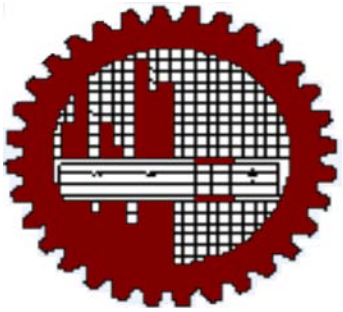
STATUS OF RAILWAY TRACKS AND ROLLING STOCKS IN BANGLADESH

Md. Tareq Yasin



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by

Md. Tareq Yasin

MASTER OF ENGINEERING IN CIVIL ENGINEERING
(Transportation)

Department of Civil Engineering
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY,
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The thesis titled **"STATUS OF RAILWAY TRACKS AND ROLLING STOCKS IN BANGLADESH"**, Submitted by Md. Tareq Yasin, Roll No: 100504413F, Session: October-2005, has been accepted as satisfactory in partial fulfilment of the requirement for the degree of **Master of Engineering in Civil Engineering (Transportation)**.

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1. _____
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Professor — (Supervisor)
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BUET, Dhaka-1000

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BUET, Dhaka-1000

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Dr. Md. Mizanur Rahman — **Member**
Associate Professor
Department of Civil Engineering
BUET, Dhaka-1000

CANDIDATE'S DECLARATION

It is hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree or diploma.

_____

(Md. Tareq Yasin)

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ABSTRACT

The rail sector of Bangladesh is experienced by more than 150 years. As of 2007, the total length of rail route is 2,835 km, of that 659 km are broad gauge tracks (in the western zone), while 1,801 km are metre gauge tracks (in the east Zone has 1266 km and the west Zone has 535 Km). The gauge problem is being tackled by introducing dual gauge. The remaining 375 km are dual gauge track (mostly in the central and western regions of the country). Significant achievement after liberation is only the direct communication between Dhaka and Rajshahi over Bangabondhu Bridge. Bangladesh Railway is not connected with all the districts of the country. At the end of 2006-2007 only 44 out of 64 civil districts of the country could be connected by railway. Allowable maximum speed of these rail routes vary from 15 to 95 kilometers per hour. In the year 1991, Government advised by the Donor Group, closed 300 kilometer rail routes as stating them economically loss projects. Even, at present many of the existing lines do not have sufficient sleepers, ballasts etc. The condition of rail routes over 1500 kilometer is very poor, due to lack of renewal and timely maintenance. 600 kilometer rail tracks of ten different routes are running dangerously. The major parts of the profit of rail comes from the carrying of goods. But due to the lack of proper planning and investment, the movement of goods by rail is time-consuming and a difficult process. Rail way seemed to be insignificant from the very beginning of Bangladesh. Allocation for Bangladesh Railway is only below 20% of the allocation of transport sector. But realizing the significance of rail Government now-a-days have increase the allocation for railway, as the allocation for BR in 2004-2006 (three year) was 75573.10 million taka; and the allocation for BR in 2007-2010 (mid term) is 29685.50 million taka. For the improvement of rail the Present Government has taken various initiatives. These projects are going on and will be completed within 2012. Also Government has taken 9 projects at a cost of about three thousand crore taka for the improvement of rail in Bangladesh. Recently Five railway projects will be worked out within by the help of Indian 100 crore dollar debt help. Bangladesh is joining her rail tracks with India and Trans Asian Railway.

Different sections of railway track in different location in the country consist of different materials and equipments according to their significance and allowable fund. Rails are made of high carbon steel to be able to withstand stresses, to provide a smooth pathway and have very little ($1/5^{th}$ of tyre) friction. For the construction of rail tracks, pre-stressed concrete sleeper, as well as, steel sleeper and wooden sleeper are used, but in any section only one type of sleeper is used. Suitable fittings and fastenings are used for relevant sleeper. Ballast used here are crushed rock.

The lifetime of a rail locomotive is 20 years. But only 28% of total engines of Bangladesh are of age less than 20 years. Most of the rest are more than 40 years aged. Because of these old engines, and having no many extra engines delay occurs in rail movement. During the year 2006-2007, average distance travelled by a BG Locomotive was 163 kilometres per day & MG Locomotive was 172 kilometres per day. The increasing passengers demand more locomotives, wagons and coaches to be repaired and bought for smooth operation. In 2006-2007, BR had a total of 9473 (BG=1935, MG=7538) wagons comprising 6599 covered, 992 open and 1882 special type wagons.

Inclusive growth and expansion of rail network to reach development to every corner of the country should be the core to developmental approach. Economically unviable projects need to be viewed with social perspective being economic necessity for backward and under privileged areas.

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ABBREVIATIONS USED

BR: Bangladesh Railway

IR : Indian Railways

TAR: Trans-Asian Railway

UNESCAP: United Nations Economic and Social Commission for Asia and the Pacific

AHN: Asian Highway Network

BG : Broad Gauge

MG : Metre Gauge

DG: Dual Gauge

HP : Horse Power

DLW : Diesel Locomotive Works, Varanasi

CLW : Chittaranjan Locomotive Works

DC : Direct Current

AC : Alternating Current

KV : Kilo Volts

RDSO : Research Design & Standards Organisation, Lucknow

BHEL : Bharat Heavy Electricals Limited, Bangalore

CST-9: Central Standard Trial-9

CHAPTER-1

INTRODUCTION

1.1 GENERAL

Railway is a guided means of land transport designed to be used by trains; both passengers and freight are transported on railways. Railway plays various proficient roles as it is an efficient means of transport as a rail carry more than a four laned road (Railway Budget India, 2009-2010). Rail transport is an extremely energy efficient means of transport. A train needs 50-70% less energy to transport a given tonnage of freight or to transport a given number of passengers than by road (Railway Budget India, 2009-2010). It is reliable, time efficient, comfortable and the safest mode of transport.

In almost, all the developed countries, the relative share of railways in total passenger kilometers and total goods carried are very significant and increasing. The Chinese State Council approved a new US$ 292 billion- railway investment plan, the country's railway network is expected to grow from 78,000 km at the end of 2007 to 100,000 km by the end of 2010 and ultimately 120,000 km by 2020 (Wikipedia, 2010). In India, both passenger and freight traffic has seen steady growth, and in the mid-1990s, the Indian Railways carried more than 60 percent of India's goods and 40 percent of passenger journeys. (India Transportation). The cargo carried by the U.S. railroads increased to 750 billion ton-miles by 1975 and doubled to 1.5 trillion ton-miles in 2005. By 2000, the share of U.S. rail freight was 38%(Wikipedia, 2010). Where as in Bangladesh Railway carries below 5 percent of total goods and only 45.8 million passengers (4.59 billion passenger-kilometers) in a year (Bangladesh Railway, 2007).

