PUBLIC TRANSPORT SYSTEM

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Abstract: *The transportation of persons through regular services organized in the interior of establishments (usually in cities) is often called the urban passenger transport or local public transport.*
Possible modes of travel for urban transport are classified according to the means of transport used, their operating mode or the infrastructure on which the transport is made. Adopting a certain mode of transport for the public transport system is made regarding numerous conditions, such as development effort and the effect on urban life. **C***omparative studies regarding modes of urban transport reveal the following:*
- From the standpoint of necessary investments , the order (from the most advantageous to least advantageous) is the following: bus, trolley bus , tram, subway
- From the standpoint of operating costs, the order is: tram, bus, trolley bus, subway.

Keywords: Transport, networks, system, methods, passenger.

INTRODUCTION

Depending on the organization mode, the person transport can be of several types (according to Annex 2 of Law no. 105/27.06.2000 for the modification, completion and approval of the Government Ordinance no. 44/28.08.1997 regarding Road Transport)
a. Transport through regular services;
b. Transport through special regular services;
c. Transport through occasional rides, other than tourist rides;
d. Transport through occasional tourist rides ;
e. Taxi transport;
f. Transport using rent a car services.
Person Transport through regular services are organized in the interior of the establishments (usually in cities) is often called the urban passenger transport or local public transport.
Possible modes for urban transport are classified according to the means of transport used, their mode of operation or the infrastructure on which the transport is made:
a. Road Transport with buses ;
b. Road Transport with trolley buses (powered by electrical current from an electricity grid suspended);
c. Transport on tracks integrated in the road infrastructure, with trams (powered by electrical current from a suspended electricity network);
d. Transport on separated rail-road track separated from the road infrastructure, on light tram lines ;
e. Transport on a suspended separated rail-road track (monorail) – powered with electrical current ;
f. Transport using underground rail-road tracks (subway) – powered with electrical current.
There are a number of conditions and restrictions for each of these modes of transport, which become initial conditions for the design of the urban public transport system.
For the transport with trams, the stop stations from the route and the end of the line requires special arrangements. Because the traction force develops at the wheel contact – rail-road, its value can not be very big, being limited by the coefficient of friction (material being steel), which limits the usage of tram transport only on routes with small gradients, and also, with low curvature.
As a result, the maximum length of trams trains should not exceed 30-35 m on city streets and underground lines can reach up to 50-60 m. The maximum length of train, tram is limited for two reasons: too long trains block crossroad streets (takes long for crossing) and make traction difficult (norms limits the road platform to 3 ... 7%, depending on the number of carriages).

The lower zones for transmission lines to raise bus because the transmission lines can be built on existing road network and requires only fitting (fairly brief) stations along the route and head of the line. The tracks allow close enough curves and gradients of up to 6 ... 7%.
Travel by trolley can be arranged on the existing road network (as in the bus - with gradients of up to 6 ... 7%.), But requires additional overhead network planning for power supply.
Subway requires very special facilities (tunnels, underground stations, ladders, ventilation systems and ventilation, communications information, etc..). Feeding Tube train is a special track (track to III). Ramps are reduced maximum allowable: 1.5 ... 3% (in terms of adherence to the tram - good weather, but for large weights trainsets).

