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Barrier Free Accessibility to Trains for All

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Abstract

This paper is the output of a collaborative European project concerning the barrier free accessibility for disabled persons to regional and long distance trains in Europe. Disabled people represent around 13% of the population in Europe. This is approximately 63 million people. The range of disabilities includes people with reduced mobility including wheel chair users, viewing and hearing impaired people and other forms of impairment. Improving accessibility aims at contributing to the provision of public transport services to all citizens in an equitable way. The purpose of the project was to analyse and to evaluate the existing solutions at selected European railways for all required modules at the entrance (doors, information and safety solutions), to derive a design concept, to develop a mock-up in meeting the needs of rail travellers with the above mentioned impairments and to test it with user groups. The project also aims at deriving components for the determination of standards. The EUPAX Design Mock-up test was performed to verify the advantages of the layout of the train segment including the different modules such as access area (including the access door, gaps between platform and train as well as boarding aid devices), entrance vestibule, information systems inside and outside the train, emergency facilities, toilet with all conveniences and the additional test arrangements regarding push buttons, steps and emergency equipment. For this purpose a questionnaire was developed for the assessment of the EUPAX segment and the additional test arrangements. With the help of this questionnaire it was possible to execute a quantitative and qualitative evaluation. During three test phases 67 experts and handicapped persons from 6 countries have evaluated the Industrial Design mock-up based on this questionnaire. The test group covered persons from North (Denmark) to the South (Italy) and from the West (Spain) to the Middle of Europe (Germany). This is especially important for the generalization (harmonisation) of the results for all European countries. According to COST 335 the information for people with reduced mobility should be clear, concise, accurate and timely. So that all information can be received from persons, they must be transferred on at least two of the three possible ways (acoustical, visual, tactile), a so called "2-sense-principle". Based on the results ergonomic specifications/ solutions for the ergonomic design of the access area, the acoustic, visual and tactile information and the emergency devices including the emergency communication system were developed, related to the benefiting passenger groups.

Keywords **:** *Barrier Free Accessibility, Handicapped Accessible Design*

1. Introduction

This paper is an output of an European collaborative project financed by the European Commission and performed by experts from railway operators (DB, SNCF and Trenitalia), manufacturers/ suppliers (Bombardier, Siemens, Alstom), associations of persons with disabilities and scientific institutions (FAV Berlin, IAS Berlin, VUT Vienna, UPC Barcelona) from six European countries. The project is coordinated by UNIFE Brussels. The objective of the project is to optimise the access to the train (including the access door, gaps between platform and train as well as boarding aid devices), the entrance vestibule, the information systems inside and outside the train, the emergency facilities, the toilet with all conveniences as an important segment of a barrier free travel chain. For this reason physically, visually and hearing impaired people, persons of small stature, elderly people and parents with small children were included from the very beginning [3].

According to COST 335 [1] disabled people represent around 13% of the population of Europe. This is approxi-

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mately 63 million people. The share of the elderly in the total population of Europe is expected to rise from 21% now to around 31% by 2020, and to around 34% by 2050. The median age in Europe is growing up from 37,7 years in the year 2000 to 49,5 by 2050 [2]. In Germany 6,6 million people are handicapped (3,5 million males and 3,1 million females). 75% are older than 55 years and 52% older than 65 years [4].

Handicapped people favour public transport over private cars. Therefore the vehicles of the local public and long distance traffic have to be designed in such a way that they can be used from all the interested persons in the sense of a barrier free travel chain including elderly and handicapped people.

2. Methodology

2.1 Basic structure

Fig. 1 illustrates the basic structure of the methodology used in the project. The starting point of the investigation was to analyse the current access situation for disabled and elderly persons in passenger trains, considering the relevant regulations, standards, operation instructions as well as the large volume of research work that has already been carried out at the international and national levels.

A user-focused analysis based on an interview manual and questionnaires was carried out. The main structure of this manual is listed below:

- Classification of people with reduced mobility and their aids,
- Ergonomic design of the access area,
- Information,
- Emergency facilities.

The main components and items of the interview manual are summarized in Table 1.

