

Urban Transport in General Input Data and Basic Ideas of Transportation Planning



Urban Transport 1.
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Principles of Urban Transport

- **Urban transport is a complex activity that is in strict connection with land-use.**
- **The role of public transport is important in the mobility within settlements.**
- **Non-motorised transport (cycling, pedestrians) represents a significant proportion in towns and needs a special attention.**
- **Transport network is denser in cities therefore network based thinking is required.**

Principles of Urban Transport

- **Intersections or junctions in urban transport networks are critical points considering traffic safety and capacity issues.**
- **In large cities there is a multi-level transportation system (i.e. metro lines).**
- **Urban transport should provide liveable space and sustainable development – for this proper proportions and balance must be established.**
- **A special topic is the sensitivity of networks.**

Principles of Urban Transport

- **There are big changes in time in case of travel and mobility demand.**
- **One issue is the difference in weekday and weekend traffic. The main problem is the daily change as the traffic in morning and afternoon periods may show very sharp and big peaks comparing to other periods of the day.**
- **There is a need for reserve capacity both on road traffic network elements and in public transport, however it is usually a costly solution.**

Transport and Land-use

- **In the past history urban spatial and building characteristics were in dependence of the technical development of transport.**
- **People required acceptable travel times and this was in connection with available traffic speed. The development level of transport networks and vehicles therefore determined the size of cities.**
- **The interaction of land use and transport resulted different solutions like the suburban sprawl or the very dense centrums.**

Transport and Land-use

- **Type and distribution of land-use such as habitation, industrial, commercial or leisure time zone, determine activities of people such as living, working, shopping or leisure activity.**
- **Spatial distribution of human activities requires motion, travel or mobility using transportation systems in order to reach distant places where those activities take place.**
- **New transport network elements may generate new types of land-use and activities.**

Transport and Land-use

- **Transport infrastructure systems provides possibilities for movements in space. Spatial access of different services or activities can be measured by accessibility metrics.**
- **Values and distribution of accessibility mutually determines decisions concerning mobility, consequently there will be changes in the land-use system as well.**
- **Optimised land use would require minimal amount of travel for necessary activities.**

Transport and Land-use

- **Sustainable development is defined in three aspects (results from the EU Propolis research project)**
 - **Environmental: less air pollution, better use of natural resources, better quality of the environment**
 - **Social: better health, ensuring social equity and new possibilities for activities**
 - **Economic: more total net benefit of transport, more total net benefit of land-use, better ability for competition in regional economies**

New Phenomena in Urban Transport

Approach	Phenomena
Physical	Saturation of the capacity of roads and junctions
Economic	Restriction of public expenses
Environmental	Decrease of emission and rejection of constructing new roads
Social	Resistance against transport system expansion
Regulation	Integrated approach of planning and financial support
Commercial	Increasing the efficiency of transport networks
Techological	Real time tolling and operation

Pictures of Urban Transport



**Separated bus corridor
(India)**

**Special transit mode –
funicular (Budapest)**



Pictures of Urban Transport



**Separated tram line
(Miskolc)**

**Tram and „other” transport
mode in Miskolc**



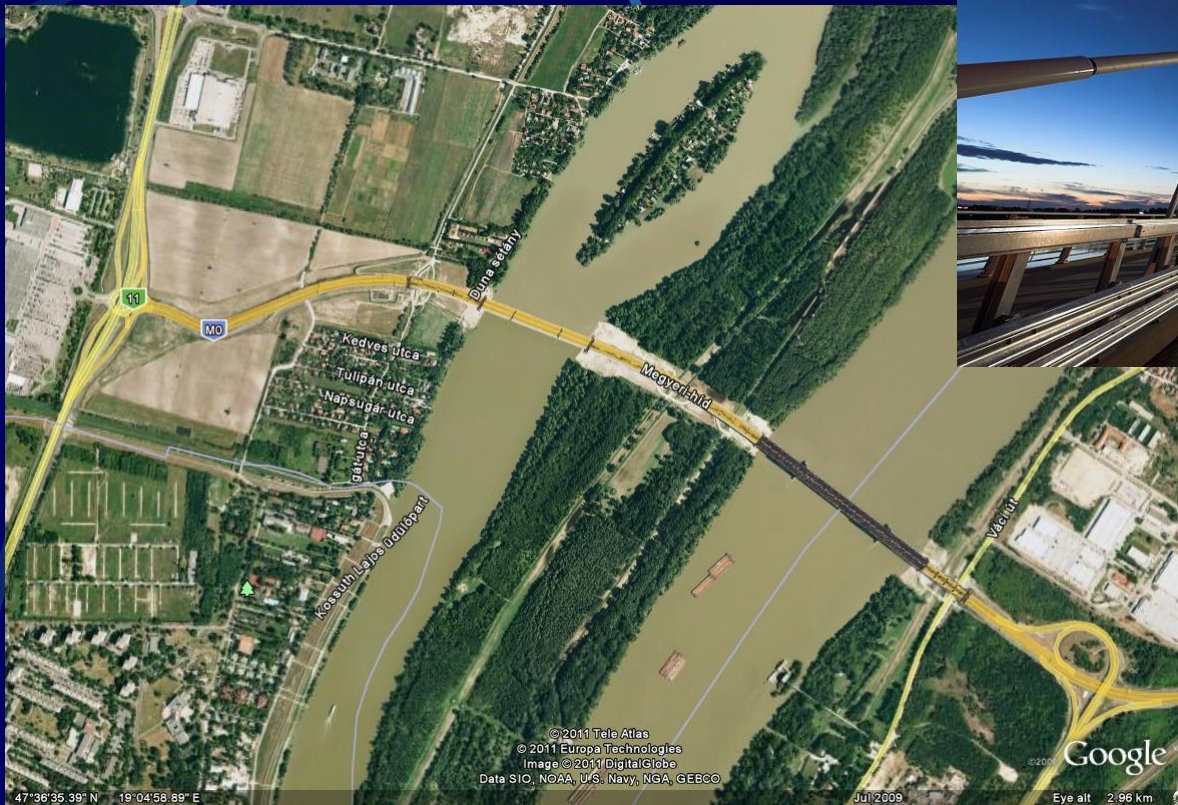
Pictures of Urban Transport



**Cars everywhere
moving (or trying to move)
and standing**



Pictures of Urban Transport



**M0 ring road
around Budapest
Megyeri bridge**

Development of Urban Transport

- **Development of urban transport is not only technical task. It has social and environmental aspects as well.**
- **Main development steps of urban transport:**
 - **development of road infrastructure**
 - **development of public transport**
 - **enhancement of the management of urban transport**
 - **development of the institutional system of urban transport**