Railway is expected to play a major role in Bangladesh in providing easy connectivity throughout the country and with abroad. Railway in Bangladesh provides social obligatory service. Inclusive growth and expansion of rail network to reach development to every corner of the country is the core to developmental approach. Economically

unviable projects need to be viewed with social perspective being economic necessity for backward areas and under privileged areas. Growth in freight transport is thought to be one of the drivers behind the increased focus on rail, and the need to increase capacity to meet rising demand. Better passenger and freight services require quick, smooth, durable and safe movements of rolling stocks.

Railway seemed to be insignificant from the very beginning of Bangladesh, as the allocation for Bangladesh Railway for the period 1973-1978 was 1261.30 million taka while for Transport sector it was 5276.10 million taka; for the period 1985-1990 for BR was 8360.00 million taka while for Transport sector was 30023.00 million taka; for the period 1997-2002 for BR was 24000.00 million taka while for Transport sector was 118000.00 million taka, (Bangladesh Railway, 2007). i.e. allocation for BR is only below 20% of the allocation of Transport sector. Realizing the significance of rail Government now-a-days have increased the allocation for railway, as the allocation for BR in 2004-2006 (three years) was 75,573.10 million taka, and the allocation for BR in 2007-2010 (Mid Term Budget) is 29,685.50 million taka. (Bangladesh Railway, 2007).

Already direct passenger services and freight services are running regularly between Bangladesh and India. Government has taken construction plan of rail tracks from Dohazari to Cox-bazar via Ramu, and from Ramu to Gandum. So that, the rail tracks in Bangladesh can enter into the integrated freight railway network across Europe and Asia (TAR) (Wikipedia, 2010).

For the improvement of rail the Present Government has taken various initiatives. Some new rail route construction, rehabilitation of some weak rail routes, collection of 21 Metre gauge locomotives, modernization of railway workshops, remodeling of station yards, collection of a 60 M Ton MG Crane and a 80 M Ton BG Crane for the accident relief train, collection of 100 BG coaches and 150 MG coaches, etc., projects are going on and will be completed within 2012 (Bangladesh Railway, 2007).

Realizing the importance of railway in the context of Bangladesh and recent initiatives taken for its development, this research study intents to investigate the status of railway track and rolling stocks in Bangladesh.

1.2 OBJECTIVE OF THE STUDY

The specific objectives of this project work are as follows:

i) To determine the status of railway tracks (for example- gauge, different speed sections and causes of speed reduction, ballast and sleeper conditions, specification of major components, etc.) in Bangladesh.

ii) To determine the status of rolling stocks (for example- types, age, horsepower, energy used, efficiency of use, etc.) in Bangladesh.

iii) To recommend some improvement options.

1.3 SCOPE OF THE RESEARCH WORKS

This thesis aims at to identify the present status of Railway tracks and rolling stocks in Bangladesh. For any kind of development of rail tracks, vast information about the rail tracks should be known. The few journals and paper have been published upon the rail sector of Bangladesh. This research works combines the data about the present status of the railway tracks and rolling stocks of Bangladesh Railway. This project paper may help those, who want to study on Bangladesh Railway. Decision maker about the development of the Rail Sector of Bangladesh can get some idea from this paper.

1.4 ORGANIZATION OF THE THESIS

The research works performed in this study are divided into different topics and presented within five chapters. A detail introduction to the general and statement of the problem is presented in the first chapter. This chapter also contains the objective and scope of the study.

Chapter 2 presents the status of railway tracks in Bangladesh. In this chapter the short history of Bangladesh Railway is presented. Presently vulnerable tracks and previously closed rail tracks, on going and up coming projects for the improvement of Rail in Bangladesh are narrated in this chapter. The different sections of rail along with the maximum allowable speed and gauge are shown in a tabular form as well as in a map of Bangladesh. Some photographs collected from the field observation are inserted in this chapter. The feature of the Trans-Asian Railway and Bangladesh – India rail routes are added in this chapter.

Chapter 3 presents the literature review of the major components of rail tracks in Bangladesh. In this chapter the definition and detail information about the major railway track components such as Sleepers, Rails, Fittings and fastenings, Ballast are gathered. The capacity, components requirement per unit construction of rail track and comparative study of these components are combined. Also the specifications for the major components of railway tracks in Bangladesh are inserted. This covers the Performance requirement, Detail specification, Laboratory tests, Permissible variation and other requirements of these components as per Bangladesh Railway. Photographical view of different components of rail tracks at different location are attached to get clear idea.

Chapters 4 represents the status of the rolling stocks in Bangladesh. In this chapter different types of locomotives and there comparative study are presented. The locomotive performance and locomotive specifications used in Bangladesh Railway are narrated here. Photographical view of different locomotives used in Bangladesh Railway enriches this chapter. The literature review of Railway Carriages such as passenger cars and

coaches, freight cars, goods wagon etc used throughout the world are combined in the chapter also. Railway Carriage In Bangladesh Railway are narrated in the chapter also. The number of different coaches and wagons, their performances and pictorial presentation are combined here.

Chapter 5 represents the conclusion chapter. Conclusion of the study and some recommendations for the improvement of rail in Bangladesh, are mentioned in this chapter.

An appendix is attached at the end of this report containing tables of information about the value added, movement of goods and passengers by rail in Bangladesh, and rate of fare and freight of different modes of transport in Bangladesh.

CHAPTER-2

STATUS OF RAILWAY TRACKS IN BANGLADESH

2.1 SHORT HISTORY OF RAILWAY IN BANGLADESH

Bangladesh Railway began in 1862. In the same year it opened 53.11 kilometers broad gauge line for traffic on 15 November between Darsana and Jagiti. The next 14.98 kilometers meter gauge line was opened for traffic on 4th January 1885. Then gradually, these rail lines were extended and new sections constructed to cover more areas. Railway Companies formed in England took up the construction and operation of these sections in middle and late 19th century. Their primary objective was to operate these sections purely commercial considerations. But later on when various sections were liked up, the British Government of India found them very important for their strategic, political and economic points of views and therefore, the Government also came in the picture with statutory control and regulations for operation and management of the Railway. In 1891, the construction of then Assam-Bengal Railway was taken up with British Government assistance but that was later on taken over by the Assam-Bengal Railway Company. On 1 July 1895, two sections of meter gauge lines were opened between Chittagong and Comilla, a length of 149.89 kilometers and between Laksam and Cahndpur, a length of 50.89 kilometers. Railway Companies formed in England took up the construction and operation of these sections in middle and late 19th century. (Bangladesh Railway,2007).

Bangladesh Railway was mostly inherited from the British-established Assam Bengal railway system on 1st January 1942. The Assam –Bengal Railway was amalgamated with the Eastern Bengal Railway under the name “Bengal and Assam Railway .At time of the partition of India in 1947, Bengal-Assam Railway was split up and the portion of the system, about 2,603.92 kilometers long which fell within the boundary of erstwhile East Pakistan was named as Eastern Bengal Railway, the control remaining with the central Government of Pakistan Later with the effect from 1st February 1961, Eastern Bengal

Railway was renamed as Pakistan Railway. Then in the year 1962, the control of Pakistan Eastern Railway was transferred from the Central Government to the Government of then East Pakistan and placed under the management of a Railway Board with the effect from the financial year 1962-63 by the presidential Order of 9th June 1962. (Bangladesh Railway,2007).

