



IIDeA

DESIGN RESOURCES

DR-16 Clear Floor Area for Wheeled Mobility
when Reaching or Grasping

DR #16: Clear Floor Area for Wheeled Mobility when Reaching or Grasping

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

Last Updated: January 4, 2011

Question: What are the minimum dimensions for clear floor area such that wheeled mobility users can maneuver within reachable distance of elements in the built environment?

Issue and Importance to Universal Design

Clear floor space dimensions for reaching are different than for seating because they require a specific orientation to the target. This type of clear floor space should be used for tasks that involve reaching or grasping to adjacent design elements such as sink faucets, door handles, wall outlets and other wall-mounted elements. Further, they can be applied to the operation of automated teller machines, information kiosks, where there is a need for allowing flexibility in use by people that are right or left hand dominant, as well as taking into account how an individual will be oriented when reaching and seek to optimize the range of reach i.e., forward vs. sideways reach. Further, bi-lateral access is desirable to insure adequate functional reach to targets, especially given that wheelchair users may only have functional reach and gripping ability in one arm and hand.

Note: For tasks that involve reaching or grasping, additional design considerations to ensure ease of approach, reaching heights, and appropriate grip or pinch force requirements for operable parts may also be relevant (see 'References' for list of related design resources). For tasks that do not involve reaching or grasping, a smaller clear floor space may be sufficient ([Design Resource #15: Clear floor area for wheeled mobility](#)).

Existing Research/Evidences

Accessibility standards in countries like the U.S., U.K., Canada, and Australia prescribe minimum dimensions for clear floor area length and width, but do not consider how users may choose to orient themselves in relation to the design element (e.g., centering the clear floor area to the reach target vs. aligning the shoulder of the reaching arm to the reach target) nor do they make any distinction between left or right handed users.

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 from 495 wheeled mobility device users from this study have been used for developing dimensional criteria for minimum clear floor area related to tasks that involve reaching or grasping. A substantial portion (26%) of wheeled mobility users sampled was found to be left-hand dominant, which is much higher than would be expected in the general population. Vastly different reaching abilities were also observed in the forward vs. sideways reach direction (see [DR #20: Functional reach capability for wheeled mobility users](#)). The minimum dimensions described here should be considered as a starting point for accessible design.

Quality of Existing Evidence

There are no design dimensions available for clear floor area applicable for designing tasks that involve reaching or grasping, and which take into account reaching with the right and left hand, and a forward or lateral reach direction. As a result the minimum dimensions for a 'generic' clear floor space are used for most design situations requiring wheeled mobility access.

Existing Design Guidelines

Accessibility standards pertaining to the built environment such as the ICC/ANSI A117.1-2003, Accessible and usable buildings and facilities (ICC/ANSI, 2003) in the U.S. prescribe minimum dimensions for a 'generic' clear floor area space to accommodate wheeled mobility users, but not take into account task demands (e.g., reaching, grasping) or any variation in how users may accomplish the task. In the U.S., the minimum required clear floor area prescribed is 760 mm. (30 in.) by 1220 mm. (48 in.).

Summary of the AWM findings

Dimensional criteria were developed for clear floor area involving reaching or grasping in the form of an accommodation model for user of different wheeled mobility device types, namely, manual wheelchair users (Fig. 1), powered wheelchair users (Fig.2), and scooter users (Fig. 3). The accommodation model provides guidance on the dimensions and location for clear floor area in relation to the reach target to accommodate:

- left and right hand users, and
- use of a forward or sideways (lateral) approach, when reaching or grasping

The dimension values were computed using four measurement dimensions from the AWM database, namely:

- 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 (represented as 'A')
- 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 (represented as 'B')
- Horizontal distance from the reaching shoulder to the forward-most (anterior-most) point of the wheelchair or occupant (represented as 'C')
- Horizontal distance from the reaching shoulder to the side-most (lateral-most) point on the opposite (contra-lateral) side of the wheelchair or occupant (represented as 'D')

The 95th percentile values for the four measurement dimensions provide a reasonable threshold value for determining the minimum dimensional criteria for clear floor spaceⁱ that accommodates at least 95% of wheeled mobility users in the AWM sample. Details about the measurement methodology and study sample are provided by Steinfeld et al. (2010a, b).

The following recommendations should be implemented to specify the position of the clear floor space more appropriately than as in current standards:

1. Where reaching is critical for completing a task, e.g. an ATM machine, the universal clear floor space for reach (Figures 1-3) should be provided and centered on the target. The size of the space should accommodate the 95th percentile of scooter users to accommodate the full range WMD users.