Development of Urban Transport

- **Realistic consideration in development:**
 - **commitment for significant development of public transport, especially rail modes**
 - **installation of traffic calming and measures for the benefit of pedestrians and cyclists**
 - **application of intelligent transport systems based on information technology in order to improve the efficiency of the existing infrastructure**
 - **introduction of tolling and restriction of new road construction**

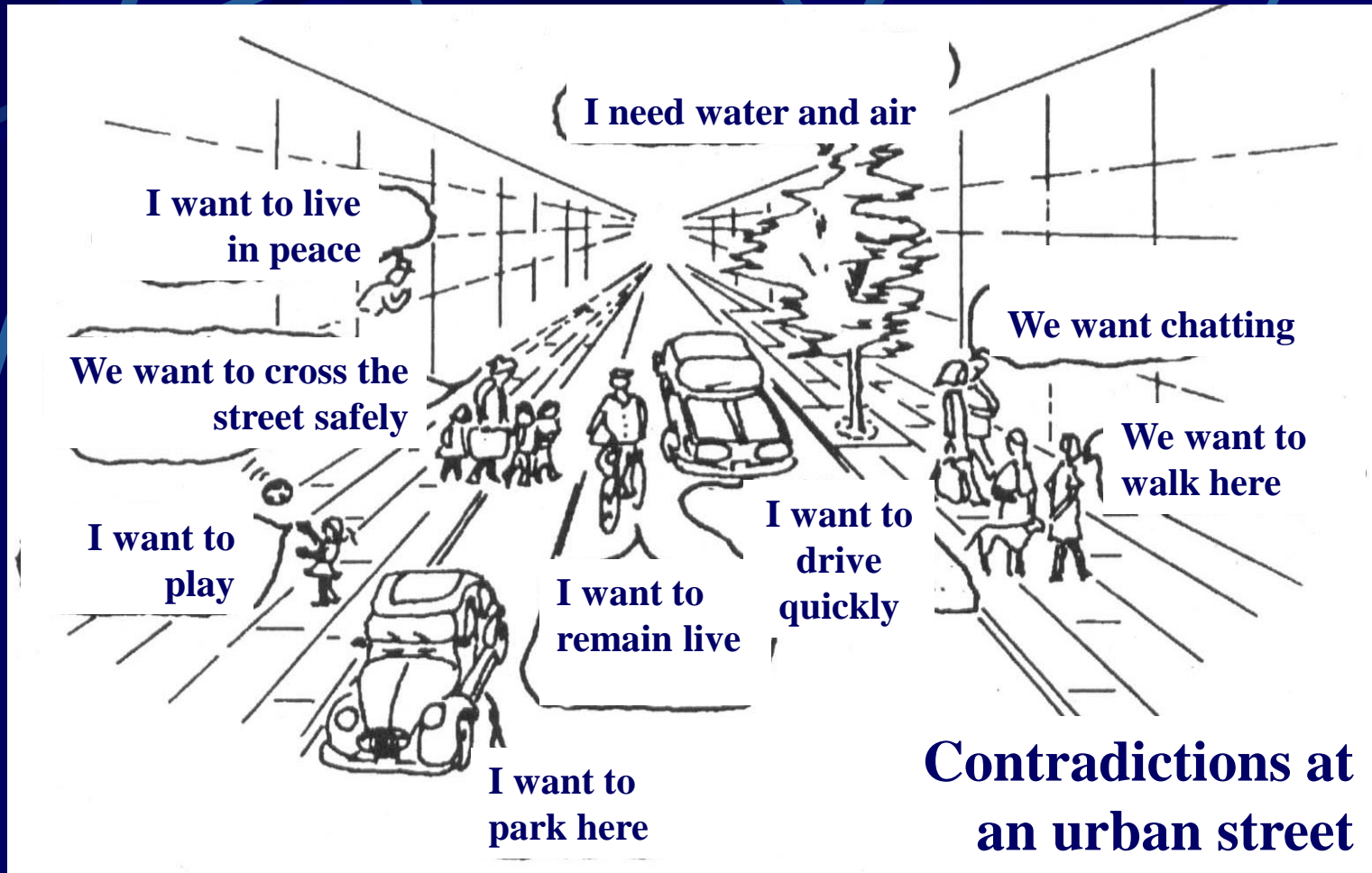
Characteristics of Urban Roads

- **Operators of urban roads are not unique – in Hungary crossing sections in settlements belong to the national road network while other roads are municipal or even private roads.**
- **There is a special system in the capital city – main and public transport roads are centrally operated while other roads belong to districts.**
- **Special urban problems are: handling of through traffic, urban freight solutions, satisfying demand for parking space etc.**

Characteristics of Urban Roads

- **Planning and design of urban roads should be made aligned with public utilities and environmental protection.**
- **Physical planning in settlements is more detailed - from wall to wall or fence to fence.**
- **Separation or unification of different settlement functions and transport modes requires individual solutions.**
- **Social participation in planning is especially important.**