Bangladesh Railway's headquarters are located in the southern port city of Chittagong, which had historically been the south-eastern terminus of the Assam-Bengal Railway. After independence from Pakistan in 1971, only a small length of additional new tracks were laid. Funding is being sought to upgrade the network and transform Bangladesh Railway into a profitable business.

2.2 RAIL ROUTES AND GAUGES

At the time of partition in 1947 rail route was 2603.92 km long. As of 2007 Bangladesh Railway has a total of 2,835 route kilometers, i.e. only 231 km increase in 60 years. Out of 2835 km, 659 km are broad gauge (1,676 mm) tracks (in the western zone). [Gauge is measured as the clear minimum distance between the running faces of the two rails]. While 1,801 km are metre gauge (1000 mm) tracks (the east zone has 1266 km and the West Zone has 535 Km). (Bangladesh Railway, 2007). The gauge problem is being tackled by introducing dual gauge where in a BG track- a third rail is inserted 1000 mm from a rail . The remaining 375 km are dual gauge track (mostly in the central and western regions of the country). Figure 2.1 shows the three different gauge rail tracks in Bangladesh. The table 2.1 shows the length of different types of rail track gauges in Bangladesh.

Table2.1 Types of Rail Track Gauges in Bangladesh

Serial No.	Gauge	Total Routes Length	Region in Bangladesh
1	Broad Gauge	659 km	In the Western Zone
2	Metre Gauge	1,801 km	1266 km in the East Zone
			535 Km in the West Zone
3	Dual Gauge	375 km	In the central and western regions

Most of the routes of Railway in Bangladesh has single line, only in some routes there are double line. Bangladesh has 234.96 km double line tracks. Out of which 82.33 km rail tracks are broad gauge and 103.07 km rail tracks are meter gauge and 49.56 km are dual gauge rail tracks. The total length of running track in Bangladesh including track on double line, in the yards and sidings is 3,974 kilometers. In the table-2.2, the total rail tracks of Bangladesh Railway are divided into 33 sections and sub-sections. The table shows the length of each section, gauge of the section and information about single or double line. In figure 2.2, A map of Bangladesh represents the single and double line rail routes.

Bridges

At the end of 2006-2007 there are a total of 3,452 railway bridges in Bangladesh, of which 524 are major bridges and the 2,928 are minor bridges.

Connectivity Throughout the Country

Bangladesh Railway is not connected with all the civil districts of the country. At the end of 2006-2007 only 44 out of 64 civil districts of the country could be connected by railway. The direct communication between Dhaka and Rajshahi over Bangabondhu Multipurpose Bridge is an achievement of Bangladesh Railway, which connects previously isolated east and west railway. In figure 2.3, A map of Bangladesh shows the districts connected with the rail routes.

Carrying of Goods

The major parts of the profit of rail comes from the carrying of goods. But due to the lack of proper planning and investment, the movement of goods by rail is time-consuming and a difficult process.

Closed Rail Routes

In the year 1991, Government advised by the Downer Group, closed 300 kilometer rail routes as stating them economically loss projects. During that time, Feni- Bilonia, Saestaganj-Salla, Hobiganj-Saestaganj routes of the Eastern part, and Lalmonirhat-Mogolhat, Rupsha-Bagerhat, Kalukhali-Vatiapara, Bheramara-Royta, Pachuria-Pukuria, routes of the Western part were closed.

Dangerous Rail Routes

Even, at present many of the existing lines do not have sufficient sleepers, ballasts etc. The condition of rail routes over 1500 kilometer is very poor, due to lack of renewal and timely maintenance. 600 kilometer rail tracks of ten different routes are running while they are not suitable for the movement of rolling stocks. Among these ten routes, 18 kilometer long Dhaka-Naraynganj line, 52 kilometer long Laksam-Chadpur line, 47 kilometer long Sylhet-Chatakbazar line, 99 kilometer long Chanchannagar-Panchagarh line, 25 kilometer long Gouripur-Shampur line and 127 kilometer long Bhoirob-Bhahadurabad & Jamalpur-Sorisabary line need immediate care. They are running out of sufficient sleepers and ballast. Also in some place the soil below the rail track subsides. These results derailment. Also more than six hundreds railway bridges have expired their life time, need immediate replacement. In figure 2.2, A map of Bangladesh represents the strong and poor rail routes.

2.3 ALLOWABLE MAXIMUM SPEED

Different sections of railway track in different location in the country consist of different materials, and equipments according to their significance and allowable fund. Allowable maximum speed of these rail routes vary from 15 to 95 kilometers per hour (Time Table No.-45, 2007). The major causes responsible for the speed reduction of the rail routes are:

Less sleeper density,
Lack of ballast,
Spoiled sleepers,
Elongated hole of sleepers and feting,
Lack and of fittings & fastening,
Spoiled sleeper,
Poor soil condition,
Having no soil at both ends of sleepers,
Presence of black cotton soil,
Weak bridge,
A large numbers of points and incorrect alignment,
Re-alignment sleeper renewal,
Sight distance at stiff slope of mountain is limited,
Narrow bridge,
Sight at level crossings are not clear, e.t.c.

In the table-2.2, the total rail tracks of Bangladesh Railway are divided into 33 sections and sub-sections. The table shows the allowable maximum speed of each section and The major causes responsible for the speed reduction of that section. In figure 2.3, A map of Bangladesh represents the 33 sections and sub-sections of the rail routes of Bangladesh, and the color of that rail section indicates the maximum allowable speed of that section.

2.4 ALLOCATION AND DEVELOPMENT

Railway seemed to be insignificant from the very beginning of Bangladesh, as the allocation for Bangladesh Railway for the period 1973-1978 was 1261.30 million taka while for Transport sector it was 5276.10 million taka; for the period 1985-1990 for BR was 8360.00 million taka while for Transport sector was 30023.00 million taka; for the period 1997-2002 for BR was 24000.00 million taka while for Transport sector was 118000.00 million taka, (Bangladesh Railway,2007). i.e. allocation for BR is only below 20% of the allocation of Transport sector. Realizing the significance of rail Government now-a-days have increased the allocation for railway, as the allocation for BR in 2004-2006 (three years) was 75,573.10 million taka, and the allocation for BR in 2007-2010 (Mid Term Budget) is 29,685.50 million taka. (Bangladesh Railway,2007).

