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1. THE HISTORICAL DEVELOPMENT OF PASSENGER TRANSPORT AND TRANSPORTATION

1.1. The history of public transport

Acquired by: SUROVEC, P., 1998

At the end of the 18th century, the importance of economic, social, administrative and cultural life began to increase in cities. This, together with changes in living and working conditions, mainly through the manufacture of production and centralisation of public administration, schools and other social functions, led to an increased need for public transport. The first signs of public transport were seen at the end of the 17th century, when the first carriages with one or two horses appeared (Paris since 1690). The horse-drawn buses were operated only from the middle of the 19th century (Prague since 1830).

After the invention of the steam railway and the railroad, which was built into a road pavement, the light rail system was created. Steam-powered vehicles were not used on light rail systems until 1930. The first electric car was introduced in 1842 and in 1850 the method of feeding electric energy into the vehicle via the rail was invented. Since 1881, light rail gradually switched to electrical operation. In Europe, electric trams reached their peak in 1920.

Due to the rapid development of the automotive industry and bus traffic, trams and trolleybuses were replaced. The first bus with an electric drive was built in 1882. Buses with internal combustion engines came into operation at the turn of the 19th and 20th centuries. In addition to trams, trolleybuses, buses and subways, a number of unconventional means of transport were designed.

1.2. The History of Public Transport in the Czech Republic

Acquired by: DRDLA, P., 2005

The development of urban transport in Bohemia, Moravia and Silesia up to 1918 was spread quite unevenly - the beginning of the development is comparable with the development in the world.

Fiakers (also known as cabs) have been present in Prague since 1789. Already in 1829 the first horse-drawn bus was introduced in Prague, whose line led from the Old Town Square (Town Hall) to the Parliament and from the Main Customs Office to the administrative post office on the Prague Lesser Town. Traffic was stopped due to lack of passengers (Prague had about 100 thousand inhabitants at that time). Traffic was resumed in 1845 with five lines. In 1875 the first racecourse was opened in Prague. It ran between Smichov and Karlin and between Prague Lesser Town and Karlin. The
vehicles had 10-20 seats and the first route was 3.5 km long. It was a big competition to the Fiakern
and Droschken. It achieved great importance at the Landtag anniversary exhibition in 1891. Operation was completed in 1905.

Between 1884 and 1900 a steam railway was operated in Brno parallel to the horse tram. In 1891 Mr. Krizik presented the first Czech electric tram at the anniversary exhibition in Prague. In 1896 the famous Czech inventor Ing. Krizik built a 5 km long tram for public transport from Prague-Florenc to Libeň and Vysočany.

In 1908 a bus service was tested in Prague. The first train went through Neruda Street in the direction of Prague Castle. Operation was later stopped due to low engine power and steep roads. The further development of city traffic came after the First World War. In 1926, Prof. Liste and Ing. Belada presented the first underground transport project in Prague. The design included four lines for three-car electric trains: A: Palmovka - Karlín - Denisovo nádraží (Těšnov) - Můstek - Karlovo n. - Anděl; B: (dnešní) Dejvická - Hradčany - Malá Strana - Můstek - Muzeum - Olšanské hřbitovy; C: Holešovice - Prašná Brána - Žižkov; D: Pankrác - Wilsonovo nádraží - Denisovo nádraží (including Nusle Bridge).

1.3. Development of public transport in our area

Acquired from: PŘEHLED VÝVOJE OSOBNÍ DOPRAVY, 2014

A special event significant for the development of public transport in our region was the fact that the car manufacturer Laurin & Klement from Mlada Boleslav won the competition for the delivery of model E vehicles for the regular postal services in the Kotor region in Montenegro in 1908. The first private bus lines in our country were put into operation after 1905. The Prague Post and Telegraph Centre officially opened two state bus lines from Pardubice to Bohdanče and from Pardubice to Holic on 13 May 1908.

Private bus lines in public transport were used for example on the routes Marienbad-Kynzvart, Marienbad-Karlsbad, Pribram-Dobříš, Prag-Melnik and others. In 1914 there were 37 private bus lines in Czechoslovakia, mainly in the tourist and excursion area.

After the war, the postal administration initially operated only trucks with makeshift bus bodies; the first was PardubiceBohdaneč from 2 May 1919. In 1927, 119 state lines with a total length of 2636 km were already in operation in Czechoslovakia. The operator was Czechoslovak State Post, respectively, the **Postal Administration of Motor Traffic** (SPAD). From this year the bus transport was no longer classified under post and telegraph, but belonged exclusively to SPAD. In 1927 the railway administration also established the public vehicle transport and the vehicle fleet was assigned to the **automobile administrations CSD**. The first line of CSD led from Chrudim to Pardubice. One year later the postal administration had 151 routes with 140 vehicles in the whole territory of Czechoslovakia and only 15 routes with 46 buses in the competition institute CSD.

Until 1932 the Ministry of Posts and Telegraphs, which had its own fleet of vehicles, controlled the activity of motor transport. In 1938, the Ministry of Post and Rail was merged. In that year CSD transported almost 20 million people with its buses on 245 routes with a total length of 8213 km. After the mobilization in autumn 1938 and subsequent lack of fuel, passenger transport was limited.

In the interwar period, the largest transport leaders received: CSD, Czechoslovak State Post Office, Transport **joint-stock company in Prague** and the **company JAS (Bohemian Company for Vehicle Transport)**. JAS gained popularity in a short period of time because it also provided transport in villages and established routes all over South Bohemia and Pilsen.

The busses of the former CSD were named **BMB- ČMD** (Böhmisch-Mährische Bahn - Českomoravské dráhy) and were under the control of the Deutsche Reichsbahn (Deutsche Reichsbahn, DRB). After the war, public transport was dependent on the outdated fleet of vehicles, which consisted of buses of domestic production, trophy cars of various

brands, deliveries of allied vehicles and UNRRA event. At the end of 1946 the first buses Praga RN/RND and NDO were delivered and one year later also the Škoda 706 RO.

Law No 311 of 22 December 1948 nationalised part of motor traffic and on 1 January 1949 a national **Czechoslovak Automobile Traffic Company (CSAD**) was established. The law provided that regular public motor transport could only be operated by state institutions. Private individuals may operate irregular public motor transport. In 1949, Czechoslovakia registered 894 traders in automobile traffic. In 1947 there were 40 bus lines with a total length of 1.796 km in the Slovak Republic and in 1953 there were 689 bus lines with a total length of 17.151 km already. Act No. 148/1950 Coll. called a new monopoly Czechoslovak state automobile transport, state enterprise (with unchanged abbreviation CSAD). Truck traffic was also assigned here.

In the whole Czechoslovakia uniform tariff conditions and bus transport network with all necessities were introduced: standardized marking of bus stops, numbering of lines, tickets, colour differentiation of buses and the like.

Other directions of bus production and bus transport also influenced the conceptual principles for the development of public transport in the period 1964-1970. Mass production of new S11 series buses started and aspects such as environmental impact or poor road network were not considered. The priority was to transport workers to and from work and provide transport for new housing estates on the outskirts.

This trend continued in the following decades, when only large buses were produced in our country and after Skoda 706 RTO came Karosa series S11 (Fig. 1.1) and 700.