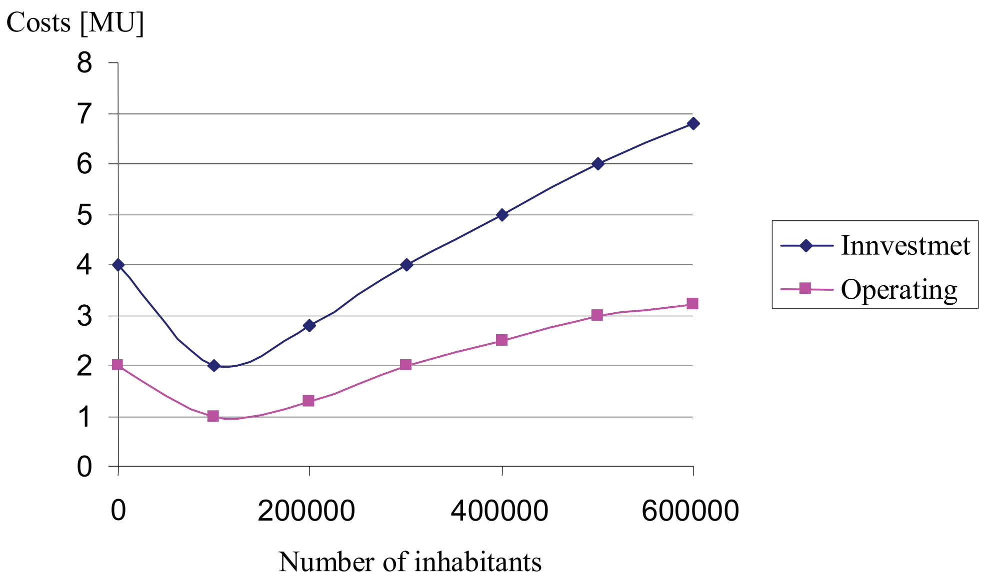
AN URBAN PASSENGER TRANSPORT METHODS - COMPARATIVE ANALYSIS

Adoption of a certain mode of transport for the public transport system is made having regard to numerous conditions, such as development effort and the effect on urban life, including:
- The local demographic, geographical and topographical;
- Investments required;
- Operating expenses;
- Consumption of electricity or fuel;
- Pollution of the city, where bus transport;
- Carrying capacity;
- Travel conditions (comfort, time, security);
- Requesting road network.

A comparative study of urban transport modes reveals the following:
- In terms of investment required, the order (from most to least possible rates) is as follows: bus, trolley, tram, subway
- In terms of operating costs, the order is: tram, bus, trolley, subway.

Regarding the relationship between costs (expressed in units of currency or another, UM) and the number of city dwellers, it is found that for large and medium cities (over 100,000), investment and operating costs increase with the number of inhabitants quasi proportional (Fig. 1.1.).

Fig. 1.1. Public transport costs depending on the number of inhabitants



It appears that the bus is the most profitable in terms of organization of transport, trolleybus is advantageous in terms of two aspects combined - the pollution of the city and the necessary facilities and the tram is the most economical (in the subway it is only possible for large urban agglomerations with over one million inhabitants).

An indicator to compare various modes of urban transport is the coefficient of energy consumption (cost of energy consumed for reporting a passenger or a passenger * km): this is two times greater for a passenger to carry a trolley passengers transported by tram or subway, and a passenger bus will be 4 times. Instead, the largest rail transport capacity has followed the tram, bus and trolley.
Indicators to characterize the extent to which the transmission system meets the requirements of travelers (travel conditions) are:
- Total travel time;
- The conditions of ascent and descent (transport accessibility);
- Ability to meet demand for transport in special circumstances (including people with physical disabilities);
- Adaptability to operate in normal and special situations.
An important indicator, which is a dominant criterion in choosing travel is time travel: the length measured from the time of departure (for example: the place) and the final point of destination (for example: work). It is determined by the distance to the station of departure / arrival time at the station waiting for departure time and duration of any transport vehicle transshipments.
It would be total travel time to the smallest, but it depends on several factors, such as:
- Travel time on foot to the station of departure / arrival depends on the transport network density and size inter stations;
- Waiting time at the station of departure is influenced by the arrival frequency of vehicles and the rhythm of their movements (this is higher than the metro, which is disrupted by a program other modes of transport, because it interferes with them);
- Average speed of transportation means (here again is higher than the metro, which is not influenced in any way the problems increasingly facing higher road today in big cities).
The choice of mode of transport must consider the length of travel literature recommending in this connection the following:
- Road transport systems (bus, trolley and / or suburban), for distances up to 12 km;
- Extra street transport systems (underground or above ground), for distances up to 45 km;
- Extra street transport system (express) for distances of up to 80 km;
In terms of space use means of transport (their workload), we notice the following:
- For trams and metro area utilization coefficient freely (without spaces) is up to 8.5 calatori/m^2;
- For buses and trolleybuses, as tires are not overloaded to value ratio is acceptable to use the free space of about five calatori/m^2, while admitting higher values with only a short period of time of transport during peak periods.
Strenuousness road network by means of transport is an important criterion in the organization of urban transport (the road network). He is evaluated by two key indicators:
a) - road surface which is a passenger transport (in view of the area occupied by a vehicle dynamics, which is envisaged to include space and the area safe braking). Thus, different means of transport (including car travel for themselves) the situation is presented in table 1.1.

Table 1.1. The road surface for various passenger vehicles.

Means of transport	Roadway surface of a vehicle [m2]	Vehicle capability (passenger)	The passenger road surface (m2/ passenger)
Tram	125	250	5
Bus	70	100	7
Troleybus	65	80	8
Car	15	1,5	10

b) - the intersection of agglomeration coefficient, which is reflected in the formula for calculating the capacity of crossing the intersection. It can be expressed in relation to a standard car (with a length of 5 m) as follows: - Car: 1; - Bus: 3; - Trolley 4.
For the tram, which has a special traffic intersections (there are special traffic lights for trams and, moreover, has gone tram priority at intersections crossing undirected), this factor can not be applied only if necessary, corrected.