2.2 Test equipment

The results of the user-focused analysis were used as

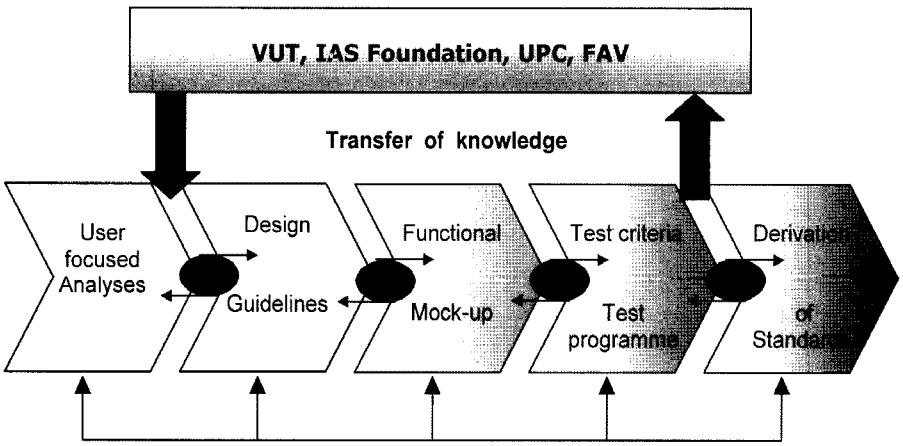

Fig. 1 Basic Structure of the Methodology

Table 1. Main Components and Items of the Interview Manual

Components	Items	
Ergonomic design of the access area	- General aspects - Access doors (throughway) - Door opening devices - Horizontal and vertical gap between platform and train and train	- Boarding aid devices - Entrance vestibule - Lighting, colour - Materials
Information	- Acoustic signals - Visual signals	- Tactile signals
Emergency facilities	- Emergency brake - Emergency egress device	- Emergency communication system
Service facilities	- Toilet	- Changing table

input for the design guidelines. A computer version of a mock-up (see Fig. 2) and finally a partly functional mock-up in the scale 1:1 were produced. Further, two additional elements were included in the tests. The first was a test panel consisting of different kinds of push buttons to open and to close the doors and the other was a special test stand consisting of steps with different depths and heights.

2.3 Subjects

Altogether 67 subjects (33 females and 34 males) took part at the tests, 57 with different handicaps and 10 without handicaps (see Table 2). The mean age of the subjects was 53 years. The test duration was about 3 hours.

3. Results

The main components listed in Table 1 were tested. The following results concerning the clear throughway of the access door were selected for this presentation. The test of the clear throughwayis especially important for wheelchair users. The assessment of the different values of the width of the access door with level access, that means without gap between platform and vehicle is shown in Fig. 3. Values smaller than 850 mm are rejected by the major-

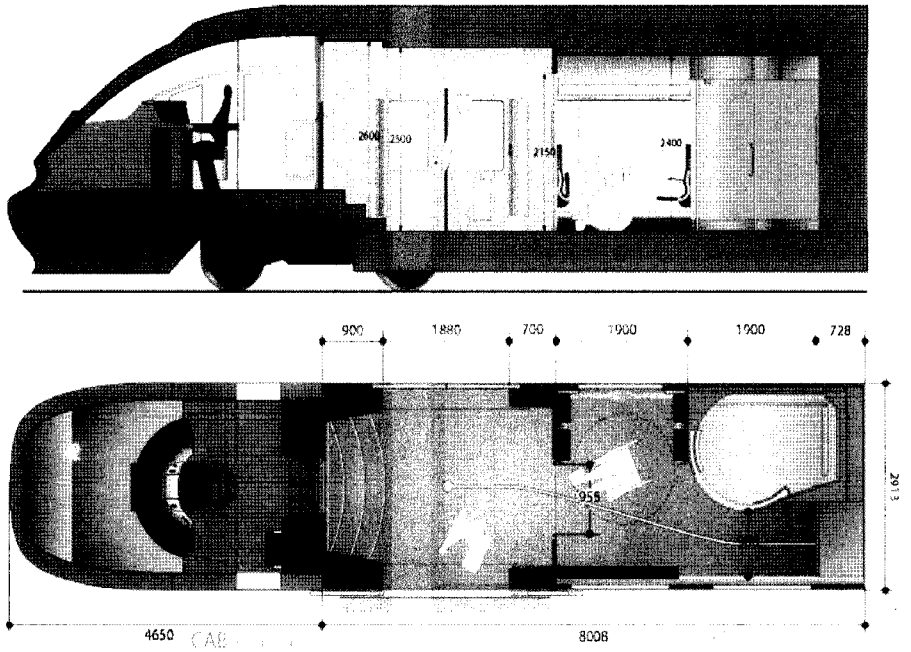

Fig. 2 Eupax Mock-up Layout

Table 2. Test Persons (TP) Including the Classification of Handicaps and Nationalities Involved*)+3 Physically Impaired **)+1 Visually Impaired

