



Mobility in Aircraft Cabins

■ Tailored On-Board Assistance

Development of an On-Board Wheel Chair

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Prof. Dr.-Ing. Gordon Konieczny

■ Introduction



Opening Remarks

The PEREC Project

The Hamburg Chair 2 in 1

The Test

Closing Remarks



■ Hamburg University of Applied Science (HAW)

Long Tradition

- History dates back to 1749
- 1970 Foundation of Fachhochschule Hamburg
- since 2003 HAW Hamburg (UAS)

Today

- 3rd largest UAS in Germany
- 4 faculties with ca. 15,000 students
- app. 2,000 foreign students
- 430 professors



■ Dept. Automotive & Aeronautical Engineering

Students

1300 in the degree programs (B.Eng. and M.Sc.)

- Automotive (800)
- Aeronautical (500)
- 200 Graduates per annum

Staff

43 professors and ca. 20 assistant lecturers

20 research assistants and other members of staff

Laboratories

Lightweight Design & Composites

CAD-Laboratory & Computer Centre

Wind Tunnel, Flight Test

Cabin & Cabin System Lab (HCAT) (newer)

Technical Acoustics (ca. 10/2016)

Aircraft Systems & Flight Deck (planned)



■ The Person



Prof. Dr.-Ing. Gordon Konieczny

Academic studies Technische Universität Dresden (TU Dresden)
Faculty of Transportation and Traffic Science; Institute for Aviation

PhD student Technische Universität Berlin (Technical University Berlin)
Faculty of Mechanical Engineering and Transport Systems
Topic: Determination of Service Quality in Aircraft Cabins

HAW Hamburg UAS

- Architecture of Aircraft Cabins (BA)
- Cabin Modules and Monuments (BA)
- Methods of System Design (BA)
- Human Factors (MA)
- Maintenance, Upgrade & Retrofit (MA)
- Lab for Cabin & Cabin Systems

Over 20 Years in Aviation

- Aircraft (Cabin) Design & Operation
- Airport Design & Operation
- Passenger & Aircraft Handling
- Systems (Reliability) Engineering
- Human Factors
- Commercial Pilot (CPL MEP IR(A))

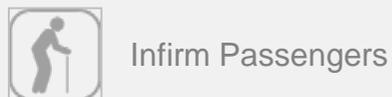
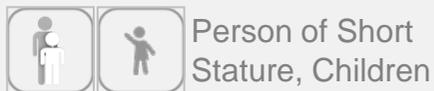
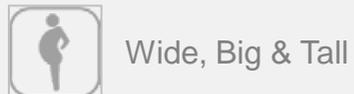
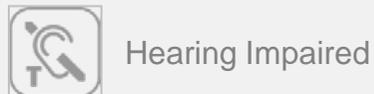
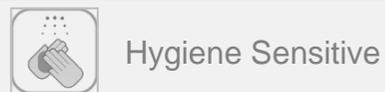
www.flyprof.de

■ The Project

PEREC

Person-Centered Reconfigurable Aircraft Cabin

for special aircraft
cabin user groups:



Project Information

- Project Duration: 2012 -2015
- Steps
 1. Situation and Task Analysis
 2. Concept and Implementation Analysis
 3. Demonstration and Evaluation

Methodical Approach:

- Continuous and early involvement of potential User-Groups, e.g. workshops, interviews
- Continuous Information Exchange with Stakeholders
- Development of Minimum Viable Products (MVP)

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

■ The Project - PEREC

Onboard Wheel Chair (OBW) – Concept Approach

- Basic Assumptions: Maintain Abilities of Home. Support Independence.



