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AREA CLAIMS OF THE PASSENGERS AT MASS PUBLIC TRANSPORT HUBS

Summary. The article presents the results of the first period of a research carried out at The Czech Technical University in Prague, Faculty of Transportation Sciences, which is aimed to set the optimal dimensions of waiting areas in the premises of public mass transport change nodes. It is aimed especially at a structure of passengers using public transport expressing the percentage of each of the groups for which different areal demands are characteristic. Such survey has not been carried out in the Czech Republic so far. Application of the research, of which the first outputs are presented in this article, allows us to upgrade an outdated methodology for setting an appropriate dimensions of public parts of railway station buildings, which is still used in the Czech Republic.

OBSZAR ROSZCZEŃ PASAŻERÓW W MASOWYCH, PUBLICZNYCH WĘZŁACH KOMUNIKACYJNYCH

Streszczenie. Artykuł przedstawia rezultaty pierwszego okresu badań przeprowadzonych w Czeskim Uniwersytecie Technicznym w Pradze (Wydział Nauk Transportowych), którego celem było określenie optymalnych wymiarów przestrzeni oczekiwania w lokalach publicznych masowych transportowych węzłów wymiany. Ma to na celu, zwłaszcza w strukturze pasażerów używających transportu publicznego, procentowe wyrażenie każdej grupy, dla której charakterystyczne są różne wymagania przestrzenne. Takie badanie nie zostało jeszcze wykonane w Republice Czeskiej. Zastosowanie badania, którego pierwsze wyniki zostały zaprezentowane w tym artykule, pozwala nam na uaktualnienie przestarzałej metodologii w celu opracowania odpowiednich wymiarów dla publicznej części budynków stacji kolejowych, które są w Czechach nadal używane.

1. INTRODUCTION

One of the many aspects of passenger transport facility design in change nodes of public mass transport is with no doubt setting sufficient, but also efficient dimensions of these facilities. This problem can be observed from three different points of view – the first one – and mainly determinative – is following the current standards. The next one to be taken into account is the view of the designer (or the operator, investor, owner), for whom the crucial parameter are the costs of the construction (reconstruction) of the facilities trying to minimize them as well as gaining the minimal changes to the existing devices / facilities. As it is necessary to increase the competitive ability of the public mass

transport, it is vital to include also the last (but definitely not least) point of view – the view of passengers themselves.

For a common passenger – speaking of the public passenger railway transport or public mass transport generally – following the current standards is not a defining indicator of a transport quality. This fact comes out mainly from the non-standardness of the passengers themselves and a variety of situations that occur during the transport process in the change nodes. Applying a discrete overview, definitely a passenger heading to his office, who has no need to look for the connection details and traveling with almost no luggage, behaves differently compared to a group of people on a holiday trip, who are using the connection for the first time and whose situation is complicated by a large amount of luggage.

These differences in the passengers´ structure must be taken into account when designing all change node facilities and it is necessary to assess, whether it is possible to simulate a group of passengers using standard values or whether in this concrete situation it is advantageous to differ the qualities of each group, which enables to reach better results when optimizing the public mass transport change node design. This applies to all areas designed for waiting or transfer of the passengers – waiting rooms, traffic halls, porches, corridors, stairs or platforms.

This article sets a goal to find and describe the differences in passengers´ areal demands by defining a typical structure of passengers according to a connection category and then to suggest a method to take these facts into account when designing the passenger areas. To be able to clearly distinguish the connection categories and also concerning the fact, that the heart of each public mass transport change node should be formed by a railway transport (it provides clear categories of international, long-distance, regional etc. connections), the following surveys were carried out only at railway stations concerning only railway passengers, but it is also applicable to a non-railway transport.

2. PASSENGER CATEGORIZATION

To be able to describe the passengers' areal demands it is not sufficient – by reasons given in the Introduction – to use standard values. Therefore it is necessary to find and define such groups of passengers, which are easy to identify and where the differences within one group are so small that they can be ignored. Based on a real situation observation, following groups of passengers were defined for further analysis:

- passengers with no luggage or passengers with a hand luggage such as purse, case or a small plastic bag etc.
- passengers with a small backpack with a size of a common school bag
- passengers with a large backpack – backpacks obviously larger than common school backpacks were recognized – usually of volume of more than 50 l, difficult to manipulate
- passengers with a suitcase or a sport bag (carried over a shoulder) – the same luggage category as the previous group, only carried by the side
- passengers with a roller-case
- passengers with a pram (baby-carriage)
- passengers with a bicycle

This sorting should concern not only the size of the transported luggage, but also the way, how this luggage is carried or transferred, because in some cases the way of carriage of a luggage of the same size means very different areal demands, on the other hand, areal demands of luggage of different size could be almost the same.