Fig. 1.1 - Bus production series S11 in Karosa - Vysoké Mýto in 1971
Source: PŘEHLED VÝVOJE OSOBNÍ DOPRAVY, 2014

2. ASPECTS OF PASSENGER TRANSPORT AND TRANSPORT AND PASSENGER HANDLING

2.1. Characteristics of transport sectors

Acquired from: VONKA, J. a kol., 2001

In passenger transport we can use different divisions of the transport sectors; one of them is division into two groups - **public transport and individual transport**.

In public passenger transport there are the following transport areas (types of transport):

- **Rail transport** - for public passenger transport on short and long distances, mainly used as urban and long-distance transport (fast rail),
- **public road transport (bus transport)** - for a small number of people on short and medium distances (especially suburban transport) - is not suitable for long-distance transport,
- **Air transport** - for a small number of people over long and very long distances (intercontinental flights),
- **Shipping** - for short and medium distances (domestic or coastal), for long distances (maritime); in our conditions only for tourist purposes,
- **Urban transport** - for public passenger transport in the area of limited housing units; for larger quantities of people underground railway (subway), underground tram, high-speed railway (suburban and urban transport, tram), tram, for smaller quantities of people trolleybus, bus, unconventional transport is used,
- **Rack and pinion railway and cableway** - application for overcoming larger height differences, which the standard adhesive track does not allow,
- **Unconventional transport** - a specific type of transport in view of the type of railway used (magnetic cushion railway, treadmills, cableways, etc.).

In **individual traffic**, the traffic areas are divided as follows:

- **Car traffic** - particularly important for tourism, where there is a lack of public transport to combine with public transport ("Park and Ride," "Kiss and Ride");
- **Taxi service** - as a complement to public transport, suitable for short distances,
- **Motorcycle traffic** - suitable for short distances, lower environmental impact than car traffic,
- **Bicycle traffic** - an important mode of transport for short distances, allows a connection to other public transport areas ("Bike and Ride," "Citybike"),
- **Pedestrians** - for very short distances, easy connection to other public and private traffic areas ("Park and Go"), in combination especially with city traffic (escalators, lifts etc.),
- **static traffic** - as parking spaces and parking areas for vehicles.

Another possible breakdown of passenger transport is:

- **Local transport** - takes place in a limited area, especially in residential units,
- **Urban transport** - ensures a connection between the housing units through public transport and its immediate surroundings,
- **Regional transport** - takes place within a larger territorial unit (e.g. regions) and connects settlements in the regions, especially in larger cities,
- **Long-distance transport** - ensures the connection between the major centres of a country, especially the administrative units in the country
- **International traffic** - takes place within a continent or between continents.

Public transport can be structured as follows: Surface transport, transport below and above ground, etc.

2.2. Public passenger transport

Takeover from: SUROVEC, P., 1998

Public passenger transport is part of the transport system and plays an important role in fulfilling the basic functions of cities and inhabited areas. With the current position of individual car transport, it is necessary to research new ways to improve the quality of public transport, techniques, technologies and organisations. This serves for environmental protection, road capacity, economy, society, energy saving, etc.

The organisation and development of public transport must be fully understood and addressed. This is due to high investment costs, finding solutions to the quality requirements of transport services and certain conservative populations.

Public passenger transport technology is a system of interconnected, organised and space and time controlled means of transport to ensure the movement of people and goods between individually selected locations and in the desired time. It includes types of passenger handling, boarding, alighting and transfer with coordination within the transport system and outside the system; communication methods and placement procedures and transport of people in means of transport.

2.3. Passenger handling and tariff system in passenger transport

Acquired from: GOGOLA, M., 2013

Passenger handling:

- Transport order,
- a transportation agreement,
- Payment of travel expenses,
- Output of the relevant documents - tickets.

Procedure for passenger clearance:

- Single service procedure with the payment of travel costs to the driver of the means of transport,
- Double service operation with travel expenses payment at the travel guide of the means of transport,
- Payment of travel expenses at the ticket office either without issue or with issue of a ticket (S-operation).

- Payment of travel expenses in ticket machines in the vehicle, which gives a ticket after payment,
- Sale of single tickets valid outside the vehicle on the particular route and the line
- Sale of subscription tickets with a certain validity in time and space,
- Sale of single tickets outside the vehicle and the designations for specific transport vehicle,
- Sale of single tickets outside the vehicle and its designation for certain transport at the bus stop before boarding.
- Payment of travel expenses after transport - the passenger receives a ticket when boarding and pays when getting off the bus,
- Payment of travel expenses with smartcards (contactless or bank transfer).

Payment methods:

- Paper ticket,
- An electronic ticket,
- Payment by mobile phone,
- Jeton.

Tariff:

- Distance-related,
- area-related,
- zone-related.
- flexible
  - temporary - the validity of the ticket is limited,
  - spatial - the validity of the ticket depends on the number of stops

3.BASIC INDICATORS IN PASSENGER TRANSPORT

3.1. Basic indicators in passenger transport

Accepted by: VONKA, J. a kol., 2001

Basic indicators in passenger transport serve to compare the quality of the individual transport subsystems with each other. These indicators can also determine the scope and extent of use of technical means and equipment (vehicles, transport routes, etc.). The indicators are divided into two groups, **quantitative indicators and qualitative indicators**.

3.2. Quantitative indicators

Adopted from: VONKA, J. a kol., 2001

Number of passengers transported in a district /region/

When determining the number of passengers, statistical data on the number of tickets sold and other accounting documents shall be used; this shall include a reasonable estimate of the number of passengers transported free of charge by the various forms of subscription tickets, etc.

Vehicles/train/kilometres in passenger transport

The vehicle and train kilometres shall be calculated as follows:

$$\sum_{i=1}^{n}(N_i * L_i) = N_1 * L_1 + N_2 * L_2 + \ldots + N_n * L_n [vozkm]$$

where: N1 is the number of vehicles /trains/ that have driven the same distance in the given period, L1 is the distance driven.

Passenger kilometres

The following formula was used to calculate passenger kilometers:

$$\sum_{i=1}^{n}(a_i * l_i) = a_1 * l_1 + a_2 * l_2 + \ldots + a_n * l_n [oskm]$$

where: a1 is the number of persons who have travelled the same distance in the given period, l1 is the distance travelled. (If it is not possible to determine the exact transport distance, the average value of the ticket is usually used.

3.3. Qualitative indicators

Taken from: VONKA, J. a kol., 2001

Orbit period of personal means of transport

The orbit time is the time between the departure of the vehicle from the starting point and the next departure from the same point. This time can be shortened by increasing the cruising speed of the vehicles. This can be achieved by shortening the stay in the starting point and in the reversal point of vehicles, possibly by regulating the transport subsystem determined by the operating process technology.

Speed

It is one of the most important indicators of passenger transport, which has a decisive influence on the quality of the transport subsystem for passengers and carriers.

The following elements have been grouped under qualitative indicators:

- **Technical speed** - average speed calculated from the ratio of distance and travel time, including a surcharge for starting and stopping the vehicle,
- **Partial speed** - average speed calculated from the ratio of distance and travel time, including a surcharge for starting and stopping, and a stop of a vehicle at stops and locations,
- **Speed ratio /coefficient/** - this value determines the ratio between a partial and a technical speed. It must be a positive number less than or equal to 1,
- **Cruising speed** - goes beyond partial speed, including transfer time between different means of transport
- **Final speed** - an important indicator for the subjective service quality assessment for passengers. It takes into account all losses and surcharges that occur, for example, when changing trains and waiting for transport.

