PubTrans4All

Public Transportation - Accessibility for All

Deliverable 4.3
Prototype BAS Development Report

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Table of Versions

Version	Date	Authors	Description	Date of Approval
0.1	2011/12/08	M. Wendelken	New document	
0.2	2011/12/23	M. Wendelken	Project partner inputs	

Table of Contents

1. Introduction and Summary

Task 4.3 consists of building and factory testing the vehicle-based boarding assistance system (BAS) and it is based on the results of task 4.2 “Vehicle Based BAS Prototype Preliminary Design” where several design concepts for a new BAS were developed and one was chosen.

During the Prototype Development Group (PDG) meeting in Vienna July 19th 2011 various recommendations for UIC wagons were presented to the PDG. Particularly due to the required space to install a BAS within the vehicle it was decided to develop a swivel lift concept.

Details of the swivel lift see Deliverable 4.2 “Vehicle-Based BAS Preliminare Design Recommendations”, point 4.7 swivel lift.

The development of products for the railway industry is based on detailed specifications, drawings and technical requirements. MBB considered the presented and received drawings and requirements carefully in order to start the prototype of the BAS.

During the fifth PDG meeting in Sofia November 9th 2011 the on-site-visit of the UIC wagons the following results were presented:

- feasibility study of BDZ
- necessary adjustments of the UIC wagon, which will be done by BDZ
- additional collisions and requirements during the on-site-visit of the UIC wagon

The new requirements have a strong influence on the design of the BAS prototype. Therefore, since the meeting MBB investigates in a new design in respect to the cover of the BAS as well as in various adaptations of the lift itself.

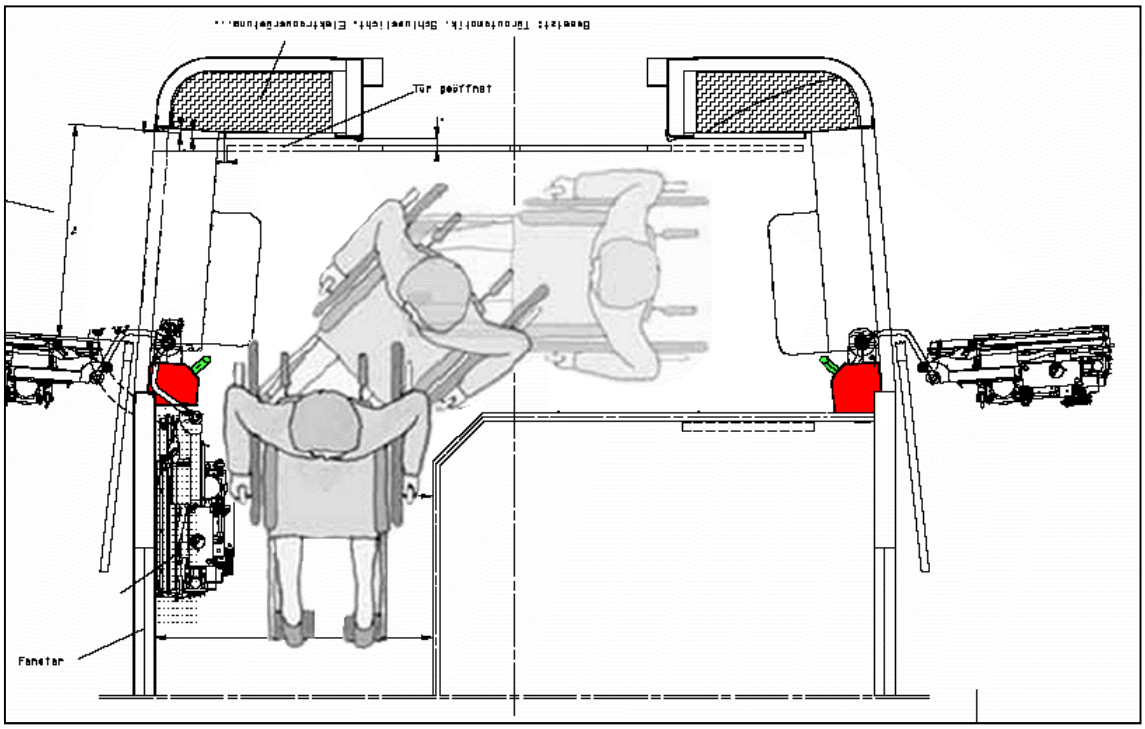
On the next pages we present the status of the project BAS prototype.

