For the mathematically minded

Handwinding Wheels

By Dr Gina Barney.

How often have you tried to handwind a geared electric traction lift and found the wheel almost impossible to turn? Try these reasons:

"You are a weakling"

"The guide shoes are tight"

"The wheel is too small"

"I do not feel well today"

"No one calculated the force needed"

The latter is more likely. Clause 12.5.1.1 of EN81-1:1988 says "…the manual effort required to move the car in the upward direction with its rated load (should) not exceed 400 N..."

An effort of 400 N is more or less a force of 40kg or 88lb. About the weight of the baggage you and your partner can take on a holiday flight. Can the effort be calculated ?

Yes !

All you have to do is find the out of balance load (L), multiply it by the sheave diameter (D), divide by the gear ratio (N), divide by the handwheel diameter (d) and divide by the gear efficiency (h) i.e.

Force = $\frac{D}{d} \times \frac{L}{N\eta}$ kg

Suppose:

Rated load:	800g	Sheave diameter:	0.6m
Dry guide friction:	50g	Handwheel diameter:	0.4m
Weight of ropes:	75kg	Gear ratio:	42/1
Balancing:	50%	Gear efficiency:	75%

Effort = $\frac{0.6}{0.4} \times \frac{525}{42 \times 0.75} = 25\,\text{kg}$

The force must be multiplied by g_n, i.e. 9.81 m/s^2 to give the effort, i.e. 245 N. This provision is O.K.

The out of balance load (525 kg) is the tricky bit, as it involves the percentage balancing, adding the dry friction and weight of the ropes. The dry friction and gear efficiency are usually an estimate.