Average daily train /vehicle / operation

This formula is used for the calculation:

$$S_{soup} = \frac{\sum NL}{\sum n_{soup}}$$

where: NL are trains /vehicles/ kilometres in passenger transport in the given period, Nsoup is number of trains /vehicles/ active on observed lines.

Use of seats

It is determined from the share of passenger-kilometres in the specified period and the number of so-called seat-kilometres (sum of the distances to which the individual seats have been moved for the specified period).

- **The average number of passengers per 1 vehicle /axle/**

Is determined from the proportion of passenger kilometres in the specified period and the number of train/axle/kilometre kilometres performed in the specified period.

It is one of the indicators for the characterisation of transport quality and the use of means of transport by passengers.

Measurement performance

Is determined from the proportion of the power device to its weight. This indicator is decisive for the carriers, it describes the degree of efficiency of energy use during vehicle movement depending on its weight.

Means of transport weight falling on 1 passenger

Is determined from the proportion of the own means of transport and passenger weight and the number of passengers. It describes the degree of efficiency of the use of means of transport; one objective of the project-executing agency is to reduce this indicator.

4. QUALITY IN PASSENGER TRANSPORT

4.1. Quality

Acquired from: VONKA, J. a kol., 2001

Quality is the designation of a perceptible state of systems and their characteristics, which are defined in a certain period of time on the basis of certain characteristics of the system in this state. Definition of quality differs then depending on which characteristics the value is put on, how they represent the quality and possibly compare with each other.

According to most people, quality is what makes the object or effect attractive to people. For example, it is the punctual and comfortable passenger transport, the short transfer time and the like. To some extent, it is a relative term that represents the subjective opinion of the particular person.

The quality in the technical meaning is reaching a standard level in all products of the same type (e.g. rail passenger transport, which are either mass-produced or individually produced). If the same quality level is not achieved for all products, the end products for the market are divided into quality classes (e.g. first class, second class, possibly Lux class). The lower quality can also be achieved intentionally, with the aim of lowering the price of the final product (lower manufacturing costs).

The quality of goods or services, this term is often used for the needs of market trade relations, but in comparison with the quality level it has much more specific meaning. It is an absolute term that refers to the goods or services. It represents the condition of the good or service and not the relationship to other goods or services. This condition shows whether the utility value of the goods or services corresponds:

- the binding conditions, the observance of which is required by the company and laid these down in binding regulations, measures or obligations which are valid for all suppliers of similar goods or services or relevant suppliers (general and individual obligation),
- the conditions agreed as contractual obligations between the supplier and supplier of the product and the suppliers (customers),
- the conditions that are generally accepted and considered common by all conscious suppliers of goods or services (ethical code).

4.2. Quality of transport services

Acquisition of: VONKA, J. a kol., 2001 a DRDLA, P., 2013

The transport system, its structures and processes depend on the direct or indirect effect of environmental influences. The quality of service is given by its aspects known as quality indicator: Regularity, reliability, safety, speed, economy, reasonable price of transport, environmental friendliness, comfort, performance, availability and affordability.

Quality indicators:

- Regularity, reliability
- Safety, speed
- Economic efficiency, reasonable price of traffic
- Environmental friendliness, comfort
- Performance, availability and affordability

In each of these areas it is necessary to introduce a system of indicators to assess an objective assessment of compliance with quality. This evaluation is based on technological procedures developed, accompanied by systematic monitoring of the level of transport services provided. This makes it possible to identify the obstacles that cause the most frequent deviations from quality.

4.3. Quality assessment

Accepted by: VONKA, J. a kol., 2001 a DRDLA, P., 2013

Each individual indicator used to evaluate the transport industry, service or property, must have a value corresponding to the overall level of quality of goods or services (e.g. high, medium or low). In valuation, a problem is an objective evaluation of the individual characteristics.

4.4. Aspects of quality

Taken over from: VONKA, J. a kol., 2001

The interests of the individual subjects are at odds in the creation of the passenger transport offer:

- **Carrier** - transport company is interested in maximizing its profits. For this reason, it rejects, for example, operating loss-making lines in unattractive times without subsidies.

- **Carrier/passenger** - optimal situation for him would be to create the complex and best offer of transport services, regardless of the environment and society and the interests of the carrier.

- **Society/environment** - for external (indirectly affected) subjects of the transport system a would be the best pedestrian and cycling transport, but this is in stark contrast to the interests of other subjects.

For this reason, a suitable middle way must be found between these interests, which will not be optimal for anyone.

4.5. Quality of public passenger transport

Acquired from: DRDLA, P., 2005 a DRDLA, P., 2013

The quality of public transport is defined by a complex of different influences of technology, engineering, organisation and traffic management that influence the physical and mental condition of passengers in the transport process.

Recommended quality criteria:

The overall quality of public passenger transport contains a large number of criteria. The criteria that represent the customer's view of the service provided have been divided into 8 categories in this standard. Categories 1 and 2 describe the public transport offer in general, categories 3, 4, 5, 6 and 7 show a more detailed description of the quality of the service and category 8 describes the impact on the environment and on society as a whole:

- **Availability** - the range of services offered in terms of geography, time, frequency and means of transport,
- **Access** - access to the public transport system, including connections with other means of transport,
- **Information** - the systematic provision of knowledge about the public transport system that supports the planning and implementation of travel,
- **Time** - Time aspects important for the planning and execution of roads,
- **Customer care** - service elements that combine standardized service and customer requirements,
- **Comfort** - service elements to achieve the comfort and relaxation of passengers in public transport,
- **Safety** - a feeling of personal safety to customers, which is based on the actual measures introduced and the activities that ensure that customers are aware of the measures taken,
- **Environmental impact** - the environmental impact resulting from the provision of public transport.

5. PROCEDURE FOR DETERMINING PASSENGER FLOWS

5.1. Transport studies

Taken over from: VONKA, J. a kol., 2001

Transport studies are an important part of the traffic analysis and in its completeness and consistency they correspond to the sociological studies in the criteria of statistical significance. Transport studies provide extensive statistical files and after their processing reliable and clear conclusions are obtained. For very large files, it is necessary to use sampling procedures taking into account that the selected sample contains all the characteristics of the basic files.

Regarding the cooperation of the participants of the selected transport study, the studies can be divided into two groups:

- Studies that do **not require cooperation** between the participants of the transport study
- Studies **requiring cooperation** between the participants in the transport study

5.2. Investigations which do not require cooperation between the participants of the transport investigation

Investigations which do not require cooperation between the participants of the transport investigation are carried out without disturbances in the transport process, and without the knowledge of the road users, so that the results are not distorted.

These studies are:

- Determination of **traffic volume**
    - Census intensity profile of the individual transport modes,
    - Examination of the transported persons,
    - Investigation of vehicle occupancy,
    - Statistics on traffic accidents,

- Determination of traffic quality
    - Determination and measurement of basic traffic characteristics (speed, dynamic

      characteristics, economic indicators)
    - Analysis of traffic accidents,
- Determination of **traffic direction**
    - Traffic direction studies,
- **Other** investigations and measurements
    - specific transport studies (the number of transport users from different locations and households in the city and for the purpose of their relocation).