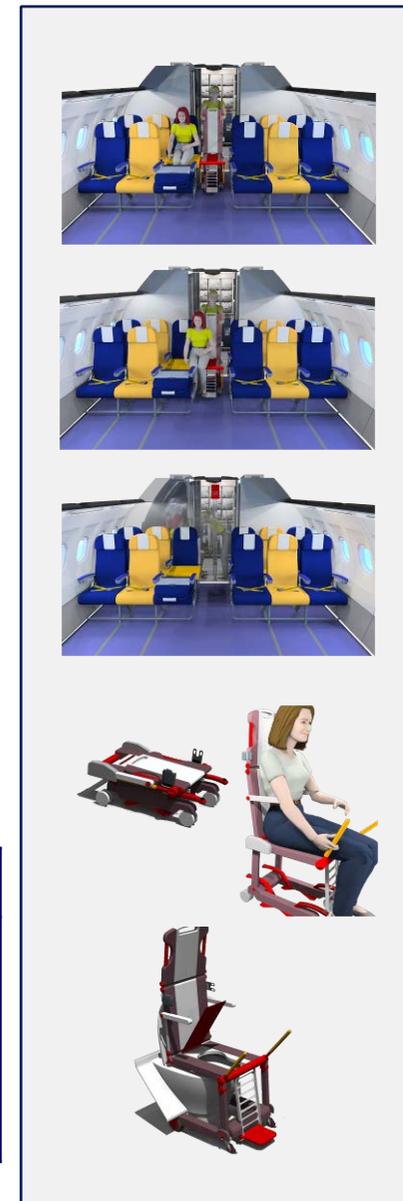
- Main Functions:
 1. Provide Cabin Mobility
 2. Provide Lavatory Usage Assistance



Level of Independence	Main Functions	
	Cabin Mobility	Lavatory Usage
Weight-Bearing (A)	✓	
Non-Weight Bearing (B)	✓	✓

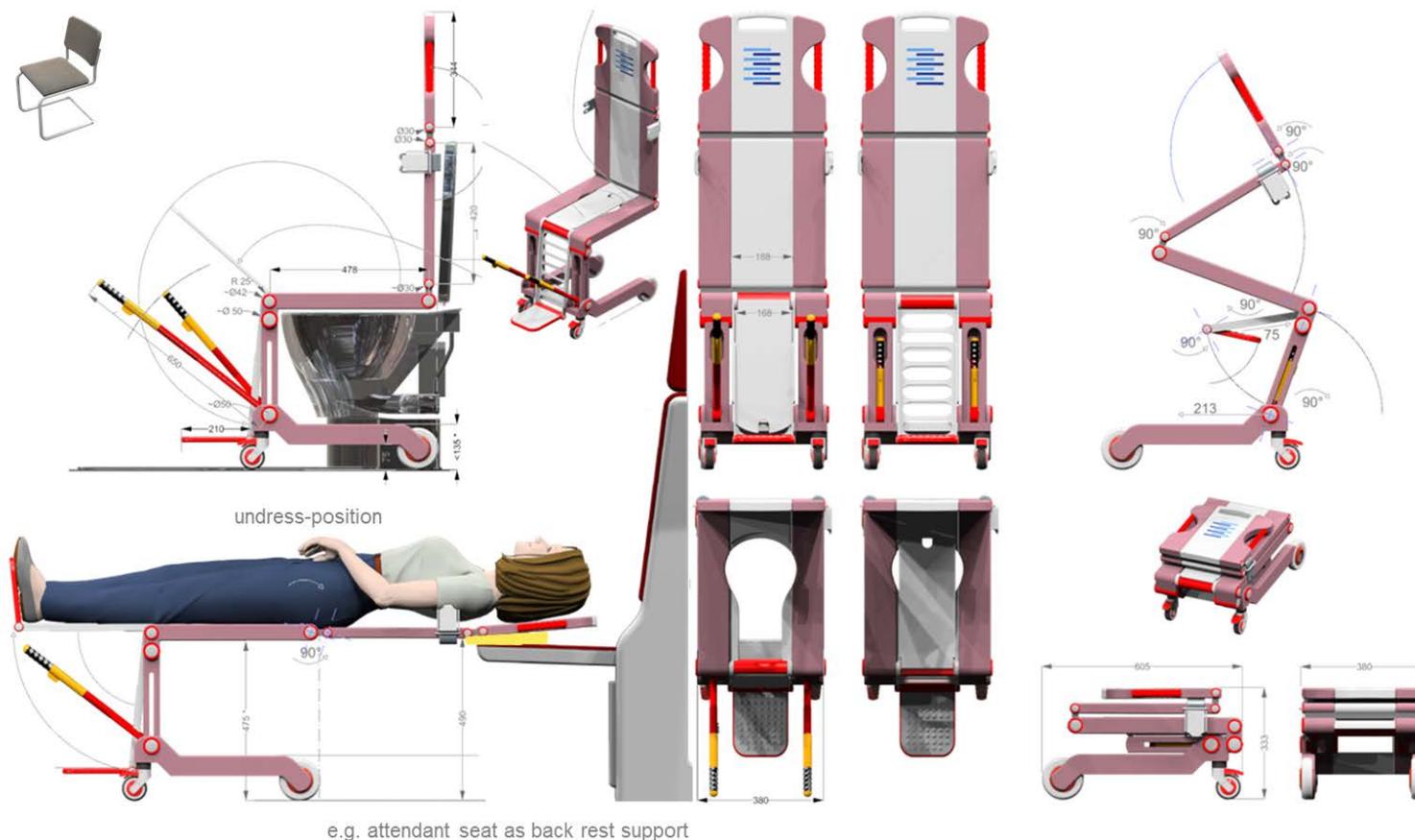
- OBW Requirements:

Safety & Security	Health & Comfort	Crew & a/c Performance
<ul style="list-style-type: none"> • FAR / CS Conformity • Misuse & Abuse • Operational Loads • Stability & Reliability 	<ul style="list-style-type: none"> • Appropriate Dimensions • High Usability • Hygienic Aspects • Convincing & Trustworthy 	<ul style="list-style-type: none"> • High Usability • Little additional Workload for all involved Persons • Applicable in <u>any</u> Lavatories • Little Alteration Efforts



■ The Hamburg Chair 2 in 1

Onboard Cantilever Wheel Chair (OBW) - Overview



Specification:

- 95th Percentile American Male (Dimensioning)
- Width < 15" (here 380mm)
- Height acc. Lavatory Bowl Height (supporting function)
- Braked and turnable wheels
- Control Rods (adjustable)
- Foot Rest (movable)
- Necessary Cut-outs in lavatory kick-strip
- Lavatory door closure for OBW forward usage
- Collapsible for stowage – minimum dimension
- Weight limitation < 10kg

Horizontal OBW Position for (un-)dressing was a Suggestion of a PRM group from Hamburg during a PEREC Workshop.

■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – Operational Concept

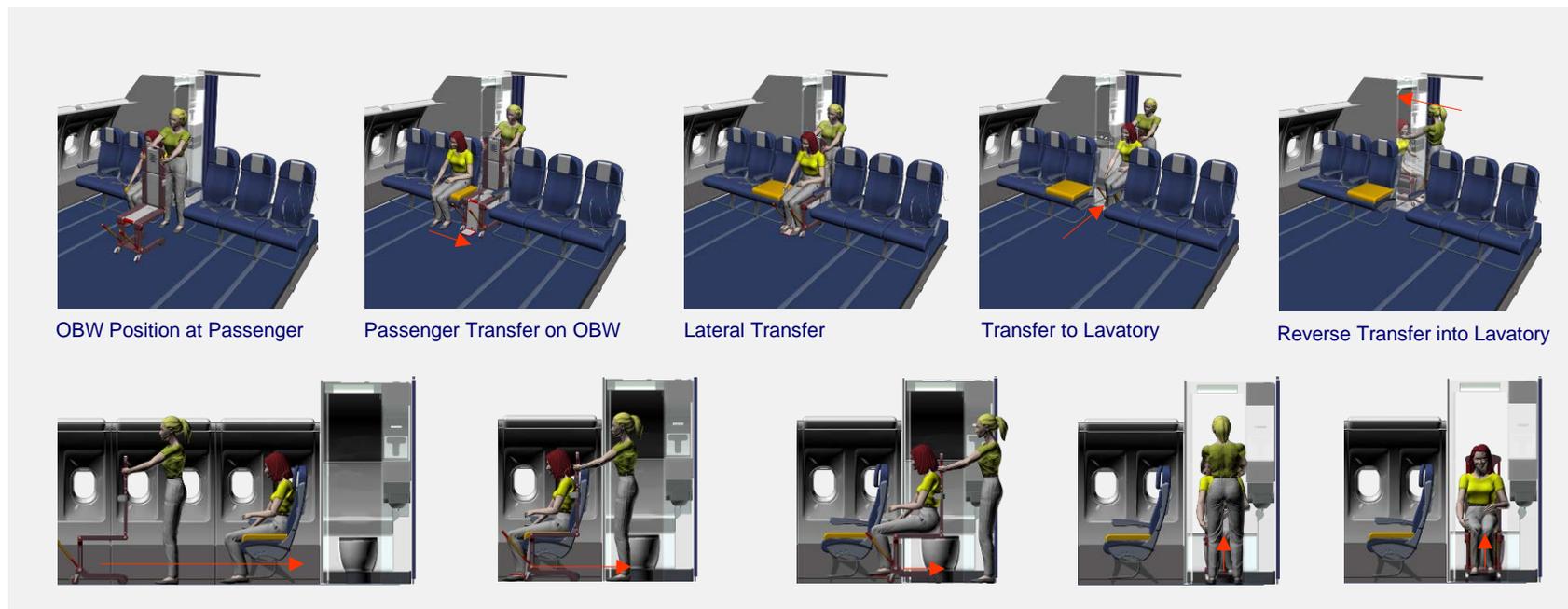
Step	Action	Remarks	Group	
			A	B
1	Transfer: Seat → Lavatory Area	<ul style="list-style-type: none"> OBW Check before Entering into Main Cabin Operation as a normal (known) OBW Easy and comfortable Use for PRM and Supporting Person No Lavatory Assist Function recognizable 	✓	✓
2	Lavatory Usage Assistance	<ul style="list-style-type: none"> Position in Privacy Area in front of Lavatory Preparation of PRM and OBW for Lavatory Usage After Usage of Lavatory - Preparation of PRM and OBW for Transfer to Seat OBW Check before entering the Main Cabin 		✓
3	Transfer: Lavatory Area → Seat	<ul style="list-style-type: none"> Upon Entry into the Main Cabin – Operation as a normal (known) OBW No Lavatory Assist Function recognizable 	✓	✓

Group A: Weight Bearing Persons

Group B: Non-Weight Bearing Persons

■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – Process Investigation



Main Findings - Aspects:

- Area in-front of Lavatory necessary for OBW Operation (Privacy)
- Multiple Usage of Area in Front of Lavatory and Provision of Covering Material for OBW Seat Surface (Hygiene)
- Meeting social norms, standards and expectations = clear separation between the two main functions during OBW usage (Acceptance)
- Necessary Assistance – Classification of WCH Users in extent to todays IATA Classification?

■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – First Concept Chair



- Development of Demonstrator for Main Functions (MVP)
- Development of Tests, Test Procedures and Criteria
- Test Execution with two Test Persons (below 95th percentile)

Test 1: Main Function On-Board Mobility

- OBW Movement through Cabin
- Evaluation of
 - OBW Maneuverability and Wheel Movement ✓
 - Necessary OBW push / pull forces (qualitative) ✓

Test 2: Main Function Lavatory Usage Assistance

- OBW Movement backwards into Lavatory
- Evaluation of
 - OBW Maneuverability into Toilet Compartment !
 - Coverage of Lavatory Bowl by OBW !
 - Position of cut-outs for OBW Rear Wheels ✓



Test by Martin Rückbrodt and Fabian Reimer

■ The Hamburg Chair 2 in 1

Thank you so much for the valuable comments we have received after the first Presentation of the Hamburg Chair to the Plenum – provided Aspects:

