Train Fire at Sakuragi-cho

April 24, 1951 at the Sakuragi-cho Station on the Keihin-Tohoku line

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A disastrous train fire occurred at the Sakuragi-cho Station on the Keihin-Tohoku line when a MOHA-63 train touched a sagging overhead wire and sparks caused a fire, killing 106 and injuring 92 passengers trapped in the railcars. Although the direct cause of the train fire was a stringing construction accident, heavy casualties were due to the train operators' inadvertent control input. The passengers were trapped inside the railcars because the operators deactivated the pantograph, locking all doors, and the window structures did not permit evacuation (the middle panel of the three-panel window was fixed to the frame). Photo 1 is the press photo of the accident.

Photo 1. MOHA-63 in Flames (Mainichi Newspapers) [2]

1. Event

Near the Sakuragi-cho Station on the Keihin-Tohoku line, the first car of a 5-car MOHA-63 train touched a sagging overhead wire and sparks caused a fire, killing 106 and injuring 92 passengers trapped in the railcars. The fire destroyed the first car completely and the second car partially. The heavy casualties were due to the closed doors and the particular window structures in which the middle panel of the three-panel window was fixed to the frame (Photo 2).

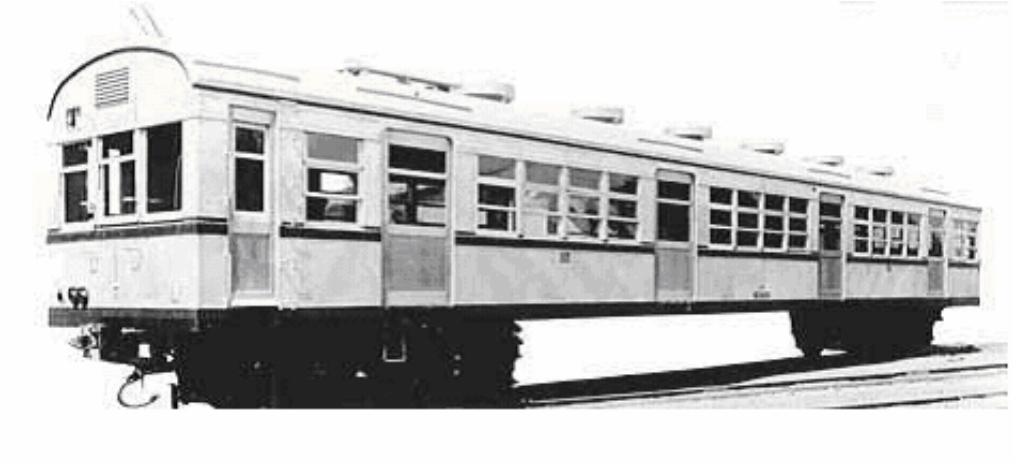

Photo 2. MOHA-63 Train [2]

2. Course

Figure 1 shows the map of Sakuragi-cho at the time. Construction crew was replacing insulators of overhead wires at the Sakuragi-cho Station. At around 13:38, one of the construction crew hit the beam with his/her spanner wrench by mistake, cutting a hanging wire at the circulatory shunt. As the result, the contact wire for the inbound line hung down. (Hanging wires support electrical wires. The train's pantograph makes contacts with the contact wire.)

A 5-car MOHA-63 train 1271B outbound for Sakuragi-cho left the Yokohama Station with a nine-minute delay. It was approaching its last stop, the Sakuragi-cho Station.

At around 13:42, the 1271B attempted to change its line from outbound to inbound at the 50m point from the Sakuragi-cho Station when the contact wire got tangled up with the pantograph of the first MOHA-63 car. The frightened train operators lowered the pantograph, but it topples sideways touching the railcar. Sparks started a fire on the wooden roof and spread to the entire car.

