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EVALUATION OF IMPLEMENTATION OF BICYCLE MASTER PLAN AND BIKEWAYS NETWORK IN WARSAW BIELANY DISTRICT /POLAND/

Summary

Conditions to development of bicycle infrastructure and utilisation was improved significantly after the 1990 - during the transformation period in Poland. One of a leader in this field is Warsaw Bielany District (136000 inhabitants). In the 1995, author of this paper elaborated the Bicycle Master Plan, that in the 1996 was accepted by Local Authority. To the end of the 2005, near by 30 km of bicycle paths was built – in significant part as independent bike paths, which represented near by 17% of all bikeways network in Warsaw. This network is supplemented by traffic calming zones existing in majority part of quarter and by bicycle friendly urban structure.

In this mean, Bielany is the most advanced part of Warsaw in implementation of sustainable traffic safety, as an integral part of sustainable development. In the paper, state of running of Bielany bicycle network are compared with measures in all Warsaw Area. The conclusions concerning technical state, functional and organisational solutions of bikeways are common for the whole area of Warsaw.

Outline of the method applicated to evaluation of development and functioning cycling network presented in the paper is a trial of definition of functioning this element of transportation infrastructure. This multicriterial method relies on the quantitative and qualitative evaluation of planning cycling network as entire network and particular cycling itineraries section. Dutch method of CROW adopted and developed to polish conditions was applicated to evaluation and to analysing of running of bicycle network. In this base ranking of functioning and quality of cycling itineraries in analysed area was elaborated.

In evaluation of implementation of Bicycle Master Plan and cycling network the following criterions have been considered five criterions expected by cyclists: coherence network, directness, atractivness, safety and comfort, as well as: level of fulfilling of bicycle network in relation to planning solution, level of utilisation bicycle infrastructure by cyclists, technical standards, signs, type and state of pavements, location of bike paths in transversal sections of streets, with special regard to relation between location of space for bike users and pedestrians and level of bicycle traffic menace. Results of analyses confirm both accuracy of operations that have been taken and their significant influence on to reduction of road accidents' menace.

1. INTRODUCTION

In the paper is presented the stage of functioning and stage of development planning of bicycle infrastructure in one District of Warsaw Bielany in the background of entire Warsaw and the outline of the method applicated to evaluation of development and functioning cycling network as a trial of definition of functioning this element of transportation infrastructure.
To this time in Poland didn't undertake to evaluation of working of bicycle networks and their ways. In this purpose, Dutch method contained in manual of planning and designing of bikeways (CROW 1993), which is recommended to evaluations of efficacity of bikeways

planning to implementation, was adapted to Polish conditions and to evaluation of working of bicycle network. This multicriterial method relies on the quantitative and qualitative evaluation of planning cycling network as entire network and particular cycling itineraries section.

2. STATE OF DEVELOPMENT OF BIKWAYS NETWORK

Development of cycling network in Warsaw is an element of official sustainable transport policy decreed as a resolution of Muinicipal Council in 1995 and in others urban planning documents. Part of them are official documents of local law. In Bielany District in the base of study of cycling network development by author (Zalewski 1994) and resolution of Warsaw Municipality Council, District Council was decreed in 1996 resloution concerning Bicycle Master Plan in Warsaw Bielany District[1].

In the project of Strategy of Development of Warsaw from 2005 role and activites of bike is taken into consideration in one of the stategic purposes – "Improuvment of quality life and safety of Warsaw inhabitants" in operational aim concerning of assurance of passanges and goods safety movements in the town and in the operational programs related to mention aim. Simultaneously it's necessary to note that developement of cycling infrastructure in Warsaw is an effect of transformation system in Poland. During previous epoch until to 1990 a problem of cycling and cycling infrastructure was profibited and eliminated by Authorities of Warsaw.

A bicycle in Warsaw conditions, as well as in conditions of polish towns and agglomerations is a seasonal transportation and recreation mode. Present participation of bike in modal split is near by 1% and in the spite of development of cycling infrastructure is generally constant. After implementation of full bikeways program (to 900 km during next years) is expected the grow to 5%.
Low level of utilisation of bicycle in Warsaw is a result of of big spatial extention of the town and big distanstes between sources and purposes of inhabitants journeys (average length of daily journey to work is more than 5÷6 km).

