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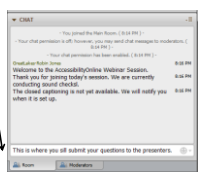

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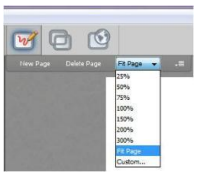

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  2. Email webinars@accessibilityonline.org ; or
  3. Call 877-232-1990 (V/TTY)

10

Vehicle's Final Rule And Research

11

Presenters

U.S. Access Board

Scott J Windley

Juliet Shoultz

12

Presenters

Department of Architecture
University at Buffalo, SUNY

Edward Steinfeld

Victor Paquet

Brittany Perez

13

Session Agenda

- Overview of Non-Rail Vehicle Final Rule
- Overview of Bus Access Research
- Questions and Answers

14

Accessibility Guidelines for Non-rail Vehicles

15

Accessibility Guidelines for Non-rail Vehicles

16

Rulemaking History

- Access Board first issued transportation vehicle accessibility guidelines in September 1991.
- In 1998, Access Board and DOT amended their respective transportation vehicle guidelines and standards to include requirements for OTRB.
- In 2008 Access Board issued revised draft of accessibility guidelines for buses and vans.
- In 2010 Access Board issued a proposed rule.
- January 2017 Access Board issued final rule.

17

Significant Changes

- New organization and format
- Consistent application of accessibility requirements
- New requirement for automated announcement systems
- Revised requirements for the running slope of ramps
- New accessibility requirements for OTRBs
- Revisions to reflect changes in technologies and Standards

18

ADA Accessibility Guidelines for Transportation Vehicles

- Subpart A-General
- Subpart B-Buses, Vans and Systems
- Subpart C-Rapid Rail Vehicles and Systems
- Subpart D-Light Rail Vehicles and Systems
- Subpart E-Commuter Rail Cars and Systems
- Subpart F-Intercity Rail Cars and Systems
- Subpart G-Over-the-Road Buses and Systems
- Subpart H-Other Vehicles and Systems
- Appendix -- Advisory Guidance

19

Organization

SCOPING

- T201 General
- T202 Accessible Means of Boarding and Alighting
- T203 Steps
- T204 Doorways
- T205 Illumination
- T206 Handrails, Stanchions and Handholds
- T207 Circulation Paths
- T208 Passenger Access Routes
- T209 Fare Collection Devices

20

Organization

- T210 Wheelchair Spaces
- T211 Wheelchair Securement Systems
- T212 Seat Belts and Shoulder Belts
- T213 Seats
- T214 Operable Parts
- T215 Communication Features

21

Non-Rail Vehicles

- ***Non-Rail Vehicle:*** **A self-propelled, rubber-tired vehicle used to provide transportation services and intended for use on city streets, highways, or busways that constitutes either a bus, over-the-road bus, or van.**
- **We call the rule "non-rail vehicles" because we are going to address rail vehicle guidelines in a separate rule making.**

22

T202 Accessible Means of Boarding and Alighting

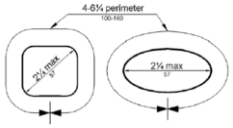
- **Non-rail vehicles must provide at least one means of accessible boarding and alighting that serves each designated stop on the fixed route to which the vehicle is assigned and that can be deployed to the roadway by one of the following:**
  - **ramps or bridgeplates complying with T402**
  - **Lifts complying with T403**
  - **Level boarding and alighting complying with T404.**

23

Chapter 3: Building Blocks

Covers basic elements and requirements found in multiple sections

- **T302 Walking surfaces**
- **T303 Handrails, stanchions and handholds**
- **T304 Operable parts**



24

Chapter 4: Boarding and Alighting

- T402 Ramps and Bridgeplates
- T403 Lifts
- T404 Level Boarding and Alighting
- T405 Steps

25

Ramp Requirements

Changed the slope requirements for ramp deployment:

- 1:6 maximum slope when deployed to curb.
- 1:6 maximum slope when deployed to street (1:4 was permitted in previous version of DOT standards).
- 1:8 maximum slope when deployed to a platform

26

Ramp Requirements

How to Measure Running slopes

- Measurement of ramp slope to the curb or the street (1:6 max) is measured to ground level with the non-rail vehicle resting on a flat surface.
- Measurement of ramp slope to a platform (1:8 max) is measured to the boarding platform with the non-rail vehicle resting on a flat surface.
- These are NOT a field tests.