Initiatives Taken for The Improvement of Rail

For the improvement of rail the Present Government has taken various initiatives. The new rail route construction from Laksham to Chinki Astana, from Dhaka to Barisal upon the proposed Padma Bridge via Maoa and Bhanga of Faridpur, from Kasiani of Gopalganj district to Tungipara, from Pukuria to Bhanga, and from Khulna to Mongla, from Tarakandi to Bangobondhu bridge; and rehabilitation of the rail routes from Panchuria to Faridpur, from Faridpur to Pukuria, from Kalukhali to Vatiapara, and from Rajshahi to Amnura- Rahonpur projects are going on and will be completed within 2012. (Bangladesh Railway.htm)

Upcoming Approved Projects

The present government has taken 9 projects at a cost of about three thousand crore taka for the improvement of rail in Bangladesh. The modernization of Sayodopur Railway Workshop, Convert of meter gauge section of Parbatipur-Kanchan-Panchagar and Kanchan-Birol into dual gauge, and convert of Birol-Birol border section into broad gauge, rehabilitation of Maymensingh-Jamalpur-Dewanganj bazar section, Completion of

rest of the works of Export infrastructure development project and rehabilitation of the railway mainline project, and rehabilitation project of Sayodpur-Chilahati section are among these projects. These projects have already been approved by the Executive Committee of National Economic Council (ECNEC). Converting the metre gauge line from Dhaka to Joydevpur into a dual gauge, planning of double lines with signal from Tongi to Bhoirobbazar are the significant achievement of the present government. For the expansion of railway, construction plan has taken from Dohazari to Cox-bazar via Ramu, and from Ramu to Gundum has taken. The rail sector needs greater attention to improve.

Recent Railway Projects

Recently Five railway projects will be worked out for the improvement of transportation infrastructure within by the help of Indian 100 crore dollar debt help. Among the 14 transportation infrastructure development and river digging projects, the emphasis will be given for the procurement of rail coaches and locomotives and construction of railway bridges. These projects are going to be worked out within November, 2010. The estimated cost of these five projects are 258.36 million dollar, (1779 crore taka).These five projects are:

a) Procurement of ten new locomotives.
b) Collection of 125 coaches.
c) For the transportation of fuel, collection of 180 BG tank wagons and bogy break vans.
d) For the movement of container, collection of 50 MG flat wagon bogy break vans.
e) Construction of two railway bridges at Brahmonbaria and Ashuganj.

Besides these five projects, Bangladesh Railway proposed to set up railway links from Mongla Sea Port to the whole country (at a cost of 1725 crore taka) .

2.5 SOME FIELD OBSERVATIONS OF THE RAILWAY TRACK CONDITION

From the field observations it is observed that different rail tracks at different places of the country has different gauge. In some places there are double lines, but most of the rail tracks of the country has single line. Major components of the railway tracks, i.e. sleeper, feting and fastenings differ from place to place. According to the major components and their conditions, track maintenance and renewal, rail track at different places have different conditions. The photographs taken from some field observations can give some clear idea about the present status of the railway tracks in Bangladesh.

Figure 2.4 represents the dual gauge rail tracks at Ishwardi Bypass-Jamtail Section. This rail track has prestressed concrete sleepers, sufficient ballast, long welded joint, straight geometric view, Allowable highest speed here is 95 Km/hr. Figure 2.5 represents the dual gauge rail tracks at Jamtail-Joydevpur Section. This rail track has prestressed concrete sleepers, sufficient ballast, long welded joint. Figure 2.6 represents the broad gauge rail track at Rajshahi-Abdulpur Section. This rail track has steel sleepers, sufficient ballast, long welded joint, renewal of sleepers. Figure 2.7 represents the broad gauge rail track at Abdulpur-Rajshahi Section. This rail track has steel sleepers, sufficient ballast, joint with fishplates and wooden sleeper, Allowable highest speed 80 Km/hr. Figure 2.8 represents the broad gauge rail track at Poradaha-Pachuria Section. This rail track has wooden sleepers, joints with fish plate, spikes. Figure 2.9 represents the meter gauge rail joint. This rail track has steel Sleepers, Pandrol elastic clip, Fish plates, Dog spikes and Wooden Sleepers at joints. Figure 2.10 represents the meter gauge rail track at Tongi-Mymensingh Section. This rail track has steel sleepers, sufficient ballast, inadequate feetings & fastenings, joint with fishplates and wooden sleeper, timely maintenance required, Allowable highest speed 65 Km/hr. Figure 2.11 represents a dual gauge rail track at curve. The curve section has prestressed concrete sleepers, sufficient ballasts, long welded joint. Figure 2.12 represents a broad gauge rail track at curve having concrete sleeper. Figure2.13 to figure 2.14 represent the rail track over a culvert or bridge. Check rail, and wooden sleeper are used here. Figure2.15 to figure 2.16 represent turnout or crossing. Figure2.17 represents five parallel dual gauge rail tracks at abdulpur junction station. figure2.18 represents a dual gauge rail track at danger where ballasts are gathered dangerously for pedestrians and small vehicle movements. Figure2.19 to figure2.20 represent the Rail Tracks under construction. Figure2.21 to

figure2.22 represent the wooden spoiled sleepers of the rail tracks need to be changed. Figure2.23 represent the renewal of sleeper in broad gauge rail track.

Figure2.4 A Dual Gauge Rail Track at Ishwardi Bypass-Jamtail Section.

Figure2.5 A Dual Gauge Rail Track at Jamtail-Joydevpur Section.

Figure2.6 A Broad Gauge Rail Track at Rajshahi-Abdulpur Section.

Figure2.7 A BG Rail Track at Abdulpur-Rajshahi Section.

Figure2.8 A BG Rail Track at Poradaha-Pachuria Section.

Figure2.9 A MG Rail joint.

Figure2.10 A MG Rail Track at Tongi-Mymensingh Section.

Figure2.11 A Dual Gauge Rail Track at curve.

Figure2.12 BG Rail Tracks at curve at Poradaha Station.

Figure2.13 A Dual Gauge Rail Track over a culvert.

Figure2.14 A BG Rail Track at Harding Bridge over the river Padma.

Figure2.15 Dual Gauge Turnout at Komlapur Station, Dhaka

Figure2.16 BG Rail Crossing at Poradaha Station.

Figure2.17 Five Dual Gauge Rail Tracks at Abdulpur Junction Station.

Figure2.18 Ballasts are gathered dangerously for pedestrians and small vehicle movements.

Figure2.19 A Dual Gauge Rail Track under construction.

Figure2.20 A Meter Gauge Rail Track under construction.

Figure2.21 Wooden sleepers in this Dual Gauge tracks need to be changed.

Figure2.22 A BG Rail Track at Poradaha-Pachuria Section.

Figure2.23 A BG Rail Track with welded joints and renewal of sleeper.

2.6 TRANS-ASIAN RAILWAY

The Trans-Asian Railway (TAR) is a project to create an integrated freight railway network across Europe and Asia. It aims to offer efficient rail transport services for goods and passengers within the ESCAP region and between Asia and Europe. The TAR is a project of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (Bangladesh Railway, 2007).