2. General

The UIC wagon shall be equipped with a total of two BAS in future. These are located on both sides in the wagon with universal WC and wheelchair spaces. Due to the given space in the entrance area (picture 1) different lift models have to be taken into consideration e.g. regarding the storage and handling. The positioning of the lifts has been reviewed in detail in Deliverable 4.2 Vehicle-Based BAS Preliminary Design Recommendations. This document also contains further details on handling and key features which should be included.

The following report is based on the feasibility study of one prototype with 270° swiveling.

Picture 1: Entrance area of a standard UIC wagon



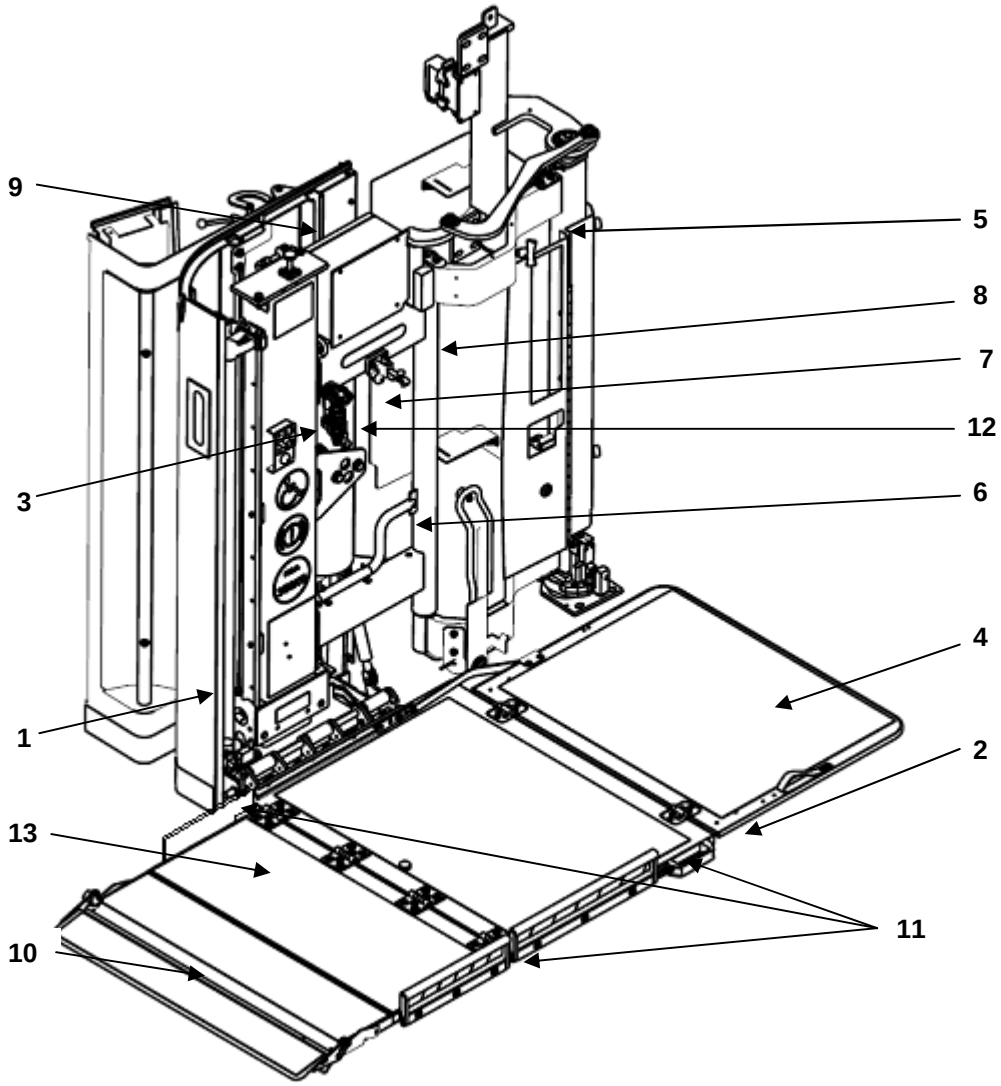
Source: Presentation PDG-Meeting, Sofia

3. Technical Details

Load-carrying capacity:	350 kg maximum
Lifting height approx.:	1000 mm (1150mm max)
Lifting Speed:	≤ 0.15 m/s (with max. load-carrying capacity)
Lowering Speed:	≤ 0.15 m/s (with max. load-carrying capacity)
Lift platform width:	800 mm
Swing-out radius:	Positively driven system, R variable
Parking position:	Width 1045mm, Depth 259,5mm, Height 1633 mm

