

Technical Investigation Report of Lift Incident
in Tsui Lai Garden, Sheung Shui on 11 September

Introduction

1. In the evening of 11 September 2010, at around 11:48pm, a male passenger was trapped inside lift no. 11 at 14th floor, Block 4, Tsui Lai Garden, Sheung Shui. The passenger was released later by FSD. EMSD officers arrived at scene at 01:55 am on 12 September 2010 and carried out investigation.

Background

2. The lift was installed in 1989 by Sigma Elevator (HK) Ltd (Sigma), a Lift Contractor registered under the Lifts and Escalators (Safety) Ordinance (LESO), Chapter 327 of the Laws of Hong Kong. The lift is driven by an electric motor with rated speed at 1.75 metre per second (m/s) and rated load at 900 kg. It served the 28-storey building with stops at every floor.
3. The maintenance of the lift was provided by Sigma since 1989. The last periodic examination of the lift was conducted by a Registered Lift Engineer (RLE) of Sigma on 19 May 2010.

Investigations and Findings

4. The incident was caused by detachment of the lift counterweight components of lift no. 11, resulting in one passenger being trapped inside the lift car.
5. The lift and its counterweight were driven by an electric motor in a 1:1 ratio roping system with 4 suspension ropes. The counterweight frame was constructed with structural steel members including a cross head, 2 U-channel uprights and a bottom section. The steel members were joined by welding. Filler weights were mounted inside the frame. The counterweight frame was

guided on two guide rails by upper and lower guide shoes attached to the frame. The layout of the counterweight was shown in Figure 1.