Kind of Handicap		Total	Germany	Spain	France	Italy	Switzerland	Denmark
Wheelchair user	(wu)	12	11					1
Blind	(bl)	9	7		1	1		
Visually impaired	(vi)	(+3)* 6	5	1				
Physically impaired	(pi)	(+1)** 9	9					
persons of small stature (number included in group physically impaired)	(ps)	(5)	(5)					
Elderly people	(el)	7	7					
Hearing impaired/ deaf	(hi)	6	4	1	1			
Parents with small children		8	8					
Persons without handicaps		10	5	1	1	1	2	
Total		67	56	3	3	2	2	1

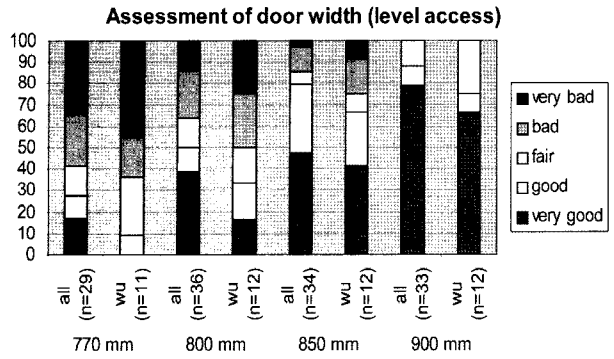

Fig. 3 Clear Throughway of the Access Door with Level Access

Fig. 4 Test of Door Width with Horizontal and Vertical Gap

ity of wheelchair users, as 50% evaluate the throughway of 800 mm with bad or very bad respectively 64% the value of 770 mm (TSI recommendation 800 mm; COST 335 recommendation at least 800 mm, the preferred minimum dimension is 850 mm). The value for the clear throughway of 900 mm as recommended in the DIN 18024 and 18030 seems not necessary.

Unfortunately the level access between platform and vehicle is realised only in some cases. Often the wheelchair users have to handle a combination of door width and gap between platform and train, which makes the boarding more difficult to them. In this context the wheelchair users tested different values of clear throughways with different values for the horizontal and vertical gap (Fig. 4).

The evaluation of these combinations is illustrated in Fig. 5. Based on this the gaps represent a serious obstacle for the wheelchair users. The assessment of same width of the door is more negatively then with level access. Already the gap of 50 mm vertically and 50 mm horizontally can not be managed by about 40% of the wheelchair users, even with a big throughway of 900 mm (TSI recommendation 50 mm vertical and 75 mm horizontal; COST 335 recommendation 50 mm vertical and horizontal). The combination of gap and small throughway of 800 mm according to TSI seems to be not adapted to the needs of wheelchair users. About 83% of the wheelchair users assessed the combination of 800 mm and a gap of 50 mm vertical and 75 mm horizontal with bad or very bad.

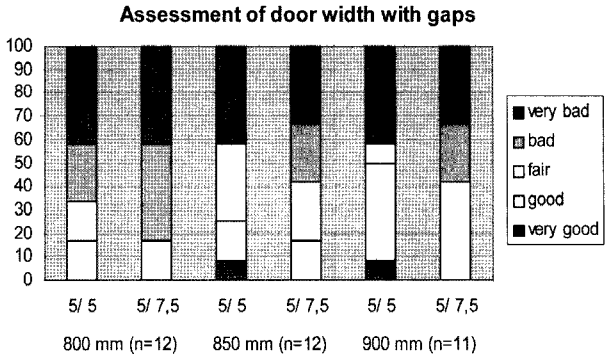

Fig. 5 Clear Throughway of the Access Door with Different Gaps (Vertical/ Horizontal) Tested by Wheelchair Users (Red – TSI Recommendation)

The comments given by the persons underline that the step is too high, that there is a shocking when overcoming the gap what feels very unpleasant. For some wheelchair users it was even not possible to overcome the gap (e.g. caused by small wheels in front). It is also said that it is easier to board the train in a diagonal way what means that a wider throughway is necessary to guarantee this possibility.