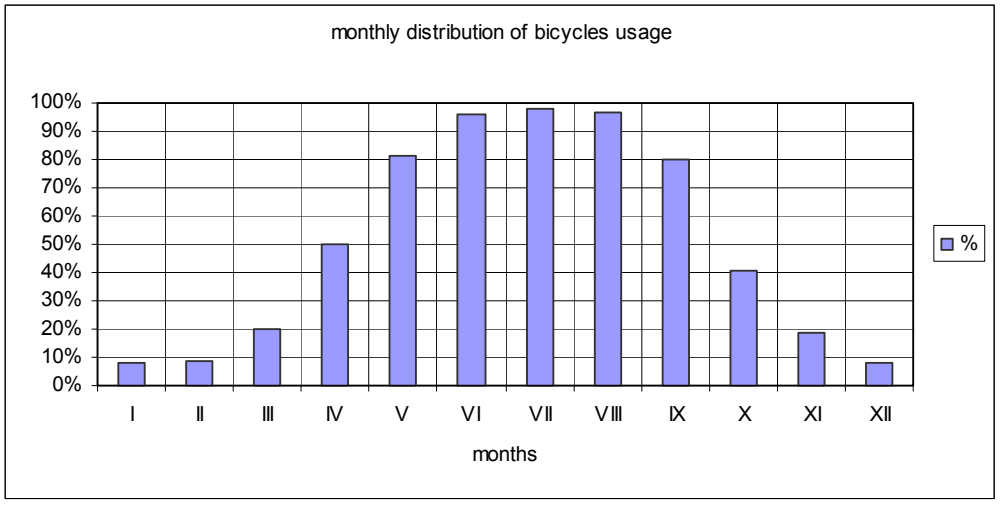

Fig. 1. Bicycle usage during the year in Warsaw according to researches (Bochenko & Gugała 2003)

[1] Warsaw Bielany District is situated the north – western zone of Warsaw in the left riverside of Vistua River. On the 32,3 km^2 live 136 thousands inhabitants. The North –West part of Bielany District borders with zone of Kampinowska Wilderness (National Park).

Utilisation of bicycles is highest during the spring – summer period. Strong increase during the period of march ÷ april and decrease during the period of october ÷ november are noted (fig. 1). During the winter (december – february) utilisation of bicycles is a very low. It's a result of very difficult atmospheric conditions (frost, snow, rains and winds). During the spring and summer, bicycle is used as a recreational mode and as well a transportation mode in the travels to shops and services.

Simultaneosly, we had to note that Warsaw:

- is a flat town,
- urban structure is in majority part monofunctional, that means longer average length of journeys,
- exists very good developed and efficient transport public network with prices of tickets generally friendly to passangers[2]
- traffic car density exceed of 3000 vh/day and speed of traffic V_{85} exceed 50 km/h in principal street network, that substantiated separation cycle from traffic car.

Existing state of development of cycling network in Warsaw is showed in fig. 2 and cycling network planned in Warsaw is presented in fig.3. Existing bikeways network and bike tourism itineraries network are showed in fig. 4. In existing stage (end of 2005 year) near by 230 km of bikewyas is running in Warsaw and 24 km of them is situated in the Warsaw - Bielany District. Bikeways network is supplemented by the bike tourism itineraries conducted in street with traffic and speed limited or in forest zones and as well as in agriculture roads (near by 30 km in Bielany District). In the number of inhabitants in entire town – 1600 thousants and 136 thousants in Bielany, spatial density of cycling network are relatively: 0,44 km/km^2 and 0,68 km/km^2. Demografical density of cycling network are relatively: 0,15 km/1000 inhab. and 0,4km/1000 inhab. Coefficients contains in Bicycle Master Plans are higher and they are planned in the level of 0,56 km/ 1000 inhab. in Warsaw and 0,7 km in Bielany District.
In this mean, in Bielany Distict cycling infrastructure is more developed than in entire Warsaw.

In cycling infrastructure in Bielany District exists following type of cycling infrastructure: independent bikepath[3] - 55%, two - way bikepath[4] - 21 %, pedestrian – bicycle mixed itinerary[5] - 21%, bike street[6] – 3%.

Similar structure of type of bikeways exists in others districts of Warsaw. In the Warsaw one-way bikepaths are exceptions and bike lanes don't exist. It's a result of location these bikeways in section of the streets, that are wide and difficult crossing.
It have to note that data concerning of stage of development of bicycle infrastructure mentioned above don't take into consideration bicycle friendly infrastructure in traffic calming zone (inhabitants area with speed limit to 20 km/h and zone of speed limit to 30 km/h) that are developed systematically and create good and safety conditions to bicycle travel[7].

Half of length of existing bikeways as well as in Bielany and in entire Warsaw was constructed as a special investments impemented bicycle infrastructure in to street section. In the base of efectueted survey (Gugała 2003), bikeways in Bielany District are used in recreational purposes in 25%. Mixed utilisation (recreational and daily travels) are in 75% of bikeways length network. In others districts of Warsaw, structure of bikeways utilisation is different and depends of local conditions. Daily usage of bikeways is estimated on 10% maximum.