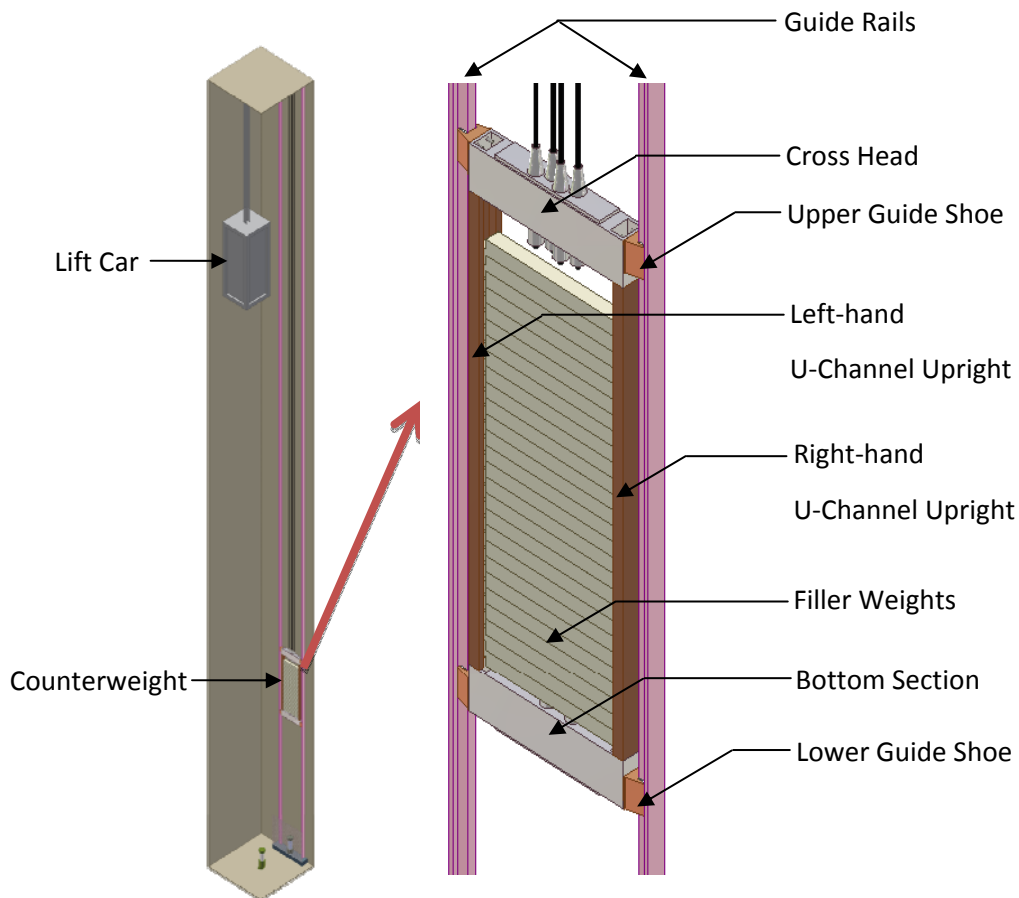


Figure 1 – The layout of the Counterweight

6. Based on the statement given by the trapped passenger and the Closed Circuit Television (CCTV) records, it was confirmed that the lift car descended from 24th floor to 15th floor under normal speed and conditions shortly before the incident. When the lift car reached the 15th floor, the counterweight components including the U-channel uprights and the filler weights detached from their frame. Without the balance of the counterweight, the lift car started descending at increased speed. According to the design requirements, the safety gear activated immediately due to the increasing speed and the lift car stopped at 14th floor level. On-site measurement revealed that, the lift car was stopped within a distance of 20 cm following the activation of the safety gear. The four suspension ropes of the lift car were found intact. As the lift car was able to stop by the safety gear within a short distance, the trapped

passenger was not injured and was later safely released by the FSD rescue team.

7. The cross head of the counterweight was found attached to the 4 suspension ropes behind the lift car at 14th floor level. The U-channel uprights with the bottom section and the filler weight were found inside the lift pit as the two uprights fractured away from the cross head. A section of the right side counterweight guide rail was found pulled outward at 12th floor level and a supporting bracket of the guide rail was found missed at the same level inside the lift shaft. There was no damage mark on the lift car.
8. The failed counterweight U-channel uprights were examined and tested by the City University of Hong Kong (CityU) using scanning electron microscope (SEM) to examine the fracture surface of the upright. The material composition and mechanical properties of the failed U-channel were also examined and tested.
9. The examination and test results revealed that the material specifications and mechanical properties of the counterweight frame were in compliance with manufacturer's technical specifications, i.e. the material specifications of steel SB41A and ultimate tensile stress of 510 MPa. However, localised embedded particles of Manganese (Mn) and Silicon (Si), which were formed during manufacturing, were found in the left-hand U-channel upright's fracture surface. This latent defect led to material strength reduction in some local spots which caused the fatigue failure in the left-hand U-channel upright of the counterweight frame. The fracture surface of the left-hand U-channel upright was shown in Figure 2.

