Study Report on Application of Lift Regenerative Power

1. Executive summary

Lift and escalator in a multi-storey building serve to bring people up and down the building floors. As most of the buildings in Hong Kong are getting taller, new lifts are running faster and are essential mechanical installation for vertical transportation nowadays.

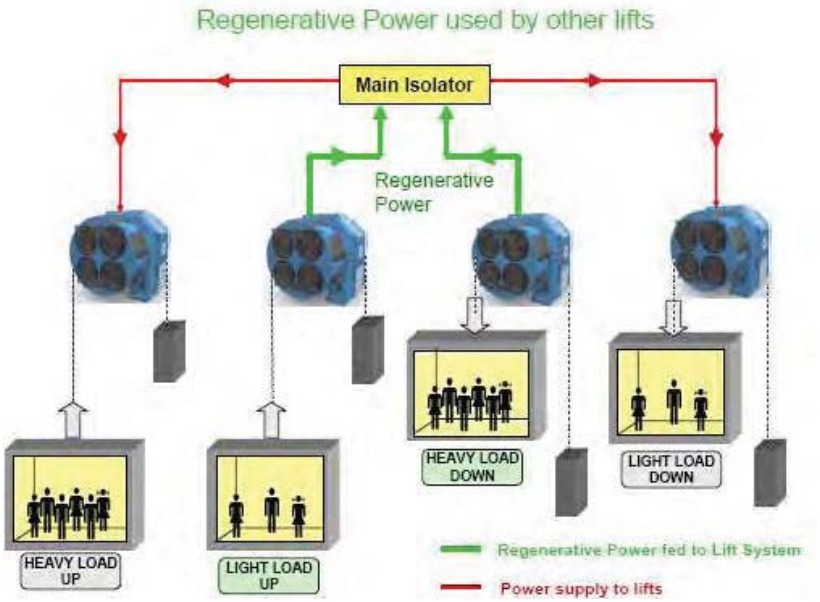
In Hong Kong, the energy consumption of lift and escalator installations are almost as much as that of lighting installation in commercial buildings. This is mainly due to their invariably large electrical motors and virtually continuous operation throughout the day in many cases. To meet the challenge of energy conservation, one of the latest technologies adopted in lifts is regenerative function which recovers braking energy from lift operation. To assess the energy saving performance of regenerative lifts, passenger lifts in the Tamar Central Government Offices were studied in 2013.

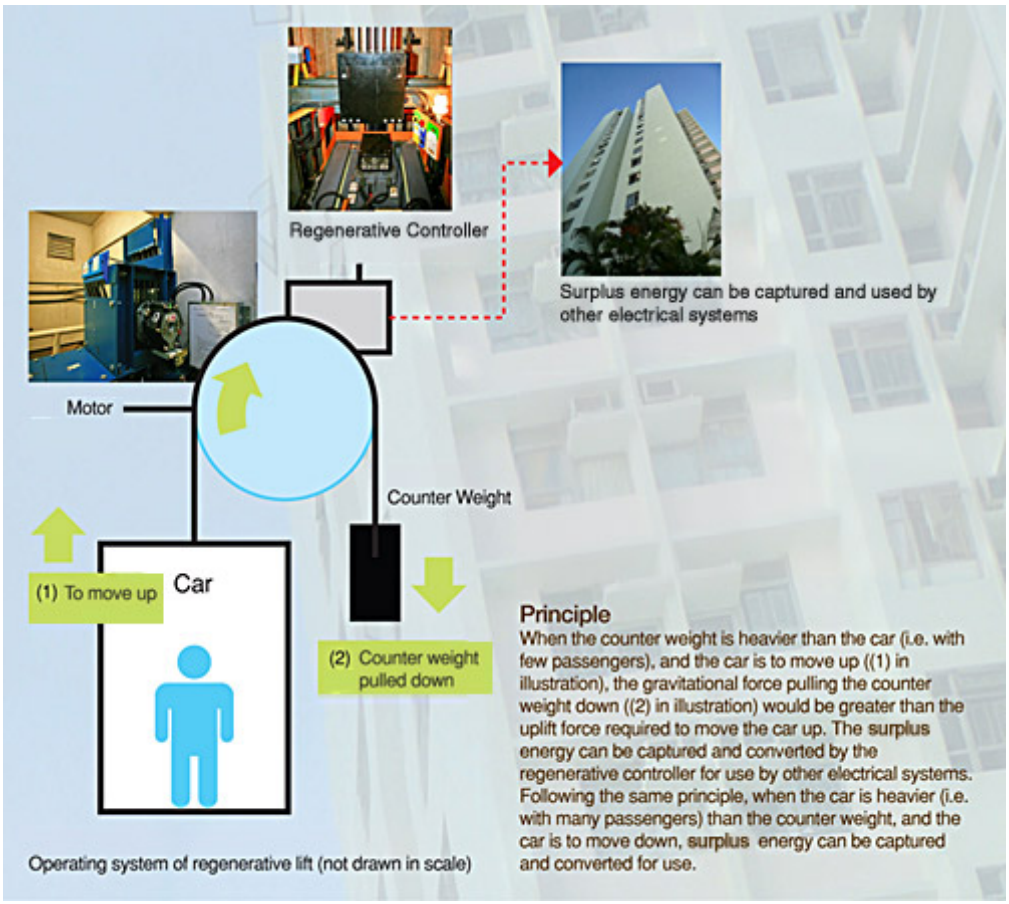
2. Description on lift regenerative power