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[2] from 2003 in Warsaw transport of bike is free of charge in transport public modes;
[3] independent bikepaths – bikepaths physically separated from cars and pedestrians;
[4] two way bikepaths – bikepaths physically sparated from cars, but from pedestrian only by colour of pavement or by horizontal marking line;
[5] pedestrian – bicycle mixed itinerary – pedestrian and cycling traffic in common surface separated from traffic cars;
[6] bike street (bike route) - car and bicycle traffic mixed with limitation of speed to max. 30 km, directional signs to cyclists and
[7] at present (fin of 2005) in Warsaw number of traffic calming area is estimated on the level of near by 300 km of local street. Traffic calming zone supports existing cycling infrasructure;

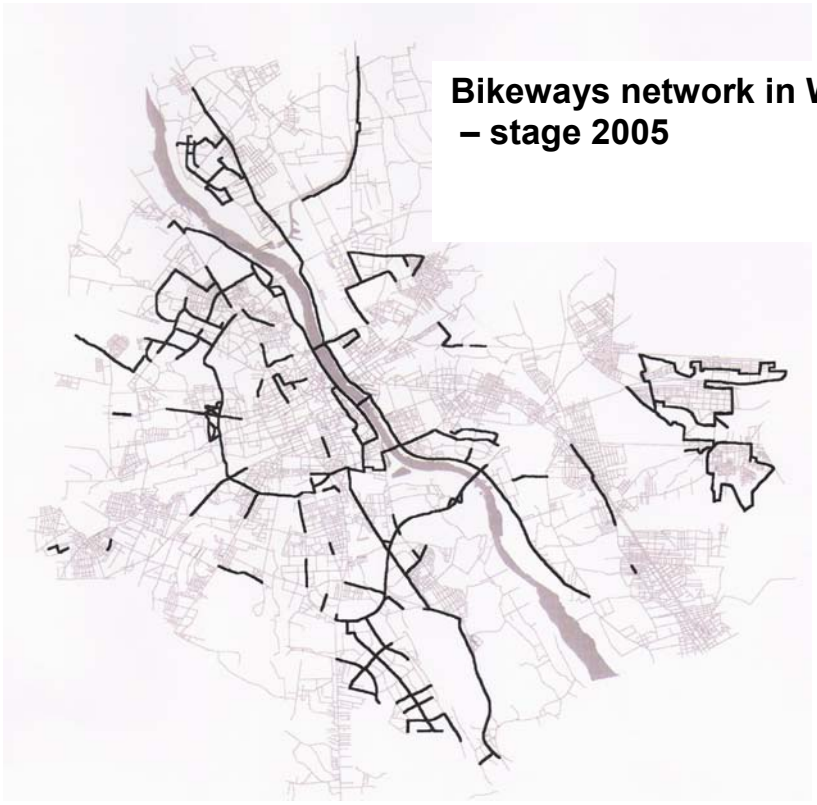

Fig. 2. Bikeways network in Warsaw – state 2004 (230 km) (Kulesza 2004)

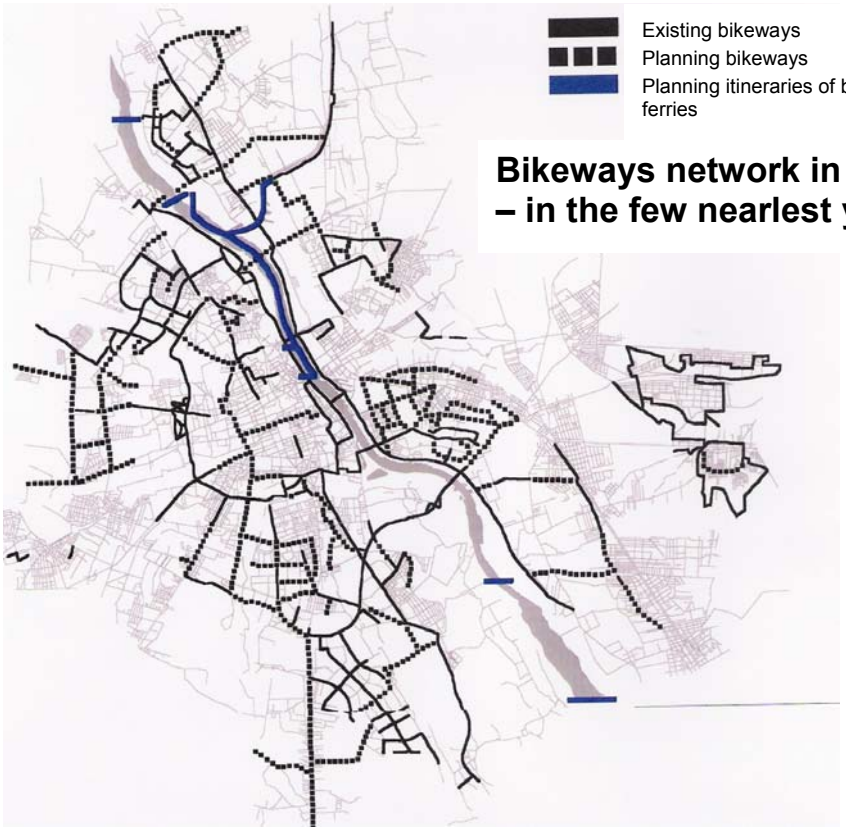

Fig. 3. Bikeways network in Warsaw in the few nearlest years (370 km) (Kulesza 2004)