TRANSPORT NETWORKS

Transport network is composed of all transmission lines, linking housing and jobs or social purpose (parks, cultural establishments ...) or between the latter (the city center and recreation area, industrial, commercial, etc. .).
The main lines of passenger traffic to be served by direct connections, and the secondary permit and transshipments.
The problem of determining the transmission network must be analyzed from two viewpoints:
- City and street network structure (for land transport network);
- Passenger flow (to meet demand for transport).
One of the most important characteristics of the transmission network is the transport network density. It is also one of the criteria for assessment of access to transport passengers, so is perceived as an indicator of travelers.
The transport network density means the ratio between the length of the transmission (which is the length of transmission lines, without considering the common ones) and the area served by the territory, expressed in km/km^2.
For the territory served by the transport network is used in the official city planning area only limited residential, commercial and industrial (more than vacant places, lakes, etc.)..
Practical values of the transport network density varies by mode of transport:
- Tram network: 0.2 ... 0.6 km/km^2;
- The network of trolley: 0.3 ... 0.9 km/km^2;
- Bus network: 1 ... 2 km/km^2;
- Metro Subway: 5 ... 10 km/km^2;
Maximum distance of nearby cross the line (if you favorable location of the lines from the surface unit, $S = 1\ km^2$;) is determined by the density D [km/km^2] using graphical representation of Fig. 1.2., namely the relationship:

$$L = \frac{1km^2}{2D} \qquad (1)$$

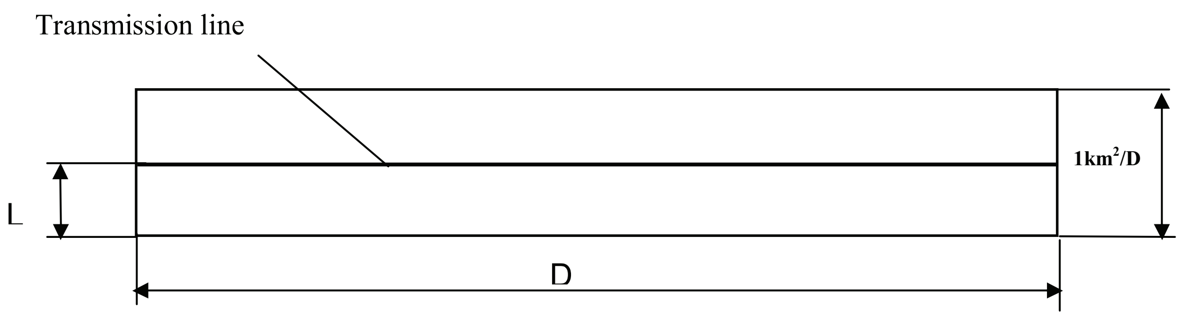
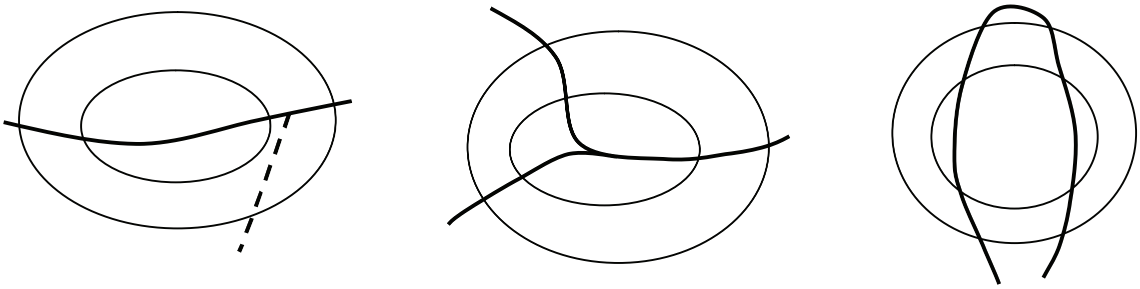


Fig. 1.2. Near the maximum transverse distance transmission line.

In terms of network density, the most favorable of the transmission bus (line may be the optimal route, it could follow any traffic artery of the city and, in addition, can be used buses with different capacities need adapted transport) . Follow transport buses (which requires relatively low cost land line) and then tram to transport planning costs per mile of line are very high.

To transport the street, taking into account the travel time of passengers walking to / from the station, it is recommended the following values for the density of transport network (compared to the residential territory):
- Tram network: 1.0 ... 1.5 km/ km^2;
- The network of trolley: 1.5 ... 2.0 km/ km^2;
- Bus network: 2 ... 2.5 km/ km^2.
Calculating the total zoom of the distances near the station cross the line and along the line, it can have values;
- Transport with trams: 5 ... 15 min;
- The transport trolley: 5 ... 20 min;
- Transport by bus: 5 ... 10 min;
- The metro transport: 5 ... 30 min.
Unlike street transport, where access to means of transport is almost immediately at the time of arrival on the subway platform is meant making the subway only to be preferable for long journeys. It considers the amount of time necessary to arrive at the subway train on the surface of the street as:
- 1 ... 2 min., Where shallow stations;
- 2.5 ... 4 min., If the deep stations.
Transport network design can be achieved at a general level or levels of detail, as follows:
- Overall design, to serve the city by public transport;
- Special design for each transmission line in part;
- Improving the design (optimization) network officials or transmission lines.