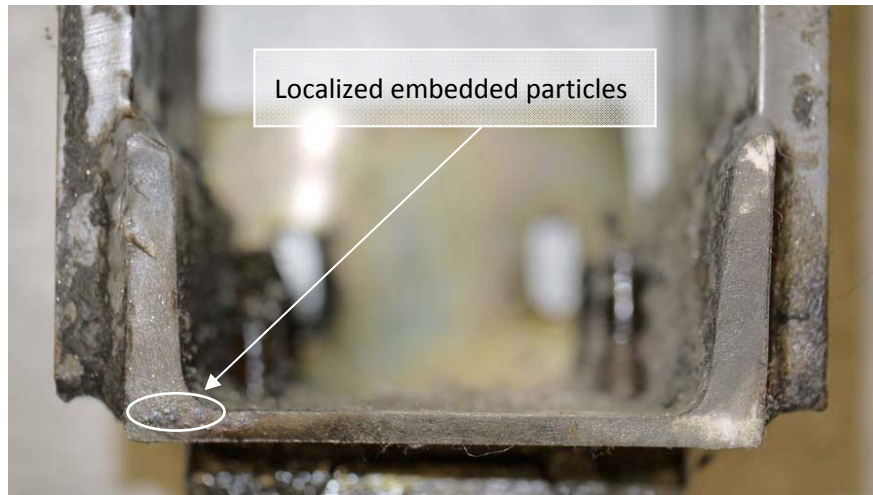


Figure 2 – Fracture surface of the left-hand U-channel upright

10. Mn and Si were normally present in the production of structural steel for certain purposes. Mn could enhance the strength of the steel and Si was one of the principal deoxidizers. There are stringent quality control measures including third party certification in steel production and localized concentrations of particles containing Mn and Si are rarely present in structural steel. No such failure in counterweight steel frame has been reported before in Hong Kong or overseas. The incident in Tsui Lai Garden was an extremely rare one.
11. According to the lift maintenance records of Tsui Lai Garden, a registered lift engineer of Sigma conducted a periodic examination of the lift no. 11 on 19 May 2010 and confirmed the lift was in safe working order. Sigma also provided periodic maintenance for the lifts once every two weeks. It was revealed that Sigma had performed regular inspection and oiling for the counterweight on 25 August 2010 according with the maintenance list. The last periodic maintenance of lift no. 11 was carried out by Sigma on 8 September 2010.

Possible Scenario of the Incident

12. Based on the findings of the investigation, it was likely that the left-hand U-channel upright of the counterweight frame fractured first due to latent defect in the material. This fracture reduced the rigidity of the frame and subsequently the lower part of the frame started to tilt downwards and sideways (See Figure 3). The bottom of the counterweight frame then started to derail from its guide rails.

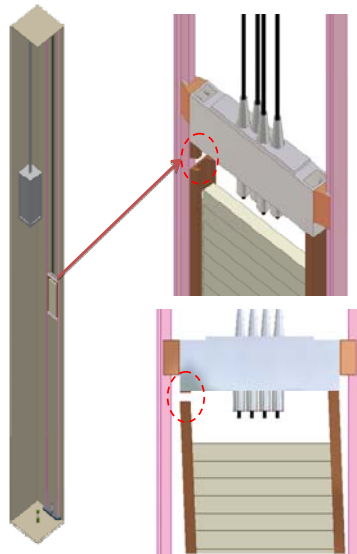


Figure 3 – Left-hand U-channel upright with latent defect fractured first

13. The top right-hand U-channel upright derailed and shifted towards the back of the lift shaft when the counterweight frame reached at 12th floor level. The bottom right side of the counterweight frame then pulled the right side guide rail and a supporting bracket of the guide rail away from the wall. This caused a section of the right side counterweight guide rail deformed outward and one supporting bracket of the guide rail was pulled out. As a result, the right-hand U-channel upright of the counterweight fractured under excessive load. The counterweight frame uprights with its bottom section and the filler weights were then detached from the cross head of the frame and fell down to the lift pit (see Figure 4).

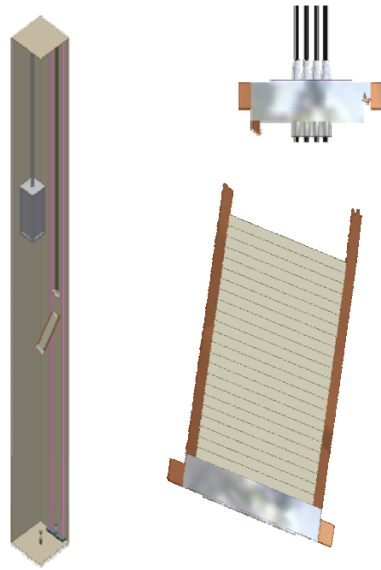


Figure 4 – Right-hand U-channel upright then fractured due to excessive load

Measures to Prevent Recurrence of Similar Incident

14. Sigma confirmed that there was a total of 23 lifts in Hong Kong, which were manufactured from the same batch of materials as those in the counterweight frame at Lift No. 11 in Tsui Lai Garden. Non-destructive tests to reveal surface and internal material imperfections including magnetic particle inspection and ultrasonic test were conducted on all these 23 lifts' counterweight frames. No similar defect was found in all these counterweight frames.
15. Sigma agreed to replace the counterweight frames of the 23 lifts by the end of December this year to enhance user's confidence in their lifts. EMSD will closely monitor the counterweight replacement work.
16. EMSD has reviewed and agreed with the trade to implement new measures during regular inspection of the counterweight frame with a view to enhancing safe operation of the counterweight.

Electrical & Mechanical Services Department
25 October 2010