

Safety at Points and Crossing of Railway Tracks in Bangladesh

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Abstract

Points and Crossings are one of the major components in railway track. They are provided to transfer railway vehicles from one track to another, either parallel to or diverging from the first track. Wear on rails, corrugation and corrosion of rails are some mode of distresses that occur at points and crossings. 90% of serious railway accidents occur in the world at or over points and crossings. This is due to the fact that points form the weakest part of the track. Hence great care should be taken to keep them in perfect running order. This paper aims at to find out some improvement options so that they can operate with maximum safety. For ensuring safety some improvement measures such as regular inspection of turnout, maintaining points and crossing inspection register, maintaining proper alignment and uniform gauge, providing adequate ballast, timely reconditioning and resurfacing should be done on regular basis.

Keywords: *Safety, Maintenance, Inspection, Rail Gauge, Resurfacing.*

1 Introduction

The railway in Bangladesh has the potential to play a major role in the context of regional transport and trade. The potential of the railway in Bangladesh needs to be unlocked through planned investment. Bangladesh is still facing unremitting deficit and management bottlenecks. The deficit can be only eliminated by increasing the standard of railway sector. The rail track is the backbone of any railway system. The finished or completed track of a railway is known as Permanent way. One of the major components of permanent way is points and crossings. They are necessary when railway vehicles are to be diverted from one track to another because the wheel of the railway vehicles are provided with flanges which require this special arrangement. The points or the switches give the facilities of diverting the vehicles and crossings provide gaps in the rails to be crossed by flanged wheels. A complete set of points and crossings along with lead rails is called a turnout. A turnout is designated right hand or left hand depending upon whether traffic is diverted to the right or to the left by the turnout (Agarwal, 2004). A turnout is constituted of tongue rail, stock rail, switch, points and crossings. In Figure 1 a right hand turnout is shown. There are mainly two types of tracks in Bangladesh, Single gauge (SG) and Dual gauge (DG). A single gauge track may be of Broad gauge (BG) or Meter gauge (MG). A dual gauge railway track provides facilities for trains of two separate gauges. The east zone of Bangladesh railway (BR) mainly consists of meter gauge rails. The west zone consists of dual gauge. To solve this problem and in order to maintain continuity some of the routes are converted into dual gauge. To provide points and crossings in dual gauge track with proper safety is a challenge. Points and crossings are a delicate part of rail track where train speed is a prime factor to avoid accident.

A switch or point is a mechanical installation enabling railway trains to be guided from one track to another. Switches are of two types: 1) Stud switch, 2) Split switch. Split switches may be divided into two types: Loose heel type and Fixed heel type. The arrangements by which different routes, are connected without any obstruction is called crossings. According to angle it is divided in Right angle, Acute angle and Obtuse angle. According to diversion it is divided into Spring, Crossover, Scissors, Diamond crossings and Gathering lines.

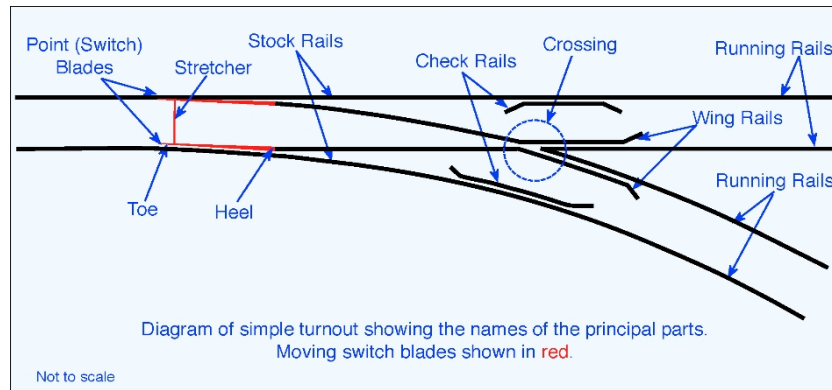


Figure 1. Right hand turnout

The points and crossings should regularly be inspected in detail as quality of riding depends very much on their maintenance. The correct setting of points is fundamental to the safe running of a railway. For example, incorrectly set points may result in two trains being on the same track, potentially causing a collision. Perhaps the greatest security challenge in railway operation is preventing the tampering of manually operable switches or points. We have mainly focused on to identify problems related to points and crossings and tried to find a sustainable improvement options for those problems in this research paper. In this regard, proper manufacturing and installation of different parts of points and crossings is very important. The speed of trains in Bangladesh is very low comparing to the developed countries. In Bangladesh Maximum speed of train is 60-70 km/hr but in Europe the speed is close to 260-300 km/hr (Wikipedia, 2016). In order to achieve high speed rail service in our country we need to improve the conventional rail infrastructure so that the trains can operate safely at higher speed.