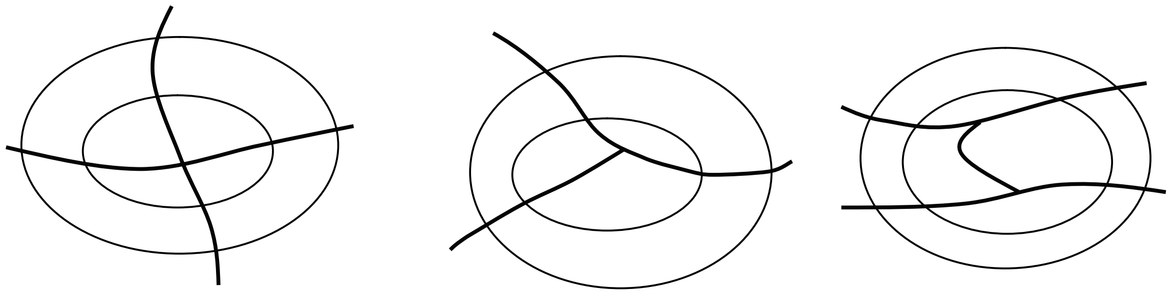
For the surface transportation network is considering street layout of the transport network design. Thus, there may be various schemes for the transmission network in various stages of development of the transport system in conjunction with the development and expansion of the city.
In Fig. 1.3 are the onset of transmission schemes:



a) b) c)

Fig. 1.3. Early schemes of transport networks.

a) - for cities with longitudinal arrangement (if and mountainous towns in the hills, located along the river - as Pitesti, Arges, Campulung, Pitesti), there is a main route, longitudinal, across town and that short transmission lines are connected from the side;
b) - the mountain towns developed at the confluence of two main valleys, are found in the transport network two converging routes and possibly other radial transmission lines;
c) - the developed cities in broad valleys on both sides of a river (Cluj - Napoca) or developed in the circular plains, suitable scheme is circular.
In the intermediate stage of development, transport networks have a more complicated structure, there are several main lines can transport:
a. - cross-shaped diagram, with a long transmission line that can serve and suburbs;
b. - T-shaped scheme, where one of the main lines of transport is the main basis for a second line.
c. - H-shaped plan for cities concentrated, but arranged on both sides of a river.



a) b) c)

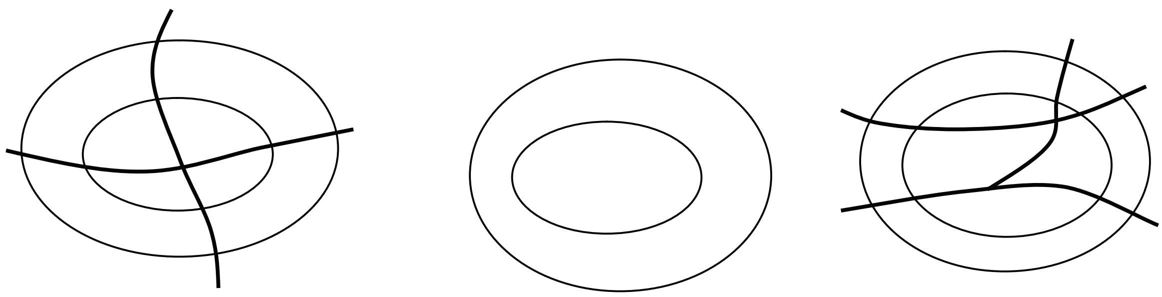
Fig. 1.4. Intermediate stage of development schemes of transport networks.

For cities and advanced stages of development of transport networks, schemes will be richer and transport requirements can be met in large extent (Fig. 1.5.):

a) - rectangular scheme of some form almost perpendicular lines that intersect, and some of the lines serving the suburbs, of this scheme can be completed with transmission lines on the diagonal direction, which emerge directly from the points of gravity (center, stations, etc..);

b) - the figure, radial, radial lines converge into a point or a central line (linear or quasi circular)

c) - Combination, which contained a rectangular or radial scheme, supplemented by one or a few lines tangential to avoid downtown.



a) b) c)

Fig. 1.5. Scheme developed transport networks.

The radial-circular patterns are two possible connection schemes of the circles with radii:
a. - when the city is small, ranging in a narrow, winding roads circle (historical area, usually), radiating lines not included in this circle but stop to it, and inside will be used only means adequate transport accessibility.
b. - the central territory is large radial lines fall within that territory, and also having links crossing or bypassing downtown.

METHODS FOR DETERMINING THE MINIMUM ROAD NETWORK

A network can be defined as a set of nodes connected by lines or arcs. One way to go from one node (origin) to another node (destination) is called a road.
Roads can be oriented in one direction or both directions, each route is usually characterized by time or cost of browsing and the distance between the ends.
Issues related to roads and transport frequently occurs in communication (which is actually an information transmission). A typical problem is to find the system optimal way (in terms of predetermined criteria) from point A (origin) to point D (destination), knowing that in different stages of the journey there are several roads available.