The project was initiated in the 1960s, with the objective of providing a continuous 8750 mile (14,000km) rail link between Singapore and Istanbul, Turkey, with possible further connections to Europe and Africa. At the time shipping and air travel were not as well developed, and the project promised to significantly reduce shipping times and costs between Europe and Asia. Progress in developing the TAR was hindered by political and economic obstacles throughout the 1960s, 1970s and early 1980s. By the 1990s, the end

of the cold war and normalisation of relations between some countries improved the prospects for creating a rail network across the Asian continent.

Much of the railway network already exists, although some significant gaps remain. A big challenge is the differences in rail gauge across Eurasia. Four different major rail gauges (which measures the distance between rails) exist across the continent: most of Europe, as well as Turkey, Iran, China, and the Koreas use the 1435 mm gauge, known as Standard gauge; Finland, Russia, and the former Soviet republics use a 1520 mm gauge; most of the railways in India, Pakistan, Bangladesh and Sri Lanka use a 1676 mm gauge, and most of Southeast Asia has metre-gauge. For the most part the TAR would not change national gauges; mechanized facilities would be built to move shipping containers from train to train at the breaks of gauge.

A big obstacle is also the need of sea transport to Japan and South Korea. A container ship has room for many more containers than a train. Therefore ships must go less regular than trains, creating a big delay. There are hopes to create an overland connection through North Korea, however there is still a break-of-gauge.

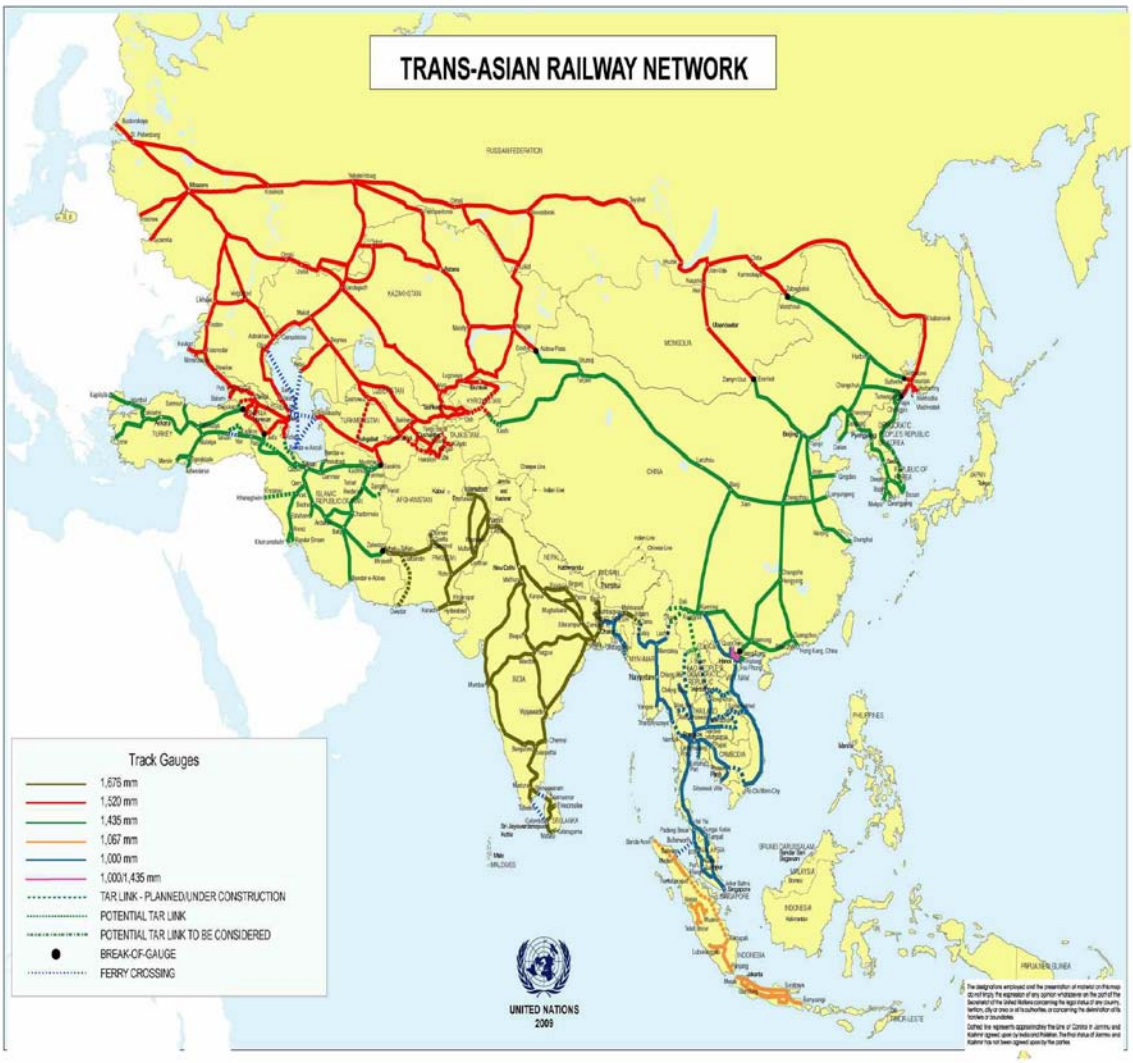

Figure2.24 The Trans-Asian Railway (TAR) Network across Europe and Asia.

2.6.1 Objective of TAR

The objective of TAR is to spur growth, yield economic benefit and ensure social development of a wider population. With the Inter-governmental Agreement on the Asian Highway Network already in place, the two accords are expected to help in realising an international integrated inter-state modal transport and logistics system for the region.

The link offers immense potential to shorten the distances and reduce transit time between countries and regions, being a catalyst for the notion of international transport as a tool for trade expansion, economic growth and cultural exchanges.

The TAR was seen as a way to accommodate the huge increases in international trade between Eurasian nations and facilitate the increased movements of goods between countries. It was also seen as a way to improve the economies and accessibility of landlocked countries like Laos, Afghanistan, Mongolia, and the Central Asian republics.

2.6.2 Bangladesh and TAR

In May 2007, the Council of Advisors of the Bangladesh caretaker government reportedly approved the proposal to join the Trans-Asian Railway Network (TAR), aiming to expand its rail communications with other Asian countries, and subsequently with Europe in the near future and in November of that year, Bangladesh has signed the TAR. However, it has not yet ratified the treaty.

Prime Minister Sheikh Hasina stated in April that the two sea ports Chittagong and Mongla would be modernised and a deep sea port would be setup for potential use of the neighbouring countries - Nepal, Bhutan and India and even China could use it. The plan of the Prime Minister demonstrates a vision of Bangladesh playing a key role in regional economic development.

