
PRIMARY ROAD Category I	CONNECT on the Flemish level	Collect on Flemish level	Highway/urban highway Express road (2x2 or 2x1) Road (2x2 of 2x1) traffic separation
PRIMARY ROAD Category II	COLLECT on the Flemish level	Connect on Flemish level	Express road (2x2 or 2x1) Road (2x2 of 2x1) with traffic separation
SECONDARY ROAD Category I	CONNECT on supra-local level	Giving access	Road (2x1 of 2x2) not necessarily with traffic separation Road Passages through built up areas
SECONDARY ROAD Category II	COLLECT on supra-local level	Giving access	Road (2x1 of 2x2) not necessarily with traffic separation Passages through built up areas
SECONDARY ROAD Category III	Carrying public transport or bicycle routes	Giving access	Road (2x1 of 2x2) special measures for public transport and cyclists
LOCAL ROAD Category I	CONNECT on local level	Giving access	Road (2x1) with mixed traffic
LOCAL ROAD Category II	COLLECT on local level	Giving access	Road (2x1) with mixed traffic
LOCAL ROAD Category III	Giving access		Road (2x1) with mixed traffic

3 Road categorization systems in Bulgaria and Romania

3.1 Comparison with the Flemish system

The Flemish system of road categorization is a rather open system: it leaves space for interpretation of the general guidelines defined in the Flemish Spatial Structure Plan for different actors as well for the selection of secondary and local roads by Provinces and Municipalities (based on the administrative principle of subsidiarity) as for the road design (as there are no fixed design standards per road type). The advantage is that the road layout can be adapted to local spatial conditions (e.g. the design of road passages of secondary roads through town centres can take into account quality of life standards and traffic safety standards for pedestrians and cyclists), the disadvantage is that it may be contradictory to one of the main purposes of road categorization: to make the expected driver behaviour clearer to the road user by means of recognizable road types.
This is a main difference between the road categorization systems in Bulgaria and Romania, where a more strict and objective methodology is used. Here first the important origins and

destination points are listed and categorized, after which a road network is set up, connecting these locations. Each road category has some tasks in connecting locations of a certain hierarchic level of interest (8). This results in a more systematic and unique categorization and moreover in fixed design standards, see fig. 3.

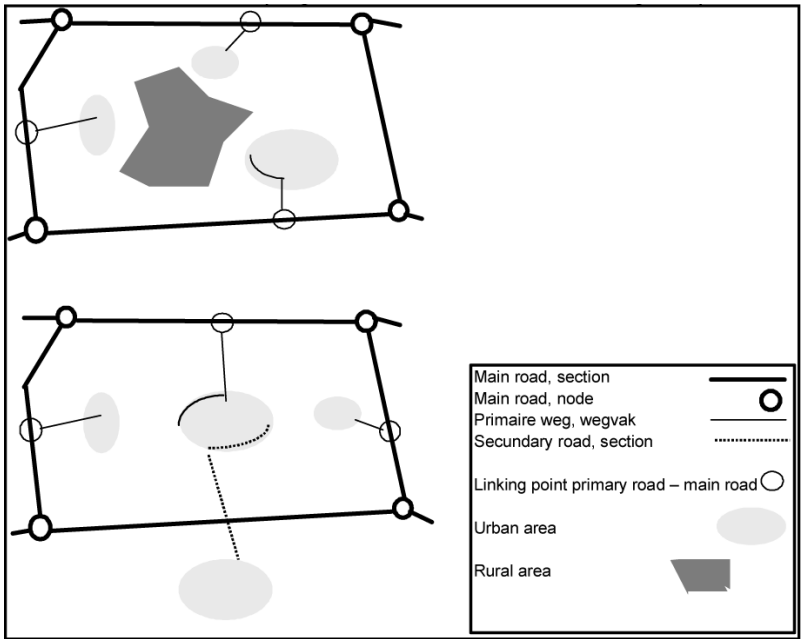

Figure 2 Avoiding cutting through of meshes at the provincial level

The Romanian an d Bulgarian road classification system leads to a more grid-like network pattern (in contrast with the Flemish tree-like pattern), leaving more freedom for the road user to choose between different routes. Furthermore well defined design standards (e.g. road width) have to be followed. In combination with the traffic amounts and features induced by the grid pattern this can lead to dangerous and unliveable road passages through (small) town centres (9).

