

EM. van den Bosch *Baggage truck: analysis of mechanical concepts.*
Literature survey, Report 2005.TL.6929, Transport Engineering and Logistics.

Compared to the nowadays mostly fully automated baggage handling and sorting systems on main airports, the baggage handling of narrow body airplanes remains outdated. This is still done by hand and this is very labour-intensive, has bad ergonomically working conditions, forms a considerable leak in the security of airports and airplanes and is time critical considering turn-around time and transfer flights.

A Baggage Truck is in development for automating most parts of the baggage handling of narrow bodies and this can be considered a major improvement. It brings the baggage into the cargo room, and only there it needs to be loaded by hand. Thus, less work needs to be done by hand, baggage handling time is reduced and the security of airports is increased.

In this report possible mechanical concept for the Baggage Truck Swap Body are analysed. Its main functions are lifting and shifting the lanes and driving the belt in the lanes. After making an inventory of available components in the market, the most reliable solution for fulfilling these functions is chosen.

Until today, no good solution for the handling of baggage of narrow body airplanes exists. A train of baggage carts transfers the baggage between the plane and the terminal and baggage is loaded by hand. This is a very labour-intensive method, with bad ergonomically working conditions that causes a considerable leak in the security of airports and airplanes. Also, this process is time critical considering turn-around time and transfer flights. But, the Transport and Logistic department at the Delft University of Technology developed the Baggage Truck and this can be considered as a major improvement in baggage handling.

The Baggage Truck mainly consists of a baggage handling system inside a swap body and an adapted vehicle for transport between the terminal and the plane. To further develop the Baggage Truck and prepare the system for the market cooperation is started between TUDelft, Terberg bv, manufacturer of special vehicles, and VanderLande Industries bv, specialist in baggage handling. The adapted vehicle for the Baggage Truck was designed in another research project [T.A. van Ginneken *Development of a Baggage Truck vehicle for baggage handling of narrow bodies*, [report 2004.TL.6873](#), Delft University of Technology, Transport Engineering and Logistics] and an impression of it is shown in Figure 1.

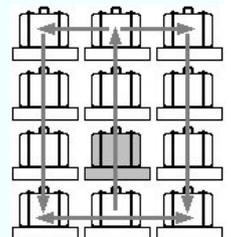
Research is done to develop and evaluate possible mechanical concepts for the Baggage Truck Swap Body. Figure 2 gives an idea of the layout of the Swap Body, taken from research done in an early stage of the development of the Baggage Truck.



Figure 1 (left). Adapted vehicle for the Baggage Truck; Figure 2 (right). Swap Body for the Baggage Truck

The lanes shown in Figure 2 can move according to the scheme given in Figure 3, the lane in grey is used for loading the Swap Body. For the evaluation of mechanical concepts a User Requirements Specification for the Swap Body is made, that contains the following main requirements and demands:

- comply with road-requirements of Amsterdam Airport Schiphol and the public road in The Netherlands
- low Mean Time To Repair
- high Mean Time Between Failure
- sorting the lanes while driving to decrease handling time of transfer flights
- high reliability
- good maintainability
- capacity of 90 bax
- max. loading speed 30 bax/min
- lifting of the lanes in 3 seconds



Also, the Swap Body will provide a lockable space to increase airport security.

Mechanical solutions are needed for lifting the lanes, shifting the lanes and driving the belt in the lanes. After comparing various different mechanical solutions, three mechanical concepts remained:

1. Chains / Chains and Crossbelt

2. Cylinders

3. Linear Positioning System

Each concept uses the same methods for lifting and shifting the lanes because this:

- simplifies control
- gives lower maintenance costs (same spare parts needed)
- reduces the need of knowledge of several different technologies
- reduces investments (discount from manufacturers when ordering larger amounts)

The concept that gives the highest reliability, the best maintainability, the lowest Mean Time To Repair and the longest Mean Time between Failure is concept 3, using Linear Positioning Systems for lifting and shifting the lanes. This concept is also best suitable for sorting the lanes while driving the Baggage Truck.

The investments needed for this concept will be higher compared to concept 1, but because large cost savings are possible with the Baggage Truck, the investments costs are of minor importance. Also concept 3 is much more reliable and has lower operating costs than the other concepts.

In all concepts, driving of the belt in the lanes is done by drummotors. The drummotors and end pulleys are bulged for better tracking of the belt, together with a steering pulley. A tension pulley is needed for getting the desired tension in the belt. The energy for the drummotors is supplied by conductor rails.

The reliability and maintainability of the lanes can be improved by keeping a spare lane or at least keeping spare parts (especially a drummotor) and optionally, an emergency drive can be designed and used for driving a lane when the drummotor is not working.

Recommendations for developing a functional design of the system within the Swap Body of the Baggage Truck:

- Further design of the concept that uses Linear Positioning Systems: Construct technical drawings of the Swap Body indicating the location and type of every LPS, calculate the needed motor powers and determine where guiding is needed.
- Design the lane, indicating the needed technical construction for the lanes. Calculate the needed motor power of the drummotors.
- Design a solution for connecting and disconnecting the lanes to and from the LPS's.

Recommendations for further developing the Swap Body of the Baggage Truck:

- Calculate the needed investments for designing, constructing and operating the Swap Body.
- Research/design other solutions for driving the belt in the lanes that might reduce investment costs while still providing a good reliability and maintainability.
- Conduct research if reliability can be further improved by constructing separate emergency drives.

[Reports on Transport Engineering and Logistics \(in Dutch\)](#)

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