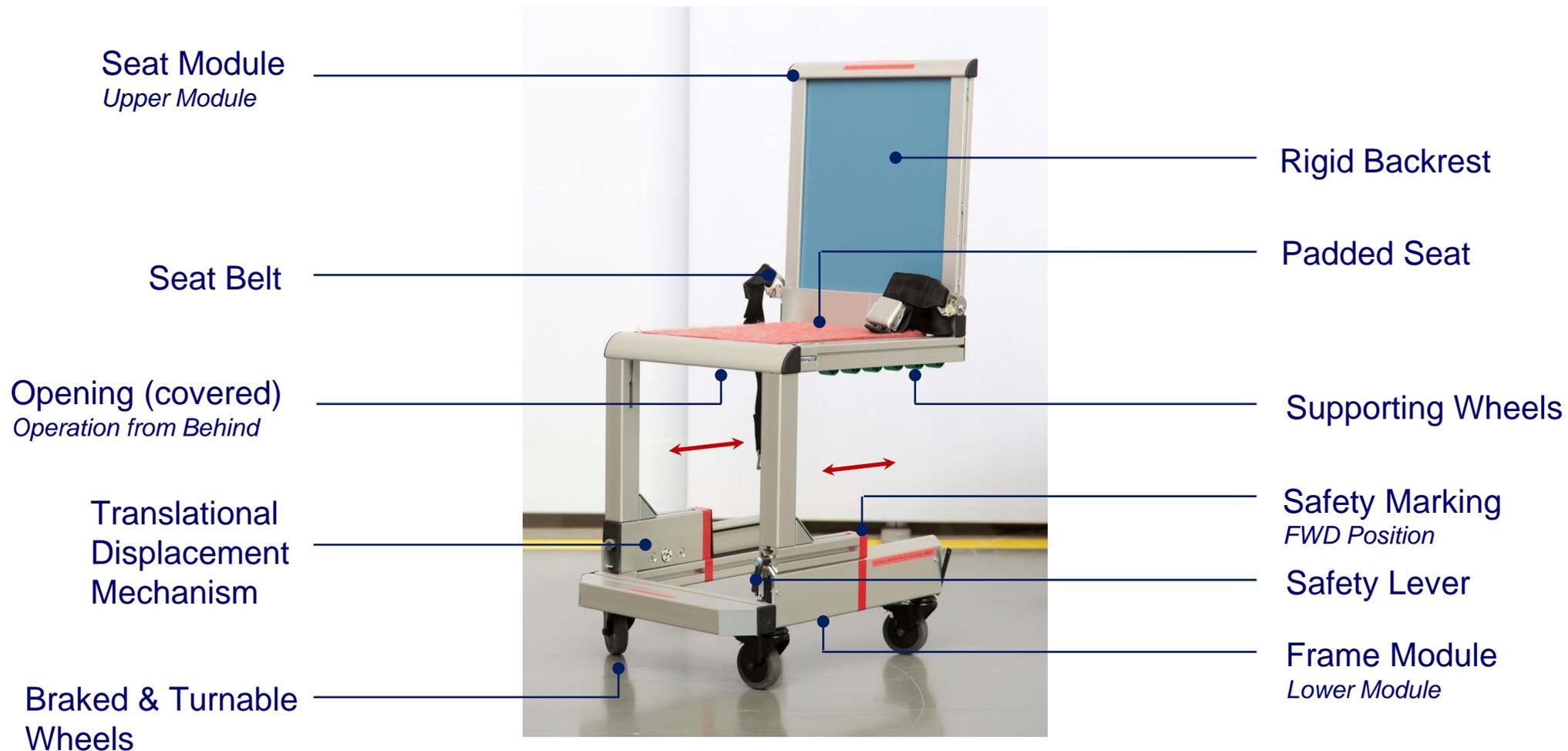
- Hygiene and Sanitation Concerns in Operation
- Lid Device – Operation of Opening
- Overall OBW Design and Operation
- Padding of Seat and Backrest
- Belts and Straps for safe PRM Movement
- Armrests
- Braked Wheels
- Applicable Loads



