Inspection standards in Iranian Railway Tunnels

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Abstracts

Railway as a most communicating tool is changing to one the most advanced and modern industry in Transportation mood. The safety of railway Tunnels during designing is one of the main point, because life and property of passengers and dangerous goods on the one hand and on the other the high speed of trains should be risky. So keeping safety in tunnels is highly important. Although, the possibilities of such events in tunnels is some how less but if it happened it should have catastrophic consequences so the designer should know how to do his job by choosing the proper tunnel system/accident deterrent/ decreasing tools and analyzing danger well to reduce the risk so in the phase of feasibility of tunnel construction, the considered safety system should be defined. The shape of tunnel system is so important in its safety. This matter should be evaluated too.

In this regard tunnels as a part of the railway network in current operational situation should be studied according safety point of view then shortages and defects which cause unsafe situation should be verified, then according to the results, solutions should be presented for inspection and increasing the safety level of tunnels. In this research, we have worked on inspection process articles, number of inspection in a specific period of time, inspection of system and equipment, evaluation and training of inspectors, saving records, ranking, national data base of tunnel, inspection team organization, technical references, quality control, ensuring the quality of inspection and tunnel maintenance. Providing suitable condition for equipment, operational processes, maintenance and design in tunnels are dependent to each other in large extend. Determining the optimum combination is needed by considering the whole life-cycle cost of the tunnel and also the current values of risk.

Keywords: tunnel inspection, maintenance safety level, ranking introduction

There would be happened three main accidents in tunnels: train derailment, collision and fire. Of course there are some other accidents in open lines such as crashes in railway junctions or with some barriers on railway (cars/trees/….) and also collision of trains during changing their routes or train derailment, natural disasters (storm, avalanche) but these events rarely happened in tunnels. For this reason and also because of easier condition of operation, the number of events in each kilometer in railway routes, tunnels has less accident comparing to those in open routes or adjacent to stations.
Unlikely to open railway tracks, firing accidents in tunnels is so dangerous. In closed environment of tunnels, this kind of accident has potentially catastrophic consequences. Subsequently some special safety measures are taken for tunnels for reducing severe effect so fire.

Because of the potentially catastrophic consequences, the most common hazards in the tunnels are considered more severe and critical events for people comparing to less dangerous events with more in numbers in intersections. Measures such as structural maintenance in tunnels, leveling and directing tracks in the tunnels and also using appropriate control systems are helpful to prevent the occurrence of accidents.

In addition, to reduce the effects of disasters can be of mechanical ventilation equipments gathered such as the application of the right of access and the creation of facilities for easily rescuing. Take that away from the accident, and rescue is also done in order to reduce the negative effects of the accident and the more planning and better prediction for getting it done is practical, a higher level of safety in tunnels will be provided. This research seeks to provide safety for the achievement of the objectives of the framework and of the railway tunnel safety performance measurement.

Therefore, with the help of reviews and ranking of structural reliability index of tunnel safety and to raise the level of operation, safety recommendations and regulations, resources and references relating to the pattern of benchmark survey and assessment should be evaluated and studied. In this regard, according to a study of the current situation of railway tunnels, defects and shortages have been identified and the appropriate conditions for being safe in tunnels, appropriate measures and strategies were provided to secure railway tunnels in the country.

**Accidents in railway tunnels and applicable classification of technical structures**

According to the overviews of the major reasons for the occurrence of the accident on the railway tunnels in Iran bellow items should be mentioned:

- a lack of proper ventilation of smog during the train movement in tunnels, particularly tunnels with geometric situation in the curves
- a lack of timely maintenance and drainage channels leading to the water in the tunnels,
- Not timely renovation in tunnels;
- a lack of timely staining shelters

Problems related to accidents in tunnels;
- problems of sediments in the vault of the tunnel and its negative effects on the superstructure instruments metal sleepers in particular, rails and connection tools,
- Geometric parameters are not observed in the tunnels in particular the lack of investigation of the exit of the centre of track in the tunnels;
- changes in the gauges in tunnels, in particular after the improvement operations
- not solved problems of wall drift in some tunnels.

Depending on the failure degree, the effect on safety (functional weakness) on priority actions for structure and maintenance can be categorized as four below classes:
SA Class: structure that is sorely affected by failure.
SC class: structure does not have functional partial defects but with less problems or its progress has been paused temporarily and had no fear of re-occurrence.
SB class: this structure deficiencies level is located between classes SC and SA. If it is progressed functionally weak and structural class achieved to SA class to avoid this problem there should be carried out the required measures.
SS class: there are no defects in Structure: or less problems are visible that are not related to the performance of the structures.

Structures that are supposed to be in class SA taking into account functional failure and implementation of corrective measures timing are classified to three bellow items:
SAA class: the structure that is not commonly to use and mostly is impossible and the remedy actions should be done quickly on them .in the fact, the main function of structures with defects and safety of trains, passengers and other users are in danger.
SA1 class: The structure presently no safety problem as soon as possible but no specific action is required The reason for this could be the result of external forces such as floods, heavy rainfall, earthquakes, etc., which are then applied to other structures are not able to meet the performance.
SA2: Existing structures are no safety problem in the future, but its performance will be greatly affected.

The increase in structural damage and defects to prevent further action is required. Otherwise, further reducing the ability of the structure can meet the safety performance of trains, passengers and users to influence and disrupt normal operation of the line.

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<th>Functional classification structures</th>
<th>Degree of effect of safety</th>
<th>Priority Action</th>
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<td>SS</td>
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Table1: Functional classification of technical structures depending on the degree of failure

The conclusion of this essay is as below:
In this study the methods of inspection of railway tunnels inspection and defining railway measure of available actions is to maintain. In this regard, the introduction of safety management system components, tunnels and understanding of the concepts, applications and
practices used within the overall safety of all those involved in railway transport is essential. Most of the old railway tunnels and having adequate attention to safety during operation and have limited space, are considered among the most critical areas rail. The establishment of a system of regular inspection is necessary to control and eliminate the defect was reported.

In maintenance process of railway technical structures, five types of inspections that include the acceptance inspection, surface inspection, general inspection, principles inspection and special inspection should be take in to account.

Rating tunnel components for its correct operation and maintenance, proper allocation of financial resources, after the inspection and operations according to the results of inspections carried out is very necessary. This classification on the basis of the extent, type and size of the place was corrupted and shortcomings in the tunnel and its structural components and the handling capacity of the components will be considered. To determine the tonnage capacity, the inspector should know the design of each component and how the existing shortcomings have negative effect on the design. The defects may be not precisely in one of these categories so the inspectors must use proper engineering judgment at the time of inspection.

References

[1]-Code of Federal Regulations, Title 49, part 213, Track safety standards
[2]-FRA Office of Safety Analysis Web Site
[3]-Transport Canada, CANADIAN ROAD/RAILWAY GRADE CROSSING DETAILED SAFETY ASSESSMENT FIELD GUIDE, April 2005
[6]-UIC Code 779-10
[8] ACT 201 Standards
[9] Tunnel rail inspection and maintenance instructions – doc code QW- way and work department