Two transformer substations, Yokohama and Tsurumi, were feeding electricity to the overhead wire at the Sakuragi-cho Station. The electrical current breaker was promptly activated at the Yokohama Transformer Substation, but not at the Tsurumi Transformer Substation. The Tsurumi Transformer Substation continued feeding 1,500V of electricity for about 5 minutes.

The first car was carrying more than 150 passengers and they attempted to escape from the fire. They were unable to open the automatic doors to outside. They attempted to escape to the second car, but the through passage door did not open. Opening of the window was too small. The passengers were literally all trapped inside the railcars waiting to be burned.

The train operators who saw fire attempted to detach the first and the second cars from the rest.

The fire completely destroyed the first car in about 10 minutes and partially destroyed the second car, killing 106 and injuring 92 people.

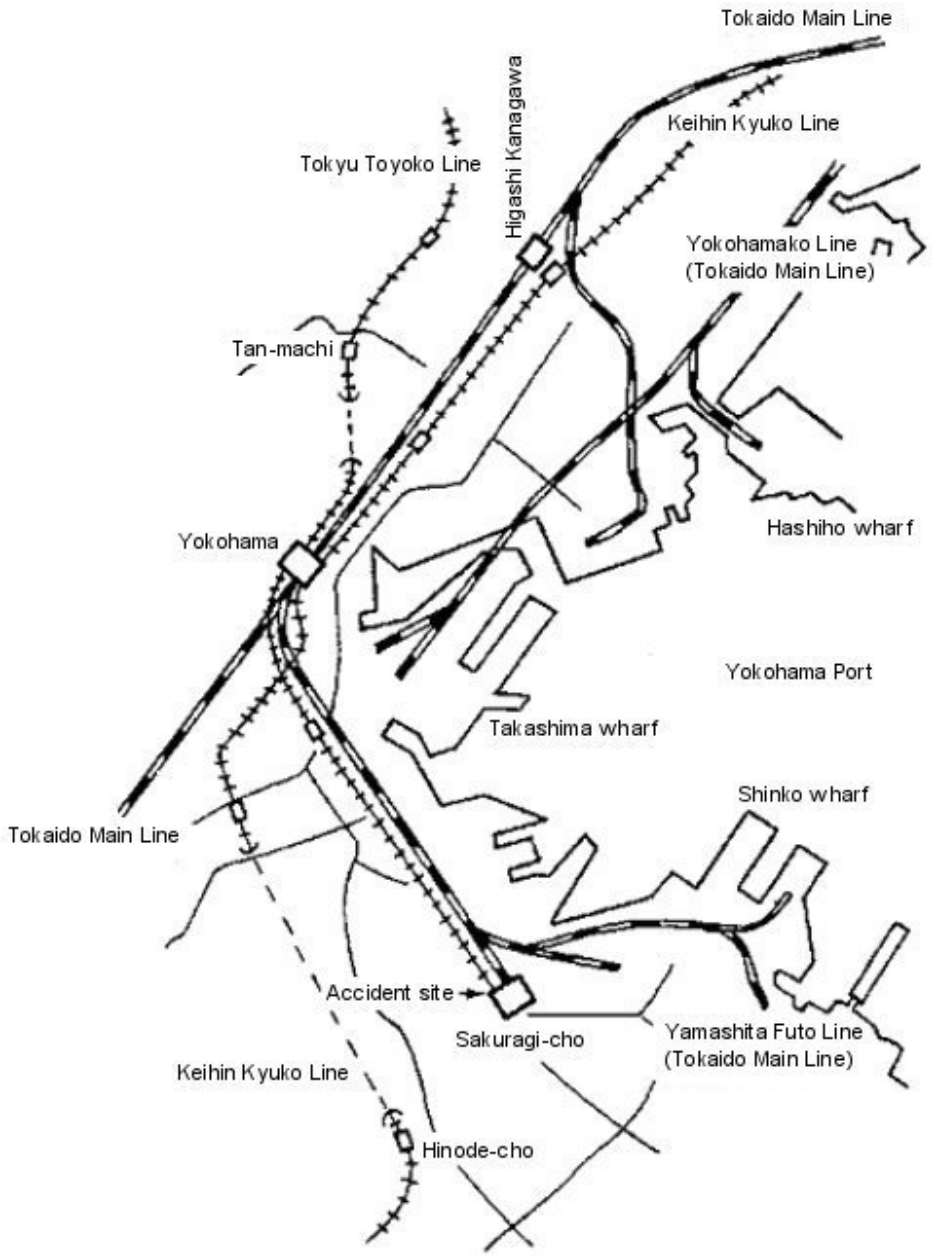

Figure 1. Old Sakuragi-cho Map [2]

3. Cause

(1) Stringing construction accident

This is the direct cause of the train fire. Considering that replacement of insulators is a regular maintenance task, this sort of accident could happen any time. The maintenance crew should have given a red flag signal and stopped the next train, but the other causes, rather than the stringing construction accident, multiplied the damage to the accident.