2 Present Conditions

The railway system comprises two gauges, BG & MG, which involves transshipments of traffic at the break of gauge points. Recently, DG has been constructed in some important sections to ease the problems. The expansion of BR has been blocked since 1947. Only 80 km rail line has been constructed for last 50 years (Hasan, 2009). On the other hand, more than 1200 km rail lines are under risk for operation due to lack of proper maintenance and attention which is mainly for insufficient fund allocation. As a result, derailment has become common. This has adverse impact on the efficiency and reliability of railway services. At present points and crossings are suffering from various distresses like wear on top and side of rails, corrugations and corrosion of rails. Present scenario of points and crossings in Bangladesh are shown in Figure 2.



Figure 2. A DG (one the left) & a SG (one the right) Points and Crossing at Kamalapur Railway Station

Trains can create large impact and lateral forces as they change course. These causes wear and deformation. That's why points and crossing have limited lifespan before we need to replace them. Less than 5% of total rail track consists of Points and crossings. During year 2013-14 net operating ratio of BR was 200.2% i.e. total expenses were 200.2% of total earnings. Expenses on repair and maintenance were 64.3% (BR Information book, 2014). Over 17% of maintenance budget is allocated to repair points and crossings. During the year 2013-14, 71.75% of the total train accidents were attributed to technical defects in rolling stock, track, signalling and interlocking apparatus (BR Information Book, 2014). From which we can easily see that the accidents related to tracks have higher percentage. This means most of these accidents have occurred due to dysfunction in points and crossings or other failures related to tracks. The comparative figures for 2012-13 (please see Figure 3) and 2013-14 (see Figure 4) are shown below.

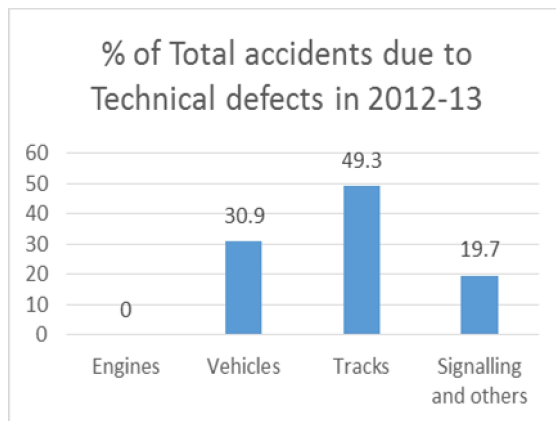


Figure 3. % of Accidents in 2012-2013

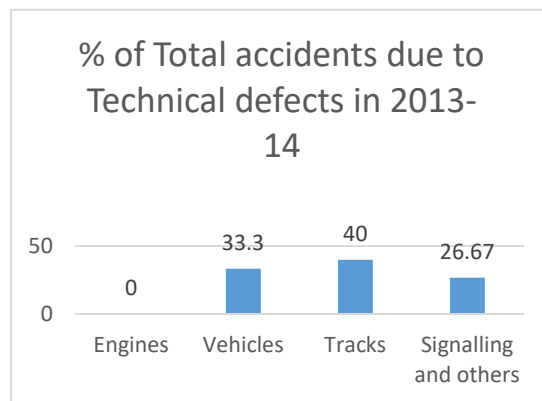


Figure 4. % of Accidents in 2013-2014

Points or switches can be propelled by various systems. One of simplest systems which is used in Bangladesh is ground frame set up. In this system a series of rods and cams are attached to lever in signal boxes. Signallers use switches to set routes. This system is now largely being replaced by remotely operated hydraulics and electromechanical devices.

3 Improvement Options

As engineers, we face an ongoing challenge to maintain and improve points and crossings. Improvement can only be done by regular basis inspection and maintenance. Further measures should be carefully attended as followings.

3.1 Inspection of Turnouts

The condition of turnouts shall be given special attention, and all components, including spacing of sleepers, fastenings, locking bolts and others must be complete and kept in good condition. It is very essential that points and crossings are inspected at regular intervals to identify defects that develop in the course of time and take remedial action to rectify them, particularly in running lines and such as are recommended for renewal, every year (Tera International Group, Inc, 2011).

3.2 Points and Crossings Inspection Register

The measurements done during the inspection of points and crossings should be entered in a Points and Crossings Register.

3.3 Inspection of Points and Crossings in Dual Gauge Turnouts

Inspection of dual gauge turnouts by various officials shall be done so as to maintain the stipulated frequency for both the broad gauge and meter gauge taken as separate lines. The gang mate and the key man shall be given special instructions for careful inspection of the dual gauge turnout. It shall be seen that the bolts and nuts are tight. Staff must look out for any loose parts and fallen parts of rolling stock which could create problems in operation.

3.4 Maintenance of Turnouts

3.4.1 Alignment, packing and fittings

The points and crossings assembly should be in good alignment with the rest of the track and should not have any kinks. Packing under the sleepers must not be loose especially under the crossing, the switches and the heel block. The chairs and fastenings and all other fittings must be complete and properly secured.