- For all other reach tasks, a square clear floor space, 1430 mm x 1430 mm (56 in. x 56 in.) should be provided, centered on the target. This will allow almost all device users to position themselves close to the target using either a front or a side reach and enough leeway for most device users to align their shoulder close to an axis on the target. But, it does not optimize for handedness.

Clear Floor Areas

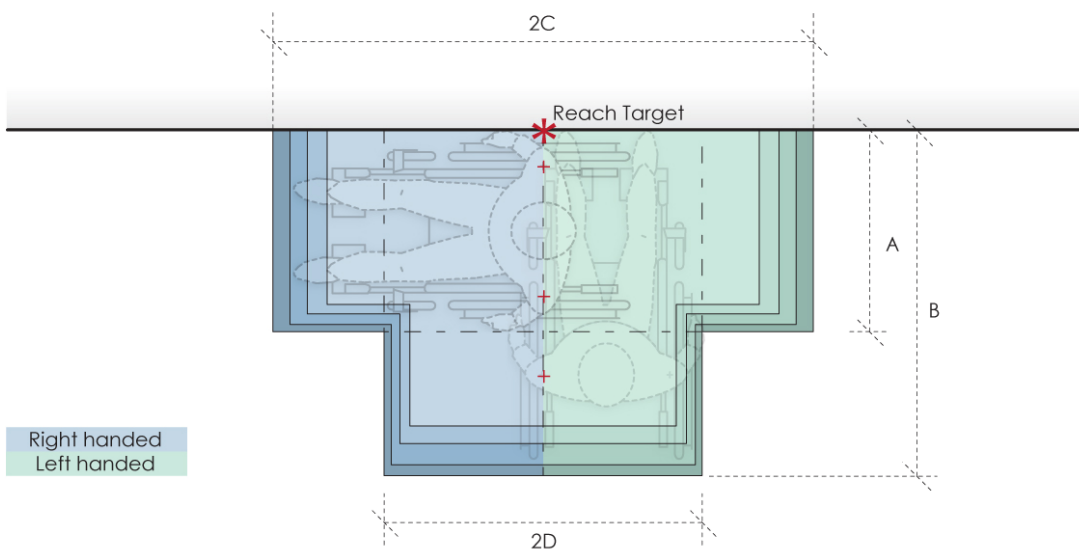
Design Guidelines for People Using Manual Wheelchairs



MANUAL

MINIMUM CLEAR FLOOR SPACE REQUIRED FOR FORWARD AND SIDE APPROACH

Manual (% accommodated) n=276					Power n=189	Scooters n=30
mm [in]	50%	75%	90%	95%	95%	95%
A	678 [27]	718 [28]	761 [30]	780 [31]	827 [33]	837 [33]
B	1154 [45]	1227 [48]	1314 [52]	1362 [54]	1414 [56]	1435 [56]
2C	1685 [66]	1849 [73]	2000 [79]	2106 [83]	2126 [84]	2369 [93]
2D	1036 [41]	1107 [44]	1181 [46]	1229 [48]	1278 [50]	1269 [50]



Copyright © 2010 Center for Inclusive Design and Environmental Access, University at Buffalo, The State University of New York

Figure 1: Accommodation model depicting the dimensions and positioning of the clear floor space required by manual wheelchair users (compared to the 95th percentile power chair and scooter users) when using either the right or left hand, for both forward and lateral reach.