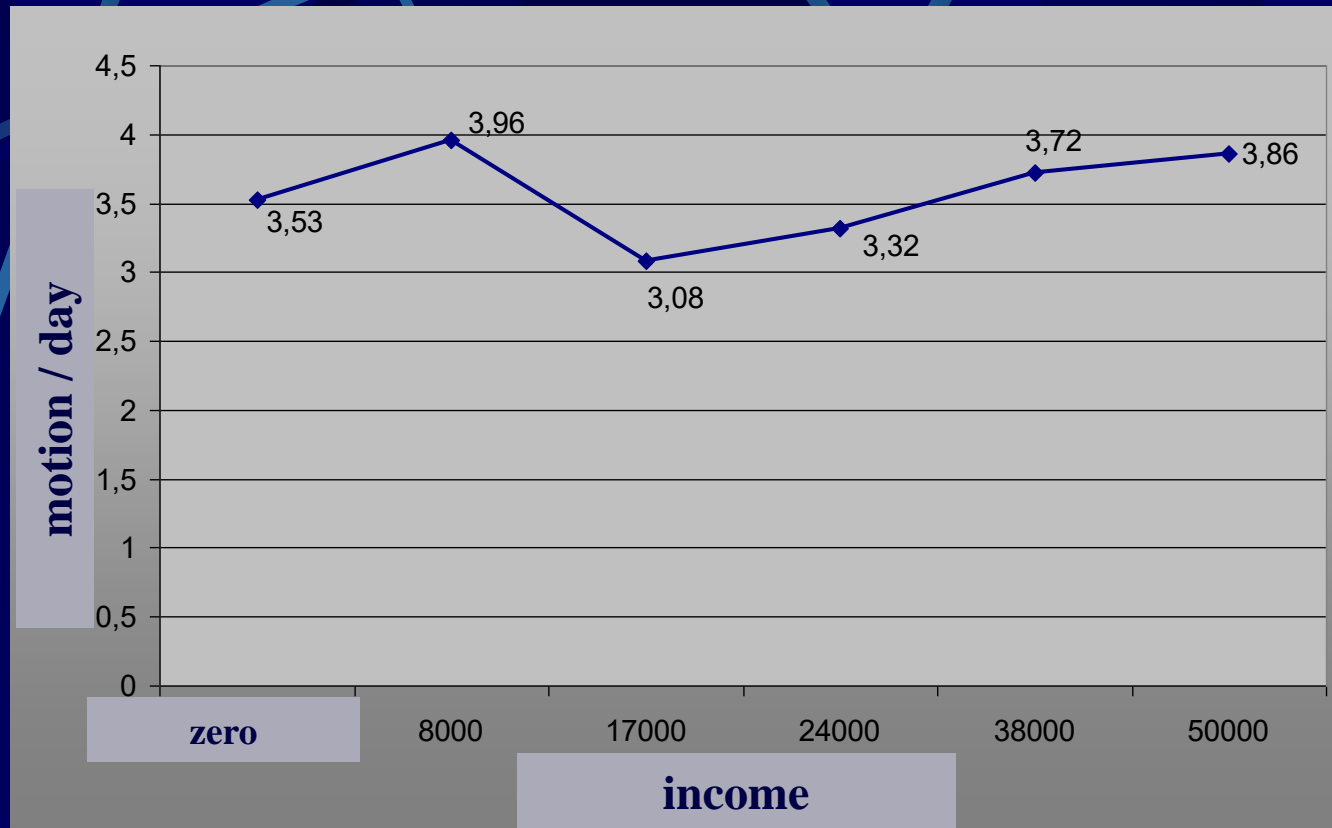
Characteristics of Urban Roads



Input Data for Transportation Planning

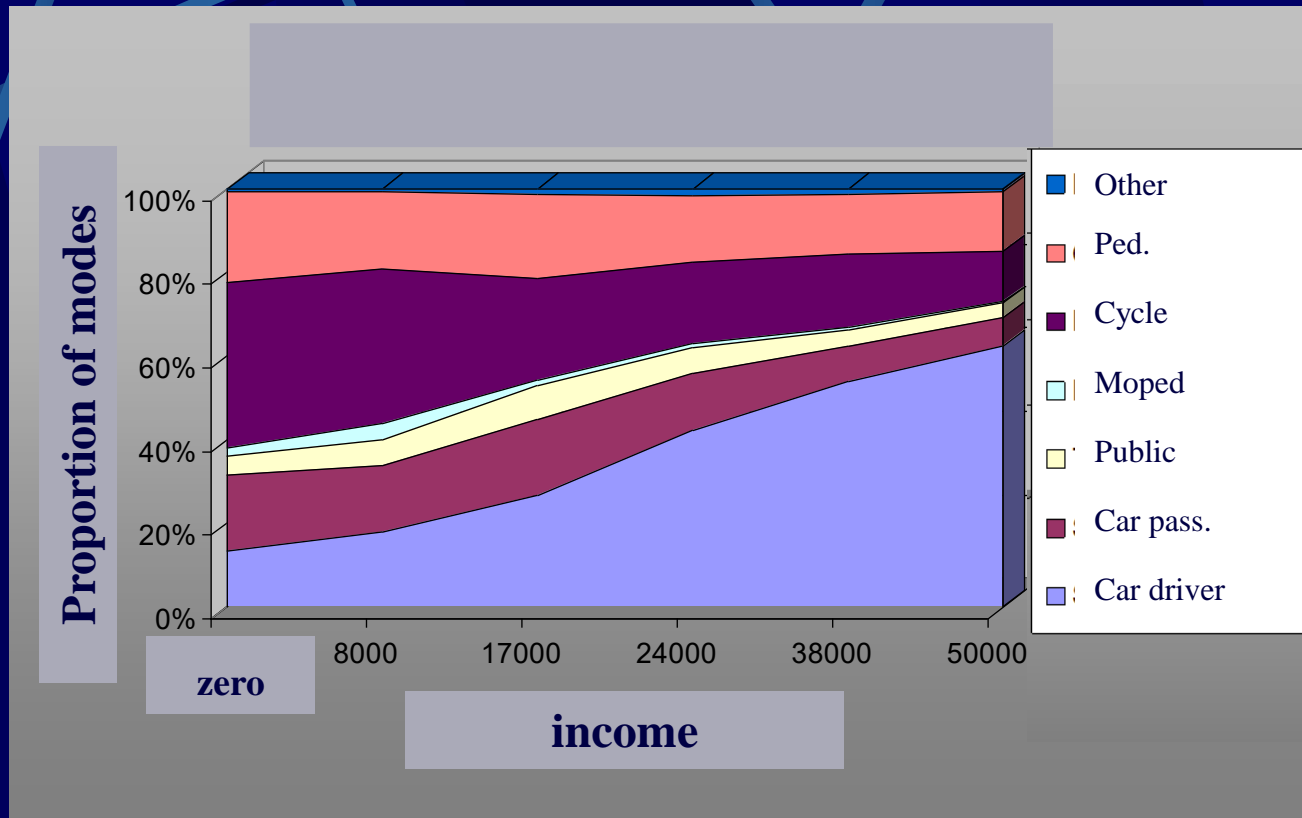
- **Analysis of existing transport facilities**
- **Land-use characteristics**
 - **Number of inhabitants**
 - **Economic indices (i.e. GDP / person)**
 - **Motorisation rate (cars / 1000 inhabitants)**
- **Specific values of trips and their tendencies**
 - **trip / person / day** **increasing**
 - **motion/ person / day** **constant**
 - **kms travelled / person / day** **increasing**
 - **time of travel / person / day** **constant**
- **Trip or travel are motorised motion**