4. Component identification

Picture 2: Example: 270° lift in operational positi on



Source: Drawing MBB

1: **Key-operated push switch** for raising and lowering the lift

2: **Handle** for opening up or closing the folded-together lift platform

3: **Retaining pin** for securing the lift platform in rest position

4: **Bridging ramp** to bridge the gap between lift platform and vehicle

5: **Unlock handle** for unlocking the lift from operating position

6: **Manual pump lever extension** for emergency use

7: **Manual pump lever** for emergency use

8: **Snap lock** for locking the lift platform package in rest position

9: **Hand wheel for the shut-off valve on the lifting cylinder** for manual lowering of the lift

10: **Rollstop** for protecting the wheelchair user during lifting and lowering

11: **Side barriers / side roll-on ramps** (two at the right side)

12: **Handwheel for the shut-off valve on the hydraulic power unit** for manual lowering

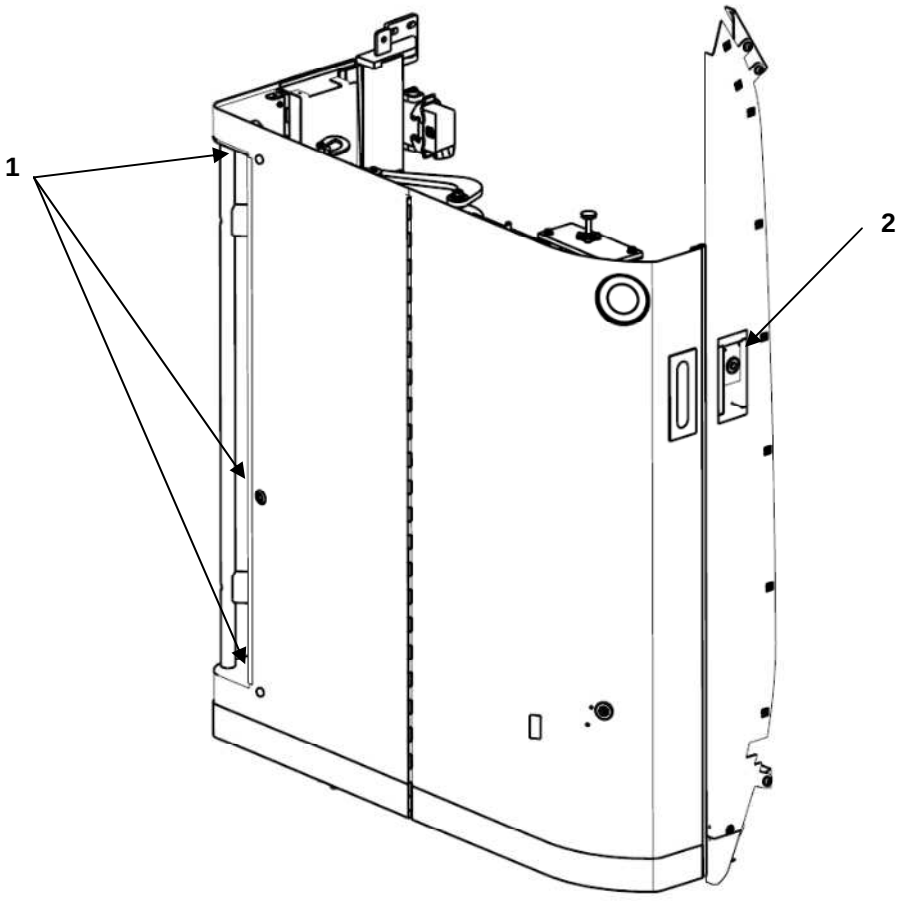
13: **Lift platform extension** for increasing platform space

5. Operation

5.1. Putting into operation

- Unlock the three sash locks and swing the casing panel around toward the main casing (picture 3-1).
- Lock the open casing panel in place.
- Open up the lock in the inset handle (picture 3-2).
- Unlock using the inset handle, the BAS is ready to swing out.

