

Manoeuvring space for electric wheelchairs and scooters

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Abstract

To be universally accessible the built environment must be adequately adapted to the needs of the widest possible range of users and to the use of mobility aids such as walking sticks, rollator walkers, manual wheelchairs and electric scooters. Delft University of Technology regularly conducts research into the spatial configurations for integral accessibility. This paper summarises the results of a small study of the turning space required by electric wheelchairs and scooters. Drawing on these results, we argue that the manoeuvring space for wheelchair users in public spaces should be based on a turning circle of at least 1.80 m, and preferably 2.00 m.

1. Introduction

Design for All means that everyone should have equal access to the built environment and be able to use it as independently as possible. This requires a thorough investigation of the requirements of each category of users regarding design, dimensioning and detailing. These can then be used to develop design criteria and determine the margins within which everyone is able to make use of the built environment. At the same time, this clarifies whether and where specific or general changes are needed for users who do not match the design criteria. Not so long ago, Design for All handbooks and standards specified a minimum turning circle of 1.50 m for wheelchair users. This dimension is based on the ability of a user of a manual wheelchair with well developed hand and arm function to turn around. In recent years electric wheelchairs and scooters have become more common. These take up more room than manual wheelchairs and need more space to turn around. This is why the Dutch Manual on Accessibility proposes a minimum turning circle of 1.80 m for outside areas, a dimension based on the experience of users involved in the preparation of the handbook. Because little information on this can be found in the literature we set up a study to identify the minimum amount of space users of electric wheelchairs or scooters need to ride indoors, turn around and ride out again.

2. Methods

A public exhibition on mobility aids and facilities for people with a disability, held in Utrecht, the Netherlands, provided a good opportunity to investigate the required manoeuvring space for turning in an electric wheelchair. The main theme of this exhibition on rehabilitation and home help was living at home, home adaptations and adaptable homes. Of course, such exhibitions attract many visitors with functional impairments, including users of electric wheelchairs and scooters. To assist the research a test area was built using wooden blocks 50 cm long, 25 cm wide and 25 cm high. These were used to mark out an area of 1.60 by 1.60 m, which could be made bigger or smaller as required (Figure 1). The entrance passage to this area was 85 cm wide. To make it easy to read off the minimum required manoeuvring space the floor was covered with a sheet marked with a 10 x 10 cm grid, divided into 1 cm units.

To reduce the testing time, and also because the difference between being able to turn and not being able to turn is more likely to be a multiple of 1 cm, the minimum space requirement was measured in steps of 10 cm. Visitors in electric wheelchairs or scooters were asked to ride into the marked out space, turn around and ride out again. By moving the walls it was possible to determine the minimum dimensions at which wheelchair users could turn without bumping into one of the walls and without having to use more than three movements (three-point turn). The type, length and width of each wheelchair or scooter were noted. Each user was also asked about how they used their wheelchair inside the home. If there was time, we discussed their personal experiences of the accessibility or inaccessibility of the built environment. Over three days 71 people took part in the research project:

- 31 people with electric wheelchairs
- 21 people with electric scooters
- 10 people with manual wheelchairs, 6 of whom with legs outstretched
- 9 people in a push (attendant) wheelchair

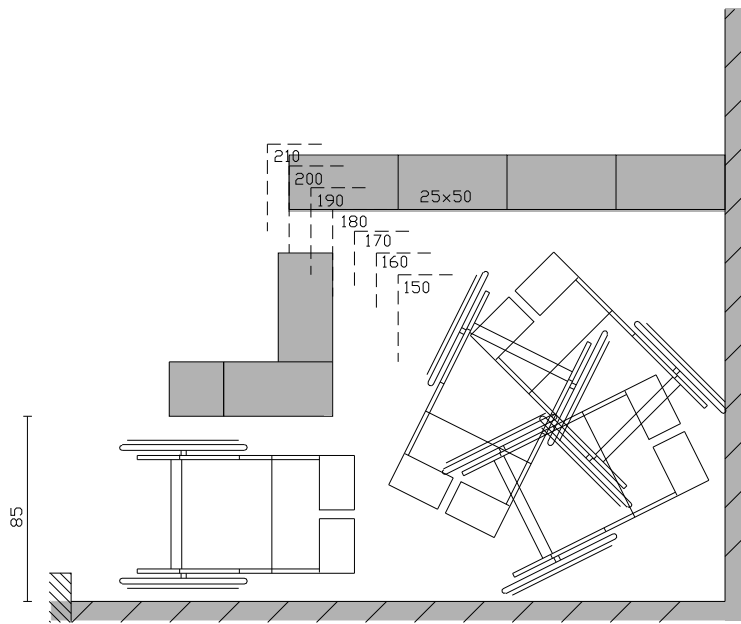


Figure 1: Top view of the test area

3. Results

a. Dimensions of wheelchairs

Tables 1 and 2 show the measured lengths and widths of the wheelchairs, including accessories such as shopping baskets, desktops and crutch holders.

