**Electric traction drives**

Electric traction drives can be grouped into several categories based on the motor type and its control.

![Diagram of electric traction system]

*Figure 6.1 Electric traction passenger lift — principal components*

*(Adopted from CIBSE Guide D)*
Historically, the required lift speed and ride quality have determined to a large extent which type of drive is used for a particular application. Gearless machines are usually used for rated speeds over 2.5m/s while geared machines are applied for lower speeds.

- Geared traction drives:
  - single-speed AC motor
  - 2-speed AC motor
  - variable voltage AC motor
  - VVVF AC motor
  - variable voltage DC motor
- Gearless traction drives:
  - variable voltage DC motor
  - VVVF AC motor

Landing door with transom panel
Geared elevator machines

Spur gear  Worm gear  Helical gear – perpendicular shaft  Helical gear – parallel shaft

Geared machines are generally used for speeds between 0.1m/s and 2.5m/s and are suitable for loads from 5kg up to 50 tons and above. Spur gears were used occasionally in the past, but with the advancement of design and production techniques, worm gearing became the accepted standard for conventional geared elevator machines. Helical gears are expected to be used for speed in excess of 2.5m/s, while for lower speeds, worm gearing will remain the standard.

Figure 6.7  Typical geared machine

(Adopted from CIBSE Guide D)
Worm gearing is sometimes used in combination with a belt drive or an additional pair of spur gears (heavy-duty freight elevators). Indirect-driven machines, utilizing V-belt drives or toothed drive belts must include at least a set of 3 belts operating in parallel. A number of machines equipped with planetary gearing have also appeared on the market.

Improvements in the control of AC motors mean that good ride quality can be achieved using AC motors. Recently, some manufacturers introduced geared elevator machines for rated speeds up to 5m/s, employing a double reduction of helical gears of high efficiency. The machine is equipped with a 3-phase AC motor and speed control is accomplished through a frequency inverter.
Gearless elevator machines

Gearless machines are generally used for high-speed lifts, i.e. speeds from 2.5m/s to 10m/s. The gearless machine is equipped with a special low-speed DC motor with speeds in the range of 100 to 220 RPM. DC motors have provided the best ride quality in the past because the speed of the motor can be easily controlled using a DC generator with a variable output. Consequently, DC motors had in the past been used for the majority of applications requiring a smooth ride and accurate leveling.

There is no gearing between the rotor and the traction sheave. All principal components of the machine, i.e. the rotor, traction sheave and brake drum are mounted on the same shaft, supported by 2 bearings. The shaft and the bearings must sustain the load imposed on the sheave as well as the weight of all these components and transmit the complete load to the building structure. The traction sheave and brake drum are usually made as one piece.

With no gearing employed, the mechanical efficiency is higher compared to geared elevator machines. The initial cost of a gearless machine is higher, but the life of the low-speed DC motor is long and the maintenance cost is relatively lower.

For speed regulation, several systems may be used. With older DC drive systems, a variable voltage control through a motor-generator set (Ward-Leonard system) was employed. Its application resulted in good ride comfort and accurate leveling at each
stop, regardless of car load and direction of travel. However, the installation cost was relatively high, space was needed for the motor-generator set, extra maintenance had to be provided for the commutator and the brushes of the high-speed generator, and the total losses (at least 3 rotating components were employed) reduced the overall efficiency of the machine.

To avoid the disadvantages of the motor-generator system, during the 1980’s, static convertors, the so called Thyristor-Leonard system, have been used as the means of supply for large DC motors. Compared with motor-generators, static convertors are more efficient, provide improved control, more reliable and incur lower maintenance cost.

Advanced voltage and frequency control techniques have also led to the introduction of AC gearless motors drives. These provide ride quality matching DC gearless machines for speeds of 2.5m/s and above.
Figure 6.3  Typical gearless machine

(Adopted from CIBSE Guide D)