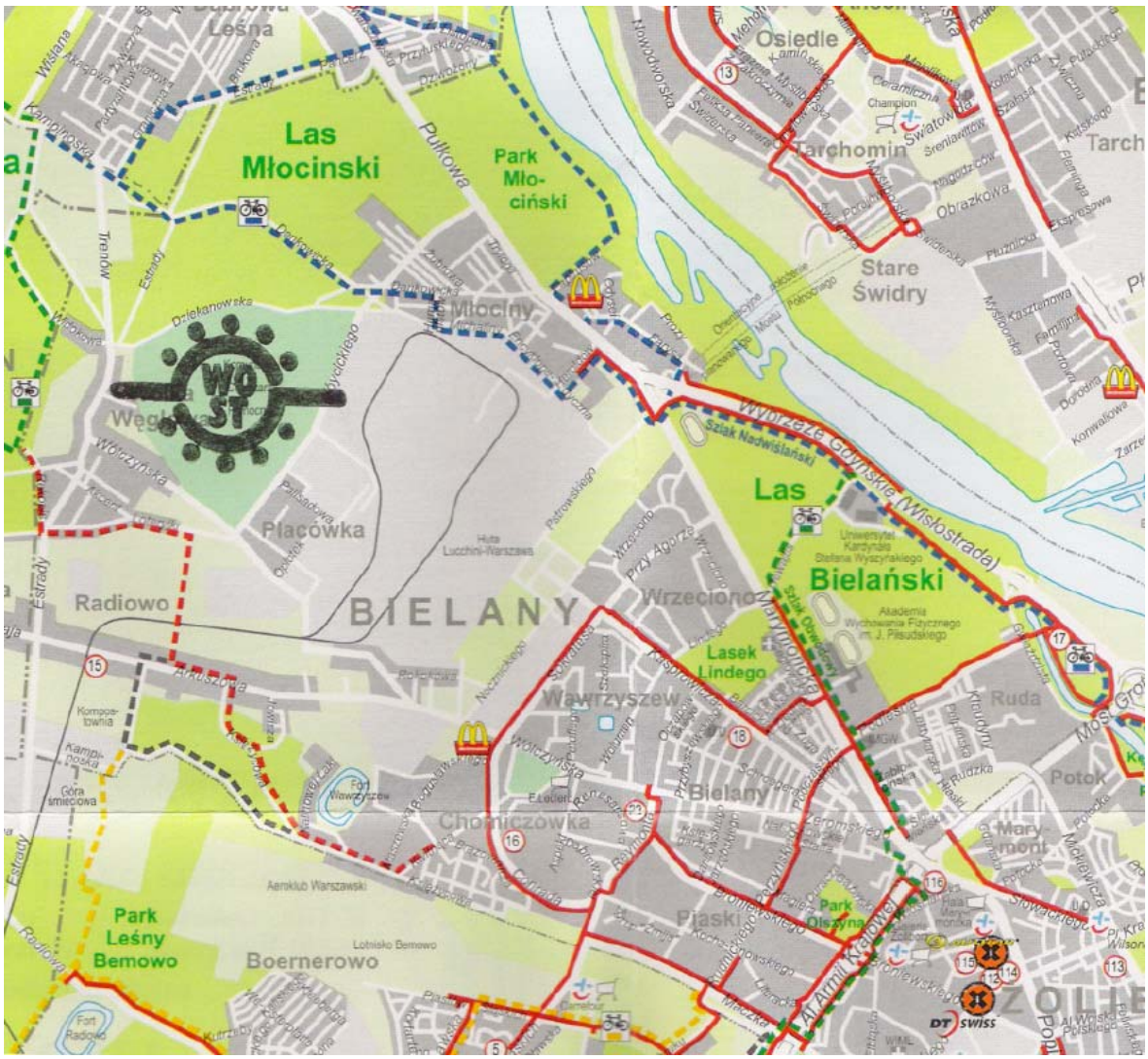

Fig. 4. Existing bikeways network and bike tourist itineraries in Warsaw Bielany District /continous line – existing bikeways, interrupted line – existing bike tourism itineraries/ (Sobotkowscy 2004)

In Bielany District existing cycling network serve majority of build – up areas, and bikeways network connects practically all zones of multifamiliar areas. Bikeways network is integrated with cycling infrastructure in neighbouring districts of Warsaw. Unfortunately links with zone of Kampinowska Wilderness (National Park) isn't in good technical and functional quality. Improvement of these connections should be priority in developement of bicycle infrastructure when recreational utilisation of bikes predominates in Warsaw.

In relation into entire town, principal problem is a small coherence of bikeways network. There are lack of dense and continous network of connections between neighbouring districts. Typical solution of different types of bikeways infrastructure in transversal section are showed in fig. 5a – 5c.

In relation to typical solution – location of bikepath between carriegeway and footpath, oposite solution of location bikepath (cycle is situated externaly in relation to pedestrians and carrigeway) was developed in Warsaw conditions. Participations of this dangerous solution permitted by polish technical standards amount 25% of cycling network.