Table 1: Numbers and recorded lengths (cm), including accessories

Type of wheelchair	< 110	110-119	120-129	130-139	140-149	150-159	≥ 160	Total
manual								
- standard	1	1	2					4
- push/attendant		7	1	1				9
- legs outstretched			2	1	2	1		6
electric wheelchair	1	6	10	10	1	2	1	31
scooter	2	2	5	4	4	2	2	21
Total	4	16	20	16	7	5	3	71

Table 2: Numbers and recorded widths (cm) of the wheelchairs

	< 60	60-64	65-69	70-74	≥75	Total
manual						
- standard			2	2		4
- push/attendant		2	3	3	1	9
- legs outstretched			4	1	1	6
electric wheelchair		5	23	3		31
scooter	1	10	9	1		21
Total	1	17	41	10	2	71

The majority of the manual wheelchairs were between 1.10 and 1.20 m long, including footrests and accessories; 77% were less than 1.40 m long. Wheelchair users with legs outstretched occupy a space up to 1.60 m long. About 13% of the electric wheelchairs and almost 29% of the scooters were longer than 1.40 m. Only 3 occupied wheelchairs were longer than 1.60 m: one electric wheelchair with a semi-reclining backrest and two scooters (both about 1.40 m long without detachable accessories). Most wheelchairs (82%) are between 60 and 70 cm wide. Less than 3% were wider than 75 cm: one push wheelchair with a desktop and protruding control panel, and one person in a manual wheelchair who, because of their disability, literally has to sit in a fully reclining position.

b. Space for turning

Figure 2 illustrates the minimum amount of space needed for each type of wheelchair. The accepted standard of 1.50 m appeared to pose no problems for the average user of a manual wheelchair. For people that need to be pushed, a turning circle of 1.50 m is on the small side: 3 of the 9 people in such wheelchairs who took part in the study required at least 1.60 to 1.70 m. People with legs outstretched also need at least 1.60 to 1.70 m. Users of electric wheelchairs can usually make do with 1.80 m, although 13% need at least 1.90 m. Even so, this is still too tight for a few users. The scooters come out top of the list: 40% need a minimum turning space of 2.00 m, while 20% needed at least 2.10 m. This is considerably more than the turning circle stated in the documentation supplied by the manufacturers. Large differences in the required turning circle were also noted for wheelchairs in the same category. This is mainly due to differences in:

- the dimensions and manoeuvrability (turning circle) of the wheelchair,
- the presence or absence of accessories such as shopping baskets, holders for walking sticks or crutches (common among users of scooters) and desktops; this can make a difference of several decimetres,
- the agility of the user.

c. Minimum passage

A free passage of 85 cm presents no problems to anyone. Some handbooks indicate that a minimum width of 76 cm is, in principle, sufficient for an electric wheelchair or scooter moving forwards in a straight line. Users of these wheelchairs operate them with a control panel or joystick at the front of the wheelchair, whereas users of manual wheelchairs have to use their arms, which therefore stick out from the sides of the wheelchair. These users are not able to manoeuvre in a doorway built to the above dimensions, which makes this acceptable only for very short sections of narrow passages.

d. Using wheelchairs inside

Of the 10 users of manual wheelchairs who were asked, 7 use the same wheelchair inside the home. The other 3 are able to walk at home, either with or without a walking stick, or change to a work chair. No information is available from the other respondents. Of the 29 users of electric wheelchairs, 25 use the same wheelchair at home. The remaining four change over to a manual wheelchair or are able to walk around their homes. Of the 21 scooter users from which information was obtained, only two use their scooter in the home; 10 change over to a manual wheelchair, a smaller electric wheelchair or a walking stick, and 9 people can walk around their homes without mobility aids. Those who change to another chair or walk in their homes store their wheelchairs in the garden shed or outhouse, or in the hall, and in one case in a covered semi-private walkway.