Functional categorization	Relation between functional categorization and technical class	Technical class	Prescribed number of lanes	Width of lanes	Maximum speed		
					flat	valley	hills
Highways		I	minimum 2x2	3,75	120	100	80
Express roads		II	4	3,50	100	80	60
National roads (TEN)							
National roads primary		III	2	3,50	80	50	40
National roads secondary							
County roads		IV	2	3,50	60	40	30
Comunal roads		V	2	3,50	50	40	25
Vicinal roads		V	2	3,50	50	40	25

Figure 3 Relation between road category and design standards in Romania

3.2 The use of traffic models: applications in Bulgaria and Romania

Road categorization and traffic modelling have been the subjects in several East-European projects by the University of Ghent. A first project in the town of Smolyan studied the transit traffic in the city centre. A macro-model was used to analyse the current traffic (origins and destinations) and to estimate possible future traffic evolution, for example by the opening of new cross-border points towards Greece. The share of transit traffic appeared to be quite low. The effect of a ring road and downgrading the existing main road is shown in fig. 4 (10).

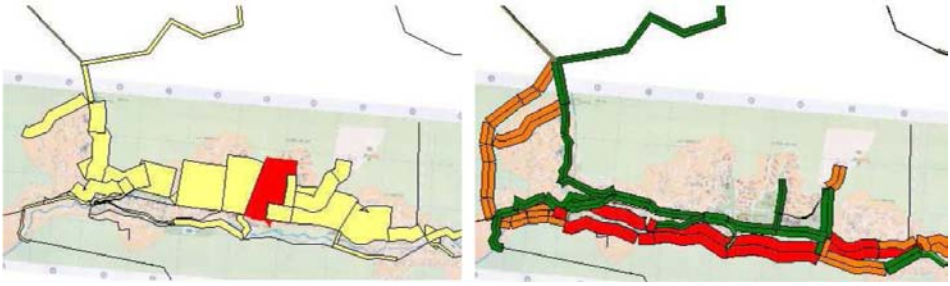

Figure 4 A selected link analysis, showing the origins and destinations of the traffic in the centre of Smolyan (left) and an estimation of the traffic flows in Smolyan in the year 2015 after road re-categorization (right)

4 Confrontation with the new challenges for mobility policy

Road categorization is an important tool for traffic planning. It provides the long-term perspective for coherent policy decisions, which can be the base for short term measures such as road and junction design, traffic management measures, … . Technological evolution such as GPS use in traffic but also new policy challenges urge for new road categorization concepts (11).
The actual orientation of mobility policy in Europe is commonly described as 'sustainable mobility'. Though sustainable mobility can be regarded as a 'container concept' predominantly three aspects are central: accessibility, traffic safety and quality of life (12). This urges a new balance between road capacity and 'environmental capacity'.
Co-modality and limited access to certain zones or routes (e.g. for freight) because of the quality of life standards make part of sustainable traffic policy.(13)
Traffic safety criteria urge clear design standards and more importantly traffic design concepts, especially of the nodes in the network. Also in the perspective of inter-modality and dynamic traffic management 'interchange' between links and modes is a central issue. Hierarchy and traffic and transport function of the nodes of het network -and the design standards and concepts related to desired features of these nodes -are becoming more structural principles in the layout and categorization of networks than the links in between.
As larger parts of road networks in urbanized areas are becoming more and more congested, dynamic mobility and traffic management urge for dynamic network categorization concepts. Accessibility can no longer be guaranteed by fixed traffic capacities of roads. Robustness of networks is becoming a more crucial performance standard. Traffic flows have to be managed through the network depending on their changing characteristics during time of day or week, depending also on environmental characteristics of certain types of traffic versus the environmental capacity of certain streets and areas.

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4 ROAD PAVEMENT