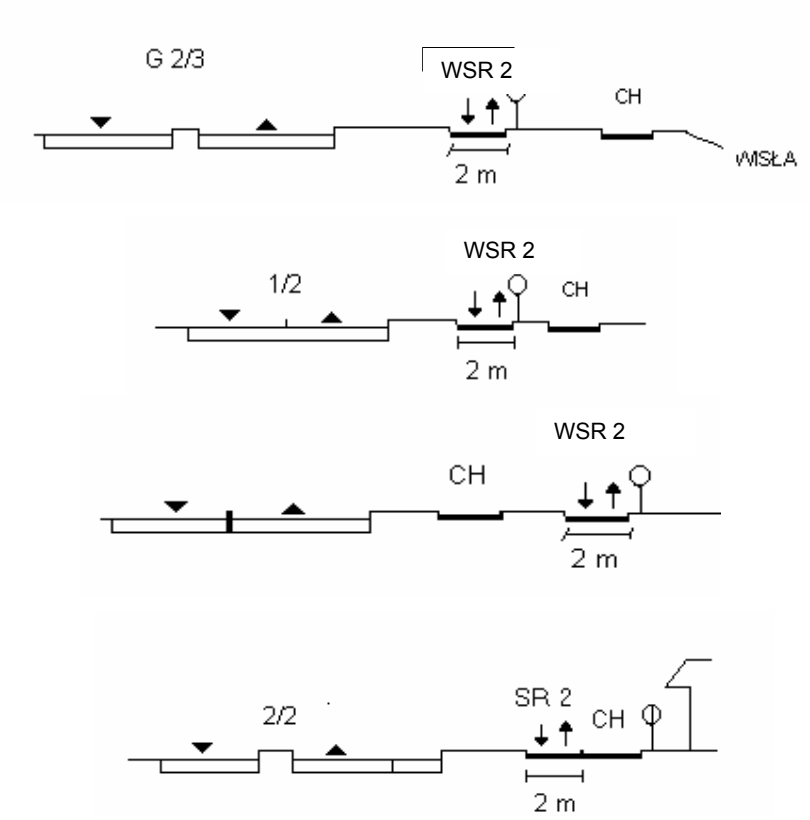

Fig. 5a. Examples of typical location of independent 2 – ways bikepaths (WSR 2) and 2-ways bikepaths (SR 2) in transversal sections of the streets (CH – footpath)

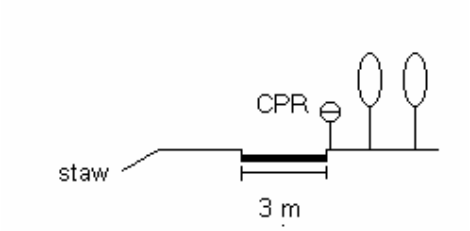

Fig. 5b. Example of typical location of pedestrian – cycle itinerary (CPR) in the out of street

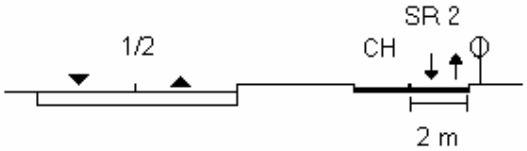

Fig. 5c Example of typical location of 2-way bikepath (SR 2) externaly in relation to foothath (CH) in transversal section of the street (solution very disadventagable of pedestrians traffic safety)

Majority width of 2-way bikepath and pedestrian – cycle itinerary is a 2 – 3 m. Stage of parking along the bikeways isn't satisfactory in Bielany District, because in ¾ lenght of cycling network, parking is permitted. In entire Warsaw situation is better – only in 50% of lenght newtwork is permitted.

Type and technical state of pavement are next measure of state of bikeways running. As well as in Bielany District and in entire Warsaw predominated is pavement in concrete bricks, non – prefered by cyclists. The pavements of bikeways are in good technical state and it's a result of relatively recently constucted of them.

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In all bikepaths are vertical signs. In bikepaths in Warsaw conditions is located 5-6 of signs average per 1 km. Horizontal sign „bike" exists only 10% of lenght of bikeways in average to Warsaw amount 25%.

Daily flow in bikeway during spring – summer period, dependly of network section is estimated on 270 ÷ 540 bikes/day in Bielany, whereas in others districts is estimalted on 270 ÷ 1040 bikes/day. In estimations of author, highest volume of cyclists is in the bikeways in reacreational area or in the bikeways conductued to this zone.

In spite of bicycle densities concerns of spring – summer period, when cycling is higer than in other part of year, in point of vue of road traffic safety, it substantiate segregation of bicycle and separation from car traffic and construction of bikepath or itinerary mixed pedestrian – bike.

Junctions, crossings, busstops and others conflict points make menace to cyclists. In Bielany District density of conflict points amount totaly 2,4 point/km and it answers to average stage in Warsaw:

- density of junctions and crossings per 1 km of bikeway – 0,5 unit/km
- density of transport public stops per 1 km of bikeway – 1,1 unit/ km
- density of other conflict point per 1 km of bikeway – 0,7 unit/ km.

In the all junctions with traffic lights equipped in bikepaths are special lights for bikes and length of green phase and other solutions concerning cycle are adopted to requirements of bicycle traffic. Parking facilities to cycles is developed systematicaly and increased as weel as in Bielany District and in others parts of Warsaw.

Analyse of measures of existing stage of bicycle infrastructure shows that bikepaths in Bielany District and in entire Warsaw are in good technical stage and willingly use by cyclists, exactly during the spring – summer period.