5.3. Investigations that require cooperation between the participants of the transport investigation

Investigations that require cooperation between the participants of the transport investigation are divided as follows:

- Investigations carried out with the **direct participation of trained payment workers**
    - in the transport process,
    - outside the transport process,
    - further investigations and measurements.
- Studies carried out **without the direct involvement of trained payment workers**.
    - Studies that use the questionnaires in the transport process,
    - Studies that use the questionnaires outside the transport process,
    - further investigations and measurements.

These methods are used to **determine passenger flows**:

- Documentation,
- Direct count,
- Count cards,
- Questionnaire.

Documentation method

Taken over from: VONKA, J. a kol., 2001

The basic source of information is reports and statistics on tickets sold. This means that the results of this procedure are indicative only and provide rough characteristics on the use of transport services during the reporting period. These results should complement the data of other methods.

Direct counting method

Transferred from: VONKA, J. a kol., 2001

The principle of this method is the direct monitoring and counting of the number of passengers in means of transport, cars, individual stations and stops.

The accuracy of the results depends primarily on experience and careful implementation of the census. Since the census is often carried out during the week, more data is available and therefore a satisfactory result can be obtained.

Method for Census Cards

Transferred from: VONKA, J. a kol., 2001

Method for counting cards is one of the methods that represents not only the volume of passenger flows, but also the partial flows at time intervals. It is used with very good results in metros and railways. Its application in urban transport is more difficult because of the open and often unlimited platforms.

The method can be divided according to the type of census cards and techniques used:

- **a clear method** - each passenger receives a coupon at the boarding point, which is returned to the destination station,
- **a mixed method** - counting cards are supplemented by a questionnaire (the passenger answers the questions on the ticket and the completed card is returned to the destination station).

Questionnaire method

Adopted by: VONKA, J. a kol., 2001

The above methods give us an idea about the current situation in passenger transport, but not the ideas and needs of passengers regarding the quality and type of passenger transport. The accuracy of this method depends on the number of respondents, and the set of questions that a **questionnaire** contains.

Questionnaires can be divided according to the following criteria:

- **Purpose of travel** - survey applies to all passengers or only a specific group of them (to work, school, recreation, etc.)

- **Means of transport** - either all means of transport or only users of rail, road, individual transport, etc.

- **Sample size of passengers interviewed** - the size of the sample group of passengers is determined either by the whole group or by the representative group

- Survey implementation - Questionnaire is carried out in different ways:
  - direct questioning of passengers during their journey by random selection,
  - Survey of residents at their place of residence in the form of random selection,
  - Questioning at work or at school by random selection,
  - Survey (partial or complete) of the operating personnel and other employees of the company.

6.IRREGULARITIES IN PASSENGER SERVICES

6.1. Types of irregularities in passenger transport

Taken over by: VONKA, J. a kol., 2001

An important prerequisite for improving the quality, efficiency and attractiveness of public transport is the practical application of operational and organisational measures of the transport process, effective planning, construction and renovation of passenger facilities within the framework of so-called Integrated Transport Systems to improve. Particular attention should be paid to the analysis of passenger flows and their intensities.

Passenger flow means the sum of people transported at a given location or part of a given time. Passenger flow is defined by its intensity, i.e. the number of passengers transported to a given location or area in a given time period.

When analysing passenger flow statistics, several types of irregularities can occur, which are divided into two groups by time and space: **temporal irregularities and spatial irregularities**.

Temporal irregularities are divided as follows:

- Change in the number of people transported after one year,
- Irregularities between months,
- Irregularities between days,
- Hour irregularities during the day,
- Irregularities at rush hour.

Spatial irregularities shall be divided as follows:

- Different turnover of passengers at stops,
- The passengers are grouped according to the direction of travel,
- load the lines,
- Irregular distribution of passengers at the stop,
- Irregular occupation of individual wagons,
- Irregular occupation of individual doors.

Temporal irregularities

Transferred from: VONKA, J. a kol., 2001

Change in the number of people transported after one year

In several years a change in the attractiveness of the transport system can occur if the technical condition remains constant: the number of people transported can rise, fall or stagnate.

Fig. 6.1 - Approximate percentage of groups of passengers in each month

Monat / Fahrgast	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Studenten	36	39	38	35	36	43	10	12	34	36	37	35
Angestellter	38	36	34	33	33	31	36	30	30	31	33	34
Anderen	26	25	28	32	31	26	54	58	36	33	30	31

Source: VONKA, J. a kol., 2001

Irregularities between months

From the statistical data, periodic variations in the volume of traffic can be observed in each month of the year.

Irregularities between days

The analysis of data from transport surveys in different periods of the year presents possible differences in the use of transport services in the days of the week. The individual working days, with the partial exception of this season, show approximately the same values for the number of passengers transported.

Figure 6.2 - Average percentage share of groups of passengers in individual days of the week

Tag / Gebiet	Mo	Di	Mi	Do	Fr	Sa	So
Industriegelände	73	80	77	80	68	21	26
Erholungsgebiet	27	20	23	20	32	79	74

Source: VONKA, J. a kol., 2001

On weekends there are great differences depending on the type of area and its population.

Hourly irregularities during the day

When determining the load on individual locations, the focus is primarily on a comparison between tomorrow's and afternoon's main traffic hours and quiet periods.

Irregularities in rush hour

If the rush hour is divided into shorter time intervals (usually after 15 minutes), it is possible to detect significant irregularities in these sub-intervals.

6.2. Spatial irregularities

Taken over from: VONKA, J. a kol., 2001

Different turnover of passengers at stops

This indicator is particularly important for comparing different stations and stops. At each stop it is necessary to determine whether they outweigh passenger handling for urban, suburban or long-distance traffic.

Passenger breakdown by direction of travel

When comparing individual lines or routes can be differences in load all directions at different times.

Load the lines

Especially in urban and suburban traffic, the load difference of individual routes can be observed from the centre centre (for urban and suburban traffic). This applies to all route variants of the routes in the city centre - radial (line or route ends in the centre) or transit / diagonal (goes through the transit centre).

Irregular distribution of passengers at the stop

Passenger flow of people arriving at the stop in individual places either uninterrupted (with an interval of 10 minutes and less) or discrete (interval greater than 10 minutes).

Irregular occupation of individual wagons

This problem occurs above all in rail transport, especially in rail transport, railways and trams.

Irregular occupation of individual doors

The irregularity can be found at the door of any vehicle for boarding and alighting passengers.

7. SUBURBAN TRANSPORT

7.1. Concept of suburban transport

Acquired from: VONKA, J. a kol., 2001 a DRDLA, P., 2013

The term **suburban transport** refers to all traffic-transport relationships between the so-called inner city and the so-called agglomeration except for the city. The character of this service is "c**entralistic radial**", because unlike regional transport lines it **does not form classical connections with their network**, but they are built in beams.