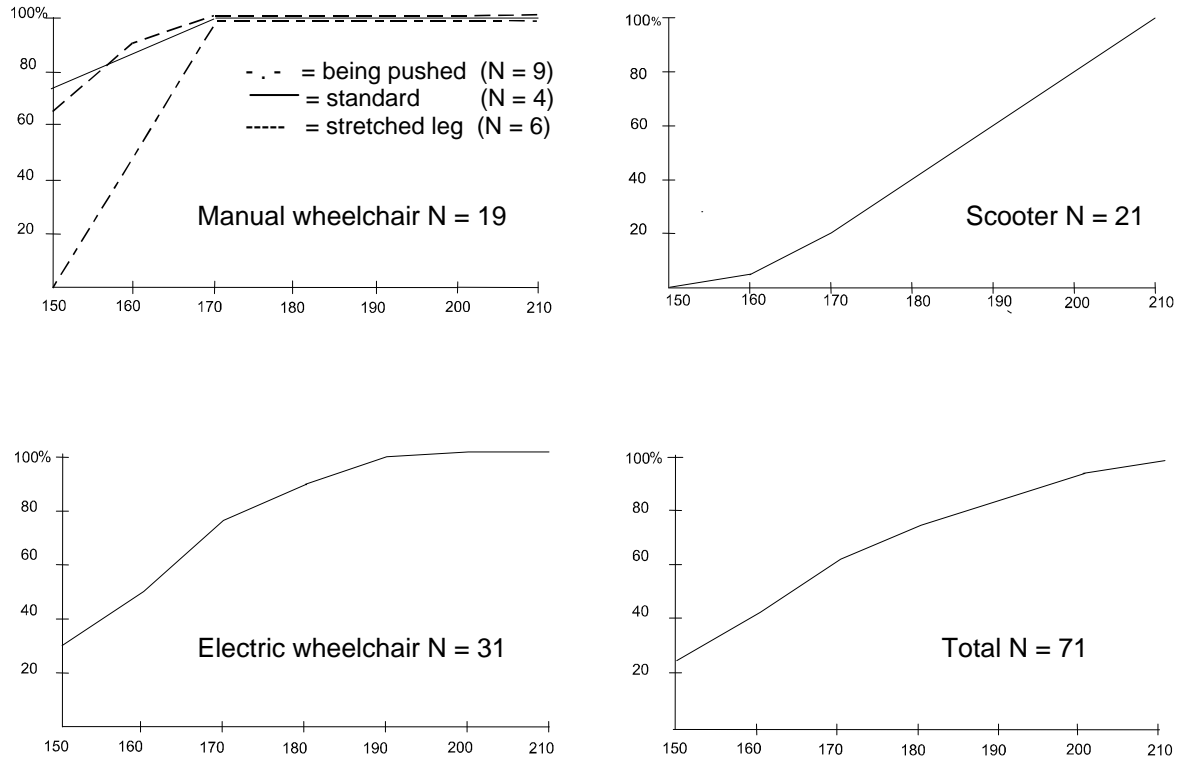


Figure 2: Cumulative frequency distribution per type of wheelchair
For each type of wheelchair the graph shows the percentage of users who can turn within passages of different widths.

e. Other remarks

The brief discussions we held with the participants in the study revealed that much needs to be done before integral accessibility is a fact and the built environment is truly accessible to all. Wheelchair users encounter numerous physical obstacles and more general constraints on their mobility. This is illustrated by a number of comments made by visitors to the exhibition:

- The International Symbol of Access (ISA) is no guarantee that a building is accessible to all.
- Even new buildings are frequently not easy to negotiate.
- Sometimes space is provided for sitting in a wheelchair, but not for manoeuvring and getting there (for example in cinemas).
- Coir mats in the entrances to buildings make life difficult for wheelchair users.
- Large revolving doors with four compartments are impossible to negotiate with many types of wheelchair; three compartments are preferable.
- Disabled toilets are often not easy to use (bowl in the wrong place, only one type of transfer from wheelchair to toilet possible, grab rails too low, unstable toilet seat).
- The bathroom cubicle for wheelchair users is often too small for assisted toilet use or the use of a hoist.
- ATMs and PoS terminals ('PIN machines') are often too high.
- Procedures for making individual adaptations are often time-consuming and difficult; sometimes even legal action has to be taken to enforce them.
- There seems to be increasing competition between elderly and disabled people for home adaptation grants.

4. Reflection and conclusions

What has clearly emerged is that disabled people still experience considerable difficulties. Despite all the available knowledge too little attention is paid to 'access for all', including people with functional impairments, when designing, building and managing buildings. We also found that scooters need a lot of space. These types of electric wheelchairs are intended primarily for outside use, but they are used a lot in shopping malls. This suggests that sufficient manoeuvring space should be made available for scooters to ride around in a circuit. Moreover, sufficient manoeuvring and parking space should be made available near entrances to homes and residential buildings.

A turning circle of 1.50 m appears to be sufficient for most users of manual wheelchairs. People in a push wheelchair and people with legs outstretched require at least 1.60 m and preferably 1.70 m. Under the current standard dimension of 1.80 m for electric wheelchairs, about 13% of wheelchair users fall outside the so-called 'wider average'. There is a case for considering this to be an absolute minimum and for introducing a preferred dimension of 2.00 m. This would allow the majority of scooter users to turn around, although 20% still require more space. This more generous standard could be applied selectively, for example in covered shopping centres and communal circulation spaces in residential buildings. To accommodate the greater length of electrical wheelchairs, scooters and people with legs outstretched, lift cages in shopping centres and large residential blocks should preferably be at least 1.60 m deep. In heavily visited areas, this extra use of space should not pose any problems because the numbers of people using the lifts would justify it anyway. In other areas, a balance will often have to be struck between conflicting demands; after all, there are financial and other restrictions on architectural solutions to spatial constraints. This means that in the development, production and purchase of electric wheelchairs much more attention should be paid to the amount of room they require.

Note

This research has been initiated and supervised by dr. Theo J.M. van der Voordt, associate professor at the Faculty of Architecture of the Delft University of Technology, with assistance of Gerard de Jong. E: D.J.M.vanderVoordt@tudelft.nl