On 21 May, 2009, it has been reported that the Bangladesh government has decided to ratify the Asian Highway Network (AHN). On june 15, the cabinet decided to sign the AHN agreement and accept the proposed routes. Bangladesh would become a member of the UNESCAP once it has signed the agreement. The Prime Minister also said after being a party to AHN, Bangladesh could raise and debate about possible route changes.

It is appropriate that Bangladesh may ratify the TAR and may become its ninth member. This will be consistent with the Prime Minister's plan for building modern and fast-track communication networks across the country and also her desire that Bangladesh would act as a “bridge between East and West”.

The proposed three routes to be passed through Bangladesh are:
Route 1 - Gede (West Bengal, India) Darshana (Chuadanga, Bangladesh)-Ishwardy-Bangabondhu Bridge-Joydevepur-Akhaura-Chittagong-Dohazari-Gundhum-Myanmar,

Route2 - Singabad (West Bengal)-Rajshahi (Bangladesh)-Iswardy- Bangabondhu Bridge-Jodevpur-Akhaura-Chittagong-Dohazari-Gundum-Myanmar and

Route 3 - Radikkapur (West Bengal)-Dinajpur-Ishwardy- Bangabondhu Bridge-Joydevpur-Akhaura-Chittagong-Dohazari-Gundhum-Myanmar.

2.7 BANGLADESH – INDIA RAIL ROUTES

In a rapidly modernising and globalising world, connectivity is the most imperative requirement and key to speedy, efficient and sustainable regional and global trade. To strengthen and promote trade and economic relations for mutual benefit between Bangladesh and India direct rail network is necessary.

The 500 km (310 mile) rail routes from Calcutta to Dhaka have the same broad gauge. Rail, sleepers, feting and fastenings and other qualities of the rail tracks of these two countries are similar. Also each country has such rolling stocks, which can run in other country without any kind of difficulty. From the rail infrastructure and technological point of view, there is no big difficulties in order to run direct rolling stocks to transport goods and movement of passengers directly from Calcutta to Dhaka.

Initiatives taken by the governments of India and Bangladesh, freight services started in 1972 but the service had to be discontinued. In 2000, goods services were restored with the commissioning of Petrapol-Benapol rail link.

Figure2.25 Dhaka-Calcutta Rail Route (The red line shows the rail route).

The Kolkata-Dhaka Moitree Express was on Monday flagged off on Bengali New Year's Day (14 Apr 2008) resuming passenger train services between the two neighboring countries after 43 years.

Recently, the Bangladesh Government would soon undertake a survey to set up a rail track connecting Tripura capital Agartala, the second rail link between the two neighbors after the Dhaka- Calcutta rail connection.

During Bangladeshi Prime Minister Sheikh Hasina's New Delhi visit in January, it was agreed that the construction of the proposed Akhaura (Bangladesh railway station)-Agartala railway link would be financed by India. A joint team of the railway authorities of the two countries will identify the alignment for connectivity.

CHAPTER-3

MAJOR COMPONENTS OF RAILWAY TRACKS AND THEIR SPECIFICATIONS IN BANGLADESH

3.1 MAJOR COMPONENTS OF A RAILWAY TRACK

Railway track is also known as permanent way. The name of permanent way is given to the track to distinguish the final track constructed for the movements of trains from the temporary track laid for transporting the construction materials such as sleepers, rails, ballast etc. The railway track costs about 40% of the total investment in the railways. (Gupta B.L., Gupta B.L. 2003).

The track is the rail road on which trains run. Basically a track consists of two parallel rails having a specified distance between them, known as 'gauge' and fastened to the sleepers. These sleepers are embedded in a layer of ballast of specified thickness, spread over the formation. The rails are joined to each other by fish plates and bolts and the rails are fastened to the sleepers with the help of various fittings such as spikes and keys. The sleepers are spaced at a specified distance and are held in position by embedding in ballast. Figure 3.1 shows the major components of a railway track.

Thus a track or permanent way is consisted of the following components.

(i) Rails

(ii) Sleepers

(iii) Fittings and fastenings

(iv) Ballast

(v) Formation

Each component of the track has a basic function to perform.

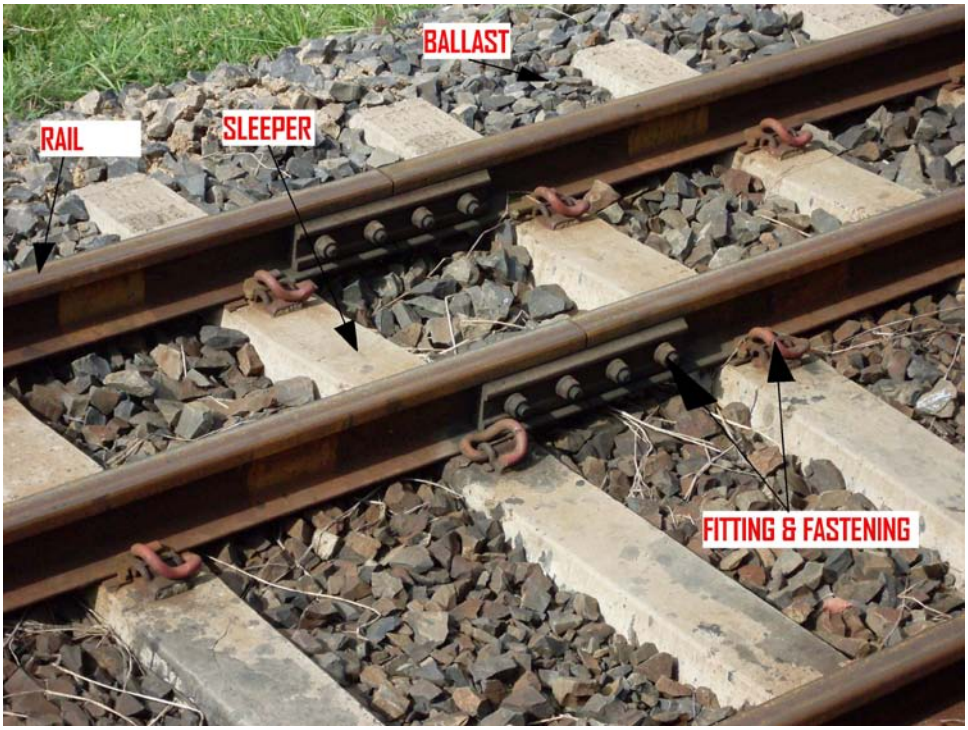

Figure3.1 Major components of a Railway track.

Functions of Track Components

(i) Rails. Rails are steel girders over which the train moves and transmit the wheel loads of trains to the sleepers below.

(ii) Sleepers. The sleepers hold the rails in proper position and provide a correct gauge with the help of fittings and fastenings and transfer the train load to the ballast below.

(iii) Ballast. Ballast holds the sleepers in position and provides a uniform level surface. They also provide drainage to the track and transfer the train load to a larger area of formation below.

(iv) Fittings and fastenings. They provide a grip between rails and sleepers. The rails are fastened with the sleepers by fittings and fastenings.