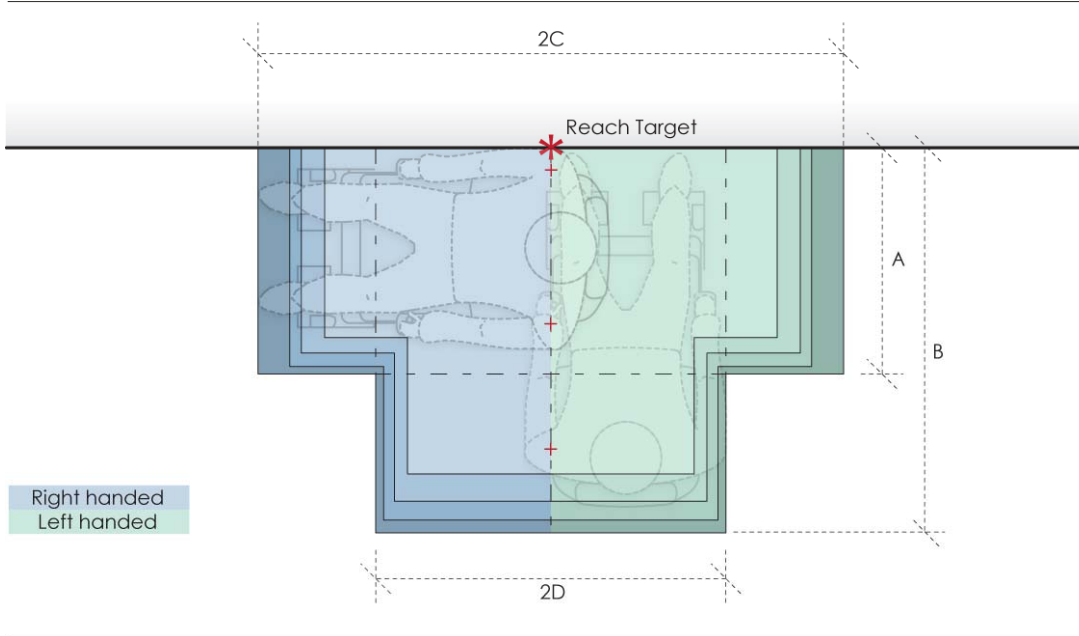
Clear Floor Areas

Design Guidelines for People Using Power Wheelchairs



MINIMUM CLEAR FLOOR SPACE REQUIRED FOR FORWARD AND SIDE APPROACH

Power (% accommodated) n=189					Scooter n=30	Manual n=276
mm [in]	50%	75%	90%	95%	95%	95%
A	695 [27]	750 [30]	802 [32]	827 [33]	837 [34]	786 [31]
B	1183 [47]	1288 [51]	1360 [54]	1414 [56]	1435 [56]	1362 [54]
2C	1653 [65]	1814 [71]	2001 [79]	2126 [84]	2369 [93]	2106 [83]
2D	1041 [41]	1135 [45]	1213 [48]	1278 [50]	1269 [50]	1229 [48]



Copyright © 2010 Center for Inclusive Design and Environmental Access, University at Buffalo, The State University of New York

Figure 2: Accommodation model depicting the dimensions and positioning of the clear floor space required by power wheelchair users (compared to the 95th percentile manual chair and scooter users) when using either the right or left hand, for both forward and lateral reach.

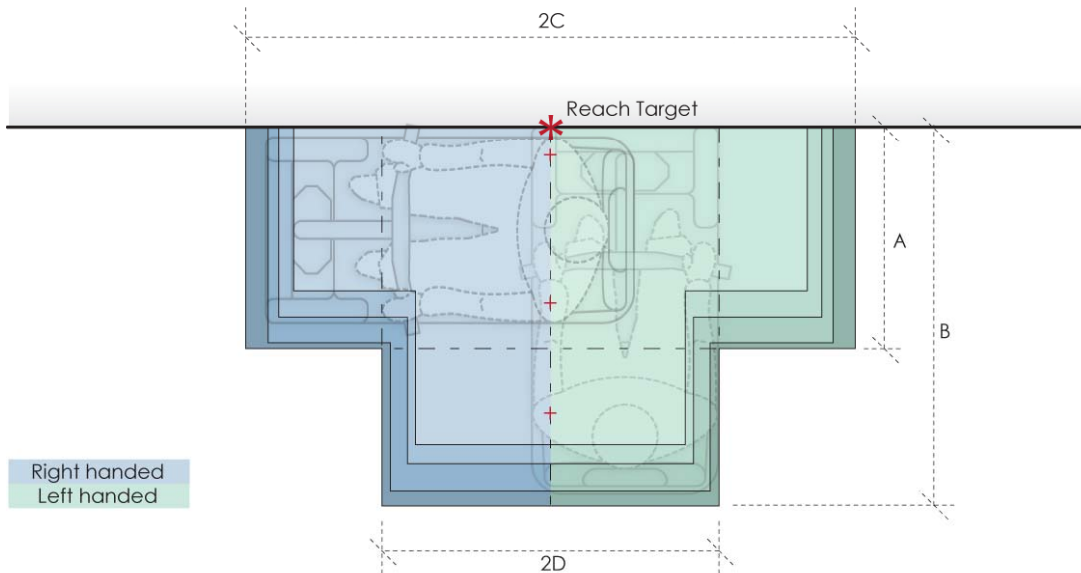
Clear Floor Areas

Design Guidelines for People Using Power Scooters



MINIMUM CLEAR FLOOR SPACE REQUIRED FOR FORWARD AND SIDE APPROACH

Scooter	(%accomodated) n=30				Power n=189	Manual n=276
	50%	75%	90%	95%	95%	95%
A	616 [24]	712 [28]	810 [32]	837 [33]	827 [33]	786 [31]
B	1203 [47]	1274 [50]	1369 [54]	1435 [56]	1414 [56]	1362 [54]
2C	1982 [78]	2071 [82]	2178 [86]	2369 [93]	2126 [84]	2106 [83]
2D	1037 [41]	1083 [43]	1218 [48]	1269 [50]	1278 [50]	1229 [48]



Copyright © 2010 Center for Inclusive Design and Environmental Access, University at Buffalo, The State University of New York

Figure 3: Accommodation model depicting the dimensions and positioning of the clear floor space required by scooter users (compared to the 95th percentile manual and power chair users) when using either the right or left hand, for both forward and lateral reach.