It can be stated that a clear throughway of the wheelchair accessible door (at least one per side of train) of 850 mm can be managed by most of the wheelchair users, also by the bigger electrical wheelchairs, which are used often when wheelchair users are travelling. The TSI recommendation of 800 mm is critical, especially if gaps have to be

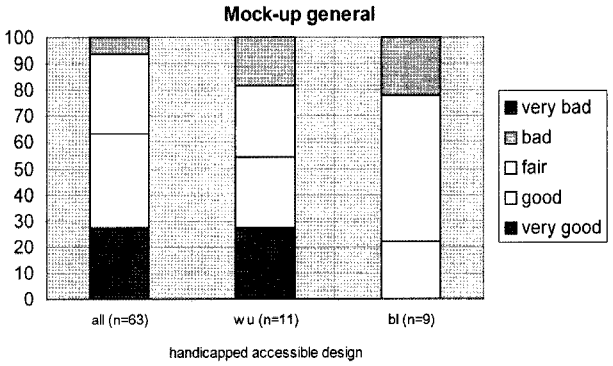

Fig. 6 Handicapped Accessible Design of the Mock-up

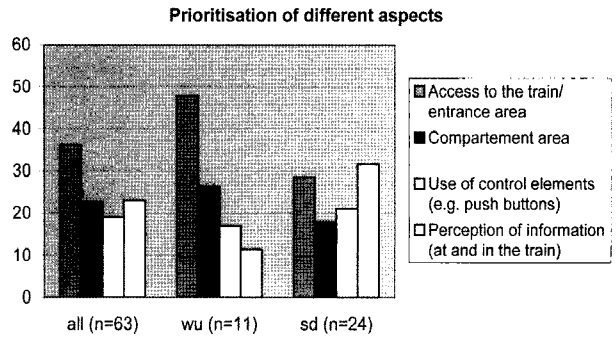

Fig. 7 Prioritisation of Aspects Regarding the Handicapped Accessible Design

overcome, as wheelchair users prefer to board diagonally in such a case. Gaps between platform and train shall be as small as possible or boarding aid devices (ramps, lifts) shall be provided, as already 50 mm vertically and horizontally can not be managed by all wheelchair users on their own.

Another fact which is supporting optimised boarding conditions for wheelchair users in order to overcome the gap between platform and train and to get through the door is the saving of time when these conditions are optimised. It takes much longer for wheelchair users, if these conditions are hard to manage by them, as small clear throughways need a high precision by the approach with a wheelchair.

The general assessment of the handicapped accessible design of the mock-up is shown in Fig. 6. Approximately 63% of all test persons evaluate the accessible design with good or very good. It can be summarized that wheelchair users (55% positive assessment) but especially blind persons (22% positive assessment) see still some potential for improvements.

Finally the persons were asked to distributing 100 points to four different aspects and thus setting priorities for the barrier free design. The aspects were: access to the train/ entrance area, compartment area, use of control elements (e.g. push buttons) and perception of information (at and in the train) (Fig. 7).

Considering all test persons the access to the train with approximately 36 % has the highest priority of these 4 aspects. That means the barrier free access to the train is the most important point for a handicapped accessible design. The other three parts are more or less equal at about 20%. For wheelchair users the access to the train is according to their evaluation of about 48% clearly the crucial point regarding a barrier free design. The sensory disabled persons (sd), including blind, visually impaired, deaf and hearing impaired persons, see the highest priority in the perception of information (32%). But again the access to the train with 29% is also an important point for this group.

4. Conclusions

It is commonly acknowledged that the EUPAX tests treated important subjects which have partly not yet been covered by R&D investigations. Therefore all the results are very useful. Before definitive fertilization of regulations (TSI PRM) and standards (EN, etc.) most results should be complemented and further on underpinned by targeted follow-up research activities.

Recommendations for standardisation which are resulting from the EUPAX tests are for example:

- Door opening devices: Round activation field with diameter min 40 mm → recommendation towards EN 14752
- Door opening devices: To be placed on the outside door leaf → recommendations towards EN 14752
- Emergency module/devices: Labelling (also tactile) by self-explaining pictograms → recommendation for EN 14752
- Visual information: For vital information (emergency) the TSI defined character size should be enlarged (doubled)

For some some parts further and deeper investigations are necessary in order to come to substantial proposals to modify the TSI PRM or relevant EN 14753. These parts are:

- Throughway and gaps
- Ramp
- Steps and handrails
- Door opening devices (topics: tactile information, inside arrangement)
- Emergency module/ devices (one single module vs. single devices close to each other height at wheelchair door, details for tactile information)
- Toilet for PRM

It also needs to be considered that a substantial market growth can be achieved by the approach to create accessibility for all [1].

Acknowledgements

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