For conventional lifts, the power generated by the traction machine is dissipated as heat in the building. Whereas, lift with regenerative function obtains power from electrical supply network, when it travels downwards with heavy load or upwards with light load, the traction machine will be act as power generator and the lift is running at "regenerative mode". In 2009, EMSTF replaced the lifts at the Sheung Shui Police Married Quarters with regenerative lifts, which convert the energy generated from the lift motor driven by gravity into electricity for other uses. This energy efficient installation provides a green lift option for client departments to consider applying in their venues. Compared to conventional lifts, regenerative lifts are 20% to 30% more energy efficient.

Lift is recognized as the second-most electricity consuming system in communal areas of public rental housing blocks. While the Housing Authority (HA) has been adopting energy-efficient variable voltage variable frequency (VVVF) type lift power systems for many years, since 2013, the HA has taken a further step to adopt lift regenerative power for large lift motors of 18 kW or above to save more energy. Lifts equipped with regenerative power feature can capture and condition the regenerated electricity for feeding directly into the power grid for immediate consumption by communal

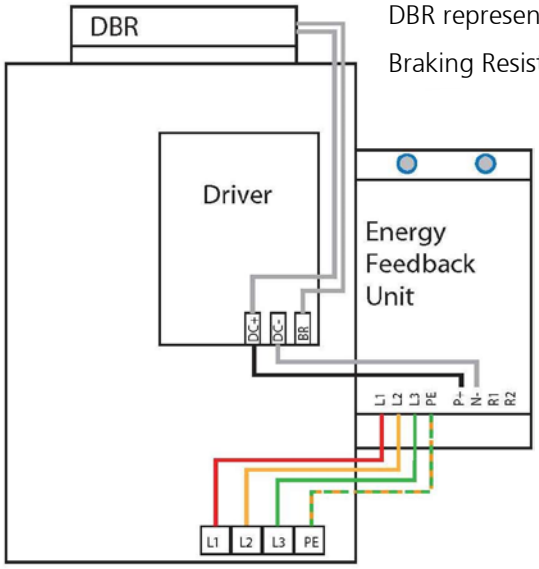
facilities. The amount of energy saving arising from lift regenerative power varies with the lift traffic pattern. The Housing Department have assessed the lift system in Kai Ching Estate[1] and found that the amount of energy regenerated is generally up to 20% to 30% of the energy consumed by the lifts.





