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Transportation Research Procedia 14 (2016) 528 – 537

Transportation Research Procedia

www.elsevier.com/locate/procedia

6th Transport Research Arena April 18-21, 2016

Street network design for a sustainable mobility system

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Abstract

An urban network's shape and characteristics can have high influence on many mobility aspects, such as travel distance, mode choice and safety. For example, can a tram be a real competition to the car? Definitely yes if the car is stuck in a traffic jam and the tram has priority, but not only in such case! With a proper system design a tram may offer a faster travel to the city centre than the car. On the other hand if the tram provides faster travel than the car only during several peak hours, it is usually enough to provide better service for a majority of people travelling in such direction.

For intense on-street public transport networks full priority is not always possible. This is another reason to resign from a paradigm of providing public transport along major car arteries – the urban public transport will be more efficient, also in speed terms, when it will be closer to commuters. Such closeness means a decrease in segregation, so part of the paper will be dedicated to theoretical calculations and practical observations of allowable tram and bus speeds on city streets.

Safety leads to a problem of homogeneity of streets' technical class and of coherence between streets' functional and technical classes. Data from both Poland and other countries shows, that such elements as traffic intensity and extend of traffic segregation should strictly coincide with proper technical parameters. It is problematic, since many European streets, for historical reasons, cannot be rebuilt to fully meet uniform standards of one class, so results of inquiries on how to make these standards adjustable without compromising safety or living quality will be presented.

Concluding, the aim of this paper is to gather experience gained from theoretical calculations and practical designs, and present a street network as a system. A system that properly implemented allows for sustainable, efficient and safe mobility. A system that to some extend is adjustable to local historical conditions. A system that, unfortunately due to local pressure and political reasons, is often overridden, with sober consequences. The investigations were focused on specific locations, but strengthened with theoretical calculations and generalised allowing for wide implementations.

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Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)
doi:10.1016/j.trpro.2016.05.108

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Keywords: street network; tram line design; street hierarchy; traffic safety; traffic lights

1. Introduction

Transport always influenced urban design. Medieval cities of Poznań and Wrocław were relocated to less defensible locations to provide better environment for commerce, including better accessibility. In the XIXth century railroads allowed workers to live in locations different from an absolute vicinity of an industrial plant. Today the car, and sometimes also the train, allows to travel long commuting distances. On the other hand, urban design, including street network layout and hierarchy, influences transport: a railroad station close by is a high motivation to commute without a car (Forsey et al., 2013), while locating a dwelling at a dead end road's terminus makes it impossible to provide that dwelling with a feasible public transport.

Unsustainable character of transport based on private cars was noticed over half a century ago. Negative effects of car traffic on city environment were summed up by Buchanan (1963), who proposed a traffic intensity limit for local streets of 200 cars/hour in both directions, allowing high traffic intensity and traffic jams only on thoroughfares with appropriate parameters. It should be noted, that using a phrase "street environment" Buchanan focused more on social environment with urban and historical values than on biology and air pollution.

Today we can see that Buchanan was right. Car traffic has annexed streets on which children played a century earlier, and is encroaching on recreational spaces of modernistic developments (Moughtin and Shirley, 2005; Rychlewski, 2013). Such annexation, both in a form of a street's area reserved only for motorised traffic and of space taken by a parking car, should be curbed (Sohn, 2011). Streets serving residential or commercial areas should be liveable (Gehl, 2010; Wachs, 2013). To reach that goal, nonmotorised and public modes of transport should be competitive to car traffic (Currie and Delbosc, 2011; Dell'Olio et al., 2012).

2. Public transport competitiveness

XIXth century tram lines were built on streets with an appropriate quantity of potential passengers. A modernistic idea of separating transport and residential areas allowed to increase commercial speed of public transport vehicles, but at a cost of moving stops away from customers and reducing accessibility. At the same time, car traffic was encroaching on residential areas, demanding allowance for parking, and for access to parking spaces, As a result:

- It usually takes a person less time to walk to his car than to walk to a street with a public transport line.
- Accessing public transport stops is timely and sometimes problematic (Rychlewski, 2010; Gadziński and Beim, 2010), especially for disabled passengers.
- Public transport vehicles, due to a need to stop at bus or tram stops, have different speed than other traffic – location of public transport lines along transit streets, which were usually optimised for through car traffic (Schmucki, 2001), results therefore in a deficiency of traffic lights coordination for public transport vehicles.
- Rychlewski (2015) proved, that locating tram network knots along transit streets usually means a very small possibility for providing public transport priority, with an exception of locating such knot on a different level than the car junction (such as Rondo Mogilskie in Cracow, Poland or Park Square in Sheffield, England).
- Leaving public transport stops and walking to a trip's destination might repeat the first two disadvantages from this list.

The above list should be extended to include other disadvantages of public transport such as a need to wait for a public transport vehicle to arrive at a stop and, in many cases, time needed for an interchange. On the other hand are advantages of commuting by public transport, listed below. These advantages are conditional: