A Research of Evacuation and Rescue Operation on Mass Transit System

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ABSTRACT

The Taipei Rapid Transit System (TRTS) stations have been operating successfully, and other rapid transit systems are also under planning in other cities of Taiwan. Based on the characteristics of space in the rapid transit station and its facilities of hazard mitigation, this research project focuses on the requirements of the hazard mitigation design and the system of reinforcements and operations after the failure of an initial emergency response. This project demonstrates the application of the passenger egress safety system and regional fire rescue planning on the Xin-Hai Station (brown line) and the Ding-Xi Station (orange line). This project also presents a handbook of passenger egress safety and the appropriate guidelines for regional rescue. This project concludes with recommendations and strategies for the phase of civil engineering design and disaster management. In applying the multi-defenses concept, we hope that the department of transportation can validly control disaster damage and launch an effective safety operation.

Keywords: Rapid transit station, large-scale earthquake, disaster management, evacuation, fire rescue.

INTRODUCTION

This research was carried out on the following aspects of the TRTS stations:
- the materialization of a preparatory but extensive earthquake disaster prevention plan and design requirements.
- subsequent rescue supportive systems should the initial disaster be out of control.
- the rescue plan should include requirements such mitigation, preparedness, emergency response, evacuation, fire control and other multi-defensive rescue actions to effectively control the damage to accomplish the purpose of operation safety.

EARTHQUAKE DISASTER SCENARIOS

The "Driving Operation Procedure and Instruction" manual already exists
and includes operation procedures for emergency situations such as the evacuation of passengers, injury or death of personnel, fire accidents and derailed trains. The manual, however, does not include instructions for earthquake disasters.

Therefore, we have taken the initiative to investigate the effects of an earthquake on the TRTS and have found inherent problems with the TRTS in dealing with earthquakes; we have also found strategies to lower the degree of injuries or number of deaths in an earthquake scenario. The following describes several possible situations that may take place as a result of an earthquake:
- A fire following the earthquake in the station.
- Power failure in the station.
- Trains may become immobile, or in a worse scenario, the train may become derailed.
- Damage to the structure of station could trap passengers.

**AN EVALUATION OF EVACUATION TIME**

By studying the movement of the passengers at the DING-SHI station, CHUNG-HO line, we were able to theoretically calculate the amount of time it takes for the passengers to evacuation.

If we consider the TRTS evacuation model, where only one train remains at the platform at any given moment, the evacuation system is successful because it only considers that the passengers in one train will unload onto the platform.

However, the NFPA 130 model suggests that passengers from two trains, not only one train, will need to unload onto the platform, thereby greatly increasing the number of passengers that will need to be evacuated.

The crux of the evaluation is the amount of time it takes to evacuate passengers. But TRTS’s calculation method is based on the assumption that two trains will not enter the station at the same time. So in fact, the number of people evacuated is different from the number that the NFPA 130 stipulates.

In the TRTS model, the current operation management responsive system can meet regulations because it estimates that passengers will be able to leave the platform in 4 minutes and reach a safety point in 6 minutes. The purpose of economical design of the platform space can be achieved. Nevertheless, the TRTS needs to consider an important question: can it adequately maintain the control scenario that it has set up?

**SAFETY EGRESS AT THE UNDERGROUND STATION**

The suggestions made to safety egress for the underground TRTS stations are:
- The planning of the temporary refuge areas for passengers such as the elderly, the children, or the handicapped. The planning of evacuation route can set up a temporary standby area at the entrance of emergency safety stairs.
- Emergency illumination equipment with night glowing function should increase visual ability in order to facilitate the evacuation process in the tunnel.
- Mark the distance of the nearest station and direction at certain interval in the tunnel (better off to adopt the flash guiding light that is
We expect that at the time of the earthquake, station personnel should be able to apply emergency adaptation measures to reduce the degree of injuries and deaths and damage on equipment. The addition of egress/evacuation operating rules and manual at the TRTS station is necessary.

REGIONAL RESCUE ON EARTHQUAKE DISASTER

The rescue itself has unique characteristics. The TRTS management personnel are responsible and in charge of the initial emergency response after the occurrence of the incident, whereas local fire brigades must provide immediate rescue support when the disaster continues to escalate and has the potential of putting mass human lives in danger.

Due to the difficulty of the rescue process at the TRTS, the rescue team must know clearly the goals of the rescue and perform the rescue in preferential order; it must also take the standard operation procedure into consideration to avoid the putting itself in danger and creating chaotic conditions in the process of the rescue.

CONCLUSION AND SUGGESTION

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In order to safeguard the safety of passengers, station facilities, vehicles and articles and the prominent purpose of the normal transport management within the TRTS infrastructure.

The following has to be planned:

- The establishment of goal planning of the earthquake disaster mitigation management.
- Integrate equipment that can withstand the effects of the earthquake and maintain its function after the quake.
- The installation of a venting system that can have different rescue operation modes — for evacuation and for rescue.
- The establishment of emergency response system.
- The design criteria of safe evacuation and the consideration of the operation management system.
- The edition of rule manuals on evacuation operation.
- Rules for the regional rescue supportive operation.

Suggestions

Through the introspection of this research/analysis, suggestions have been made out to TRTS engineering department and TRTS management company of the mitigation (engineering planning and design) and preparedness step.

1. Engineering planning and design
   - The establishment of the estimated relationship between the damage and the intensity scale of the earthquake within the TRS infrastructure.
   - The consideration of the safety maintenance within the TRTS infrastructure.
   - The integration and design of equipment that are resistant to the effects of the earthquake.
   - The planning of the evacuation route.
   - Take into consideration the existence
of neighboring occupancies such as department stores and underground malls.

- The set up of the essential equipment for the fire rescue activity.

2. Operation management

- The essentiality of the emergency evacuation drill at the TRTS station.
- The edition of the emergency pocket manual and the evacuation/escape manual for personnel.
- The installation of fire-fighting equipment for the personnel.
- The development of the disaster information system.
- Sectional arrangement of work sharing for self-defensive organization.

REFERENCES