According to data of Municipal Highway Administration, in Warsaw average yearly is happened 60 acidents with cyclists and during 2002 – 2004 years it was near by 3,3% ÷ 3,6% of all road accidents in the town. It isn't high coefficient and he's in same level from few years. But, if we take into consideration that participation of cycling in road traffic flow is small and the fact that quite each accident with cyclists mean the death or the serious injuries, it's a significant problem in road managment. During 2000 – 2003 in Bielany District happened average yearly 6 accidents with cyclists. The same data concerning injured cyclists. Data mentioned above are

concerned generally to group of accident cycle – car. Accidents cycle – pedestrian have smaller participation, but theirs effects, exactly to pedestrian are equally serious as effects of accidents cycle – car[8]. According to statistical data of Highway Municipality Administration less than 1 cyclists average yearly was killed in a few last years. In Bielany District only 1 cyclists was injured deadly in road accident. Comparation of coefficient of number of cyclists dealt in road accident with coefficient of number people killed in all accidents happend in Warsaw don't conduct to synonymous conclusions. In Bielany District is least menace of death in accident by cyclists in relation to remaining 17 district of Warsaw, because only in 1 to 16 accidents are deadly effects. Probably it's a result of development of functional cycling network in this district.

3. OUTLINE OF THE METHOD EVALUATION OF IMPLEMENTATION OF BIKEWAYS NETWORK

3.1. Scope of indispensable data

Outline of the of evaluation of implementation of bicycle master plan and bicycle network concerns existing and planned solutions. According the author's evaluation of function of bikeways should be expressed in relation to entire network and to each particular section of bikeway or to bikeway itinerary separately.

To evaluation of stage development of bicycle network should be used following functionnal – technical quality and quantity parameters:

- existing and/or planned lenght of bicycle network [km],
- spatial density of bicycle network [km/km^2],
- demographical density of bicycle network [km/1000 inhabitants.],
- structure of bicycle network according of type of bikeway [km] – length of independent bikepaths, two and one way bikepaths, pedestrian – bike itineraries mixed, bicycle street (parts of streets with traffic mixed friendly to cycle),
- type of bicycle network usage [km i %] – daily, recreational and mixed.

In the scope of evaluation of elements of bicycle networks solutions should be taken into consideration following functionnal – technical quality and quantity parameters:

- length of bikeway [km]
- width of bikeway [m,
- form of parking along of street [km i %] – parking permitted and unpermitted,
- kind of pavement material (concrete brick, asfalt, soil, footpath flat, etc.) [km i %],
- technical stage of pavement [km i %],
- stage of vertical and horizontal alignment in units/km and their technical stage,
- bicycle traffic average volume:
  - daily [bikes/day],
  - hourly [bikes/hour],
  - speed and percentile V_{85} of bicycle traffic [km/h],
  - average hourly volume of car traffic [vehicle/h],
  - average daily volume of car traffic [vehicle/h],
  - percentile V_{85} of car traffic [km/h].

In scope of measures of road traffic safety should be analyse statistical data concerning accidents and their causalities from few last years. Following coefficients of traffic road safety related to cyclists should be estimated:

- average yearly number of accidents with cyclists
- average number of injured cyclists per year,
- average number of killed cyclists per year,

[8] Moreover same part of accident cycle – pedestrian aren't regisred in official statistics.

- average number of accidents with cyclists /100 accidents per year,
- average number of causalities cyclists/ 100 accidents per year,
- coefficient of average number of cyclists accidents in relation to all road accidents per year[%]
- coefficient of average number of causalities cyclists in accidents in relation to all roads accidents per year [%]
- coefficient of number of killed cyclists in relation 100 injured cyclists per year
- coefficient of number of causalities cyclists in relation to all victims in road accidents
- density of conflict points along of bikeway [units/ km] with distinction of crossing by bikeway (junctions and exits), public transport stops, others collission points.

State of development of bikeways network and his utilisation should be compared with final development stage or with model any unknown solutions in anothers towns and agglomerations.
Data mentioned above are very detailled. Collecting comparable data can be make some difficulties and therefore is necessary to use measures with available data.

3.2. Definition of measures of principal criterions

In presented method is adoption to polish conditions of dutch method [CROW 1993] with taking into consideration of principal criterions of cycling-network: coherence, directness, atractivness, safety and comfort in formula mentioned below:

$$\mathbf{Ef = I*(U1*E1*W1+U2*E2*W2+U3*E3*W3+U4*E4*W4+U5*E5*W5)} \quad (1)$$

where:
Ef – effectiveness of a measure,
I – number of cyclists benefiting from measure (average seasonal volume of cycling traffic),
U1 do U5 – urgency score per criterion,
E1 do E5 – efect of measure per criterion 1 - 5 (value of parametr characterized particular criterion)
W1 do W5 – weighing factor per criterion,
In existing cycling network should take value of urgency U1 ÷ U5 as 1. In analyse of planning bicycle network or bikeways itineraries urgance is a suplementary weigh and can take other values relative to needs.