Basic Ideas of Transportation Planning



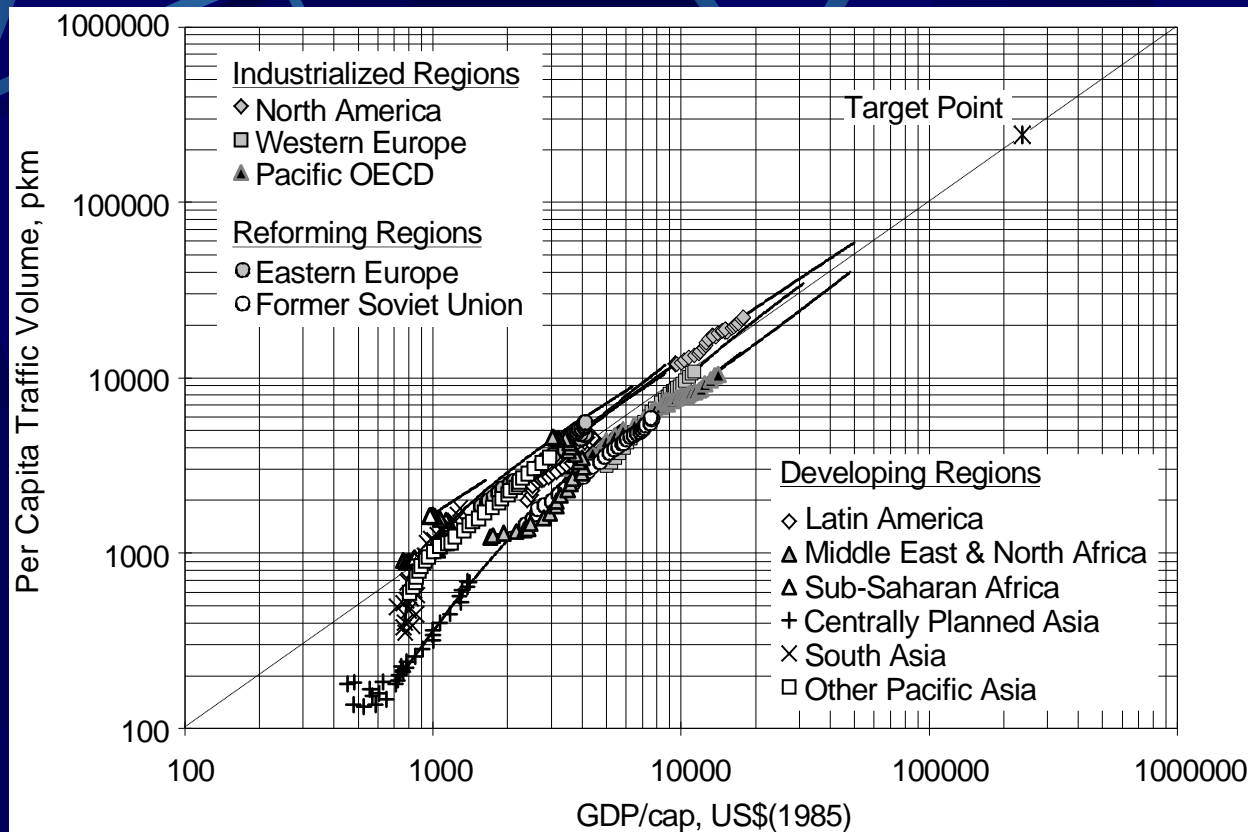
**Number of motions depending on income rate
(The Netherlands, 1990)**