Although the sorting is quite detailed, it is necessary to use the average values out of a large amount of data, as even within one group we can see an appreciable spread of the gained values. This is caused mainly by the differences in the passengers´ bodies themselves, way of their stance and walk, by a shape of their luggage and the way it is carried or by other outer impacts (e.g. in a full waiting room surrounded by other people the passenger demands subconsciously lesser area than in an

empty one). However, even after covering these individualities, after averaging the gained data it is possible to find clear differences among the previously defined groups and these values can be used – together with other collected data – to optimize passenger facilities design in change nodes.

3. AREAL DEMANDS ACCORDING TO THE PASSENGER CATEGORY

The first step to define the reliance between the area demanded by one passenger and a connection category is setting an areal requirement of passengers divided according to the previous chapter.

For the on-site surveys more important stations and nodes within the Czech railroad network were chosen, because it is possible to await there a more varied structure of passengers, which allows us to obtain a relevant amount of data for each of the groups and the results can be then considered appropriate. The surveys were carried out in the stations Beroun, Hradec Králové hl. n., Kolín and Praha Masarykovo nádraží – both on working days and at the weekends. The methodology was chosen in such a way, so the passengers (or their stance, way of luggage handling etc.) were not influenced by the awareness of the ongoing survey. It was therefore necessary to find a procedure accurate enough, which does not include the passengers´ assistance. For this reason the survey was carried out in such places, where the ground is covered in floor tiling. When the tile size is small enough, it is possible to count the number of them, occupied by the passenger quite precisely and knowing the area of each tile, it is possible to find out the passenger´s total areal demand. For the calculations tiles with area from 0.01 to 0.0225 m^2 were used. Calculated results can be found in the Table 1.

Table 1

Area demanded by different groups of passengers

	area demanded by 1 passenger [m^2]		
luggage category	**max.**	**min.**	**avg.**
no luggage / hand luggage	0,27	0,14	0,21
small backpack	0,36	0,18	0,22
large backpack	0,80	0,20	0,48
suitcase / sport bag	0,79	0,25	0,42
roller-case	1,89	0,41	0,73
pram	1,44	0,47	0,83
bicycle	0,95	0,63	0,74

It is clear from the table that by some of the groups a larger spread of values was registered. They are mainly the groups with a larger luggage or a pram, where the way of handling and a position of the luggage play a role. On the other hand the spread of the bicycle group gets smaller again – this can be explained by a restricted number of possibilities how to handle a bike concerning its stability. Generally speaking the results supported the assumption that a passenger area demand depends on the size of his or her luggage, finding that the demands of ground-transported luggage (roller-case, pram, bicycle) grow faster.

4. DETECTION OF PASSENGERS´ STRUCTURE ACCORDING TO THEIR CATEGORY

To be able to discover areal demands of passengers in the change node facilities, it is necessary to find out not only the areal demands of each of the categories, but also their percentage structure among all passengers. At this time it is possible to recognize two types of areas. The first one are the areas where it is not possible to define a connection category, which was (will be) used by the passenger. The example could be a waiting room, where passengers of all trains stopping at the station gather. In this case average values must be used.

The other type are such areas, which could be advantageous to differ according to the passengers´ structure. The example of these areas could be platforms. Some of them are used for fast trains and higher-quality trains, whereas the others are used only for local and regional transport. In such cases, applying different requests for areal demands depending on the passenger categories, it is possible to prevent designing the corridors and platforms excessive together with providing comfort and safety increase in the areas, where passenger demands are higher.

In the Table 2 a structure of passengers recorded in the railway station buildings and in passenger railway carriages is presented. The survey was carried out to distinguish the passengers according to their connection category. The station surveys were carried out in stations Beroun, Česká Třebová, Zábřeh na Moravě, Šumperk, Brno hl. n., Praha hl. n., Plzeň hl. n., Hradec Králové hl. n. and Praha Smíchov.

Table 2

Structure of passengers during survey

	passenger structure [%]	
luggage category	**stations**	**trains**
no luggage / hand luggage	42,6	41,9
small backpack	26,4	25,7
large backpack	8,6	13,4
suitcase / sport bag	10,4	9,4
roller-case	9,4	8,6
pram	0,9	0,7
bicycle	1,7	0,4

Comparing these figures we can find out that the values of each category differ only by tenths of percentage rate and that an average structure of passengers waiting within the area of a railway station corresponds to an average structure of passengers recorded later on trains (the only exemption is the category with a large backpack – concerning the little deviation of the other categories we can deduce, that this is not caused by a survey error, but by the fact, that this category wait for their connections in places different from those, where the survey was carried out, i.e. waiting rooms and halls). Further it is necessary to point out, that the number of passengers with prams and bicycles was remarkably lower than the other, so their percentage structure is probably burdened with greater statistical error.