Suburban traffic, as well as general passenger traffic, is conducted by individual transport (car, taxi, motorcycle, bicycle, pedestrian traffic, etc.) or by public transport (bus, trolleybus, tram, subway, high-speed train, etc.). It is also possible to assign unconventional means of transport here. In suburban traffic, the means of transport are combined with main means of transport and complementary means of transport. The most important means of transport are railways and high-speed trains (urban and suburban), in the area we also pay subway (metro), tram and suburban railway in addition to regular means of transport.

7.2. Requirements for the organization of suburban transport

Acquired by: GOGOLA, M., 2013 a VONKA, J. a kol., 2001

The suburban traffic, regardless of the different conditions in each region, it should **correspond to the following points**:

- The number of suburban means of transport should satisfy the transport needs of the inhabitants in the agglomeration, not only from the point of view of the general transport needs of passengers in 24 hours, but above all during peak periods in individual days of the week.
- The means of transport must efficiently ensure regular transport, not only in the so-called strong traffic direction, but in the opposite direction to ensure.
- Sufficient traffic density must be ensured - in such a way that there is minimal loss of time while driving and waiting.
- Stopping lines at stops must be organised according to time criteria and local needs.

When organising suburban traffic, other conditions must be taken into account in addition to the various temporal and spatial irregularities. The complex of transport requirements can be determined by transport flows of passengers, going down with increasing distance from downtown
to suburb. For this reason, the individual lines are usually divided into areas.

Principles of design solutions for suburban traffic:

In the following sections, the above requirements for suburban traffic should be understood as a coherent complex as a prerequisite for its popularity among the travelling public. In order to meet the requirements, appropriate design solutions for suburban traffic in accordance with the following principles shall carry in particular:

- Separation of passenger traffic from truck traffic in the city. All truck traffic should be transferred to detours outside the city.
- Separation of long-distance traffic from suburban traffic.
- Management of suburban traffic, rail, rapid transit and long-distance traffic through the city centre.
- Ensuring complete connection of suburban traffic to long-distance and urban traffic.

Requirements that are placed on suburban traffic:

The requirements for suburban transport described in this chapter are based on the requirements of the travelling public. Passengers expect the highest quality transport services after payment on the one hand, on the other hand there is the carrier and its possibilities - the expectations of both sides should be balanced. In the following section, basic requirements are introduced in the order of survey results:

- Transport speed,
- Number of connections,
- Regularity,
- Comfort,
- Security,
- Reliability,
- Fare,
- Courtesy and courtesy.

7.3. Organization of suburban traffic and types of timetables

Accepted by: GOGOLA, M., 2013 a VONKA, J. a kol., 2001

Suburban transport organizations depend on many factors, but above all on transport management in a broader context, the logistics of stops, density and settlement, the organization of other modes of transport, connection to other modes of transport - means of transport (cars in the park & ride, bicycles in the bike & ride system, etc.). The most important criterion for the establishment and optimisation of the organisational structure of suburban transport is passenger flows.

Basic types of suburban transport organisation can be divided into two groups:

- **Operation of suburban traffic on common transport route with other traffic (before all road traffic)** - it is a less capital-intensive variant where suburban traffic should be favoured during morning and afternoon peaks, but there are operational problems here (e.g. permeability of lines) in connection with the simultaneous operation of other traffic in a road traffic in the suburbs to connections to the common road network of S-Bahn traffic of mixed operation with other types of railways.

- **Operation of suburban transport on special transport route** - it is a very capital-intensive variant, but the transport routes allow very high throughput and the ability to achieve high quality transport services for commuter bus service, build separate lanes or a recessed transport route, rail transport is completely a typical example of suburban rail in Germany.

Interval timetables of suburban traffic:

- Interval (also clock) timetables must comply in addition to the above criteria for the band schedules with the following points:
- Use of a uniform fleet with comparable transport characteristics,
- selected transportation hubs for passenger transfer (for example, where the situation connects to the main transportation / rapid transit / additional / or bus)
- Arrival of passengers before departure of the vehicle with subjectively selected time reserve (continuous arrival of passengers to the stop would be at a distance of less than 10 minutes)
- regularly repeated operational procedures relating to the safety of a vehicle,
- more efficient use of the fleet,
- simple reminder of departure times, etc.

8.INTEGRATED TRANSPORT

8.1. Integrated Transport System

Acquired from: GOGOLA, M., 2013 a DRDLA, P., 2013b

Public passenger transport is for most citizens a necessary public service that provides transport services in one place and ensures the availability of destinations. The aim and mission of transport services is to ensure effective and efficient transport that meets the transport needs of the population in the region while taking advantage of the reasonable costs of public finances.

Experience from practice and abroad shows that an **integrated public transport system** is an effective way to ensure a public transport. In the Czech Republic, these systems are called **integrated transport systems** (IDS) abroad, these are the transport unions.

From the many possible definitions of an ITS, this was chosen: "Integrated transport system is the possibility of coordinated use of several types of public transport by several carriers (including organized connections to individual car transport) with the aim of ensuring the effective and efficient transport services of the area with regard to the economic and non-economic needs of the residents and institutions present in the system".

With regard to the passengers who are essential for ITS, ITS is characterized by:

- uniform common transport services (coordinated timetables);
- a common fare with a single public offer of tickets;
- uniform common transport conditions;
- guaranteed quality standards;
- a single common information service, and
- uniform presentation of the system to the public (uniform communication of each transport mode and each passenger carrier).

Integration, is an association that defines it as IVS:

- combined use of several means of transport to satisfy the transport needs of users,

- Coordination in transport and traffic to ensure optimal connections between the lines and means of transport of different carriers, or interdependent provision of services,

- Coordination of the tariff in the use of a uniform tariff for all institutions, without this affecting the validity of the other tariffs of these institutions,

- Cooperation in the field of economics, organization and management of the carriers and other subjects responsible for public transport with the aim of ensuring coordination in order to achieve an optimal balance between costs and benefits of this service for individuals

  and organizations, taking into account economic and non-economic influences,

- The organisation, provision and operation of transport is carried out in three components of IVS. These components are three interconnected subsystems:

  - Organisational-economic subsystem,
  - Tariff subsystem,
  - Traffic subsystem.

Features of integration in IVS subsystems:

IVS is based on the progressive unification of transport systems, public transport, rail transport and public bus transport (VLAD) in one organisational system. This association is guided by a coordination and control and in the aforementioned subsystems IVS is presented as follows:

- Integration of organization and economy
- tariff integration
- Traffic integration.

8.2. Integrated Transport Systems in the Czech Republic

Acquired by: DRÁPAL, F., 2013 and DRDLA, P., 2013

The purpose of the integrated public transport system (IVS) in the larger agglomerations in the Czech Republic is to create a system that optimally satisfies the transport needs of the inhabitants and visitors of the region at given economic opportunities. In general, this means using a common travel document (transfer ticket) without taking into account the means of transport and time and space limits. The decisive criterion should be the availability of the destination in the most efficient way.