Basic Ideas of Transportation Planning



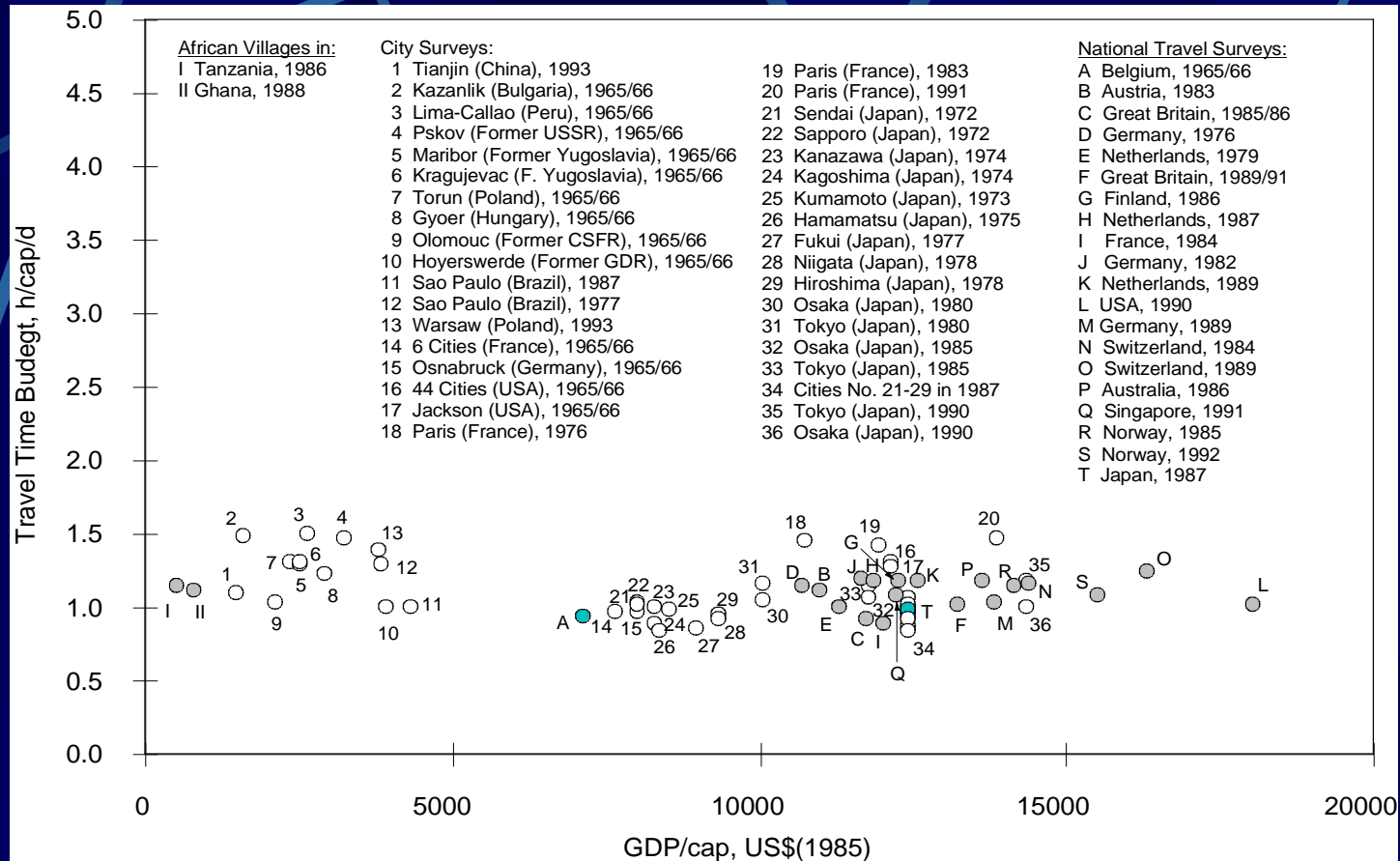
**Mode choice for motion depending on income rate
(The Netherlands, 1990)**

Basic Ideas of Transportation Planning



Kms travelled (km/person/year) depending on gross domestic product (GDP, USD/person/year)