The last group of surveys was carried out to find out the reliance of a passengers´ structure and a connection category. It was carried out strictly in the carriages, so the results are not influenced for example by people accompanying the passengers to the platform. For the purpose of this survey the trains on the Czech railway network were divided into three categories:

- higher quality trains: EC, IC and Express trains (Ex)
- inter-regional trains: Fast trains (R), Limited-stop trains (Sp)
- regional trains: Local trains (Os)

The differences among the train categories are presented in the left part of the Table 3 and they correspond with the assumed usage of these categories – whereas Locals trains (Os) are used for short-distance transport mainly to work or school, higher category trains are used for longer distances, which means a larger number of passengers with larger luggage.

Table 3

Passenger areal demands according to the train category

	passenger structure [%]			**relative areal demands**		
luggage cat. / train cat.	**EC/Ex**	**R/Sp**	**Os**	**EC/Ex**	**R/Sp**	**Os**
no luggage / hand luggage	27,4	40,0	52,5	5,8	8,5	11,1
small backpack	17,5	25,1	31,3	3,8	5,5	6,8
large backpack	21,0	18,4	4,1	10,1	8,9	2,0
suitcase / sport bag	14,0	7,7	8,1	5,9	3,3	3,4
roller-case	20,0	8,1	2,0	14,6	5,9	1,5
pram	0,1	0,1	1,6	0,1	0,1	1,3
bicycle	0,0	0,6	0,4	0,0	0,4	0,3
			Σ	**40,3**	**32,5**	**26,4**

An illustrative picture of how the passengers´ areal demands differ according to the train category is provided by grouping the data of areal demands of passenger groups with their percentage structure within all passengers (see the right part of the Table 3). It is clear, that the total area demands (represented here by a dimensionless quantity of relative areal demands) of passengers with smaller luggage decrease with a train category increase and on the other hand they increase by the passengers with larger luggage.

5. COMPARISON TO CURRENT RAILWAY TECHNICAL STANDARDS

Dimensions of areas for passengers in railway stations and railway stops are included in the Railway Technical Standard (Technická norma železnic) TNŽ 73 4955. For stop and station buildings with low peak frequency it sets a minimal area of 0.5 m^2 per person for sheltered waiting areas, for inside areas it is 0.55 m^2. For station buildings with higher peak frequency the standard sets the minimal area of 1.2 m^2 per person. Further values are set for waiting rooms for passengers with children and for cultural or restaurant facilities. These values are further corrected by other coefficients and frequency dissipation. However, none of the coefficients takes into account the passenger or train category.

The Czech Technical Standard (Česká technická norma) ČSN 73 4959 is used to set the minimal platform dimensions. Aside the minimal dimensions regarding safety, it sets a minimal area of 0.5 m^2

per person concerning the peak frequency of all passengers entering and exiting all trains standing by the platform within 15 minutes, where the area of safety strips does not count. Neither in this case the passengers´ structure is taken into account. When comparing these values it is obvious, that the minimum values per person are excessive for passengers with small luggage, whereas for passengers with larger luggage they are insufficient.

6. CONCLUSION

Based on the survey results it is possible to say, that the areal demands within the passenger facilities areas differ according to the passenger category, as well as the percentage structure of these groups differs according to the train category.

Following these results it can be said, that it is possible to design passenger facilities better knowing the structure of their users. The whole station (or public transport change node) can be involved, where for stations and platforms without higher category trains and with prevailing local transport more economical design can be used, whereas for stations with high category traffic larger area demands have to be taken into account as well as presumably longer period of stay within these areas. On the other hand based on this knowledge the areal demands only within one station can be differed, if its facilities are divided according to their purpose (e.g. platforms assigned to suburban transport). In both these cases the local particularities must be taken into account – for example in tourism-important stations on a lower category railway the share of passengers with larger luggage can crash-increase in low category trains.

A further step of this research is meant to be a more detailed passenger behaviour description in the station (or a node). The above presented analysis did not include the passengers´ routes within the station so far, it only mapped their structure. The next goal then is to find out if there is a connection among here presented passenger categories and the areas and services within the station. All results of this survey will later find their place among the official public outputs of the grant ´Parametres of facilities for personal transport regarding their layout and capacity, placement and structure of the information presented in such areas´, which are targeted at the owners and operators of a railway infrastructure for its design and modifications.

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