To sum up, the integrated transport system will be built to ensure high quality transport services and thus improve the competitiveness of public transport vis-à-vis individual

The key criteria for the integrated system are time, price, comfort, reliability and safety. The basic principles of ITS are:

- Unified system of regional transport based on preference of rail transport (rail, metro, tram), bus transport is primarily organized as connection to the terminals of transport stations,

- The system enables combined transport by car and public transport, which is realized by P&R car parks, which were built at the rail transport terminals on the outskirts of the city and its surroundings,

- uniform transfer of the pricing system, which enables a single ticket journey with the necessary changeover, regardless of the means of transport and carriers chosen,

- Creation of conditions for market and competitive environment on the transport

  market in order to maintain the necessary economic efficiency of operation, to maintain coordination and cooperation during transport.

9. HIGH-SPEED TRANSPORT

9.1. High-speed rail transport

Acquired by: VONKA, J. a kol., 2001 a DRDLA, P., 2013

In order for rail transport to remain competitive even for long-distance transport, it began to increase transport speeds on individual routes. In addition, attempts were made to operate special vehicles at high speeds.

The increase in speed will be achieved partly by modernising existing lines up to 250 km/h and also by building completely new high-speed lines for speeds above 250 km/h. The new lines will be equipped with a new, more efficient and more efficient system.

In 1964, new direction showed first Japanese high-speed line Tokaido to 210 km/h, in 1972 the line Sanyo was with the speed of 250 km/h, in 1983 to 1987 further lines. In 1981 in Europe, the Japanese followed the French with French TGV lines for 300 km/h, in 1988-1991 the Italians on the Diretissima line for 250 km/h and in 1991 the Germans with ICE for 300 km/h. In 1972, the Japanese followed the French with TGV lines for 250 km/h and in 1991 the Germans with ICE for 300 km/h. These new tendencies proved that denounced by many skeptics rail transport is able to gain an important position in the transport market due to the significant modernization and automation.

The most important trans-European high-speed corridors (HG corridors):

- **East - West**: London - Berlin - Warsaw, Paris - Vienna - Budapest, Barcelona - Milan - Belgrade,
- **Northwest - Southeast**: London - Paris - Marseille, Haag - Milan - Bologna, Hamburg - Prague - Belgrade
- **Southwest - Northeast**: Paris - Haag, Barcelona - Stuttgart - Hamburg, Trieste - Ostrava - Warsaw.

The system of the core network of European corridors in the Czech Republic:

- (Germany) - Decin - Prague - Ceska Trebova - Brno - Breclav - (Austria)
- (Austria) - Breclav - Prerov - Petrovice u Karvine - (Poland) + the branch Ceska Trebova - Prerov,
- (Germany) - Cheb - Pilsen - Prague - Olomouc - Ostrava - (Slovakia)
- (Germany) - Decin - Prague - Veseli nad Luznici - Horni Dvoriste - (Austria).

9.2. Operating methods on high-speed lines

Adopted by: VONKA, J. a kol., 2001 a DRDLA, P., 2013

Separate operation:

In this case, on fast high-speed lines, only high-speed trains for persons without freight transport shall be considered as such. High-speed trains are generally composed of co-herent electric motor units running on individual lines of approximately the same speed (the directions are parallel). Therefore, there are no overtaking manoeuvres and there is no need to build evasions.

Mixed operation:

Technical conditions for the construction of high-speed lines with mixed traffic are more demanding. A smaller inclination (up to 12.50/00) is required, normal wheel camber in curves, the maximum axle load of 22t, a larger radius and construction of dodges after about 30 km, between which about 15 km are lane crossings and use of two-lane safety equipment for each line.

The high-speed lines with mixed traffic are characterized by the following features:

- Operation of high-speed passenger trains at regular intervals,
- to reduce the transport of large deliveries and to increase the share of small, fast deliveries,
- Reduction of throughput times,
- to increase the proportion of traffic at night, i.e. receiving the consignment from the carrier in the afternoon or evening, with its delivery in the morning the next day,
- Increase the number of direct trains without the use of folder stations (related to a reduction in the number of these stations),
- higher demands on the accuracy of the delivery,
- Division between road and rail transport by "combined transport".

9.3. High-speed lines

Acquired by: VONKA, J. a kol., 2001

Factors influencing the construction of high-speed lines:

The construction of high-speed lines is difficult because these lines impose considerable demands on its lines. A large influence on the fulfilment of these conditions is the surrounding landscape, in particular the diversity of the terrain and the height and vertical orientation. Economic factors, such as construction costs and their return, and their relation to socio-geographical conditions, including population density, population growth, and the distance between cities, are therefore of primary importance, as they determine the mobility of the population and the level of transport requirements.

Requirements on high-speed lines:

- **Quantitative requirements for high-speed lines:**
    - **the ratio of different types of trains with direction of travel** - this is particularly important to compare the ratio of fast passenger and freight trains,
    - **Differences in speed trains** - large differences in speeds influence the permeability of

      the infrastructure
    - **Distance of rail joints (or dodges) for overtaking manoeuvres** - used on high speed mixed traffic lines where overtaking comes on the "slow" trains of fast trains, using adjacent dodges or rails,
    - **Equipment safety equipment** - signal devices to secure high speeds on the line, in stations and lines, signal devices for transition are not useful here because their existence is undesirable,
    - **Maintenance and closure work on the line** - this element significantly affects the performance of a permeable high speed line due to the higher maintenance requirements caused by very high speed traffic on the road.
- **Quality requirements for high-speed lines:**
    - As far as travel time is concerned, the travel time of a high-speed train must always be shorter than the travel time by car. This results in the fact that the line speed has to be higher, i.e. at least 160 km/h. This value is often used as a standard on the German rail network for fast transport. Compared to the transport level at a distance of 500 km, it is currently preferred to use a high-

train for distances up to 300 km.

Requirements to meet the requirement of high-speed lines:

These assumptions can be divided into three groups:

- with sufficiently permeable performance on the "classical" existing line, using suitable type of safety device, only depending on traction and modifications transport routes can achieve an increase of line speed up to 160 km/h,

- In order to achieve a desired permeable performance, it is recommended to increase the performance of the permeable track construction of another (usually third) track line, but with the line speed of 180 to 200 km/h,

- After exhaustion of permeable performance on the classical line is expedient to build new high-speed line with a speed of 200-300 km/h.

10. UNCONVENTIONAL TRAFFIC

10.1. Unconventional transport service systems

Acquired by: GOGOLA, M., 2013 a VONKA, J. a kol., 2001

In practice in some countries - particularly west of our borders, i.e. North America, Japan, Australia, etc. - we can observe the operation of unconventional means of transport. From a historical perspective, the first unconventional means of transport appeared already in the nineteenth century - the oldest operated unconventional transport system is the well-known German Wuppertal Schwebebahn from 1901. These vehicles are characterized by unconventionality, i.e. non-standardized type in road transport, construction vehicles and the type of drive or system of organization and operation.

The requirements for unconventional transport systems (hereinafter referred to only as UTS):

- Reduce road congestion (urban, suburban, ...),
- higher performance and saving of transport time,
- Environmental protection, noise protection and air pollution,
- Improve security,
- Ability to automate operations,
- Efficient fuel consumption (construction and operating costs, tariffs, ...)
- Improve comfort and convenience of travel,
- Integration with existing transport systems,
- harmonious integration into the urban architecture,
- smaller demands on the city's footprint.