The problem of finding the way to ensure minimum cost can be solved in principle by identifying all possible, the identification and costing less. But this requires an exhaustive enumeration of all variants and analysis - so, obviously, it is desirable less laborious way to find your way with the lowest cost, even to use the most effective method for this.
Methods for solving the problem consists in determining the optimal path of a road linking two or more nodes and minimizing (or maximizing) a road efficiency measures (time, distance or cost), which is a function of measures arcs attached map (usually, the amount thereof).
For a road to be acceptable sometimes impose certain restrictions (eg not to pass the second time already covered by a node, or pass through each node once and only once). Arcs have limited capacities (this can be the carrying capacity for its browsing speed or so.). In addition, there must be safety plan (backup or contingent) for the case closure (for renovations or interference) of some road sections.
A simple example of the problem is where you want to go from one point to another, and there are several possible routes, which include various points of call. It is assumed that the way to reach a node does not make it go the way of that node.
Consider where you want to catch a point (origin) in paragraph 6 (destination) - Fig. 1.6. Some arcs may be completed in both directions, but some can be taken only in one direction, as shown in the figure. Measures are known for the arches that can be taken, Sjk.
There are several variants of the scroll of the road from the origin to destination, which will choose the one providing the minimum time (or distance or cost).
In general, there are various methods for minimizing (or maximizing), based on an analysis of possible matrix system, such as:

- Way north - west or distribution method in scale;
- Minimum line element method;
- Minimum column element method;
- Maximum difference method (approximate method Vogel);
- Houthakker method;
- A complete or exhaustive method (relaxation method);
- Factors method solved (Kantorovich method);
- Diagonal method (Dantzig method).

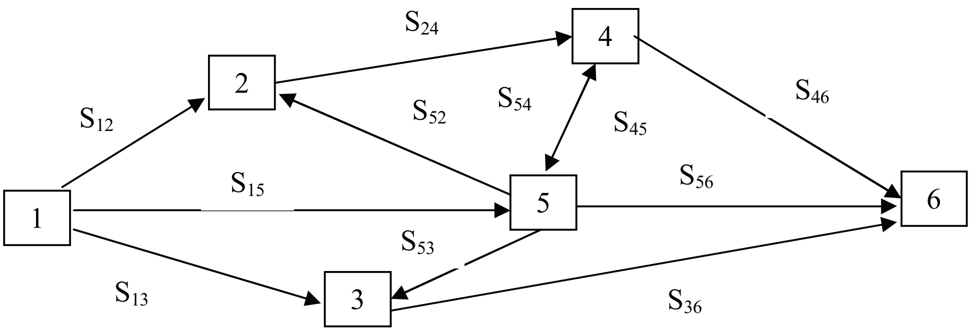


Fig. 1.6. Network working minimum path problem.

A method of solving the problem considered using some „dispersion matrix” of Shimbel. The method does not allow direct explanation of the shortest path between any pair of points in the network, but you can obtain the necessary information from the map results.
Minimum path algorithm to identify the next steps involve:
a) Based on data about the network (values S_{ij}) is done with a matrix structure $S_1 = [s_{ij}]$ of size k*k, where k is the number of points. s_{ij} value is used - if there arc from i to j, respectively s_{ij} plus infinity - otherwise. Main diagonal elements of matrix $[s_{ij}]$ is void.
b) We define the sum of two special matrices, „S” and „T”, as follows:

$$S + T = U, \qquad (1.2)$$

where:
$S = [s_{ij}]$ $T = [T_{IJ}]$, $U = [u_{ij}]$, (1.3)
and
$u_{ij} = \min [S_{I1} + t_{1j}, S_{I2} + t_{2j}, S_{I3} + t_{3j}, ..., s_{ik} + t_{1j}]$, (1.4)

c) Using these rules we add matrix with itself S_1 and S_2 as the first matrix to obtain the dispersion matrix. Its elements are the shortest distances from the „i" to „j" in two or fewer steps. Analog arrays are obtained dispersion S_3, S_4 etc..
d) As a result, S_{k-1} matrix elements must be the shortest paths. However, if $S_n = S_{n-1}$, with $n <k-1$, where Sn-1 already contains the shortest paths.
Basically it starts from the need to ensure the city between two points the shortest route for a transmission line in common. Based on the analysis scheme of the city - street network, existing network transmission limitations of different nature (bridges, one-way streets) - working to establish the network, that the points attainable and that a policy will cause still unknown nodes located searched along the route (network generally consists of more nodes than those where the route passes sought).
As the network nodes so welcome all points of which are considered exist a choice of at least two variants of the route. This requires that you first have established categories of streets that can be assigned to the movement of vehicles for seeking the minimum path (all other streets disappear from the horizon investigated).
In case of any additional conditionality is possible to follow the present methodology by dividing the problem into several partial problems (for example If outside the points A and D and the longer a condition to achieve an intermediate point X, the problem is divided into a network problem from O to X and a network problem from X to D).