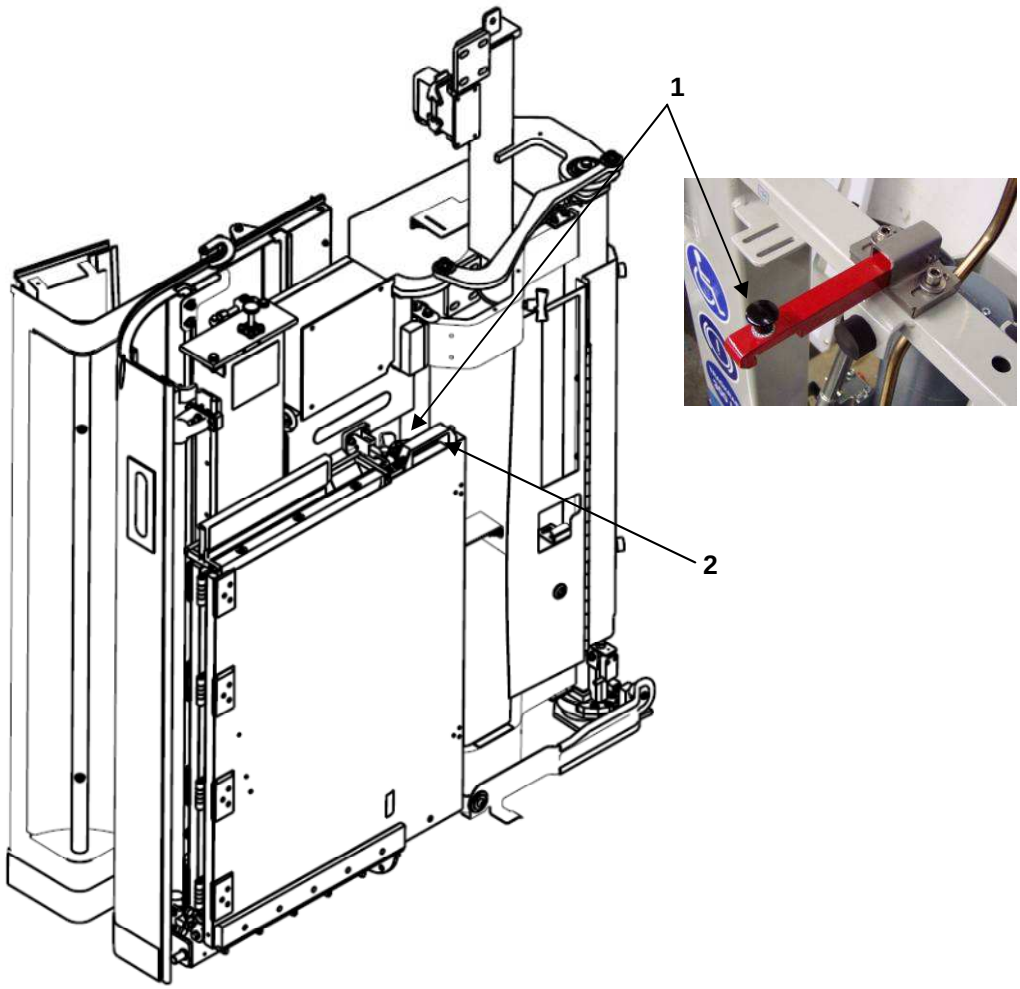
Picture 3: Example: 270° lift in rest position



Source: Drawing MBB

- From the platform, the lift platform (snap lock, picture 4-1) has to be unlocked and laid down into operational position. The handle must be used (picture 4-2).

Picture 4: Example: Lift platform ready to be laid down.

