



# **DESIGN RESOURCES**

DR-15 Clear Floor Area for Wheeled Mobility: Redefining the 'common wheelchair'

## DR #15: Clear Floor Area for Wheeled Mobility: Redefining the 'common wheelchair'

Clive D'Souza, Edward Steinfeld, Victor Paquet, Jonathan White IDeA Center, University at Buffalo

Last Updated: January 4, 2011

**Question:** What are the minimum clear floor area dimensions required for accommodating wheeled mobility users and their devices in the built environment?

#### Issue and Importance to Universal Design

Clear floor space dimensions are the basis for the minimum required size of spaces used by wheeled mobility users (e.g. platform/wheelchair lifts) and for spaces/locations that are designated for wheeled mobility users such as in seating areas of movie theatres and sports stadiums and in securement spaces of vehicles like transit buses. The clear floor space width also informs the minimum clearance width for successful passage through corridors, doorways and wheelchair ramps.

Unlike turning spaces that are based on dynamic requirements, clear floor space represents the space required for a stationary wheeled mobility device. This area is typically depicted as a rectangular space the dimensions of which are based on measurements of occupied length and occupied breadth of wheeled mobility devices, which are defined as follows:

- Occupied length: measured as the horizontal distance between the forward-most (anterior-most) point and the rear-most (posterior-most) point on the wheelchair or occupant.
- Occupied width: measured as the horizontal distance between the side-most (lateral-most) points of the wheelchair or participant on the right and left sides.

Minimum dimensions for clear floor space should be considered as a starting point for accessible design. When determining the clear floor space for tasks that involve reaching or grasping to adjacent design elements (e.g., bathroom sinks, automated teller machines, information kiosks) additional design requirements regarding flexibility of use (see Design Resource #16: Clear floor space when reaching or grasping) and ease of approach (See Design Resource #17: Knee and toe clearances for wheeled mobility users) also need to be considered.

#### **Existing Research/Evidences**

Accessibility standards in countries like the U.S., U.K., Canada, and Australia prescribe minimum dimensions for clear floor space length and width. Quite often, the dimensional criteria for clear floor space recommended in these standards have been developed based on research studies in their respective countries that measured the occupied length and breadth of wheeled mobility users (See 'Anthropometry Research Studies' listed in the References section).

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., 2010c). Measurements of occupied length and breadth obtained from 495 wheeled mobility device users from this study are being used for developing minimum dimensional criteria for clear floor space.

#### **Quality of Existing Evidence**

There has been very little research completed on the minimum dimensions for clear floor space based on users of currently available manual chairs, powered chairs, and electric scooters. Furthermore, 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., 2010c). These factors can limit the ability to generalize findings to the present-day wheeled mobility user population. The comparisons also highlight differences in space requirements for wheeled mobility users across different countries as user anthropometry and device characteristics may differ from country to country (Steinfeld et al., 2010c).

#### **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 floor area of 760 mm. (30 in.) by 1220 mm. (48 in.) for wheeled mobility access, and vary substantially in comparison to minimum requirements for clear floor space in the U.K., Canada, and Australia (Table 1).

Table 1: Comparison of Clear Floor Area Dimensions in Accessibility Standards across Four Countries

Minimum Clear Floor Space Dimension	Country & Standards Document			
	Australia	Canada	UK	USA
	AS 1428.2 (mm)	B651-04 (mm)	BS8300:2001 (mm)	ICC/ANSI A117.1 (mm & in.)
Width	800	750	900	760 (30)
Length	1300	1200	1350	1220 (48)

#### **Summary of the AWM findings**

Data on occupied floor area length and width were summarized in the form of an accommodation model (Fig. 1) that depicts the 50<sup>th</sup>, 75<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentile values computed for occupied length and width across manual chair, powered chair and scooter users using data from our study. The 95<sup>th</sup> percentile dimension values for occupied length and breadth provide a reasonable threshold value for determining the dimensions for clear floor space length and breadth. Details about the measurement methodology and study sample can be found in (D'Souza et al., 2010; Steinfeld et al., 2010a; 2010b).

Accommodating the 95<sup>th</sup> percentile for both occupied width and length requires a minimum clear floor space dimensions of 786 mm. x 1362 mm. (31 in. x 54 in.) for manual chairs, 827 mm. x 1415 mm. (32 in. x 56 in.) for powered chairs, 837 mm. x 1435 mm. (33 in. x 56 in.) for scooters. These sets of dimensions are more applicable when needing to accommodate 95% of the measured sample for either one of the dimensions, i.e., either occupied length or occupied width.