Establishment costs represent the second phase of the solution. This step depends on the notion that quality is assigned cost: time or equivalent benefits:
a) - for space, the algorithm is simple, drawing on the scale determine the distances between network nodes on the network and notes;
b) - the time, the problem is simple if the network is composed entirely of arcs crossed paths already in operation, but becomes more difficult if there are already routes operated out of arcs. In the first case, measure the tracks recorded times of vehicles depending on rush hour traffic and possibly by major media coverage values to ensure normal deviations from the itinerary is determined values credited as working on network costs. In the second case, the problem is solved by applying the principle that in the same area of the city's street network is achieved the same speed.

In essence, the method (called „similarity") is as follows:
- Look for the nearest circuit - topological - has the following characteristics: each arc of the circuit is part of one of the routes in operation, passes through nodes that limits the arc or arcs for which no data could be collected directly, we know journey times for each arc of the circuit, the period in question, known arc lengths.
- In these circumstances, the principle stated, ie the speed is calculated on the circuit and its value is assigned to the arc or arcs that are not familiar with data.

If you can not find a circuit (usually to the bordering arcs network) circuit is possible to use a fake, ie a circuit that contains even the spring (only one) for seeking the identification of data.
c) - the cost, the problem can be solved only on an experimental basis because the costs would definitely depend on driving style, the length of the park, the state of wear of the road etc..
In the third stage applies the algorithm for determining the minimum path between nodes considered.

THE DETERMINATION OF TRANSPORT LINES

The model assumes that the conditions for the establishment of the city structure, based on areas that current sources of traffic.

Knowing the population distribution can determine the concentration of its points, ie potential of travel centers: it is considered that the population is concentrated in the center of gravity of each area, making the determination is analogous to determining the center of gravity of a system of bodies in mechanics, dividing the area into several areas and each area separately using the relations:

$$x_0 = \frac{\sum_i (x_i \cdot m_i)}{\sum_i m_i} \quad (1.5)$$

$$y_0 = \frac{\sum_i (y_i \cdot m_i)}{\sum_i m_i} \quad (1.6)$$

where:

- m_I - number of inhabitants;
- X_0, y_0 - center coordinates resulting potential travel;
- X_i, y_i - coordinates of the center surface potential components.

In this way possible to treat each component surface with a point and by placing this point (center lead) to the nearest arterial street network structure becomes zonal, district, regional, in a graph structure.

In Fig. 1.7. illustrates the determination of what data are incorporated into the above relations.

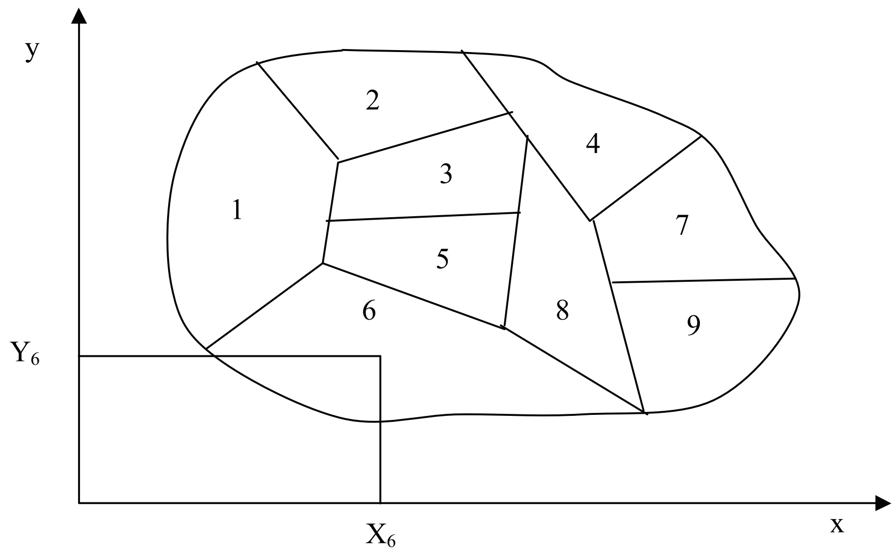


Fig. 1.7. Determining the potential center of an area.

Applying the methodology for determining traffic streams can most likely find the exchange of travel between areas.

The problem lies in identifying those most likely route which will run passenger exchanges between the areas identified as potential centers.

Since the network is much broader than a simple (single) link between these areas and even if there is only one link between two adjacent areas, the problem would still crossing intermediate areas to areas that are not adjacent.