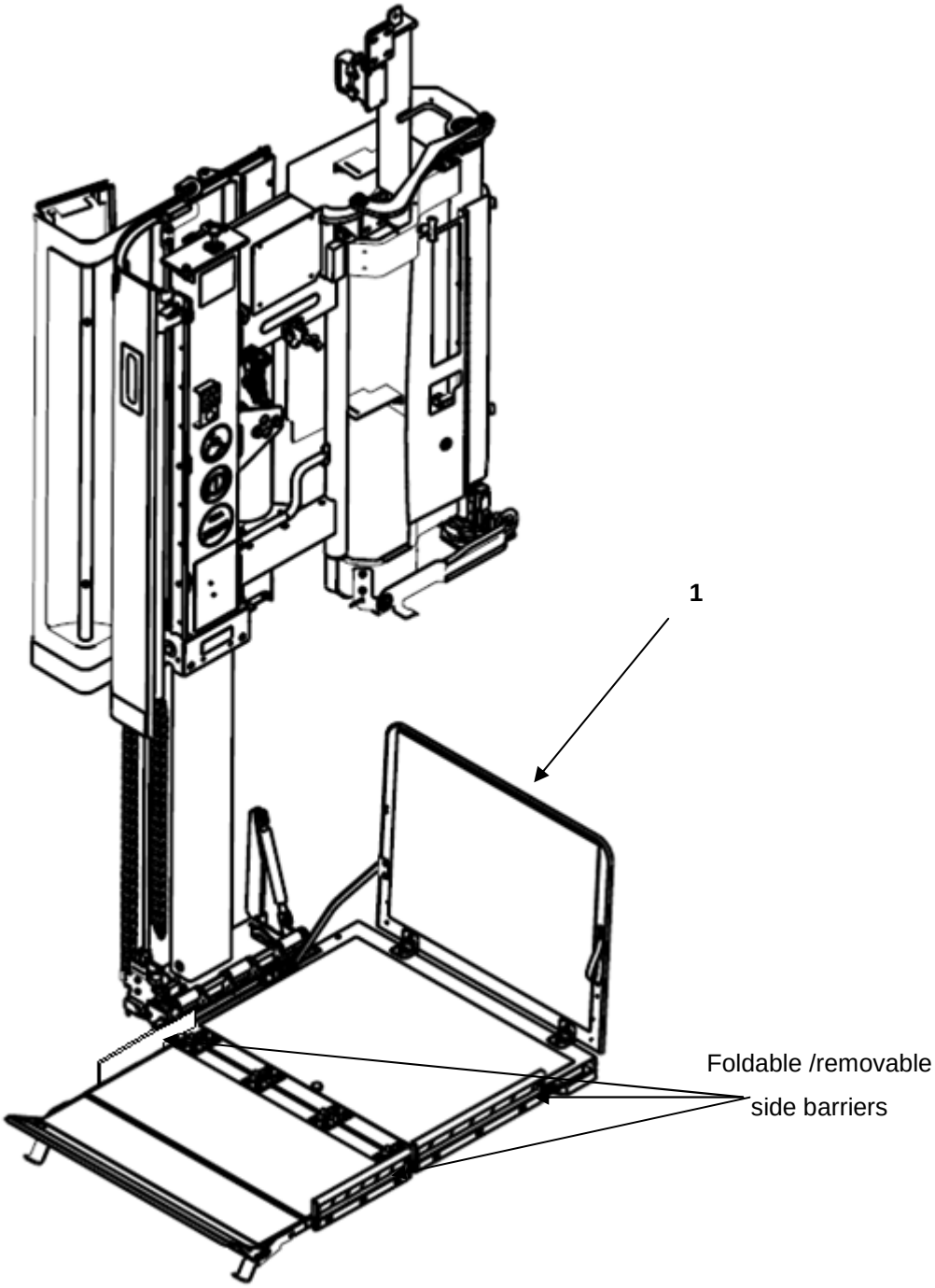


Source: Drawing MBB

- If the vehicle has a retractable foot step, it must now retract automatically.

- The bridging ramp (picture 5-1) to the vehicle is placed vertically. Locking into place is accomplished via the guide linkage and spring lock.
- The BAS is positioned in the upper operating position.

Picture 5: Example: 270° lift in lowered operating position



Source: Drawing MBB

5.2. Entering the vehicle

- The BAS is swung out and ready in the upper operating position.
  The service personnel is standing on the train platform.
- The bridging ramp must be locked in the 90°-position. Locking in place is accomplished via guide linkage and spring lock (picture 5.3-2).
- Afterwards the "**Lower**" key-operated push button has to be actuated counter-clockwise until the lift is set down on the platform.
- During lifting, the operational personnel must keep the wheelchair user under constant observation.
- The wheelchair user leaves the Trainlift.

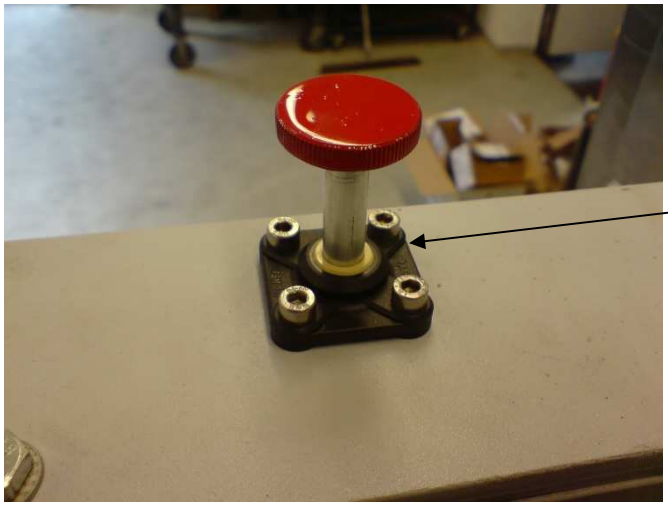
5.3. Return to the parked position

- The Trainlift is standing ready, swung out in the lower operating position on the train platform.
- The operational personnel is likewise standing on the platform.
- Actuate the "**Lift"** key-operated push button (clockwise) until the lift platform reaches its upper stop.
- Fold in bridging ramp and lay onto lift platform.
- Fold in lift platform extension and lay onto bridging ramp.
- Fold up lift platform using the handle and audibly lock in the snap lock.
- Unlock BAS with unlock lever.
- Swing the BAS back inside the vehicle until it audibly snaps locked in place.
- Lock the lock in the inset handle and remove key.
- Swing casing panel all the way back in and lock the three sash locks starting from the top.