Result: Development of a new Concept Chair within 14 days (Functional Demonstrator)

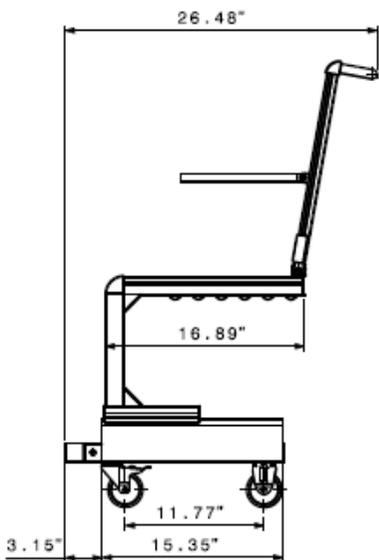
■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – Second Concept Chair



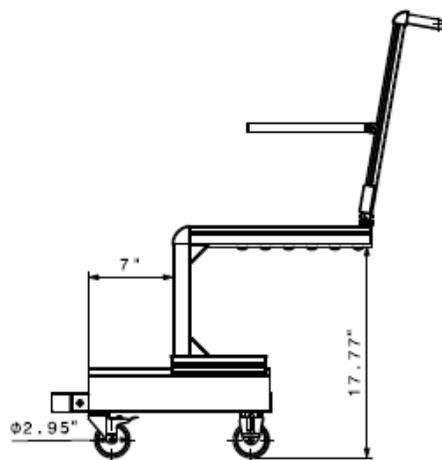
■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – Second Concept Chair



