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DESIGN RESOURCES

DR-21 Turning Space for Wheeled Mobility Users –
the 360-deg Turn

DR #21: Turning Space for Wheeled Mobility Users – the 360-deg Turn

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Question: What is the minimum turning space required for users of wheeled mobility devices to complete a 360-degree turn in the built environment?

Issue and Importance to Universal Design

Dimensions for 360-degree turning spaces are used to determine the minimum spaces needed for turning around in spaces with only one point of entry. Sufficient space needs to be provided for users of manual and powered wheelchairs and scooters to complete such turns in environments such as an elevator or toilet stall.

Existing Research/Evidences

Accessibility standards in countries such as the U.S., U.K., Canada, and Australia prescribe minimum dimensions for turning spaces. Quite often, the dimensional criteria for clear floor area recommended in these standards have been developed based on research studies in their respective countries that measured the turning space requirements for wheeled mobility users e.g. measurements of 180- and 360-degree turns by Ringaert et al. (2001), 180- degree turns documented in the BSI (2000), and studies on turning spaces for scooters by King and Dutta ([DR # 9: Scooters in the built environment](#)).

As part of the Anthropometry of Wheeled Mobility (AWM) Project, the IDeA Center has been developing a comprehensive anthropometry database on manual chair, powered chair and scooter users in the U.S. (Steinfeld et al., 2010b). Measurements of turning spaces obtained from 339 out of 495 wheeled mobility device users from this study that were able to independently perform a turning maneuver were used developing recommendations for 360-degree turning spaces.

Quality of Existing Evidence

There has been limited research completed on turning spaces required by wheeled mobility users in the built environment. Research findings and comparisons with the accessibility standards have been summarized by Steinfeld, et al. (2010a). However, comparisons across research studies conducted in the U.S., U.K., Canada, and Australia show considerable differences in the recruitment and sampling of wheeled mobility users, measurement methods used, and in some cases a number of years having passed since the research were completed (see review by Steinfeld et al., 2010a). For instance, differences in whether the measurement space was bounded or unbounded, or whether the measurement protocol required a smooth continuous turn vs. permitting the use of a series of smaller movements or allows either, would produce different results.

Existing Design Guidelines

In the U.S., federal accessibility guidelines pertaining to the built environment are described in the ICC/ANSI A117.1-2003, Accessible and usable buildings and facilities (ICC/ANSI, 2003) document. Currently, these standards prescribe a minimum diameter of 1525 mm. (60 in.) circular space for wheeled mobility access (Table 1).

Table 1: Comparison of Minimum Turning Space in Accessibility Standards across Four Countries

Country & Standards Document			
Australia	Canada	UK	USA
AS 1428.2	B651-04 (mm)	BS8300:2001	ICC/ANSI A117.1
1540 x 2070 mm ²	1500 mm	1500 mm	1525 mm (60 in.)
rectangle	diameter	diameter	diameter

Summary of the AWM findings

Data from the AWM Study are based on measurements of wheeled mobility users performing 360 turns within an enclosed square space built with lightweight movable walls. To better represent conditions in the environment, we based our measurements on a square-shaped space rather than circular as the former allows WMD users to use the corners thereby optimizing space utilization. The enclosed space was incrementally varied from a size of 1300mm x 1300mm to 2300mm x 2300mm in steps of 200mm. The minimum space required for performing a complete 360-turn within moving or knocking down any of the walls was recorded. Use of multiple short turns was allowed in contrast to a single continuous turn.

The 50th, 75th, 90th and 95th percentile dimension values for turning spaces across manual chair, power chair, and scooters are summarized in Figure 1.

The study found that only 50% of the manual and powered wheelchair users measured in this study could complete a 360-degree turn within the minimum required space of 60 in. diameter prescribed in the current U.S. accessibility guidelines. Further, in order for 95% of the manual and powered chair users in this sample to successfully complete a 360-degree turn, a minimum square area of 83 in. x 83 in. was required. Corresponding dimensions for scooter users was found to be 98 in. x 98 in.

For applications where all of three types of mobility devices (i.e., manual chair, powered chair and scooters) need to be accommodated, the largest of the turning space across the three device categories should be used.

Examples of Application

Dimensions for turning spaces provide guidance on the minimum space required by wheeled mobility users when maneuvering within an enclosed space such as inside an elevator, alcove, toilet stall or other such enclosed spaces with only one point of entry.

Accessible Pathway & Corridor

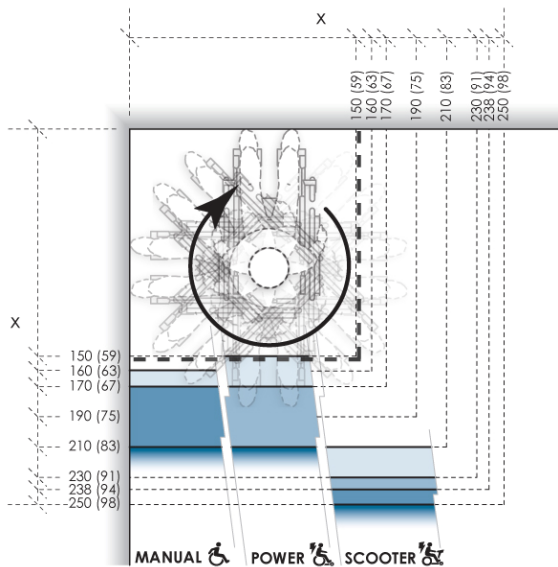
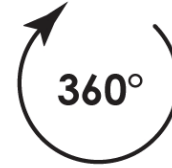
Design Guidelines for People Using Wheeled Mobility Devices



MINIMUM CLEAR FLOOR SPACE REQUIRED FOR 360-DEGREE TURN

percent accommodated (fixed wall)		x = floor space dimension, units: cm (in.)		
		MANUAL	POWER	SCOOTER
< 50%		185 participants	139 participants	15 participants
	50%	160 (63)	150 (59)	210 (83)
	75%	190 (75)	170 (67)	230 (91)
	90%	190 (75)	210 (83)	238 (94)
	95%	210 (83)	210 (83)	250 (98)*

* due to small sample size, x = maximum value observed
 - - - - - = ADA § 304.3.1 specification of 152.5 cm (60 in.)



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Figure 1. Minimum square clear floor space required for completing a 360-degree turn by manual wheelchair, powered wheelchair and scooter users.

Research Needs

Space requirements for wheeled mobility have changed considerably in recent decades following technological advancements in wheeled mobility device technology, increased diversity in wheeled mobility sizes and shapes, as well as user demographics. Hence, it is required that these minimum clear floor area requirements are continuously and systematically re-evaluated to ensure adequate environmental accommodation for contemporary wheeled mobility users.

However, the implications of our findings are so significant that the authors recommend starting broad discussion of options among stakeholders before a concrete proposal is made to adopt a particular strategy. An example of one strategy would be to base design dimensions on the 50th or 75th percentile values and requiring at least one of each type of space somewhere in a building to be large enough to accommodate the largest devices.

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Anthropometry Research Studies

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Relevant IDEA Center Publications

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Steinfeld, E., Paquet, V., D'Souza, C., Joseph, C., & Maisel, J., 2010b. Anthropometry of wheeled mobility project - Final report. Report prepared for the U.S. Access Board. Buffalo, NY, IDeA Center.

Relevant Design Resources

DR # 9: Scooters in the Built Environment



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