5.4. Emergency use

In the case of loss of the electrical power or failure of the hydraulic power unit during operation with a wheelchair user on the lift platform, the lift can be manually lowered.

Picture 6: Example: Shut-off valve on the hydraulic cylinder



Source: Photo MBB

5.5. Lifting

- Close both shut-off valves again (Picture 6).
- Take the extension piece (picture 7) for the manual pump lever from the mounting beneath the crossbeam and insert it.
- Move the manual pump lever back and forth, the lift platform rises. Raising the lift platform from the level of the platform to the upper stop requires approximately 200 pump strokes.
- The lift platform has to be pumped up to the upper stop.

Picture 7: Example: manual pump lever

Source: Photo MBB

6. Description of Components

On the next pages the components used for the BAS prototype will be described.

6.1. Supporting structure

The frame is implemented in the form of a strong-dimensioned steel construction composed of welded right-angled hollow sections.
The top and bottom of the rotary column each have one bearing pin for seating the structurally identical swivel bearings. These sit in fittings with which the Trainlift is screwed into the vehicle.
In the lower bearing flange there sits the lock for the swung-in parked position and the operating position swung out 180°/270°.
The lifting column guide constitutes the other side of the supporting structure. At the bottom there are sturdy, adjustable pulleys for guiding the lifting column mounted inside.

6.2. Lifting column

The lifting column is implemented in the form of a right-angled hollow profile and slides down in the guide pulleys of the lifting column guide and up in two maintenance-free pulleys mounted in the lifting column.
At the bottom, the lifting column carries the lift platform via a hinge.
The lifting column moves via a hydraulic drawing cylinder located inside.

6.3. Complete lift platform

The lift platform consists of the platform centrepiece, the roll-on ramp with automatic rollstop and the ramp for bridging passage into the vehicle.
The bridging ramp and roll-on ramp can be folded over onto the lift platform. In this position the lift platform can be completely folded up for stowing away and vertically locked in place. Here, a pneumatic spring counteracts to a great extent the weight of the platform.
The side barriers can be laid down respectively taken off the platform in case of spacial restrictions, in order to allow the sideward boarding in case of narrow station platforms.

6.4. Hydraulic system

The hydraulic power unit is implemented in the form of a fully integrated unit with oil storage tank, gear pump, directional control valve, pressure control valve, measuring connection, oil level monitor, air filter and manual pump for emergency use.

Propulsion of the lift is carried out via a hydraulic draw cylinder with a shut-off valve directly on the cylinder for pipe breakage protection. Hydraulic power unit and lifting cylinder are connected to each other via a pipeline.

6.5. Electrical system

Electric motor and controls are fed through the on-board vehicle power supply network via a terminal strip on the Trainlift. A sufficiently long connection cable

and a connection plug for the vehicle-side connection are provided by the vehicle's manufacturer.
The electrical system consists of the switch box with terminal strips and motor control contactors, control voltage supply, four position switches and one key-operated push button.
One position switch indicates that the rotary column is locked in the swung-out position for operation (rotary column locked).
The second position switch indicates the position: lift platform folded out.
The switches are connected in series. Both signals are necessary so that the electric motor of the hydraulic power unit can be connected.
The third position switch indicates that the Trainlift is swung-in in the parked position.
The fourth position switch shorts the security switch and puts the lift out of operation.

6.6. Safety features

The BAS is equipped with the following safety features:

- Lifting and lowering are possible only when the Trainlift is swung out and locked in place and the lift platform is laid down.

Exception: Manual emergency activation!

- In the case of obstacles for the lowering motion, the Trainlift remains still because lowering is accomplished only by gravity with support from a pneumatic spring.

- The foldable roll-on ramp has automatic roll-away protection (rollstop) against the wheelchair user rolling off.

- The entire surface of the lift platform and of the ramps has a slip-resistant construction (slip-resistance class: R13).

- Lifting of excessively heavy loads (beyond 350 kg) is prevented by a pressure control valve.

- The pressure control valve restricts the force when approaching the upper fixed stop during lifting motion.

- The shut-off valve directly on the lifting cylinder prevents the lift platform from plummeting in the event of a hydraulic pipe rupture.

- Yellow warning marker encompassing the lift platform, ramps and rollstop.

- For the safety of the wheelchair user there is a handle at the side on the lifting column guide.

7. Functional Description

7.1. Unlocking the lift from rest position

The locks on the pivoting casing panel have to unlocked and swing the casing panel toward the main casing.Unlock lock.
The inset handle is released by the lock.