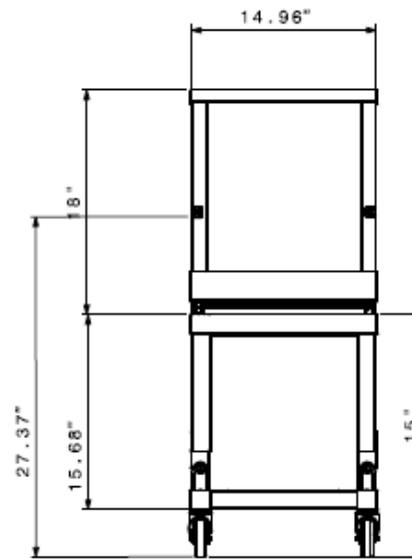
Side view
Scale: 1:5

Position for Function:
On-Board Mobility

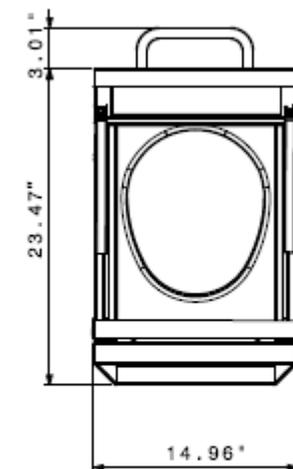


Side view
Scale: 1:5

Position for Function:
Lavatory Usage Assistance



Front view
Scale: 1:5

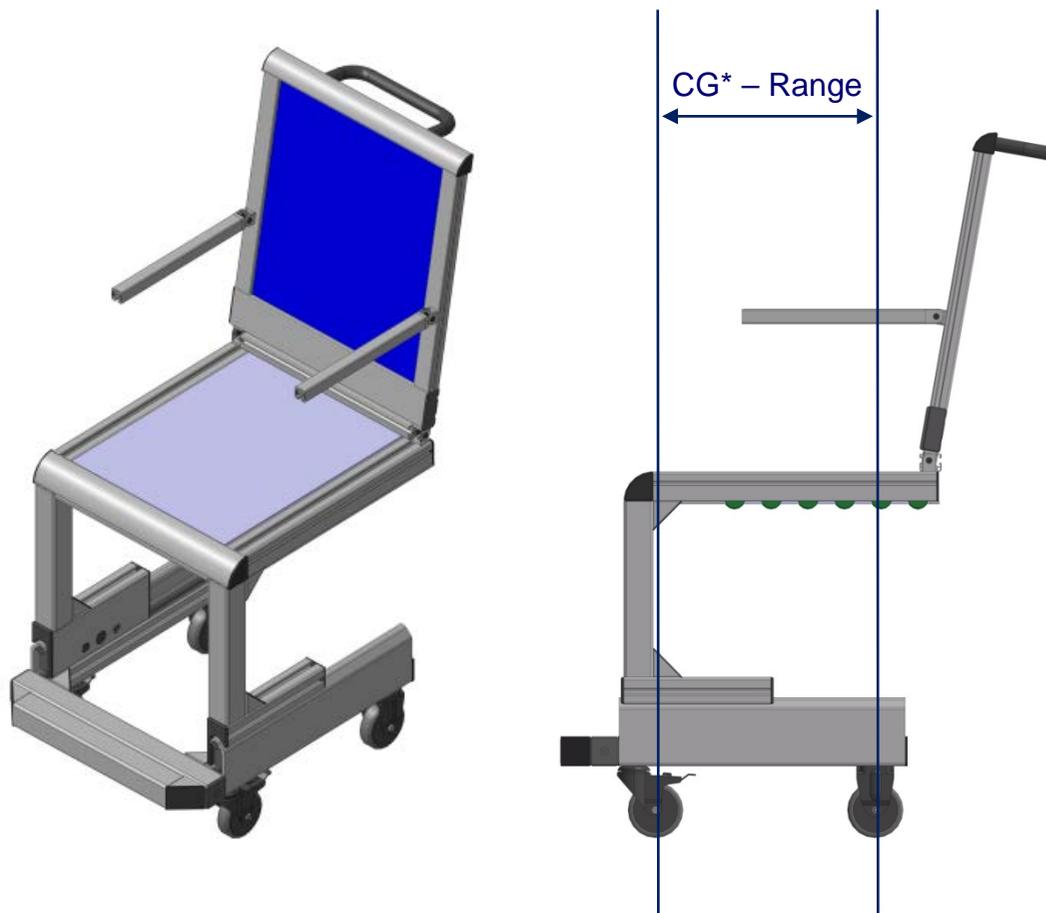


Top view
Scale: 1:5

Two defined OBW Positions