Adaptation this method to polish conditions was required to apply measures of particular criterions which were possible to define in base of available data. The author has been proposed following definition of criterions mentioned above.

Coherence – to evaluation of function of cycling network this criterion author propose to definie by:
a/ degree of coherence network by Prihar`a [Potrykowski, Taylor 1982];

$$\mathbf{C_{st} = v(v-1)/2e} \quad (2)$$

where:
C_{st} – degree of coherence network (maximal possible number of links to number of borders of network)
v – number of nodes
e – number of borders (arches)
Degree of coherence of network take value between: 1 – coherence maximal, v/2 – coherence minimal.
and

b/ coefficient of homogeneity of quality of cyling network defined as average wieighing coefficient of particular section:

$$\mathbf{Q_w = \Sigma\, O_i * L_i / \Sigma L_i} \qquad (3)$$

where:
O_i – rank admitted to particar type of bikeway
L_i – lengtht of section i
ΣL_i – sum of network length .

Homogeneity of facilities in entire section was definied as coherence of section. Type of cycling facilites was evaluated and following ranked:
- independent bikepath (2-way) – 5 points,
- bikepaths without of separation with pedestrians – 3 points,
- itinerary pedestrian – bike and bike route – 1 point.

In ranking of different type of bicycle facilities was taken into conisderation that cyclists prefer facilities with physical separation bike form pedestrian and from car. In this way, most lower rang received itineraries mixed (pedestrians – bikes and bikes – cars).

To analyse of cycling-network sum of product of rank particular type of bikeway and lenght of particular section divided by entire length of cycling-network.

Directness – this criterion was defined by:
a/ coefficient of inverse of network extention W_w:

$$\mathbf{W_w = 1 / \Sigma\, l_i / l_{oij}} \qquad (4)$$

where:
l_{ij} – length of section of bikeway caluclated by cycling network in spatial relation i - j,
l_{oij} – length in air lined in spatial relation i - j,.
and by:
b/ coefficient cycling speed weighing by length of section in network W_p[9]:

$$\mathbf{W_p = \Sigma\, l_i V_i / \Sigma\, l_i} \qquad (5)$$

where:
V_i – speed journey specific of type of bicycle network,
remaining symbol as above.

Cycling network sections was ranked in function of speed value. Therefore, average speed journey was ranked in range 0-5: 25 km/h – 5 point, 20 km/h – 3 point, 15 km/h – 1 point.

Atractivness – the criterion of atractivness in relation to entire cycling network, was evaluated by coefficient of network atractivness – W_a, according to following formula:

$$\mathbf{W_a = \Sigma\, l_i * A_i / \Sigma\, l_i} \qquad (6)$$

where:
A_i – atractivness of particular section in function of type of bicycle facility,
l_i – lenght of section of particular type of bikeway.

The sections of network, in atractivness aspect was definied in the following terms:
- 5 points – atractive lanscape, good traffic conditions
- 4 points – atractive landscape, average traffic conditions,

[9] this measure of directness is recommended in dutch method [CROW 1993];

- 3 points – little atractive landscape, good traffic conditions,
- 2 points – little atractive landscape, average traffic conditions,
- 1 points – unatractive lanscape, difficult traffic conditions.

Safety – implementation of cycling route situated outside of carrigeway generally eliminate or reduce significantly number of accidents with cyclists. In Poland, accidents in bikepaths even happened in bikepaths, they are as non numerous non registred in statistics of road safety[10].

Therefore, is very difficult to applied objective measures expressing real stage of traffic menace in particular section of bikeway, as parameter describing particular section in function of road safety. In evaluation of cycling traffic safety in particular section of bikeway was applied coefficient of potential menace of cyclist safety definied as a sum of quotien of length of bikeway and number points crossing of bikeway with different barriers: transversal road, junctions, busstops, exits and others conflict points in zone od intensive pedestrian traffic per 1 km of cycleway. Then, results was presented in the range 0 – 5 and average weighing according to following formula:

$$W_b = \Sigma\, l_i * B_i / \Sigma\, l_i \qquad (7)$$

where:
B_i – coefficient of potential menace in particular section of bikeway,
l_i – as above.

It should note, that estimated coefficient of potential menace of cyclist traffic safety, in mean presented above, is a relative measure and isn't considerate level of cyclist traffic safety. In author's opinion, this potential measure of menace of cyclict traffic safety in comparative analyses of particular section of cycling network, as well as in comparative analyses as a criterion between cycling networks.

Comfort – in evaluation of function cycling network was applied coefficient of comfort network – W_k, definited as average a weighing length of sections in network and coefficient of comfort, according to following formula:

$$W_k = \Sigma\, l_i * K_i / \Sigma\, l_i \qquad (8)$$

where:
K_i – atractivness of particular type of bikeway,
l_i – length of particular of type cyclists section.