(v) Formation. Formation is the base of the track. It gives a level surface where the ballast rests. It takes the total load of track and the trains move on it.

3.2 RAILS

3.2.1 Introduction

Rails are the members of the track laid in two parallel lines to provide an unchanging, continuous, and level surface for the movement of trains. To be able to withstand stresses, they are made of high carbon steel.

3.2.2 Functions of Rails

Rails are provided to perform the following functions:
(i) Rails provide a continuous and level surface for the movement of trains.
(ii) Rails provide a pathway which is smooth and has very little friction, ($1/5^{th}$ of tyre and melted road) (Chandra, S. and Agarwal M.M. 2007).
(iii) Rails serve as lateral guide for the wheels.
(iv) Rails bear the stresses developed due to vertical loads as well as breaking and thermal
forces.
(v) Rails carry out the function of transmitting the load to a large area of the formation through sleepers and the ballast.

3.2.3 Standard Rail Section

The rail is designated by its weight per unit length. In FPS units, it is the weight in lbs per yard and in metric units it is in kg per metre. The weight of a rail and its section is decided after considerations such as:
(i) Heaviest axle load
(ii) Maximum permissible speed
(iii) Depth of ballast cushion
(iv) Type and spacing of sleepers
(v) Other miscellaneous factors

The standard rail sections in use on Indian railways are 60 Kg, 52 Kg, 90R, 75R, 60R and 50R. Here R stands for revised British specifications. A rail of 60 kg/m or 52 kg/m use for broad gauge is 13 metre long. And a rail of 90 lb/yd or 75 lb/yd or 60 lb/yd use for meter gauge is 12 metre long.

3.3 SLEEPERS

3.3.1 Introduction

Sleepers are transverse support for a railway track to give stiffness to it. Transverse sleepers were introduced on the railway track for the first time in 1835 and now they have been accepted universally.

3.3.2 Functions of Sleepers

Following are the functions of the sleepers:

(i). To hold the rails to correct gauge and alignment.

(ii). To give a firm and even support to the rails.

(iii). To transfer and distribute the axle load through rails over a sufficiently large area of ballast.

(iv). To act as a elastic medium between the rails and ballast to absorb vibrations and blows of the moving wheels.

(v). To maintain the alignment of the track.

(vi). To provide insulation for electrified track.

(vii). To provide proper grade, longitudinal and lateral stability to the track.

(viii). To provide means for easy replacement of rail fastening with out disturbing the traffic during its service life.

3.3.3 Requirements of an Ideal Sleeper

An ideal sleeper should meet the following requirements.

(i). The initial as well as maintenance cost should be minimum.

(ii). The weight of the sleeper should be-moderate, so that it can be handled easily.

(iiii). It should be easy to handle, so that the gauge may be adjusted easily and maintained correctly.

(iv) It should be shock and vibrations absorbent, developed due to passage of fast moving trains.

(v). The design and material of sleeper should be such that it may be possible to have track circuiting.

(vi). The material of the sleeper should be such that it does not get damaged or break while packing below it.

(vii). The sleeper should have sufficient bearing area.

(viii). The sleeper should he so designed that it docs not get disturbed 'from its position easily by the passage of trains.

(ix). It should have anti then and anti sabotage qualities.

(x). The design of sleeper and fastenings should be such that it is possible to remove and fix the rails easily.

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3.3.4 Sleeper Density

The number of sleepers used per rail length is known as sleeper density. Generally one sleeper is used for everyone metre length of the rail. It is specified as N + x or M + x where N or M is the length of the rail and x is an mathematical number which varies according to the following factors.

(i) Axle load and speed of the train.

(ii) Type and section of rail.

(iii) Type and strength of sleeper.

(iv) Depth of ballast cushion.

(v) Nature of formation.

On Indian railway. the sleeper density on B.G. track is adopted as (N + 7) or (N + 4) and on M.G. tracks as (N + 3). The standard length of B .G. and M.G. rails is taken as 13 m and 12 m respectively. On American Railways the sleeper density is adopted as (N + 11) or (N + 13). The number of sleepers depending upon the density of sleeper is shown in table 3. I. The specification of number of sleeper per km rail length is relevant in case of welded rails and the length of rail does not have much bearing.

Figure3.2 Sleeper spacing of a dual gauge track.

Table 3.1: Sleeper Density

Type of-Sleepers	Sleeper	No. of sleepers		Remark
	density	Per rail length	Per kill length.	
For B.G.				For B.G. track rail length is 13m and sleeper density N + 7
Wooden	(N + 7)	13 + 7 = 20	1538	
Metal	(N + 7)	I 3 + 7 = 20	1538	For M.G. rails length is 12m and sleeper density as (N + 3) i.e. 12 + 3 = 15 sleeper per rail I length.
Wooden	(N + 4)	13 +.1 = 17	1308	
Metal	(N + 4)	13 + 4 = 17	1308	
For M.G.	(N + 3)	12+3=15	1250	

3.3.5 Classification of Sleepers

Mostly following four types of sleepers are used. In other words sleepers can be divided into the following four categories.

(i). Wooden sleepers

(ii). Steel sleepers

(iii). Cast iron sleepers

(iv). Concrete sleepers

3.3.6 Wooden Sleepers

Wooden sleeper is the ideal type of sleeper, hence they are universally used. The utility of timber sleeper has not decreased due to passage of time. However due to the low service life about 15 years and high maintenance cost the use of wooden sleepers on main lines has been completed stopped by the year 1999.

3.3.6.1 Size of the sleepers

The size of sleeper should be such that consistent with the economy, it can give desired strength and stiffness to the sleeper as a beam and also provide sufficient bearing area. The thickness or depth of sleeper governs the stiffness of the sleepers as a beam and the length and breadth of the sleeper control the necessary bearing area.

3.3.6.2 Advantages and disadvantages

Advantages of wooden sleepers

Wooden sleepers have the following advantages:

(i). They are cheap and easy to manufacture.

(ii). They are ideal for track circuited sections

(iii). They are more useful for heavy loads and high speeds.

(iv). They are easy to handle with out damage.

(v). They absorb shocks and have good capacity to dampen the vibrations. Thus they retain packing well.

(vi). They are more useful for yielding formations.

(vii). Alignment can be corrected easily.

(viii). They are more suitable for modem methods of maintenance.

(ix). They can be used with or with out stone ballast.

(x). They can be used on bridges and ash pits also.

(xi). They can be used for gauntleted track also.

Disadvantages of wooden sleepers

(i). They are easily liable to attack by virmins and weather. Hence their life is shorter than any other type of sleepers.

(ii). It is difficult to maintain gauge with their use.

(iii). They are susceptible to fire.

(iv). By beater packing they are liable to mechanical wear.

(v). Scrap value is negligible.

(vi). Their maintenance cost is higher than other types of sleepers:

(vii). Their serviceable life is about 12 to 15 years.