27

Picture courtesy of Lift-U

Lift Requirements

T403 Lifts

References Federal Motor Vehicle Safety Standards which addresses:

- **Design load**
- **Controls and manual operation**
- **Platform characteristics**
- **Threshold ramps**
- **Deflection and movement**
- **Handrails etc.**

Lift can be entered in either direction.

28

Level Boarding and Alighting

T404 Level boarding and alighting

29

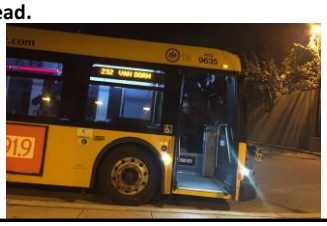
Chapter 5: Doorways, Circulation Paths and Fare Collection Devices

- **T502 Doorways**
- **T503 Illumination**
- **T504 Passenger access routes**
- **T505 Fare collection devices**

30

Doorways and Illumination

- The walking surface of ramps, bridgeplates, and steps serving doorways must be lighted with 2 foot-candles minimum
- Exterior lighting to illuminate walking surfaces of boarding and alighting areas when the doors are open. At 1 foot-candle min. for a distance of 3 feet beyond the doorway or bottom step tread.



31

Chapter 5: Doorways, Circulation Paths and Fare Collection Devices

T504 Passenger access routes

- Maintained language for passenger access routes to provide clearances that are sufficient to permit passengers using wheelchairs to move between wheelchair spaces and doorways.

32

Chapter 6: Wheelchair Spaces and Securement Systems

- T602 Wheelchair spaces
- T603 Wheelchair securement systems
- T604 Stowage
- T605 Seat belts and shoulder belts

33

Wheelchair Spaces and Securement

T602 Wheelchair Spaces

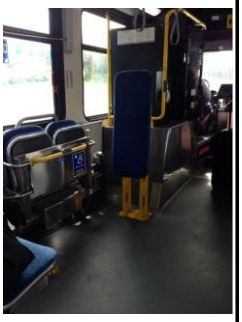
- **T602.2 Surfaces.**
- **T602.3 Approach.**
- **T602.4 Size. 30 inches (760 mm) minimum in width and 48 inches (1220 mm) minimum in length.**

34

Wheelchair Spaces and Securement

T603 Wheelchair securement systems

- **Allows rear facing securement and references ISO 10865-1:2012, Part 1: Systems for rearward facing wheelchair-seated passengers**



35

Chapter 7: Communication Features

- **T702 Signs**
- **T703 International Symbol of Accessibility**
- **T704 Announcement systems**

36

Communication Features

- **The following requirements apply to Large Transit Entities which is defined as:**
- ***Large transit entity.*** **A provider of public transportation that is required to report to the National Transportation Database (49 U.S.C. 5335), and that, for an any given calendar year, reports to such database the operation of 100 or more buses in annual maximum service for all fixed-route service bus modes collectively, through either direct operation or purchased transportation.**

37

Communication Features

T704 Announcement systems **(large transit entities only)**

- **Internal - Automated stop announcement systems shall provide audible and visible notification of upcoming stops on fixed routes.**

38

Communication Features

T704 Announcement systems **(large transit entities only)**

- **External - Automated route identification systems shall audibly and visibly identify the fixed route on which the non-rail vehicle is operating.**

39

Research Efforts

40

ACCESSIBLE PUBLIC TRANSPORTATION: BUS

RAMPS, SECUREMENT, AND INTERIOR LAYOUT

Edward Steinfeld, ArchD
Victor Paquet, ScD
Brittany Perez, OTD, OTR/L

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41

Funding Acknowledgement

RERC APT

NIDILRR
National Institute on Disability, Independent Living, and Rehabilitation Research