(2) The electrical current breaker did not function at the Tsurumi Transformer Substation.

(3) Structural issues of the train model
   a. The middle panel of the three-panel window was fixed to the frame (each panel was only 29 cm high). Opening of the window was too small for a person to go through (Figure 2).
   b. There was no sign indicating how to open doors in an emergency.
   c. Through passage doors to adjoining cars open inward. The doorway was too crowded with passengers for any of them to open the door inward (Figure 3).
   d. The model was produced during or right after the war, and it was a combustible product with minimum installation of safety devices and with flammable-painted plywood roof.

(4) The train operators and crew did not manually open doors to let the passengers off the railcars.

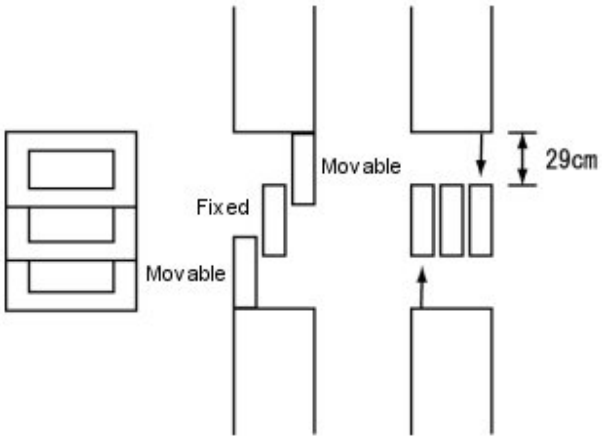

Figure 2. Three-Panel Window Structure of MOHA-63

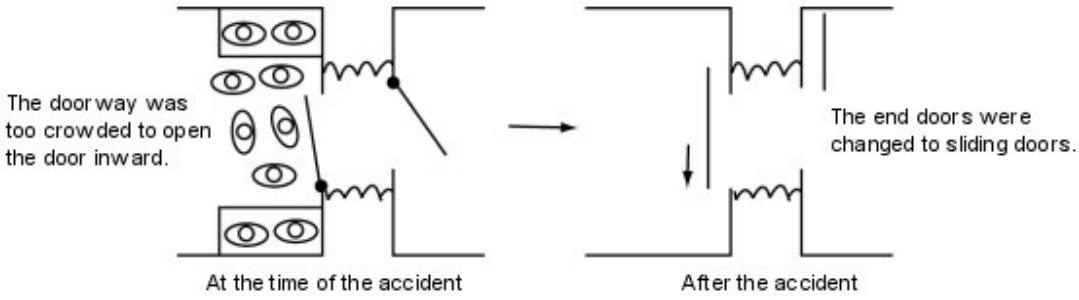

Figure 3. MOHA-63 Doors

The train operators attempted to detach the first and the second cars from the rest as trained when they assessed that the fire was not extinguishable. However, one can hardly believe that their action is based on reasoned judgment and lifesaving.