Upon swinging open the handle, the floor latch is opened via a linkage. The lift is then free to swing out.

7.2. Closing and opening the lift platform

The lift platform is folded up against and locked onto the lifting column in rest position. After unlocking, the lift platform is manually folded out. The handle must be used.

In the hinge section of the lift platform there is pneumatic spring that counteracts to a great extent the weight of the lift platform while swinging.
After folding the lift platform back up, it automatically locks back up in the vertical position.

7.3 Lifting the lift platform

The electric motor of the hydraulic power unit can be controlled with the key-operated push button only when the BAS is swung out in operating position, the lift platform folded out and the signal for retracting the foot step given.
The hydraulic power unit presses oil into the lower piston annulus of the cylinder: The piston with piston rod is lifted and lifts the platform hanging on it.

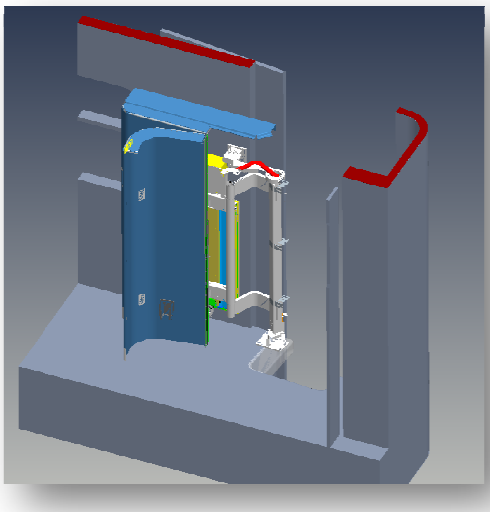
7.4 Lowering the lift platform

The shut-off valve on the lifting cylinder and the return valve are electrically opened via a key-operated push button. Via a flow-control valve (valve for controlling the lowering brake) the oil can flow back from the lifting cylinder to the storage tank.
A pneumatic spring supports the lowering motion. This ensures that the lowering speed for an unloaden lift platform is sufficiently high.

8. Installation Case Study / Collisions

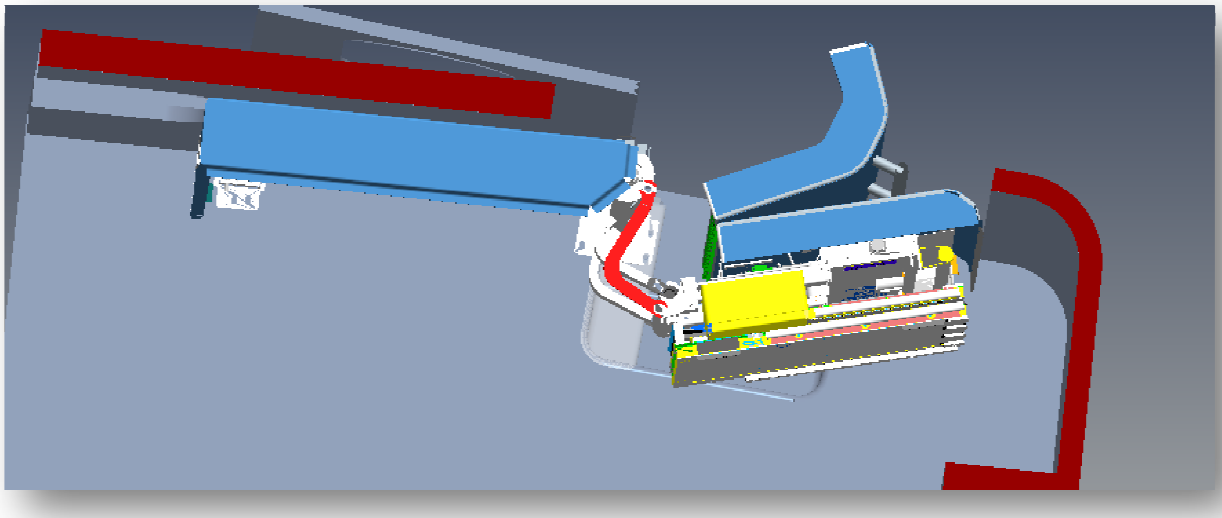
Based on the drawing the following installation case study was made and presented during the last two PDG meetings.