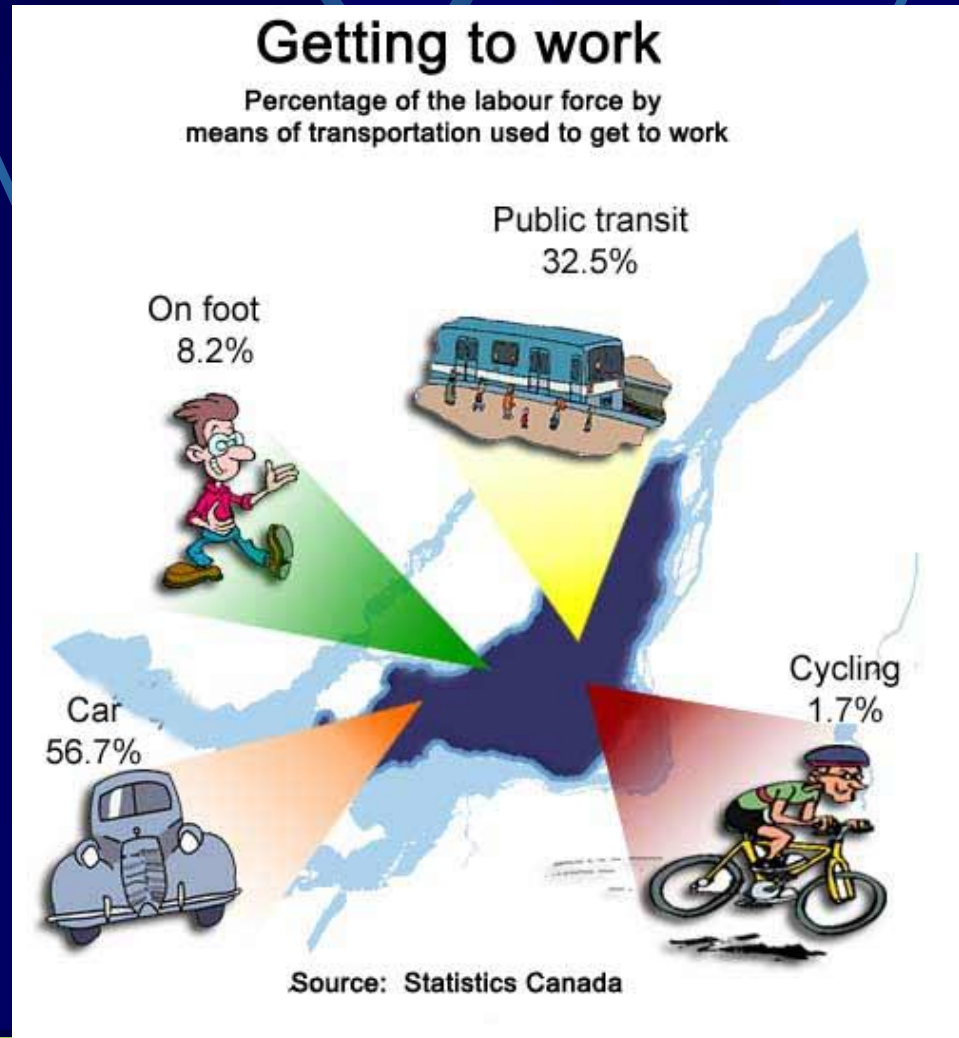
Basic Ideas of Transportation Planning



Time of travel (hour/person/day) depending on gross domestic product (GDP, USD/person/year)

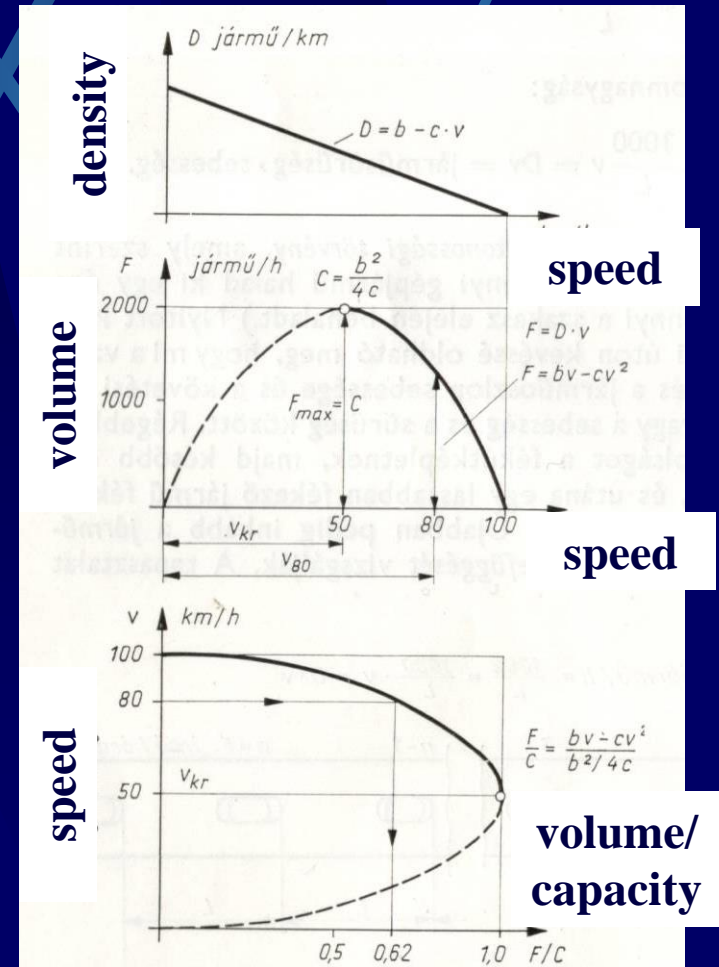
Basic Ideas of Transportation Planning

Proportion of modes in getting to work (Canada)



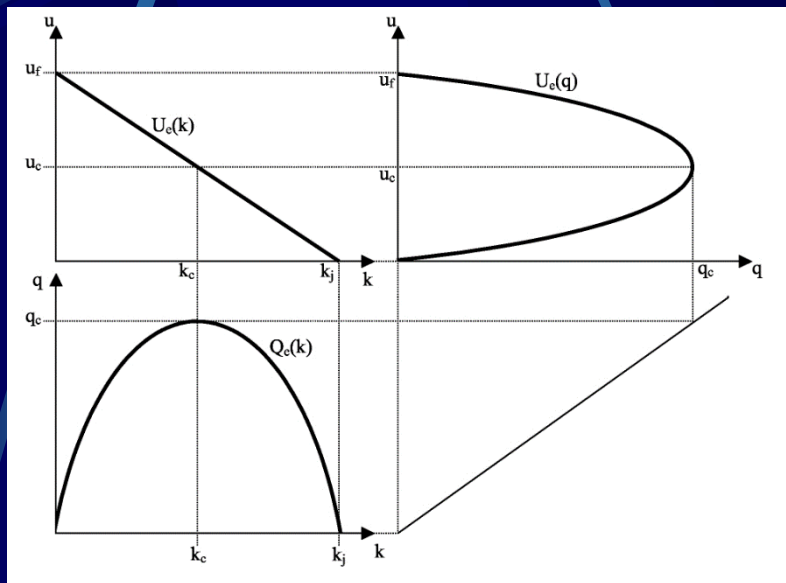
Fundamental Diagram of the Traffic Flow

- Traffic volume of a cross section is in linear proportion with traffic density and speed
- $F (v/h) = D (v/km) * v (km/h)$
- This is the fundamental relationship and diagram
- Explains the congestion (traffic jam) phenomena