■ The Hamburg Chair 2 in 1

Main Function: On-Board Mobility



Remarks:

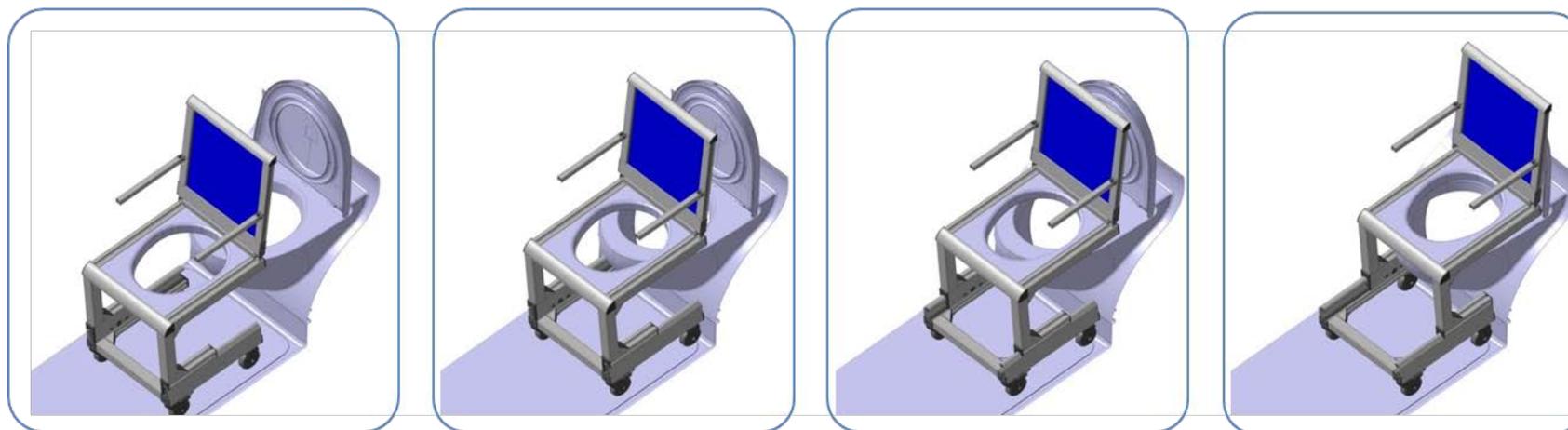
- Second assisting Person always necessary
- For Passenger Transport Seat Module must be in most forward Position, secured and Status must be fully identifiable
- Demonstrator with Safety Lever and Safety Marking