[1] http://www.legco.gov.hk/yr14-15/english/panels/hg/papers/hg20150414cb1-702-4-e.pdf, page 3

Traction machines are commonly adopted in lifts of Hong Kong and could be retrofitted with regenerative braking module either by geared or gearless traction drives. However, the add-on regenerative braking module can only be added on the Variable Frequency (VF) drives to serve as regenerative braking function. The regenerative braking module is connected in parallel with the rectifier of the motor drive (between the DC bus and AC supply). After installing the regenerative braking module to the Variable Voltage Variable Frequency (VVVF) drive, it can save electricity consumption of lift up to one fourth as compared with that of lifts without regenerative function.



3. Regenerative lifts at the Tamar Central Government Offices

Lifts at the Tamar Central Government Offices were equipped with power regeneration drive whereby energy was regenerated as electricity whenever the lift machine was operating in a "generator mode". By adopting the lift power regeneration technology, using reclaiming energy for a useful purpose rather than wasting it as heat is an effective form of overall energy conservation.

Lifts at the Tamar Central Government Offices were designed to achieve flexibility services for low zones (i.e. serving 1/F to 14/F) as well as high zones (i.e. serving 1/F, 14/F to 23/F) of East Wing and West Wing. In 2013, we studied energy performance on passenger lifts with rated capacity of 1,600 kg and rated speed of 6 m/s, 5 m/s, 3.5 m/s, 3 m/s, and 2.5 m/s. Results indicated that the amount of energy saving from regeneration depended on various operating factors and parameters such as the design capacity, travelling speed, loading profile and travel distance. The table below shows

the energy consumption and energy regenerated from several categories of lifts in the Tamar Central Government Offices.

Lift No. (Speed)	Item	Energy from 16 Aug to 16 Dec 2013 (kWh)	% of Electricity Saving
East Wing High Zone (6 m/s)	Energy Consumed	45,913	25.7%
	Energy Regenerated	15,847	
East Wing Low Zone (5 m/s)	Energy Consumed	29,311	22.4%
	Energy Regenerated	8,459	
West Wing High Zone (5 m/s)	Energy Consumed	43,518	27.0%
	Energy Regenerated	16,072	
West Wing Low Zone (2.5 m/s)	Energy Consumed	24,640	18.9%
	Energy Regenerated	5,760	
East Wing Passenger (High + Low Zone) (3 m/s)	Energy Consumed	9,405	23.3%
	Energy Regenerated	2,852	
West Wing Passenger (High + Low Zone) (3.5 m/s)	Energy Consumed	16,181	26.4%
	Energy Regenerated	5,796	
East Wing Services (High + Low Zone) (2.5 m/s)	Energy Consumed	7,361	22.4%
	Energy Regenerated	2,120	
West Wing Services (1 to 3/F) (1.75 m/s)	Energy Consumed	2,505	17.1%
	Energy Regenerated	565	

From the above results, the lift regenerative function could achieve an energy saving of 17% to 27%. The high zone lifts could achieve more saving as compared with the low zone lifts under the same configurations. It indicates that the amount of regenerative power obtained depends on lift operating speed and travel distances.

4. Conclusion

Regenerative lifts can save electrical energy under certain lift operating speed and travel distance. For lifts operating at speed greater than 2.5 m/s under light load in upward direction and heavy load in downward direction with the designed lift, the energy saving performance is obvious. Besides, regenerative function of lifts can greatly reduce the heat dissipation arising from braking of lift, thus saving overall power consumption of lifts. On electrical power quality aspect, the harmonic distortion could also be minimized so as to prevent possible abnormal disturbance of the power network and to reduce the energy losses due to harmonic currents.

However, the payback period may be longer as the cost of energy retrofit is likely higher than the expected saving from lift regenerative function. Besides, extra cost will be incurred if the existing lift drive has to be upgraded or replaced together with the installation of add-on regenerative braking module.

Nevertheless, energy saving of 17% to 27% could be achieved through lift regenerative function according to the study on passenger lifts at the Central Government Office. Regenerative function will become best practices for new lift installations as well as retrofits on existing lift installations. As energy saving is one of the concern factors of most lift manufacturers, in a long run, it is believed that the lift regenerative function will become a standard feature of lifts, especially for high speed lifts. Finally, please select a lift system with regenerative power which can be reused by other electrical installations in the building

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