10.2. Structuring of unconventional transport systems

Acquired by: GOGOLA, M., 2013 a VONKA, J. a kol., 2001

UTS means of transport in terms of **occupancy** are subdivided vertically by the type of use:

- **individual transport** - for a maximum of 4-5 persons, in exceptional cases up to 12 persons,
- **public transport** - for a larger number of people,

In terms of surface coverage, it is divided horizontally into three groups:

- **City centre systems** - means of transport operated on a separate transport route. On short distances these are: NETWORK, CAB, TRANSVEYOR

- **whole city** - means of transport operated on a separate transport route together with

  other passengers or combination e.g. MONORAIL, GTR, dual bus.

- **whole agglomeration** - only those means of transport operated on a separate transport route. E.g. ALWEG, SAFEGE, Airbus, hovercraft.

10.3. Transport service systems

Acquired from: GOGOLA, M., 2013 a VONKA, J. a kol., 2001

The introduction of new passenger transport systems aims to promote and increase the attractiveness of public transport and to reduce the negative impact of individual transport on the environment. These transport systems are part of the integrated transport systems that create favourable conditions and opportunities for individual transport. For example, it is not only about parking spaces for cars on the outskirts of cities in the P&R system, but to build a network of cycle paths with appropriate connections, and much more.

System Park-and-Ride (P&R):

The purpose of the park-and-ride system is to reduce the number of cars in city centres. This system makes it possible to leave a car in the parking lot and with the payment of a parking fee, a ticket for public transport is usually also obtained.

System Bike and Ride (B&R):

This system favours the use of bicycles together with public transport compared to cars. The parking spaces and storage for bicycles were built near stations of a public integrated urban transport system or downstream transport systems.

System Kiss and Ride (K&R):

In this system, a car is used as a vehicle for the delivery (or collection) of passengers to the desired locations with public transport connections. The principle of the system is therefore to leave the car safely at a certain place near public transport, where some people get out of the car and the rest of the crew drives on.

System and Bike Park (P&B):

The system where a driver on the outskirts of the city comes by car to the parking lot and continues riding the bike. This system is an alternative to conventional bicycle traffic, which can be overcome by running longer distances so as not to drive into the city centre by car. It is advantageous if the cycle paths are built near parking lots, separated from pedestrian zones.

The Park and Go system (P&Go):

Construction of parking lots as Park and Go. This system is for passenger cars, which is based on the pedestrian corridor to the city center on the following as a parking lot. Therefore, passengers
who leave the car park their car, then walk into the city. On marked paths for pedestrians, their safety is primarily ensured.

The Hail and Ride system:

This system is a new public transport service technology that combines the advantages of taxis and public buses. It is characterized as a dispatcher individual transport with small buses and is used in sparsely populated areas.

System Call-and-Ride (call and ride, similar to the German system Anrufbus and Belgian PhoneBus):

This service is usually operated as a utility and is used for the collection and distribution of disabled and elderly people. A minibus arrives at the destination by telephone and takes the passengers to the desired destination.

System Park and Pool:

A system in which individual drivers collect their vehicles in the designated parking spaces and then drive together only in one car.

Door-to-Door:

The system where passengers are transported at night. The operator guarantees to provide their vehicle to the passenger's place of residence. The customer drives either in the car or by taxi.

Car pooling, car sharing, ride sharing:

One of the ways to reduce the scope of IAD are often considered different forms of car sharing. This may not always be the case. It depends on how goals and system parameters are set.

11. TRANSFER NODES

11.1. Bus stations

Bus station (Busbhf) is an important part of transport connections public road transport, where the boarding, alighting, transfer and waiting happens. All bus stations should provide good connections to other types of public transport in particular, and provide connections to city transport, railways and other buses.

The bus stations are divided into long-distance bus station and city bus station, urban and suburban bus station and combined bus station. The long-distance bus station and city bus station are further divided according to their importance (bus station I - IV category), operation (terminal, transit, combined) and purpose (central, district, company).

Busbhf consist of the following elements:

- railway station buildings (business premises, waiting rooms, luggage storage, information, ticket sales, social facilities, catering facilities, departure boards, timetables, self-service information stands, etc.)
- the platform, possibly exit,
- Entry station for the exit,
- Walkways (or underpasses) for pedestrians, including stairways,
- other facilities (water supply, drainage, lighting, barriers and railings, etc.).
- Communication for vehicles,
- Arrival and departure communication, including control centre (departure and arrival times) and barriers,
- Parking (or garage with minor repair shop),
- reserve area
- maintenance facilities
- Objects with facilities for drivers and others (telecommunications equipment, green area, etc.).

Bus stop requirements:

With regard to environmental protection requirements when designing a new or existing bus station, care must be taken to avoid exceeding the limit values for noise intensity and air pollution and the maximum permissible concentrations of petroleum products in waste water.

To ensure safety, the following points must be observed:

- separate passenger rivers and passenger car rivers,
- Clarity of the individual areas,
- Reduction of the maximum speed of vehicles in the bus station area to 20 km/h.
- One-way operation of vehicles on the roads,

- barrier-free bus station,
- uniform and standardised vertical and horizontal traffic signs,
- ensure a good surface for passenger traffic (carry out sufficient surface drainage)
- prevent the undesired movement of passengers through effective safety barriers,
- normalize the passenger information system,
- Bus station must meet the fire protection requirements.

The type and routes of the bus line on the platforms:

The following types of platforms are used to row buses (Fig. 11.1):

- **Length platforms** - the most frequently used method, the buses are arranged one behind the other; disadvantages are high demands on the length of the platforms,
- **stepped platforms** - buses standing in stations have the axis to the platform at 10 to 20 ° angle; departing buses travel backwards or not,
- **toothed platforms** - here the angle between the axes 30 to 45 ° is used; on departure, reverse travel is unavoidable,
- **Burr platforms** - is used the angle between the axes 45 to 90 °; in this case the high requirements on the width of the road.

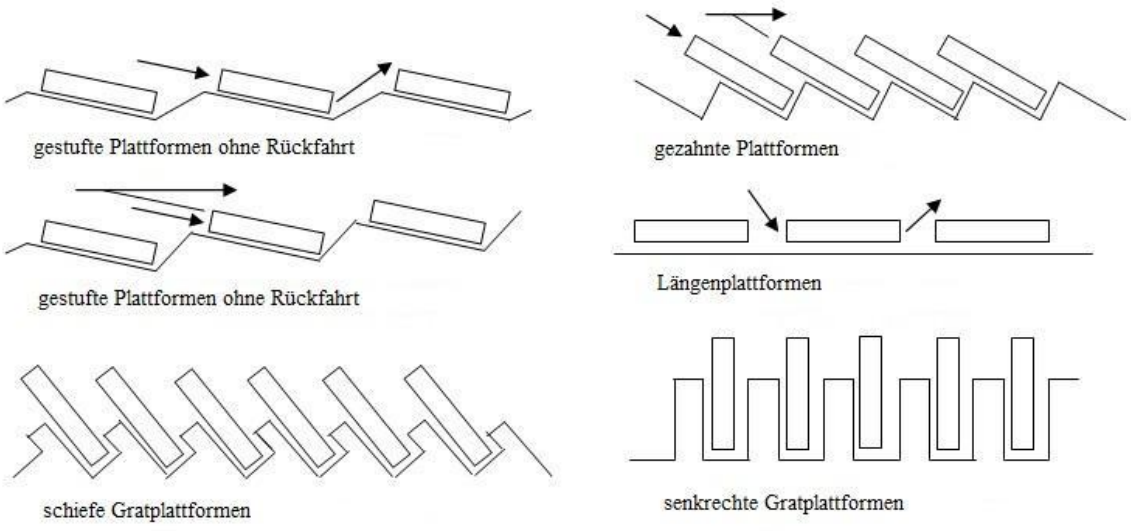

Fig. 11.1 - Type and routes of the bus line on the platforms
Source: VONKA, J. a kol., 2001

The line of Busbhf platforms:

The platforms can be arranged in the frame of the Busbhf in the following way:

- **Parallel** - individual platforms are arranged next to each other, whereby in the axis of the bus station usually (preferably separately) allows transition between platforms and the station building (e.g. Busbhf Pardubice).