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Outline

Ramp Slope
- Ramp Study #1: RERC APT 2008-2013
- Ramp Study #2: RERC APT 2013-2018

Interior Layout
- Seating: RERC APT 2008-2013
- Fare Payment: RERC APT 2008-2013

Securement
- Usability Testing: RERC APT 2013-2018

RAMP STUDY #1

RERC APT 2008-2013

Lenker, J.
Paquet, V.
D'Souza, C.
Bareria, P.
Steinfeld, E.

Study Design – Apparatus

1:12 1:6 1:8 1:4

Study Design – Participants (n=80)

Group	n	Age Range
Manual Wheelchair	14	19-55
Power Wheelchair	20	29-82
Scooter	5	29-65
Vision Impairment	20	22-75
Walking Aid	21	28-80

N = 80

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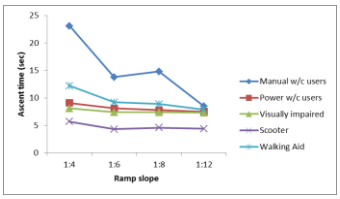
Findings – Ascent Time



ANOVA: Main effects for user group ($p<.001$) & slope ($p=.027$). Non-significant interaction

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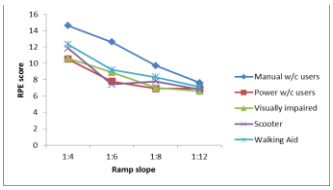
Findings – Ratings of Perceived Exertion



ANOVA: Main effects for user group ($p<.001$) and slope ($p<.001$). Non significant interaction

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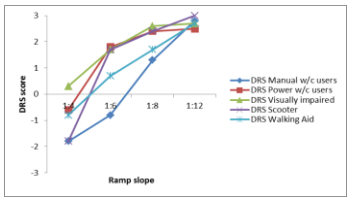
Findings – Difficulty Rating Scale



ANOVA: Main effects for user group ($p<.001$) and slope ($p<.001$). Non-significant interaction

Summary

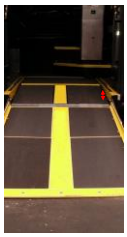
- 1:4 and 1:6 slopes are too steep.
- 1:4 – 9 participants (33%) could not complete
- 1:6 – 4 participants (14.8%) could not complete
- 1:8 – 1 participant (3.7%) could not complete
- 1:12 – all completed
- *Descending* ramps can be challenging for some groups
- Participants expressed concerns about using the ramp in *winter*
- Correlations among RPE, DRS, and ARS reinforce the validity of these scales

RAMP STUDY #2

RERC APT 2013-2018

Perez, B.
Lenker, J.
Paquet, V.
Choi, J.
Steinfeld, E.

Research Design— Apparatus



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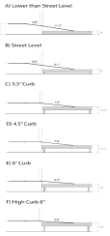
52

Research Design— Test Conditions



Ramp Condition	Segment Angle (rise:run equivalent)		
	Inside	*Middle*	*Outside*
A. Below Street Level	1.2° -	9.0° (1:6.3)	11.7° (1:4.8)
B. Street Level	1.3° -	8.9° (1:6.4)	9.1° (1:6.2)
C. 3.5" Curb	1.3° -	2.5° -	7.8° (1:7.3)
D. 4.5" Curb	1.3° -	0.4° -	7.6° (1:7.5)
E. 6" Curb	1.3° -	0.3° -	5.7° (1:9.9)
F. High Curb 8"	1.3° -	0.3° -	3.6° (1:15.7)

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Research Design – Participants

Participant Group	n
Manual Wheelchair	15
Power Wheelchair	15
Scooter	6
Vision Impairment	15
Walking Aid	15