3.4.2 Cant to rails

The rails over the points and crossings shall be laid without cant. The track on approaches to points and crossings is provided with a cant of 1 in 20. The change in the vertical position of the rail from approach track to turnout should not be abrupt as otherwise undesirable oscillations will be set in a vehicle moving on the track.

3.4.3 Gauge and Ballast

It is a good practice to maintain uniform gauge over turn outs. If gauge of track adjoining the points and crossings is maintained wider or tighter than the gauge on the turnout, the gauge on the adjoining track must be brought to same gauge as that of the turnout and shall be run out at the rate of 1 mm in 3 meters to the requisite extent. Speed restriction due to lack of ballast is a very common phenomena in Bangladesh. Turnouts in the main line should be packed with 25 mm size ballast. The depth of ballast in the turnout portion should be the same as for the main line track, subject to a minimum depth of 200 mm for broad gauge and 150 mm for meter gauge. A highly cost effective solution for the reinforcement of ballast over a soft subgrade are Tensar biaxial geogrids, which bring significant benefits to railway engineers (Islam, 2015).

3.5 Maintenance of Switches or Points

Switches should fit 'home' properly under the stock rails. When the tongue rail is in closed position, it must bear evenly against distance studs or blocks and all bolts on switches should be kept tight. To check the housing of the tongue rail and also the throw of the switch, all non-interlocked points should be operated by hand lever and other points from the signal frame, when traffic permits doing so. In case of straight switches, correct amount of bend should be given to the stock rail on the turnout side at the theoretical toe of switch, to avoid misalignment or a kink. Slight wide gauge at the toe of switch over and above the required widening to house the tip of the tongue rail, may be adjusted by providing suitable steel packing between the web of the stock rail and the lug of the slide chair wherever feasible. On wooden sleeper layout assembly, the slide chairs should be fixed to timbers by plate screws; round spikes should not be used for this purpose. Tongue rail should bear evenly on all the slide chairs. This will be ensured when all the sleepers are packed properly.

3.6 Maintenance of Crossing

No crossing is to be changed if it has less vertical wear than 6 mm in the wing rails or point rail in lines where speed is 65km/hour or more and 10 mm where speed is less than 65 km/hour. No crossing is to be changed which has vertical wear less than 13 mm. It is good maintenance practice to recondition or resurface the point rail and wing rails by welding if the vertical wear has reached 6 mm.

3.7 Replacement of Points and Crossing

Three main methods for points and crossings renewal or replacement can be identified such as: Assembled in situ, Pre-assembled in the vicinity of the work, Modular switch. The criteria to decide which method should be used during the points and crossings renewal are based on economic aspects, and for that reason the most common method is the pre-assembling near the site (90%). Usually there is line side space available for the pre-assembling of the points and crossings and track access roads to transport the switch components and machineries. In practical, 99% of cases, heavy railway cranes (up to 40 tons) are used for installing the new switch panels on their final position. . In developed country like Germany Multi-purpose railway crane commonly used for switch renewal (please see figure 5). Other installation systems such as UWG system, excavators or VAIA-Car crane-beam are infrequently used. On the contrary, when there are line side space constraints to the preassembly of the switch, such as in tunnels or embankments, the modular switch method is preferred. The modular switch renewal concept accounts for only 1-3% of the total points and crossings renewals. One of the main reasons of this low use of the modular concept is the reduced number of special tilting wagons available for the transport of switch panels from the factory to the worksite (Mainline Consortium, 2014).



Figure 5. Multi-purpose railway crane commonly employed for switch renewal

3.8 Reconditioning and Resurfacing Technique

The cost of switches and crossings is comparatively much higher than other permanent way materials. The reconditioning of worn-out area of these components shall be undertaken to enhance their service life, as a part of maintenance. This is done using approved technique for metal arc welding and the use of suitable materials. For resurfacing, the conventional manual arc welding technique in which two types of electrodes are used to make up for the entire worn out portion (initial layer and finishing layer) of the crossing shall be used. The worn out points and crossing can be resurfaced by this method by gradually depositing number of layers as per requirement using 4mm diameter electrodes to avoid high heat input. Only approved types of electrodes that are suitably packed to guard against damage during transportation and moisture ingress shall be used (Tera International Group, Inc, 2011).

4 Concluding Remark

Railways form an important part of the transportation infrastructure of a country and plays an important role in sustaining a healthy economy. It is high time Bangladesh Railway geared up to overhaul and upgrade its infrastructure to meet future demand of growing traffic. Special emphasis should be taken on spreading the railway network by laying new tracks and also on increasing transportation efficiency by running heavier, longer and faster trains. For railway tracks we need up to date points and crossings system. We have to find out a sustainable point and crossing systems which can be easily applicable for our country and which should last longer and require less maintenance.

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