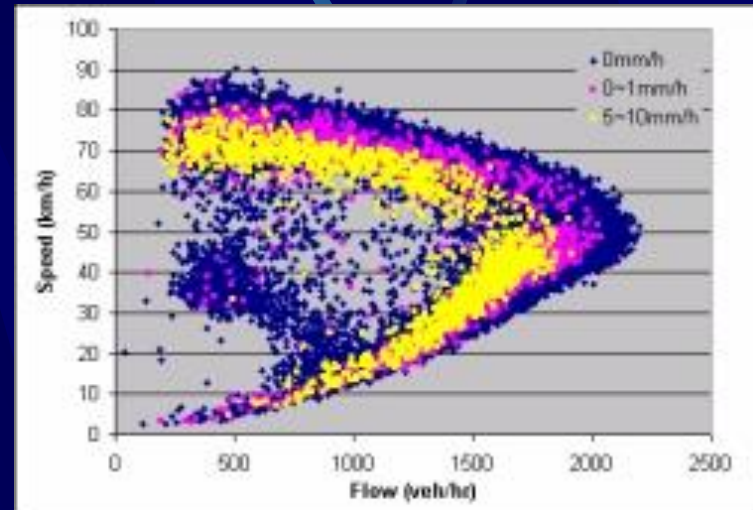
Fundamental Diagram of the Traffic Flow

Theoretical diagram and measured example



Speed – Volume - Density

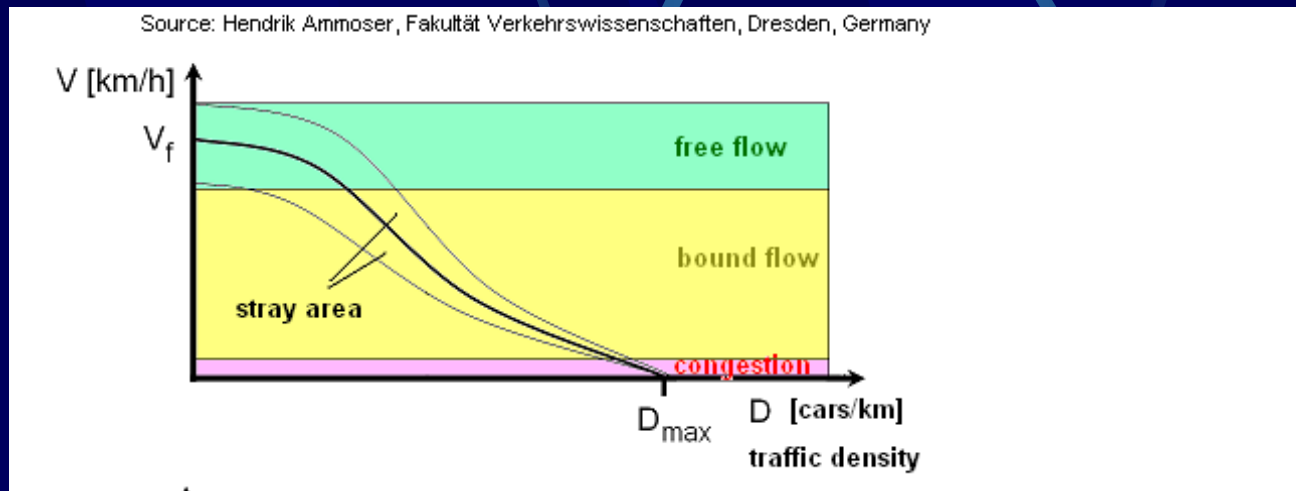
Real speed – volume diagram



Source: Prof. Immers, L.H., Logghe, S.: Traffic Flow Theory. Katholieke Universiteit Leuven, Faculty of Engineering, Department of Civil Engineering, Section Traffic and Infrastructure, 2002.

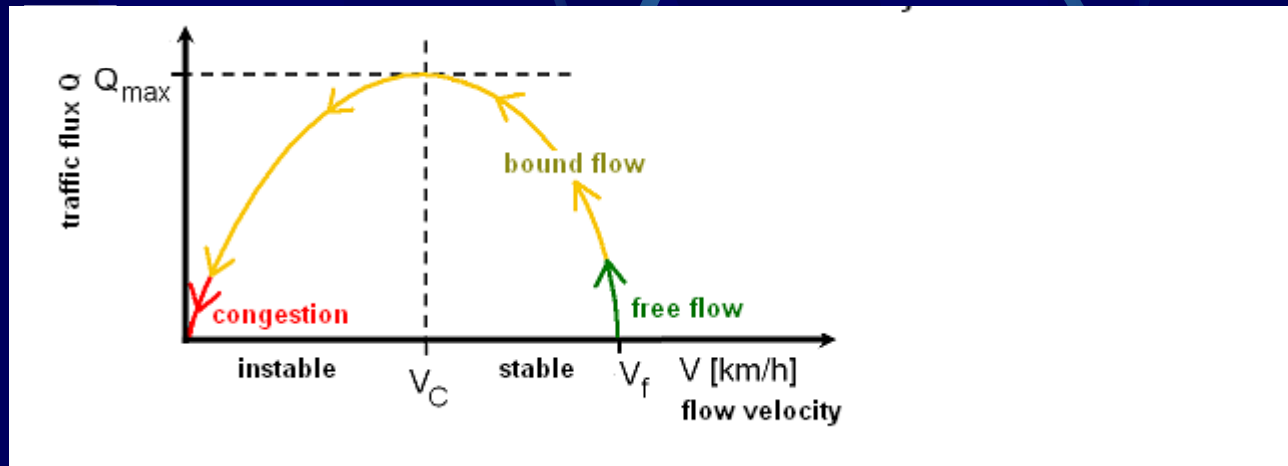
Fundamental Diagram of the Traffic Flow

- When the traffic density increases, the speed decreases and the free flow becomes bound, finally congested.