*CG – overall CG including CG of Person and CG of OBW

■ The Hamburg Chair 2 in 1

Main Function: Lavatory Usage Assistance

Usage in Privacy



Operation:

- Remove Cover of the Opening outside the Lavatory Compartment (Operation from behind)
- Position OBW backwards direct in front of Lavatory (lower Frame Module in contact with Shroud)
- Brake Wheels then disarm Safety Lever
- Move Upper Seat Module to the very back position (by User or Assistant)
- After Use of Lavatory move Upper Seat Module to the most forward Position (by User or Assistant)
- Arm Safety Lever then release Wheel Brakes
- Position OBW outside in front of Lavatory
- Apply Cover for the Opening (Operation from behind)
- After OBW Check transport Passenger to the Seat

■ The Hamburg Chair 2 in 1

Onboard Wheel Chair (OBW) – Test



Test Persons:

- 2 Female and 1 Male Test Persons
- ca. 80th Percentile, normal stature
- WCH User, all weight-bearing
- Able to hold-up for a short time with Arms and Hands
- Able to walk short distances assisted

Task:

- OBW Lavatory Usability Test for actual Lavatory Layouts
- Using and testing all Lavatory Compartment
 - with OBW
 - without OBW – Walk-In of Test Persons (Group A)

Results & Findings:

- Overall positive OBW Perception
- Lavatories in the rear a/c more suitable (Privacy)
- Area in front of Lavatory needed for OBW Operation - Assistance required
- Improvement of individual Independency
- Narrow Lavatories with Pros and Cons
- Hygienic Aspects comparable to regular Lavatory Usage (adapted Seat Covers)
- Development of Collapsible Mechanism

■ The Hamburg Chair 2 in 1

Comments from Tests

Brakes should be applicable at all wheels simultaneously by the user.

This Chair is better than the other ones. You sit safer. I can do this myself. It is not difficult.

The Closeness of the Side Wall of the Lavatory gave me a sense of stability, because I could lean against it.

This Chair appears to be wider, more stable and comfortable.

Cool. Yes. I can use the Lavatory by myself – alone.

It is ok. The Chair is reasonably comfortable.

You sit well and safe, a handle would be helpful to move yourself.

The sliding Mechanism works easier than expected. Chair positioning is a bit tricky.

This Chair is far more useful than a lot of Ideas I have been presented before.

At first glance, the Swing made an unsafe impression, but it is no problem when you sit on the Chair.



■ Closing Remarks

- Cantilever OBW as feasible solution for tailored on-board Mobility in Single Aisle Aircraft (Functions: Cabin Mobility and Lavatory Usage Assistance)
- Successful Tests with **Hamburg Concept Chair 2 in 1** and positive Perception as a very useful Item by involved Test Persons
- Discussions regarding Hygiene and Privacy ongoing – Procedures necessary
- Definition of Procedures necessary for safe OBW Operation including usage of Area in-front of Lavatory for Preparation Activities

Benefits for User

- Improvement of On-Board Mobility
- Enhanced Travel Experience

Benefits for Operator

- Better public Image and Enhanced Passenger Service
- Only Minimum additional Workload
- No Changes in Lavatory Design

■ On-Board Wheel Chairs

Q & A