N=51

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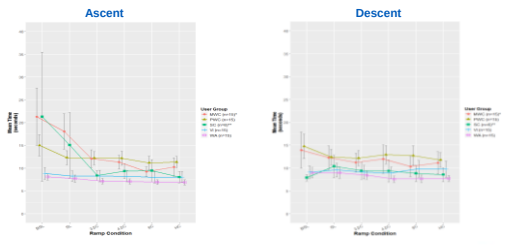
54

Findings – Time



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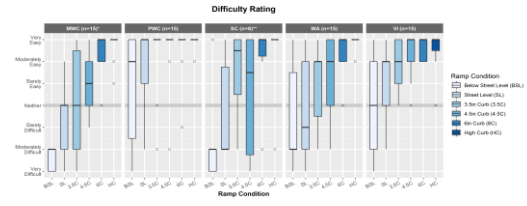
Findings – Difficulty Rating Scale



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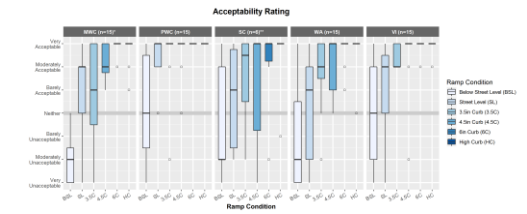
Findings – Acceptability Rating Scale



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Summary

- Curb deployment is clearly more favorable than street deployment
- Performance and acceptability begins to level out between 1:6 – 1:7
- 20% of MWC users need assistance even on a 4.5 in curb (steepest segment measures 1:7.5)
- The grade break conditions created with older (two-segment) ramps alleviated by the three-segment, dual-mode ramp design.
- Other factors may have impacted participant ratings
  - Width of ramp
  - Circulation space at the top of the ramp

Implications of Ramp Studies

- Supports changing the maximum slope for transit ramps to 1:6
- With a 1:6 maximum condition at street level, any environmental facilitation will support easier boarding and alighting:
  - Deploy ramp to curb wherever possible
  - Standardize bus stop conditions to allow loading to curb
  - Longer handrails could help
- 1:7 or 1:8 maximum slope condition at street level would ensure most inclusive access conditions

INTERIOR LAYOUT: SEATING AND FARE PAYMENT

RERC APT 2008-2013

Clive D'Souza
Victor Paquet

Research Design

Layout 1 | Layout 2 | Layout 3

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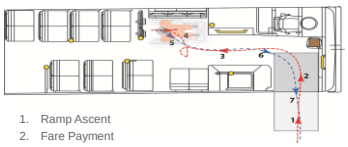
61

Research Design—Task Description



1. Ramp Ascent
2. Fare Payment
3. Moving to the Wheelchair Securement Space (WSC)
4. Entering and Positioning
5. Exiting the WSC
6. Moving to the exit door
7. Ramp Descent

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Findings – WhMD Users (N=48)

- Narrow turning space near the front of the bus
- Inadequate turning space with second wheelchair on board

- Longitudinal seats less desirable: Increased risk of feet getting run over

- Limited reach capability among wheeled mobility users

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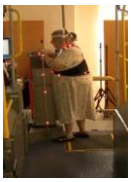
Findings: BVI (N=18), Walking Aid Users (N=24)



- Locating features in the environment
- e.g., Fare payment

- Orientation and mobility
- Finding a vacant seat
- Risk of collisions, trip hazards

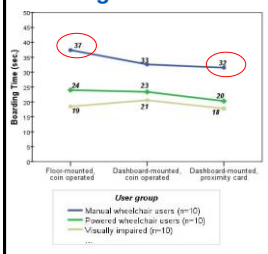
- Use of assistive supports during sitting & rising
- Legroom and device storage using side vs. forward facing seats

Fare Payment and Maneuvering Clearances

Floor-mounted fare machine

Dashboard-mounted fare machine

Findings



- Quicker boarding times across designs
  - Floor /dashboard > swipe card
- Floor-mounted fare-box design
  - Space constraint for wheeled mobility users
  - Easier to detect by cane users
- Dashboard-mounted
  - Proximity cards over coin
  - Greater % of task completion

SECUREMENT

RERC 2013-2018

Perez, B.
Lenker, J.
Paquet, V.
Choi, J.
Steinfeld, E.