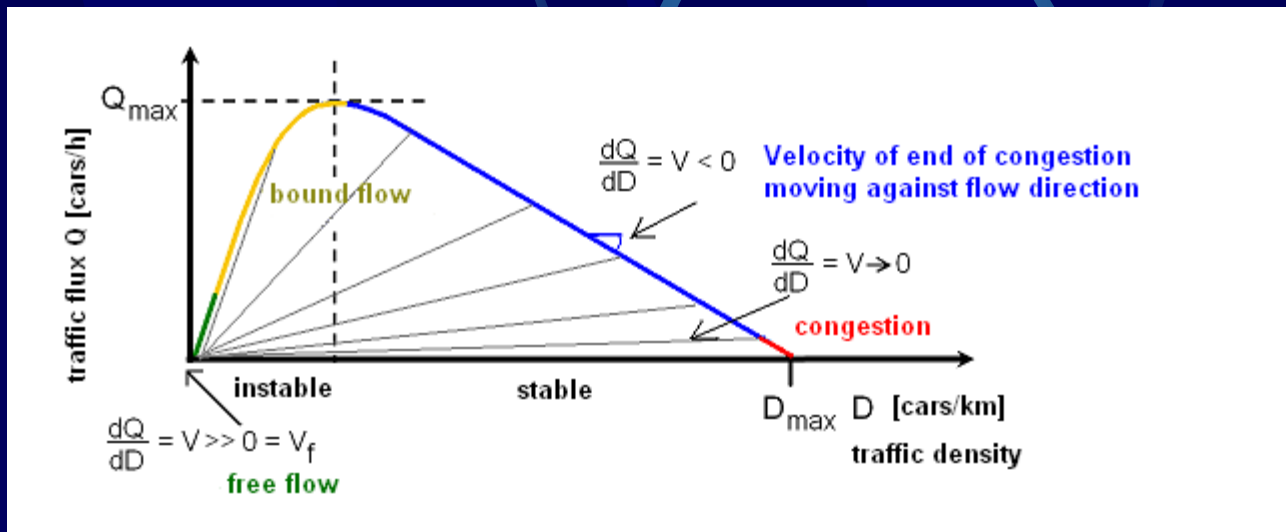
Fundamental Diagram of the Traffic Flow

- There are two different speed values at a given traffic volume: a free and a congested.
- The maximum volume can be reached at the critical speed.



Fundamental Diagram of the Traffic Flow

- There are two different density values at a given traffic volume: a free and a congested.
- The maximum density can be reached at the congestion.



Fundamental Diagram of the Traffic Flow

- **Example for calculation based on the fundamental diagram ($F = D * v$) - on a given road section 1 km length there are 30 vehicles moving at 60 km/h.**
- **Traffic density:** $D = 30 \text{ veh/km}$
- **Traffic speed:** $v = 60 \text{ km/h} = 16,7 \text{ m/s}$
- **Traffic volume:** $F = 30 * 60 = 1800 \text{ veh/h}$
- **Headway distance:** $H = 1000 / D = 33,3 \text{ m}$
- **Headway time:** $t = H / v = 33,3 / 16,7 = 2 \text{ s}$

Fundamental Diagram of the Traffic Flow

- **Example for calculation based on the fundamental diagram ($F = D * v$) - on a given road section 1 km length there are 90 vehicles moving at 20 km/h.**

- **Traffic density:**

$$D = 90 \text{ veh/km}$$

- **Traffic speed:**

$$v = 20 \text{ km/h} = 5,6 \text{ m/s}$$

- **Traffic volume:**

$$F = 20 * 90 = 1800 \text{ veh/h}$$

- **Headway distance:**

$$H = 1000 / D = 11,1 \text{ m}$$

- **Headway time:**

$$t = H / v = 11,1 / 5,6 = 2 \text{ s}$$

Good or False Thinking in Urban Transport

- *„Time can be spared by increasing traffic speed.“*
- Present technical solutions usually provide 20-25 times higher speeds compared to pedestrians therefore about 95% of travel time could have been spared already.
- Travel time distributions in case of different transport modes (including walking and cycling) are considerably overlapping. The truth is that higher speeds provides a gain not in time but in distance, consequently our aims and activities may spread to a wider area.

Good or False Thinking in Urban Transport

- *„We may not gain time but distance and connections surely.“*
- **Cities built for pedestrians have had a dense structure with a lot of aims and rich connections, providing one of its main functions, the meetings, in a small place**
- **Development of transport does not increase the number of possible meetings and connections, only widen its locations.**
- **Transport network is able to increase the ability for development (and not the state of development) that means transport in itself cannot provide economic development.**

Good or False Thinking in Urban Transport

- *„The modern world and modern people in it are characterised by an increased mobility.“*
- **Some people think that the increase of mobility ensures more connection possibilities, therefore mobility should be one of the reasons, value and result of our development.**
- **Nevertheless this way of thinking narrows the concept of mobility to motorised trips, although, as a matter of fact, mobility covers all motions in general.**
- **Motorisation have not increased the number of all motions, only directed a part of them into a mechanised transportation system.**

Good or False Thinking in Urban Transport

- *„A very common reasoning is that the demand for transport is constantly increasing.“*
- **Formation of demand is a fact but motion is only a means to satisfy the demand. Actually society expresses its needs for different services and activities in the form of demand for transport.**
- **There can be a solution for satisfying these needs without travel as well. A good example is the swimming pool within the campus.**
- **If that is not the case, people compelled for travel must cover longer and longer distances in order to satisfy their needs.**

Good or False Thinking in Urban Transport



It leads to the open manhole across the road... A blessing in disgust.

„Separated pedestrian crossing”
not recommended 😊

Summary

- **Urban transport is a complex activity that is in strict connection with land-use and requires coordinated development.**
- **Typical features are: higher number of motions, significant role of public transport, bigger proportion of non-motorised traffic.**
- **Taking into account environmental aspects is extremely important**
- **Traffic volume of a cross section is in linear proportion with traffic density and speed.**

Thank you for your attention!

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