4. Immediate Action

In order to analyze the accident causes, Japanese National Railways (current Japan Railways) conducted

fire experiment at then Toyokawa Branch Factory. In less than two months after the accident, the Railway Safety and Inspection Bureau of the Ministry of Transport published the investigation report. The report described that the structure and the safety features of the MOHA model was neither fire-resistant nor prepared for fires. All railcars produced during the war were improved by coating of railcars with fire-retarding paint, better insulation of collector, and provision of a through passage to adjoining cars for evacuation.

5. Countermeasure

(1) Window structures to permit evacuation. Three-panel windows were changed to two-panel windows. JNR train models aborted three-panel windows after the Sakuragi-cho accident. For all MOHA-63 trains in service, the middle panels of the three-panel window were modified to be movable.
(2) Signs indicating how to open doors in an emergency. The emergency handle locations under the passenger seat were indicated by red paint and signs "In case of emergency, use this handle to manually open the door" were installed.
(3) Provision of a through passage to adjoining cars.
(4) Better insulation of pantograph and roof.
(5) Fire-retarding coating to improve fire-resistance.
(6) Mechanisms permitting rapid power shutdown in case of abnormal current flow.

6. Summary

The MOHA-63 model was developed aiming at the maximum capacity for a smaller railcar area in wartime years. The three-panel window was developed to air the packed railcars and make passengers including the standing in aisles as comfortable as possible. The window had a fixed middle panel, and the top and the bottom panels slid open for ventilation. The use of natural ventilation and sustainable energy are more economical than forced ventilation and seems a brilliant idea, but this particular window structure compromised safety of the passengers.

7. Knowledge

(1) A small accident may lead to a disaster.
(2) Improvement in performance and efficiency may compromise the safety.
(3) Designers and developers must ascertain the safety of the resulting product when implementing a new structure. They must test the safety under various hypothetical emergency situations.
(4) Instruction manuals and rules do not work in some circumstances. They may produce a fatal mistake.
(5) Passengers may want to be prepared and check evacuation routes when traveling by public transportation. Passengers must remain calm in emergency circumstances to minimize the accident.

8. Background

The MOHA-63 model was a commuter railcar produced more than 1,000 during and after the war. It was in service on the JNR lines as well as on private railway lines as JNR transferred railcars to help the private sector during the postwar years of recovery. The MOHA-63 model was design to carry as many passengers as possible in a railcar and it had the reduced number of seats. The number of doors was increased to 4 from the average of 2 – 3 per a railcar to quickly load and unload passengers. Due to the wartime and post-war shortage in production material, some key devices were dropped or substituted by inferior ones. Its design and production traded in quality for quantity, disregarding the safety. In response to the Sakuragi-cho accident, the model number was changed to MOHA-72 after various improvements including fireproofing were made. Considering the fact that the improved model was in service until recently and the current commuter railcars have 4 doors for its 20m-length body, the 4-door body must have been an appropriate design. For railcar windows, while the three-panel window was inappropriate for safety reasons, more railcars have fixed sash windows in recent years as air conditioners became popular and large-size glass became more reasonable in price. This may be due to vast improvement brought in fireproofing and fire-resistance design over the years.

References

[1] "Nihon-no Ressha Kasai Taisaku-wa Banzen-ka? (Does Japan Have Effective Train Fire Control Policy?), Pail and Rapid Transit Mechanical Engineering (Nagase Laboratory), Kanazawa Institute of Technology, http://www2.kanazawa-it.ac.jp/knl/nagase/comment19.html

[2] Yasutomi Sasaki, Ryoichi Amiya (1995) *Zoku Jiko-no Tetsudooshi (History of Train Accidents II)*, Nihon Keizai Hyoron, LTD.

[3] "Hokusoo Yawa (Northern Sobu Nights)", http://www.ne.jp/asahi/hokuso2/hokuso2/html-yama-03.html

[4] "Kako-no Omo-na Kasai Jiko (Major Fire Accidents in the Past)", http://www1.odn.ne.jp aaa81350/kaisetu/kasai/jikorei.html