

**Ngong Ping Ropeway
Cabin Dislodgement Incident on 11 June 2007
Abstract of Expert Panel's Report**

Note : This abstract will not cover the Parts of the Expert Panel's Report concerning the design, management, operation, maintenance of the cable car system and the prerequisite requirements for re-opening which were released on 18 September 2007.

Expert Panel

An Expert Panel was appointed by the Government on 15 June 2007, with members as follows:

- (i) Prof. Gabor Oplatka (Chairman);
 - (ii) Prof. Josef Nejez (Deputy Chairman); and
 - (iii) Ir. Frank CHAN, JP (member).
2. The objectives of the Expert Panel were as follows :
- (i) to conduct detailed investigation into the incident;
 - (ii) to review the design, operation, maintenance and management of the ropeway; and
 - (iii) to recommend prerequisite requirements for re-opening of the ropeway for use by the public.

Background information on the ropeway

3. The ropeway system has a circulating route that enables passengers to travel in both directions at the same time. Ngong Ping ropeway has a maximum passenger carrying capacity of 3,500 persons per hour per direction. At full capacity, it carries a total of 109 cabins, each can accommodate up to 17 passengers. It is of length 5.7km, and is divided into two sections, each has its own driving units, braking system, and separate rope systems for cabins.

Section I – From Tung Chung Terminal to Airport Island Angle Station, of length about 0.6km.

Section II – From Airport Island Angle Station to Ngong Ping Terminal, of length about 5.1km.

4. The maximum operating speed of the ropeway is 7m/s. Since opening to the public in September 2006, the operating speed was limited to 5m/s, for the purpose of allowing the ropeway to overcome initial teething problems, all of which were not safety-related, but of concern on reliability which is required to be enhanced to meet public expectation.

5. The ropeway has two terminals at Tung Chung and Ngong Ping, two angle stations at Airport Island and Nei Lak Shan, and eight intermediate towers, numbered as 1, 2A, 2B, 3, 4, 5, 6, and 7, with the number 1 tower closest to Tung Chung Terminal. The ropeway being of bi-cable design, employs two types of ropes, namely track rope and hauling rope, to perform two distinct functions :

- The track rope, which is a stationary rope of nominal diameter 70mm, serves to carry the weight of the cabins and provides a smooth track for the cabins to move in the direction of travel.
- The hauling rope, which is a moving rope of nominal diameter 42mm below the track rope, functions to pull the cabin to travel along the track rope through a detachable grip. This grip will automatically open when the cabin arrives at the terminal, such that the cabin will be released from the hauling rope and moves with a much lower speed along a conveying system for embarkation/disembarkation of passengers within the terminals.

Approach of the investigation

6. From 15 June 2007, the Expert Panel conducted a series of examinations and tests on the ropeway system and its components, with particular attention given to the operation of the brake test during the annual examination carried out on 11 June 2007.

7. The approach adopted by the Expert Panel in conducting the investigation is as follows:

- (i) Analyze the data of the ropeway;

- (ii) Study and review the manufacturer's operation and maintenance manual of the ropeway;
- (iii) Interview concerned staff members of operating company;
- (iv) Inspect, check and analyze ropeway components that were involved in the incident;
- (v) Conduct site measurements and desk-top analysis of the dynamic behaviour of cabins and the hauling rope; and
- (vi) Arrange for forensic examinations by the Government Laboratory and Hong Kong Productivity Council.

Design of service brake

8. The service brakes of the ropeway drives are divided into two groups. During normal operation, these brakes are actuated automatically with modulation, for the purpose of bringing the ropeway to a safe stop under controlled deceleration. The braking system provides manual testing control to simulate failure of the modulation, but to avoid excessive deceleration as a result of the simulation test, the ropeway manufacturer stipulated that the deceleration rate for Section I should be limited within 2m/s^2 and Section II to 1m/s^2 .

Brake test on 11 June 2007

9. The brake tests with empty cabins in the evening of 11 June 2007 were part of the annual examination. One of the test items was to simulate the failure of modulation of one group of service brake. It was noted that, during the test, both groups of the service brakes were operated by the maintenance personnel at 19:39 which resulted in an excessive deceleration of 1.6 m/s^2 being applied to Section II of the ropeway.

Oscillation and swing of cabin and rope

10. Due to the excessive deceleration, the cabins were made oscillating in a forward-and-backward manner, and the hauling rope was also caused to swing with a wave motion in the vertical plane. Deriving from the inspection on the scratch marks made on the track rope, it was believed that at about 173 m from Tower 2B, the cabin no. 21 was thrown upwards and caused to derail from the track rope by the resultant of its

own oscillating momentum and the excessive swinging of the ropes.

Partial derailment of carriage

11. After the derailment, the cabin still hung on the track rope by the connecting shafts of the station guide rollers. The derailment was not detected when the ropeway was re-started to operate.

Dislodgement of cabin after reaching Tower 2B

12. As the derailed carriage of cabin no. 21 was in a misaligned position, when the carriage reached Tower 2B, the detachable grip collided with the series of roller wheels mounted on top of the tower. The collision caused damage to the roller wheels and also to the hauling rope grip. The cabin thus fell through about 50m and collapsed on the ground next to Tower 2B.

Conclusion

13. The Expert Panel is of the opinion that:
- (i) improper operation of the service brakes caused the incident;
 - (ii) brake test conducted (to simulate the failure of modulation of both groups of service brakes) during annual examination on 11 June 2007 is not necessary, and should not be allowed in any circumstances;
 - (iii) it has to be pointed out that during normal operation of the ropeway, the possibility of simultaneous failure of both groups of service brakes is extremely remote;
 - (iv) the ropeway manufacturer informed that there has not been any occurrence of simultaneous failure of both groups of service brakes in over 130 similar ropeway systems, either mono-cable or bi-cable systems having the same service brake configuration, installed between 2003 and 2006 by them; and
 - (v) the design of the Ngong Ping ropeway is in line with the prevailing international standards and practices.

Recommendations

14. The Expert Panel proposed the following remedial measures to prevent recurrence of similar incident:

- (i) provide refresher training course for ropeway operators and maintenance staff;
- (ii) prepare properly documented procedures and necessary work instructions for annual examination;
- (iii) introduce a quality management system;
- (iv) conduct visual check for possible cabin derailment before system restarting wherever the ropeway experiences excessive deceleration;
- (v) monitor visually the entire ropeway line during brake tests;
- (vi) provide interlock for the operation which must not be carried out at the same time.

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