When requiring to accommodate 95% of users for both, length and width dimensions simultaneously, a bivariate analysis is preferred (D'Souza et al., 2010). Using this method, the minimum clear floor area dimensions recommended are: 820 mm. x 1420 mm. (32 in. x 56 in.) for manual chair users, 850 mm. x 1480 mm. (33.5 in. x 58 in.) for powered chair users, and 860 mm. x 1440 mm. (34 in. x 57 in.) for scooter users.

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 occupied length and width values across the three device categories should be used. Thus, a "universal space" to accommodate 95 % of the total population would be  $860 \text{ mm} \times 1480 \text{ mm}$  (34 in. x 58 in.).

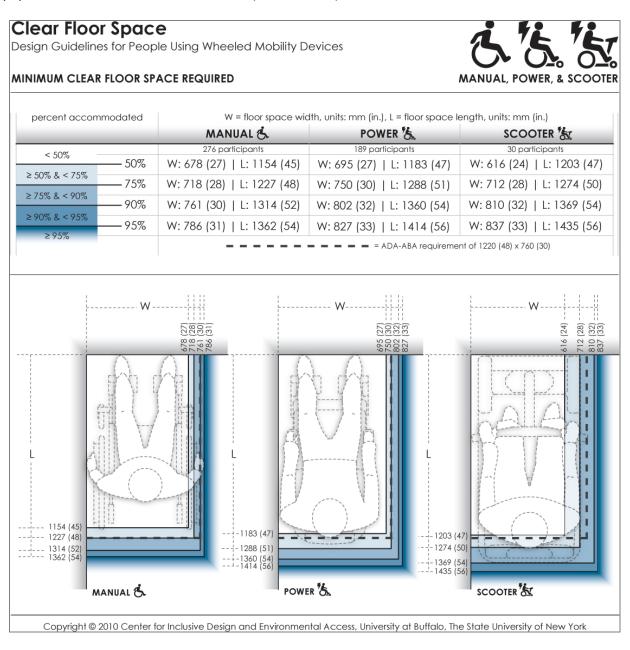


Figure 1: Accommodation model on clear floor space for wheeled mobility users

Our findings on clear floor space show that current dimensions used in the ICC/ANSI 117.1 document and the ADA-ABA guidelines are inadequate for the larger mobility device users, especially power chair and scooter users. However, the required wheelchair seating space sizes in public assembly areas described in the ADA-ABA provide for some additional tolerances for wheeled mobility users to get into and out of a wheelchair space. When including these tolerances, the clear floor space is actually about the same size as the "universal space" with one exception, the front or rear entry condition. The depth of this space should be increased from 1220 mm (48 in.) to 1480 mm (58 in.), or, to be consistent with the side entry condition, 1525 mm (60 in.) required by the ADA-ABA. While this would still make it a tight fit for maneuvering into the space for the largest users, it would only inconvenience a few people. Requiring some rear or front entry seating areas in each facility could be an alternative strategy.

Where aisles and other spaces adjoin the clear floor area, the real need for a "universal space" may be minimal. For example, the occasional very long occupied device can be accommodated without too much inconvenience to people passing by or interference with minimum egress requirements. Also, where several wheelchair seating spaces are provided at once, it is unlikely that all the occupants approach or exceed the 95<sup>th</sup> percentile in both length and width. In other words, a certain amount of overlap with other spaces and between spaces could be provided to reduce the impact on space utilization without serious consequences. Thus, in the ADA-ABA clear floor space for two devices, a lower overall width of 1676 mm (66 in.) is probably sufficient.

#### **Examples of Application**

Clear floor area dimensions provide guidance on the minimum required size of spaces used by wheeled mobility users (e.g., platform/wheelchair lifts) and for spaces/locations that are designated for wheeled mobility users such as in movie theatres and sports stadiums. The clear floor area width also informs the minimum clearance width for successful passage through corridors, doorways and ramps.

#### **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.

Additional research is required is to describe more precisely, the environments and situations where such floor area is sufficient, where additional space is required (e.g., when reaching is involved), or situations where certain constraints (e.g., environmental, technological, economic) currently make providing adequate space difficult or unfeasible (e.g., on buses) thus requiring alternate innovative design solutions.

#### Acknowledgement

This research was supported by the U.S. Access Board (contract # TDP-02-C-0033) and the National Institute on Disability and Rehabilitation Research (NIDRR) through funding of the RERC on Universal Design (Grant # H133E990005). The opinions expressed herein are those of the authors and do not represent the policy of the Access Board, nor of NIDRR.

#### References

#### **Accessibility Standards Documents**

Australian Standard, 2001. AS1428.1-2001 Design for access and mobility—Part 1: general requirements for access—new building work. Sydney, Australia: Standards Australia International.