Picture 8: Lift in parking position



Source: CAD model MBB

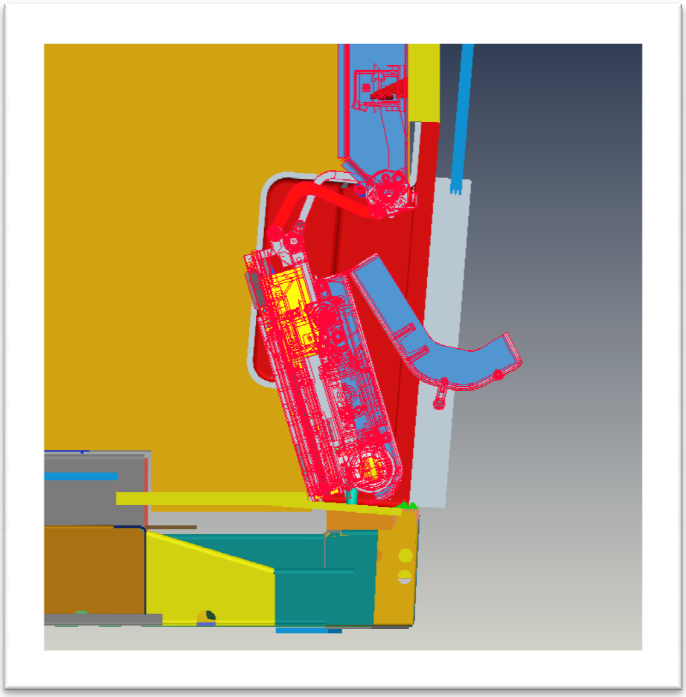
Picture 9: Lift in swivel position



Source: CAD model MBB

Further investigations showed that there are collisions in the entrance area of the wagon.

Picture 10: Collisions



Source: CAD model MBB

There are collisions with the handrail and the cover of the end wall (picture 10 – blue marking). One solution will be “an embedded handrail instead of an outside handrail should be provided”*[1] by BDZ. In addition the wall has to be adapted.

The on-site visit showed new requirements:

There are two additional collision areas (picture 10 – red markings):

A) the door locking system of the entrance door (picture 12 and 13) and

B) the guide rails of the passing door, which are on the floor and not embedded. Additional vehicle drawings are necessary for further investigations.

New requirements for the cover of the lift as it has to be adapted to the window shape (picture 14)

Picture 11: End wall

Source: Photo UIC wagon BDZ

[1]Project intern To Do-List for BDZ, October 18th 2011

Pictures 12 and 13: Door locking system

Source: Photos UIC wagon BDZ

Picture: 14: Profile of the window

Source: Photo UIC wagon BDZ

Finally, the investigation study showed that the swivel step must be decoupled from the door impulse. The collision is not only the swivel step itself but the the vertical connection rod to the wheel step. The collisions are with the fixing support and rotary column of the lift. The decoupling of the swivel step from the door impulse is necessary to have the BAS installed properly and to ensure a perfect operation of the lift.

9. Conclusion

This deliverable contains the results of the development for a new boarding assistance system prototype. The details of the BAS in respect to its operation and its components are explained.

This project shows the importance of the information in respect to BAS solution which depends on the special requirements of the entrance area as “all trains have differing widths, heights or shapes depending on the vehicle type”[2].

Due to the new requirements and collisions further investigations have to be made in respect to the design as well as to the necessary material, which will influence the project.
Furthermore, the mock-up, where the prototype will be installed for testing might have to be adapted accordingly.

The challenge is that BAS prototype will fit in the UIC wagon we saw in Sofia and to find a final and mutual solution for the presentation at the Innotrans 2012 and other exhibitions.

[2] Cf. Deliverable 4.2, Dennis Behnken.

10. List of Pictures/ Tables

Attachments:

List of Abbreviations

10.1. Abbreviations

Table 1: List of Abbreviations

BAS	Boarding Assistance System
BDZ	Bulgarian Railways
BS	British Standard
CAD	Computer Aided Design
CDR	Conceptual Design Review
CM	Corrective Maintenance
DA	Design Approval
DF	Design Freeze
DIN	German Institute for Norms
DR	Design Review
EMC	Electromagnetic Compatibility
EN	European Norms
FAI	First Article Inspection
FMEA	Failure Modes and Effect Analysis
FTA	Fault Tree Analysis
HST	High Speed Trains
IDR	Initial Design Review
IRIS	International Railway Industry Standard
LCC	Life Cycle Cost
MTBF	Mean operation Time Between Failures
NFF	Norme Francaise
PDG	Product Development Group
PM	Preventive Maintenance
PRM	People with reduced mobility
RAMS	Reliability, Availability, Maintainability, Safety
TSI	Technical Specification for Interoperability
UIC	International Union of Railways
UNI	Italian Norms
VDE	Verband der Elektrotechnik, Elektronik, Informationstechnik e.V.