To determine the major directions of traffic in the city - which may become future routes of transportation lines - have used a mathematical model.

Whether the „i” to its neighbors zones „l” and „k”, the „k” to its neighbors zones „i” and „j” and the „l” to its neighbors zones „i” and „j” (Fig. 1.8.).

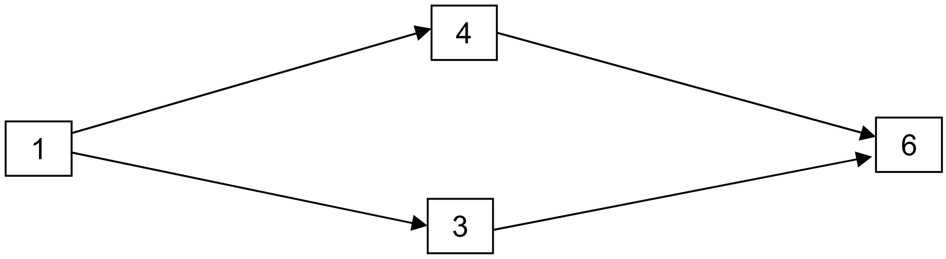


Fig. 1.8. Connections between areas.

The path from "i" to "j" can be chosen in two ways:
• (i ... l ... j) with value $C_{il} + c_{lj}$
or
• (i ... ... j k) C_{ik} + value C_{kj}
where C_{il}, C_{IJ}, ... represents the potential cost of transport between the centers of the area.
The passenger who wants to make the movement between the ,,i" and the ,,j" choose the minimum path criterion journey. It is assumed that the road meets the road condition is ,,i ... k ... j ", consisting of portions ,,k"and ,,kj".
It also means traffic led n_{ij}, obtained by a method not of interest to the present problem. These passengers will be loaded with value ,,n_{ij}" section as ,,ik" and section ,,kj", but will not cause any harm sections ,,il" and ,,lj".
Loads of all arcs (sections) are calculated with the graph:

$$S_{ij} = \sum_{1}^{h} w \cdot \sum_{1}^{h} z \cdot n_{wz} \quad (1.7)$$

where:
• i, j - dwz nodes belonging to the road;
• dwz - minimum path between nodes w and z;
• h - the number of graph nodes;
• w, z - each pair of nodes of the graph;
• n_{wz} - the number of passengers between nodes w and z.
If one accepts the idea that all passengers will choose the minimum roads, then we can even calculate the minimum path ij the number of passengers who go this route, in addition to those specifically nominated nodes "i" "j" and others (although one had starting point "i" or point of destination "j").

$$N_{ij} = \sum_{1}^{h} w \cdot \sum_{1}^{h} z \cdot n_{ij} \qquad (1.8)$$

where i, j - each pair of nodes of the graph.
Below is the route in both directions, ij and ji. Number of passengers who go on this route (if it will become the transmission line) is

$$\mathbf{N_{ij} + N_{ji}}$$

and choosing the maximum among all pairs of nodes can be said to have caused most loaded line corresponds to route traffic that would be most preferred transport (this is the route with the highest demand)

$$\mathbf{max \{N_{ij} + N_{ji}\} = (d_{ij})} \quad (1.9)$$

Eliminating ij route requests resolved, the calculation can be resumed to determine the second route in order of importance etc..

APPLICATION

Among the numerical indicators, particularly significant is the degree of overlap of the county public transport network, because it directly characterizes the efficiency of the county transportation, but has also indirect effects on metropolitan transport (increases passenger flows on major metropolitan routes and, as a result, increases also economic efficiency).

Thus, using the data from table 1 regarding the length of routes, one can determine the total length of county and municipal routes connecting the metroplitan area, in the current:

$$L_{tot} = \sum_{i=1}^{85} L_i = 2800\,\text{km}; \tag{1}$$

The total length with which will be shortened the 85 tracks, by limiting their access to the transhipment bus stations will be:

$$S_{tot} = \sum_{i=1}^{8} N_i \cdot S_i = 19 \cdot 16 + 10 \cdot 3 + 9 \cdot 2 + 16 \cdot 8 + 7 \cdot 8 + 8 \cdot 11 + 12 \cdot 9 + 4 \cdot 6 = 756\,\text{km} \tag{2}$$

There is a reduction in the length of the county public transport network from the Pitesti municipality area in value of:

$$\Delta L[\%] = \frac{S_{tot}}{L_{tot}} \cdot 100 = \frac{756}{2800} \cdot 100 = 27\% \tag{3}$$

which means a substantial efficiency of transport in the county (with beneficial effects on transport costs, traffic, pollution levels etc..).

In addition, the public transport efficiency possibilities can be also explored in the 8 groups of county routes that will be formed. For example, fot public transport from the Topoloveni area, which corresponds to Stefanesti bus station, based on the assessment of transport demand, can be a restructuring of the transportation network, according to the table 1.