Ranking of sections in comfort aspect was described as followed in range 1 to 5:
- 5 points – bikepath physically separated from footpath, in different colour and good technical stage of pavement,
- 4 points – bikepath physically separated from footpath and technical stage of pavement variable,
- 3 points – bikepath conducted along of footpath, separation by marking line divided surface between pedestrians and cyclists, other colour of pavement and pavement in good stage,
- 2 pkt. – bikepath runned along of footpath, separation by marking line divided surface between pedestrians and cyclists, frequent contacts with pedestians and pavement in average stage,
- 1 points – bikepath runned along of footpath separation by marking line divided surface between pedestrians and cyclists or itinerary pedestrian – cycle mixed and pavement in the bad stage,
- 1 points – cycle road (cycle – car mixed traffic).

[10] in polish conditions accidents pedestrian – cycle are declarated very rarely to police raports and to insurance societies;

In evaluation of function network in particular cycling network area was applied relative measures:

- in I serie of parameters characterized stage of development of cycling facilites:
  - coherance as a coefficient of homogeneity of section quality of cycling network ,
  - directness as a average cycling speed weighing by length of section in network,
  - atractivness as coefficient of cycling network atractivness,
  - safety as coefficient of potential menace in particular section of bikeway,
  - comfort as coefficient of bicycle network.
- in II serie of analyses, measures of coherance and directness was repliced by degree of coherence network by Prihar`a and coefficient of inverse of network extention.

Others measures wasn't changed.

The method presented above can be use to analyse of function of cycling itineraries. Existing cycling network was divided into coherente itineraries of cycling infrastructure compount from few particular section of network and assured of connecting place frequently use by cyclists. Each of distinguished itineraries was evaluated according of criterions mentioned above. In this analyse coherence of itineraries was estimated by the coefficient of homogeneity of quality sections and directness by the coefficient of average cycling speed weighing by length of sections in the particualar itinerary. Others criterions was estimated by measures presented above in evaluation of cycling network.

Two serie of analyses was made, that differented in used weight distributions among the five main requirements.

Regardless of used weight distributions in the highest ranking places was the itineraries compount from independent bikepaths and conducted in atracticive lanscape conditions, where can travel with speed 20 – 25 km/h and sections that made connections with other parts of network. This itinerarary are very frquently used by cyclists, too.

Analysed cycling itineraries according of 5 main requirements and two series of weights was evaluated to defined of influence of weight into ranking efficacity of cycling itineraries. Correlation coefficient of Spearman to rankings of cycling itineraries was used in formula mentioned below:

$$\rho := 1 - \left[\frac{6 \cdot \Sigma \cdot d_l^{\,2}}{N \cdot (N^2 - 1)} \right] \qquad (9)$$

where:

N – number of cycling itineraries,

d_l – difference ranking place in two series.

Estimated correlation coefficient of Spearman of cycling itineraries ranking was following:

- 0,97 to rank of efficacity of cycling itinerary when density of cycling traffic was taken into consideration,
- to rank of efficacity of cycling itinerary when density of cycling traffic wasn't taken into consideration,.

In two analysed weight disposition, high values of coefficient of correlation of ranks indicate, that disposition of weight don't infuence of efficacity of usage of cycling itinerary. Itineraries runned along the footpath, characterized of poor technical parameters and low importance in connections in cycling network, was situated in the latest ranking places. Evaluations of bikeways network and bikeways itineraries done for others Warsaw districts, as: Bemowo, Wola (Bochenko 2003), Żoliborz (Gugała 2003) and Ursynów (Michalak 2004) confirm conclusions from analaysed concerned Bielany District.

4. FINAL CONCLUSIONS

As experimental ranges was chosen five districts of Warsaw and results concerning one of them – Bielany Districts was presented in the paper. This district was chossen because there is existing bikeways networks quite well developed and proposed method could been applied to evaluation of network and to running of bikways.

Obtained results confirm, that most functional solutions for bicycle traffic are these, which are separated bike traffic from car and pedestrian traffic. On separated and independent bikeways make possible travelling with speed average of 20 - 25 km/h. Cycling is in attractive landsacape and environment conditions and this attraction for users. Intensity of bicycle traffic is very essential element of evaluation in analyses of working bicycle network and and their sections. Cycling traffic is very unstable of urban journeys and procedure of its measurement should be elaborated to comparability of results.

In reference to definie of criterions of working, in relation to bikways network as entire and in relation to of each bikeway, forms of parametrization of criterions should be seek and is nessecary to univocal qualifications for each types of bicycle ways.

In reference to examined districts of Warsaw, executed analyses confirm rightness driven of activities in range of development of bikeways network. Independent two-way - bicycle paths and two-way - bicycle paths driven along street diminish significantly state of accident menace of cyclists. Alarming occurrence from point of view traffic safety is tendency to locating of sidewalk to pedestrians between street and bicycle path, if pedestrian and cycle move on common surface and are not separated physically. These solutions cause considerable increase of traffic safety menace of pedestrians and cyclists, too.

In coming years of activity in range of development of bicycle network should be conducted first of all in aspect of integrating till now realized of bikeways to improve of cohesion of network.

In spite of, that in report to evaluation of working were analysed only bikeways network in five districts, these introduced attentions relating to technical state, functional - organizational solutions of bikeways networks and their elements, conclusions can be stretch on bicycle ways in all Warsaw.

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