The universal clear floor space for reach, shown in figures 1-3 are designed to accommodate bilateral reach, thus it takes the offset of shoulder point to the lateral and anterior most points of the clear floor area into account and does not require a cross body reach. However, when needing to optimize for handedness using only enough space for a forward reach or side reach, the clear floor space (see [Design Resource #15: Clear Floor Space for Wheeled Mobility](#)) has to be offset from either the lateral most edge of the space (front reach) or the anterior most edge of the space (side reach) (see Figure 4):

1. **Front reach:** Typically, the shoulder joint is about 175 mm (7 in.) inboard from the extreme lateral most point of occupied WMD. This offset should be used for locating the clear floor space in relationship to the target. This means that the clear floor space would be offset, from the target, a distance of 175 mm (7 in.) to the right for a right-handed approach and 175 mm (7 in.) to the left for a left-handed approach.

2. **Side reach:** The anterior most edge of the clear floor space needs to be offset to one side of the target so that the shoulder is aligned with the reach target or slightly behind it. Offsetting the anterior most edge of the space by 1193 mm (45 in.) from the target will accommodate the 95th percentile of scooter users and, thus, provide sufficient room for everyone else to optimize their reach.

Note that using the offsets above is not feasible with the current ADA-ABA standard of 760 mm (30 in.) x 1220 mm (48 in.), but are intended for use with dimensions provided in [Design Resource #15: Clear Floor Space for Wheeled Mobility](#).

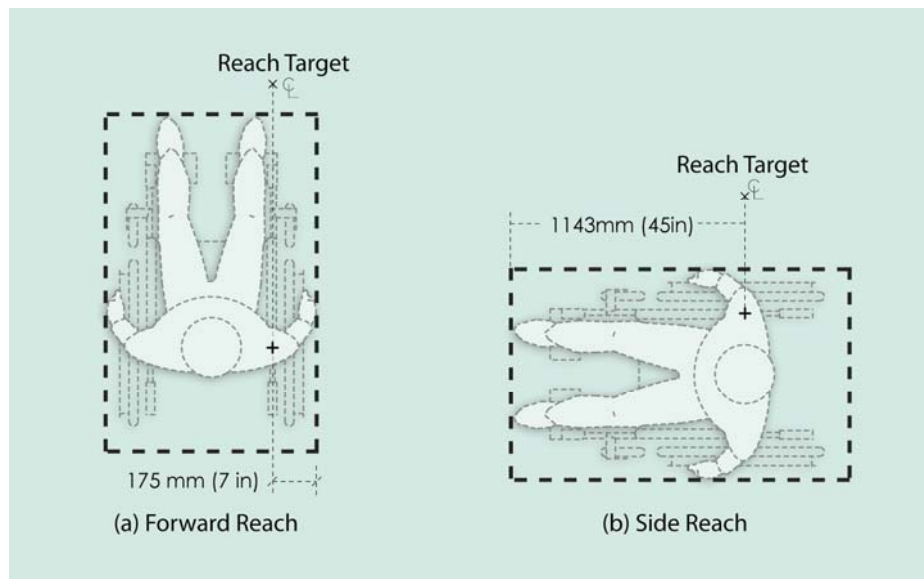


Figure 4: Offsets required when positioning the clear floor space in relation to the reach target for a (a) forward reach, and (b) side reach.

Examples of Application

The clear floor space dimensions provided in this resource are intended specifically for situations that involve reaching, grasping or some type of interaction with nearby features in the environment. The position of light switches, wall outlets, and other wall-mounted elements are good examples. Further, the operation of windows, the ability to reach items on a shelf or countertop, operate a telephone, automatic teller machine (ATM), use an information kiosk, etc. are all dependant on the clear floor area provided for reaching. Providing for the additional space allows users to perform tasks in a way that are most comfortable i.e., using the right or left hand, and a forward or lateral approach direction.

Research Needs

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

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

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>.

Relevant IDEA Center Publications

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

Relevant Design Resource Articles

DR #15: Clear Floor Area for Wheeled Mobility

DR #20: Functional reach capability for wheeled mobility users

DR #17: Knee and toe clearances for wheeled mobility users

ⁱ Dimension values corresponding to the 95th 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 95th 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- 16 Clear Floor Area for Wheeled Mobility
when Reaching or Grasping

© 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