Introduction

- The four-point belt-type tie-down system is the most common method of securement.
- It is up to the transit authority to require the use of the wheelchair securement
- Use of use of seatbelts and shoulder harnesses is voluntary.
- Identifying appropriate attachment points on the wheelchairs is a key issue.
- Devices complying with ANSI/RESNA WC19 standard have attachment points for this purpose.
- Wheelchair securement rates - around 39% (Buning et al., 2007).

Research Design – Participants

Participant Group	n
Manual Wheelchair	15
Power Wheelchair	15
Scooter	6

N=36

Research Design— Securement

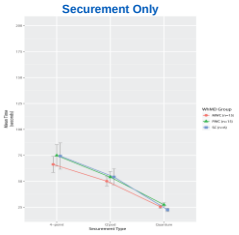
4-Point

Q'Pod

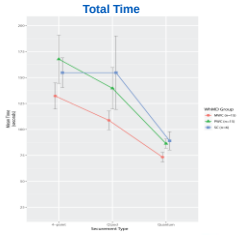
Quantum

Findings – Time, all participants

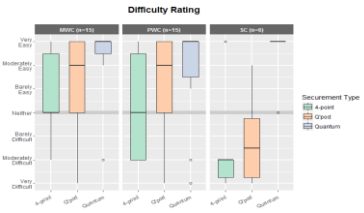
Securement Only



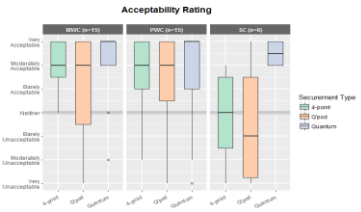
Total Time



Findings – Difficulty



Findings – Acceptability



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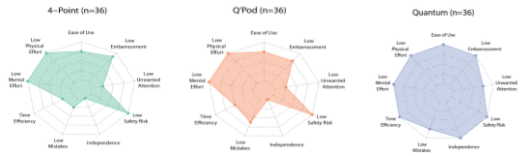
73

Results – RAPUUD, by device



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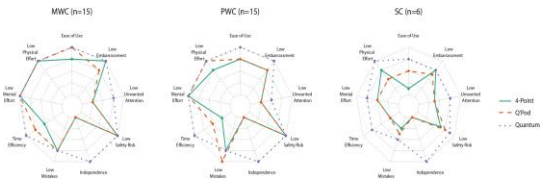
74

Results – RAPUUD, by user group



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75

Summary

Groups	N	Participant Preference		
		4-Point	Q'Pod	Quantum
MWC	15	3	3	9
PWC	15*	2	2	10
Scooter	6	0	0	6

*Note: One PWC user did not specify a preference for a single securement system.

Implications

- The Quantum securement system saves time and reduces effort
- The Q'Pod saves time and is rated more positively than the 4-point traditional system
- Concerns about Quantum related to seating orientation, safety in motion, and emergency back-up options.
- The Quantum and the Q-Pod should be field tested to produce evidence to support adoption by transit agencies

Summary

- There will not be "one best solution" to accessibility
  - Impact of features varies by user abilities
  - Crowding makes a difference
- Walking aid users
  - Longitudinal (side-facing) seats preferred for legroom
  - Storage space for walkers a concern

Summary

- Increasing minimum clearances by small amount will increase the percentage of people accommodated, particularly wheeled mobility users.
- Everything is interrelated, e.g. fare location and maneuvering, entry location, securement, and stop design.

Future Directions

- Ramp design features:
  - Railings
  - Bus stop design
- Automated mobility device securement
  - Is it working in the field?
  - Cost benefit analysis
  - Use in smaller vehicles (shuttles, vans, etc.)
  - Integration with autonomous vehicles (robotics)

Future Directions

- Interior Layout
  - Patterns of use and density – BRT vs Shuttle buses
  - Technological developments in fare payment – phone based, bluetooth, tap an go (NFC)

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82

Questions?

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83

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84

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85