Table 1. Current and proposed trails Trails Topoloveni area.

Current Trail / Route Length		*Proposed Route / Route Length*	
1	Pitesti Sud – Suseni / 41 km	1	Stefanesti – Topoloveni - Leordeni / 18 km
2	Pitesti Sud - Glimbocata / 30 km	2	Stefanesti – Calinesti - Carstieni / 17 km
3	Pitesti Sud - Botesti / 45 km	3	Stefanesti - Gara Golesti / 4 km
4	Pitesti Sud - Negresti / 40 km	4	Stefanesti - Valeni Sat / 6 km
5	Pitesti Sud - Priboieni / 29 km	5	Stefanesti - Udeni / 2 km
6	Pitesti Sud - Leordeni / 26 km	6	Stefanesti – Topoloveni - Negresti / 32 km
7	Pitesti Sud - Stefanesti Sat / 41 km	7	Topoloveni – Priboieni - Botesti / 23 km
8	Pitesti Sud - Izvorani / 12 km	8	Leordeni-Glimbocata / 4 km
9	Pitesti Sud - Gara Golesti / 12 km	9	Leordeni-Suseni / 15 km
10	Pitesti Sud - Topoloveni / 21 km		
11	Pitesti Sud - Cirstieni / 25 km		
12	Pitesti Sud - Vranesti / 15 km		
13	Pitesti Sud - Udeni / 14 km		

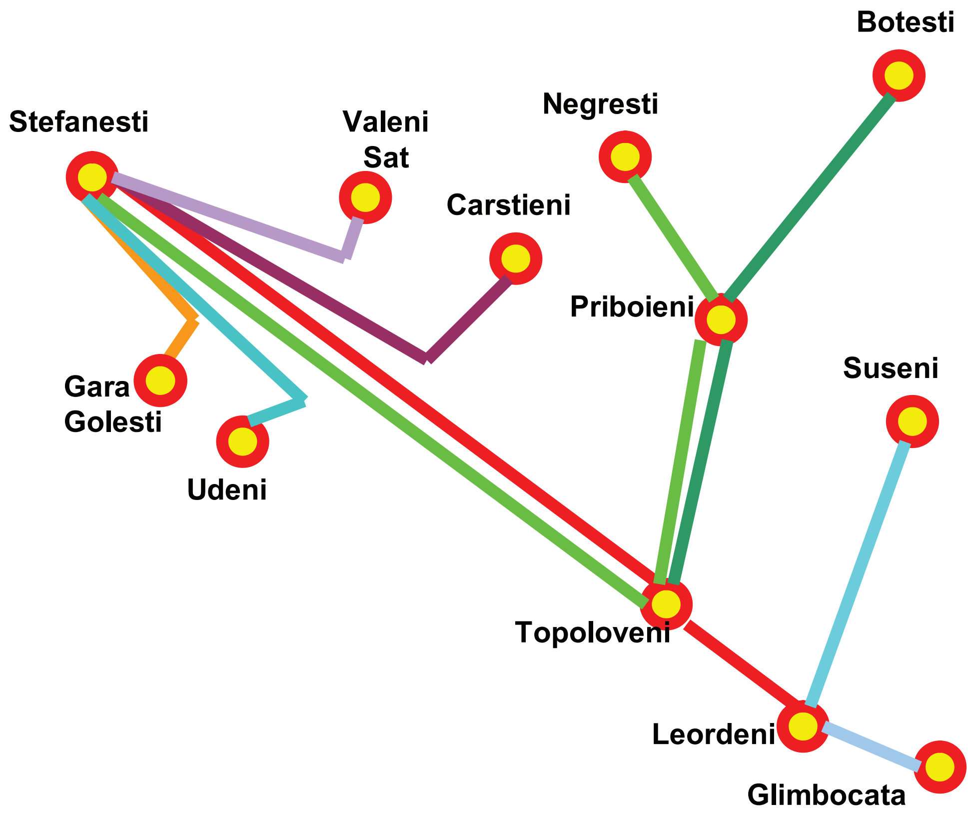


Fig. 1. The scheme of county transportation network proposed in the Topoloveni area

One can note that the number of routes in the proposed solution is reduced from 13 to 9, and 3 are secondary routes, linking these towns and major routes by the axis Stefanesti - Topoloveni - Leordeni. Network length will be reduced from 351 km to 98 km and the degree of overlap of the network will be much diminished - Fig. 1. But the new solution is possible only in case of auction of paths as a group paths, because only in case when there is a single transport operator in the area the secondary routes will be served, because they have short lengths - making them not profitable, but the activity will be effective in the whole group of tracks. Obviously, a detailed economic analysis requires also a evaluation of investments for the development of 8 bus stations, modification of circulating fleet used in county and metropolitan transport, etc..

All these financial efforts financial for investments will be covered by increasing the economic efficiency of public passenger transport in the entire county.

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