Australian Standard, 1992. AS1428.2-1992 Design for access and mobility—Part 2: enhanced and additional requirements—buildings and facilities. Sydney, Australia: Standards Australia International.

British Standards Institution, 2001. BS8300:2001 Design of buildings and their approaches to meet the needs of disabled people—Code of practice. London, U.K.: BSI.

Canadian Standards Association, 2004. CAN/CSA B651-04 accessible design for the built environment standard. Mississauga, Ontario, Canada: Canadian Standards Association.

International Code Council/American National Standards Institute, 2003. ICC/ANSI A117.1-2003, Accessible and usable buildings and facilities. International Code Council, New York.

U.S. Access Board, 2004. Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines for Buildings and Facilities. Washington, DC: U.S. Access Board. Retrieved February 17, 2010, from http://access-board.gov/ada-aba/index.htm.

#### **Anthropometry Research Studies**

Bails, J.H., 1983. Project report on the field testing of the Australian standard 1428-1977 part 1—Recommended amendments and index to part 2 detailed reports. Adelaide South Australia, Public Buildings Department.

Bails, J.H., 1983. Project report on the field testing of the Australian standard 1428-1977 part 2—Details of field testing of AS1428. Adelaide South Australia, Public Buildings Department.

Ringaert, L., Rapson, D., Qui, J., Cooper, J., and Shwedyk, E., 2001. Determination of new dimensions for universal design codes and standards with consideration of powered wheelchair and scooter users. Manitoba, CA: Universal Design Institute.

Seeger, B., Costi, J., and Hartridge, M., 1994. Final report of consultancy on wheelchair user requirements for the National Accessible Transport Committee Commonwealth Department of Transport. Kilkenny, South Australia: Regency Park Centre for Young Disabled.

Stait, R.E., Stone, J., and Savill, T.A., 2000. A survey of occupied wheelchairs to determine their overall dimensions and weight: 1999 survey. Berkshire, U.K.: TRL Limited.

Hitchcock, D., Hussey, M., Burchill, S. and Galley, M., 2006. A Survey of Occupied Wheelchairs and Scooters: Conducted in 2005. Leicestershire, UK: Centre for Employment and Disadvantage Studies.

#### **Relevant IDEA Center Publications**

D'Souza, C., Steinfeld, E., Paquet, V., & Feathers, D., 2010. Space requirements for wheeled mobility devices in public transportation: An analysis of clear floor space requirements. Transportation Research Record: Journal of the Transportation Research Board, No. 2145, 66-71.

Paquet, V. and Feathers, D., 2004. An anthropometric study of manual and powered wheelchair users. International Journal of Industrial Ergonomics 33(3); 191-204.

Steinfeld, E., D'Souza, C., and Maisel, J., 2010a. Clear Floor Space For Contemporary Wheeled Mobility Users. In Proceedings of 12th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED 2010), Hong Kong.

Steinfeld, E., D'Souza, C., Paquet, V., White, J., 2010b. Clear floor area for wheeled mobility users. In Proceedings of 3rd International Conference on Applied Human Factors and Ergonomics, 2010 AHFE International, Miami, Florida, Taylor and Francis, Ltd.

Steinfeld, E., Maisel, J., Feathers, D., D'Souza, C., 2010c. Anthropometry and Standards for Wheeled Mobility: An International Comparison. Assistive Technology 22 (1), 51-67.

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

Steinfeld, E., Paquet, V., & Feathers, D., 2004. Space requirements for wheeled mobility devices. In: Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting.

#### Relevant Design Resources

Design Resource #16: Clear floor area for wheeled mobility when reaching or grasping

Design Resource #17: Knee and toe clearances for wheeled mobility users

Dimension values corresponding to the 95<sup>th</sup> percentile imply that at least 95 percent of the measured sample (and the overall population if the sample is representative) would be reasonably accommodated. Not accounting for values exceeding the 95<sup>th</sup> percentile would help adjust for any measurement outliers or errors, and extreme cases or circumstances that result in measurement values that are uncharacteristically large and very rare (less than 1 in 20 instances of wheeled mobility users), but may result in the possibly exclusion of a genuine case.



### **DESIGN RESOURCES**

DR- 15 Clear Floor Area for Wheeled Mobility: Redefining the 'common wheelchair'

© 2010 Center for Inclusive Design and Environmental Access
University at Buffalo
School of Architecture and Planning

378 Hayes Hall 3435 Main Street Buffalo, NY 14214-3087

Phone: (716) 829.5902

Email: ap-idea@buffalo.edu

Fax: +1 (716) 829.3861