Summary

Human Conveyance Systems (HCSs) such as lifts, escalators and moving walks are used to satisfy human needs in terms of access and mobility. HCSs typically represent 3 to 8 % of the total electricity consumption of buildings, depending on the structure and usage of the building, the type and number of equipment used (ELA, 2007). In the field of HCSs the potential reduction of electric energy consumption is estimated to be 65% for lifts and 28 % for escalators (Almeida, Patrão, Fong, Nunes, & Araújo, 2009). Energy savings on HCSs can clearly contribute in an attempt to minimise the energy usage in buildings. However, the HCSs industry struggles with the question on how to make HCSs more energy efficient. Partly this is caused by the lack of standardized methods to calculate the consumption (Dütschke & Hirzel, 2010). The goal of this report is to give an overview of methods available for the calculation of energy consumption for HCSs.

HCSs are complex systems, due to the variety of electric machines and drive systems, lift types and traffic flow. To get a complete view on the working principle of HCSs, these factors have firstly been explained in the report.

The main components of all HCSs to contribute to the energy consumption are the electric machine and the drive system. Together they provide a qualitative ride of the HCSs. Especially the developments in drive systems have contributed to an improvement of comfort. In addition, a reduction in energy consumption has been established.

A distinction in lift types can be made, depending on the technique used to lift the car. The main types are hydraulic lifts and traction lifts. In addition there are types used less often: pneumatic lifts, rack & pinion lifts and drum lifts. Between the systems there is a difference in the usage of energy, reflecting on the energy efficiency. Escalators and moving walks use the same working principle. Therefore the systems do not differ in the usage of energy.

The traffic flow in buildings determines the type of HCSs used and the system’s design upon capacity and the management of traffic. The capacity will be determined with a traffic flow analysis. The management system also affects the capacity that can be handled by the HCSs. Adjustment of the control algorithm to the specific traffic pattern leads to a higher efficiency in handling capacity and energy consumption.

Between the methods given in the report a distinction has been made upon methods developed before 2000 (classic) and methods developed after 2000 (advanced).

One classic energy consumption calculation methods for lifts has been found:

- With this method the energy consumption of new lifts can be calculated based on measurements performed on lifts with different drive systems.

Three advance energy consumption calculation methods for lifts have been found:

- The first method generates a model out of measurements performed on a specific lift system that gives the energy consumption per lift journey. In combination with a traffic simulation program, this model can be used to predict the total energy consumption of the specific lift system.
- The second method uses a combination of energy consumption measurements for a reference cycle of a specific lift system and factors considering the motor load, balancing and travelling distance to calculate the total energy consumption of the specific lift system.
- The third method aims to provide a classification of the standby power requirement and energy demand of lifts according to standard criteria. The method uses a combination of energy consumption measurements for a reference cycle of a specific lift system, lift characteristics and the estimated number of trips to calculate the total energy consumption of the specific lift system. This method provides the basis for the an International Standard.

Two advance energy consumption calculation methods for escalators and moving walks have been found:

- The first method uses fixed energy losses measurements on escalators with different lengths of rise. The measurements in combination with calculations, considering the variable energy losses due to the passenger load, are used to calculate the total energy consumption of a specific escalator.
- The second method uses only measurements on a specific conveyor system. It considers different modes to calculate the total energy consumption for a specific conveyor system.

As a result of the complexity of HCSs the use of simple energy consumption calculations is not possible. The methods found, both classic and advanced, are all to some extent related to measurements performed on a particular HCS or a comparable type.

One can conclude that the energy consumption of HCSs up till 2000 was not of great interest, based on this lack of classical literature found. However, the increase in methods proposed over the last decade shows an increasing interest in the ability of accurately calculating the energy consumption for HCSs. This is in line with the growing awareness for the need of reducing energy consumption.

The ability of comparing energy consumption by lift systems of different companies has increased with the introduction of the German Standard VDI 4707 and the upcoming International Standard ISO 25745. This is expected to increase the competition between companies upon energy efficient HCSs, leading to advanced improvements upon energy efficiency.