



D1 Amusement Park Accidents Caused by Fatigue Failure

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Learning Overview: After attending this presentation, attendees will understand the mechanism underlying two amusement park accidents caused by fatigue failure of mechanical parts of the rides.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by introducing failure mechanisms of amusement park rides.¹

This presentation introduces two cases of amusement park accidents. One is a bungee drop accident caused by the fatigue failure of rolling bearings. The other is the “Crazy Clown” accident caused by fatigue failure of fastening bolts. In the bungee drop accident, a moving frame with 15 passengers stopped abruptly in the middle of the main structure at a height of 27m. While the rescue team was trying to rescue the passengers from the moving frame, it suddenly dropped, causing one rescue worker to fall to his death. A second accident happened nine years after the first accident. The moving frame with 12 passengers dropped abruptly as it was moving upward. It stopped at a height of 53cm due to the operation of the emergency brake system. Some passengers suffered spinal fractures. After an investigation, this study concluded that the moving frame was in an unstable equilibrium that would be broken with a small disturbance load while the rescue team was in operation. The unstable equilibrium state was maintained by the weight of the passengers and the frictional forces caused by the urethane wheels and poor lubrication of the pneumatic rod. The urethane wheels were severely worn out, and some were octagonal as a result. The rolling bearings of urethane wheels failed by flaking and corrosion that added frictional force. The moving frame was tested by varying the compressed air pressure as well, and all of the test cases were recorded by a video camera to analyze the time difference of the moving frame at each operation step. It was also concluded that the moving frame dropped because only one air compressor was operating while the other air compressor was not operating at the time of the second incident. It was recommended that a control system for the bungee drop should be installed to prevent the start-up of the moving frame, given the poor state of the compressed air system.

In the Crazy Clown accident, the fastening bolts of the rotating arm were broken abruptly when it turned around the central axis. The passenger was injured by the dropped cabin that was attached to the arm. After an investigation, the broken bolt was determined to have failed by fatigue as beach marks were commonly shown on the broken surface; however, the mechanical properties satisfied the requirements. From this, it was concluded that the fatigue was caused by external factors, such as improper fastening.

Reference(s):

¹ Johannes B., Paul E., Ludwing H., Karl W. *Ball and Roller Bearings Theory, Design and Application*. New York, NY:John Wiley & Sons, 2000.

Amusement Park Accident, Fatigue Failure, Flaking