- **Standard** - at smaller bus stations, where parallel to the road are built one or two platforms,

- **Standard-parallel** - similar to parallel, where the two parallel platforms are positioned one behind the other,

- **Looped** - at the edge of the strip there is a platform, in the middle there is a space to park the buses (e.g. bus station Liberec),

- **Combined or special** - considers spatial possibilities on site.

11.2. Railway station

Single railway stations (BS) are built in large crossings to separate freight and passenger traffic.

BS and a bus station consist of several elements:

- Station buildings, arrivals and forecourt,
- Platform,
- transitions between platforms (underpasses, overpasses),
- Tracks for arrival, departure and machine lanes (e.g. for bypassing),
- Lane for parking and depositing vehicles,
- Track and equipment for luggage and mail,
- Lay ward.

In the wards, services take place that are connected with:

- **Passenger trains and passenger cars** - Handling of passing trains, arrivals and departures of "local" trains, arrivals and departures of suburban trains, cleaning and equipment of passenger cars, inspection and repair of vehicles,

- **Passenger services** - boarding, alighting, transfer and waiting passengers, ticket sales and seat reservations, loading, unloading, reloading and storage of baggage

press services, passenger information, etc.

Structuring of stations:

Railway station can be divided into two types:

- **According to the relative positions of the track and station buildings:**
  - End station (head, blunt)
  - Transit station (island, side, cross)
  - End-transit station,
  - possibly grinding station;
- **According to the operating procedure:**
  - mixed (directional)
  - single (lines)

12. OTHER PASSENGER TRANSPORT SYSTEMS

12.1. Foot and cycle traffic, two-wheeled powered vehicles

Acquired by: VONKA, J. a kol., 2001 a DRDLA, P., 2013

Foot traffic:

Foot traffic does not seem to have a significant influence on passenger transport systems, but it should be noted that within a distance of one kilometre foot traffic is the cheapest and fastest means of transport. Practice shows that even up to a distance of three kilometers, walking is a real alternative to other modes of transport. However, favourable conditions must be created for this.

The promotion of walking consists in shortening the distance, including increased comfort and safety. Only in this way can necessary conditions be created to be the attractive alternative to motorized forms of transport.

- **Means to pedestrian traffic:**

  Foot traffic is divided into two types: horizontal and vertical. For the horizontal movements of the following means are used: Under- and overpasses, corridors, platforms, sidewalks, moving walks, etc.; for vertical movement: Stairs, ramps, escalators, elevators, paternosters, etc.

Cycling:
Compared to pedestrian traffic, cycling traffic has a wider range of applications. The bicycle is suitable for short distances as an alternative to the car (i.e. up to about 8 to 10 kilometres). Bicycles are relatively fast and with an average speed in urban areas 15-25 km/h at these distances are often faster than cars, especially at peak times. They are also more reliable for estimating the accuracy of travel time.

Partial replacement of cars can have significant environmental impacts. However, cycling traffic must be faster, safer and more comfortable. This is a priority after defining the requirements for this traffic.

12.2. Individual traffic and static traffic (ISV)

Acquired from: VONKA, J. a kol., 2001 a DRDLA, P., 2013

Support measures in the framework of ISV:

In large cities, traffic from work and school is already mixed with tourism traffic on Friday afternoons. Significant problems are also caused by high concentrations of road users returning to the city in the evening hours on Sunday.

Restrictive measures within the framework of ISV:

At the same time, significant restrictions on the use of cars in the city centre are implemented (i.e. blue zone.): zone with reduced speed (zone 30), artificial barriers discourage drivers to drive into the central city zone (narrowing of streets, limitation of the number of parking spaces, surface treatment of streets, etc.).), environmental barriers (entry into the centre only for vehicles with a so-called green card), toll (charge for entry into the city centre), preferences and measures for public transport (SSZ, railways, one-way streets in both directions (+ cyclists), stop structure, dividing strips), introduction of city buses, etc.

Static traffic:

Static traffic, also called "Ruhe Verehr", is a necessary part of the transport process, especially in individual car traffic, and also for some of the following vehicles. Since the ISV vehicles are not constantly in operation, their storage should be planned. Parking space and parking lots - used for parking and parking of vehicles.

- **Parking spaces** - the location of vehicles outside the roads (e.g. for the duration of shopping, visits, work, loading or unloading). Parking time can be divided into length and short-term duration (up to 2 hours) and long-term duration (more than 2 hours).

- **Parking area** - the place where the vehicle is placed outside the road (usually at the place of residence or at the driver's seat) for the duration when the vehicle is not in use.

- **Stand area** - an area used for parking or parking the vehicle.

12.3. High-speed railway

Accepted by: VONKA, J. a kol., 2001 a DRDLA, P., 2013

In the 19th century, with the development of railways and the exploitation of their benefits, it was expected to increase their share of the transport market at the expense of other modes of transport. The reason for this was that the traffic is more advantageous for transport of larger number of passengers.

The average number of passengers depends on many factors:

- population (the decisive factor),
- the overall cultural and living standards of the population,
- mentality of the population towards high-speed rail,
- development of individual car traffic,
- tariff costs,
- the structure and extent of the high-speed rail network,
- urban concept and urban communications,
- character of the city,
- other means of transport, etc.

Structure and marking of high-speed railways:

The high-speed lines can be divided into three groups - **according to the direction of the line**:

- underground (subway - metro, connecting lines)
- rural areas (urban and suburban high-speed railways, integration of trams and railways)
- above ground (above ground or suspension railway).

This structure does not include the so-called suburban railway, which has part of the line underground and the rest on land.

Classification by means of transport:

- **Subway (Metro)** - it is a high-speed electric traction line that runs either through the city or entirely underground.

- **Connecting line** - this is a special type of metro that connects stations in major cities of particular importance located outside the city centre.

- **S-Bahn (in the city)** - this railway with its operation are similar to underground railways - are guided in a special body surface. Only in exceptional cases lead underground or above ground.

- **S-Bahn (in the suburbs)** - are operated, either by conventional S-Bahn lines or their special transport route, which is led in the vicinity of subways separated from external influences.

- **Integration of tram with railway** - a special vehicle suitable for operation via S-Bahn lines to classic urban tram networks with a secure intersection.

- **Above ground or suspension railway** - a high-speed railway over the ground led over viaducts and Estakade.

- **Subway** - it is a certain type of urban tramway, where some line under the ground are led - especially in the city center.

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