3.3.6.3 Classification of wooden sleepers

Wooden sleepers may be classified into two categories depending upon the properties of the timber.

(i). Durable type

(ii). Non durable type

(i). Durable type. The sleepers of this class do not require any treatment. They can be laid in the track with out any treatment. These sleepers are produced from trees such as sal, teak, rose, anjani, kongu, manila, padauk, lakooch, wanta etc.

(ii). Non Durable type. These sleepers require treatment before being put in the track. These sleepers are produced from the timbers as Deodar, Chir, Kail, Fir, lamun, and Gunjan etc. If this type of sleepers are treated before use, they last longer and their life is comparable to that of durable type. However sleepers made of Fir do not give good service. Hence their use is restricted to only those routes where traffic density is not more than 10 GMT.

The normal service life of wooden sleepers on Indian Railways has been found as 15 years due to weather conditions mainly humidity and rains, where as on other advanced railways it has been found much longer.

Treated and untreated sleepers

Some times wooden sleepers are also classified as hard wood and soft wood sleepers depending upon the wood of which they arc made. Broadly speaking, timber obtained from trees having broad leaves is known as hard timber and timber obtained from trees having long leaves is known as soft timber.

The committee set up by Railway Board to suggest measures to increase the service life of wooden sleepers has recommended that for simplification and rationalizations wooden sleepers be classified only in the following two categories.

(i). U or "untreated sleepers" obtained from natural durable species of trees.

(ii). T or "Treated sleepers" obtained from undurable species of trees called as soft trees.

3.3.6.4 Defects in wooden sleepers

In wooden sleepers mainly following defects have been found

(i). Split ends

(ii). Centre heart

(iii). Presence of knots, twists. warps. shakes etc.

(iv). Twisted grains etc.

3.3.6.5 Treatment of wooden sleepers

To enhance the service life of wooden sleepers, soft timber sleepers are treated by forcing the preservative into the sleeper under pressure. But before giving treatment to sleepers it is essential that their moisture content be brought to about 25% so that the treatment may he effective. Thus before treatment sleepers are seasoned. The seasoning of sleepers can be done by any of the following methods:

(i). Artificial seasoning in kilns

(ii). Boiling under vacuum known as Boulton process

(iii). Air seasoning

3.3.6.6 Important points for good performance of wooden sleepers

In order to obtain the best performance of track using wooden sleepers, following points should be observed.

(i). On each side of the rail joints, good quality sleepers should be used.

(ii). The sleepers should be laid centrally i.e. the centre of the sleeper should lie on the centre of the track..

(iii). To prolong the life of the wooden sleepers, their good side should always be laid down wards and poor side upwards.

(iv). The sleeper should be laid at right angle to rails, except in turn outs, where an oblique layout is permitted.

(v). Adzing should he done true to shape and location.

(vi). For fixing spikes, boring should be done right through the full thickness of the sleepers to avoid splitting of the bottom of the sleepers.

(vii). For boring holes in sleepers correct size of the augers should he used.

(viii). In case of respiking is done in the sleepers. the spare holes should be plucked with wooden spikes to check entry of rain water in the sleepers.

(ix). To avoid centre bound defect, sleepers should not be packed at central 90 cm distance. The centre bound defect is the source of rocking of sleepers due to loose ballast below the rail scat.

(x). While stacking the sleepers, care should he taken that there should be free circulation of air between them and there is proper ventilation.

(xi). At points and crossing the total number of sleepers required is 70 for \ in 12° and 51 for 1 in 8.5^0 turnouts for B.G. tracks.

(xii). For deck bridges, the regulations laid down by Railway Board must be maintained for sleeper dimensions. At bridges no Adzing should he done and the use of bearing plates is compulsory.

3.3.6.7 Specification for wooden sleeper in Bangladesh

Quality of wooden sleeper

Treated sleeper should be supplied from durable species of timber as follows :

BOTANIC NAME	LOCAL NAME
i) DIPTEROCARPUS SCABER	Batiya Garjan
ii) DIPTROCARPUS TURBIATUS	Tellya Garjan

The Sleepers shall be sawn form healthy and sound logs. Hewn sleepers are not acceptable. The logs from which the sleepers are sawn shall have been cut form sound matured trees. The timber shall be free from spongy or brittle wood. Except as otherwise permitted in BR's specification the sleepers shall be straight and square edged with parallel degree, be free from center heart, serious cracks & splits, cup, twist, warp, damaged free, decay or not heart defects, hollows, knots, scars, harmful insect attack or hearts or the resultant damage there form ruptured ends excessive sapwood, shakes, excessive wane or any other harmful defects which will reduce appreciably (by more than 10 percent) the life, strength and durability of the sleepers. Knots are not allowed within 25mm of rail seat zone including the seat areas. In other area single knot of more than 38mm and sum of all knots more than 75mm are not allowed.

Strength requirement of wooden sleeper

The required strength properties and their permissible values of wooden sleeper are expressed in the table 3.2.

Table 3.2: Strength Requirement of Wooden Sleeper

SI. No	Properties	Required strength value (Air dry basis)
1	Specific Gravity	0.71 to 0.76
2	Modulus of rupture	15600 lbs/sq. in.
3	Modulus of elasticity	2150000 lbs/sq. in
4	Maximum crushing strength	787 lbs/sq. in
5	Compressive strees proportional limit	1290 lbs/sq. in
6	Hardness: Side (lbs) End (lbs)	1425 1433
7	Nail holding capacity Average:- Side (lbs) End (lbs)	 450 250
8	Shearing stress: Radial (lbs/sq.in.) Tangential (lbs/sq.in.)	1640 2010
9	Tensile stress perpendicular to grain: . Radial (lbs/sq.in) Tangential (lbs/sq.in)	 1010 1060
10	Cleavage Radial Tangential	470 lb/in. of width 650 bl/in of width
11	Moisture content	Not more than 12%

3.3.7 Steel Sleepers

The increasing shortage of good timber in the country and other economical factors are mainly responsible for the use of steel and concrete sleepers. About 27% of the track on Indian Railways is laid on steel sleepers. India uses the metal sleepers more than any country of the world. Steel trough sleeper essentially consists of a rolled steel plate about 12 mm thickness and pressed to a suitable through shape and rail seat canted to 1 in 20. To retain the ballast, the ends of the rolled sections are flattened in the shape of a spade. The weight of standard B.G. trough sleepers is 81 kg and that of M.G. sleepers is about 35 kg. Steel sleepers have the following main advantages over wooden sleepers.

3.3.7.1 Advantages and disadvantages

Advantages

(i). It is more durable. Its service life is about 50 years.

(ii). it is easy to maintain gauge and lesser maintenance problems.

(iii). It gives better lateral rigidity.

(iv). Lesser damage during handling and transport.

(v). Manufacturing process is easy i.e. easy to manufacture.

(vi). It is not susceptible to vermin attack.

(vii) It is not susceptible to fire hazards.

(viii). Its scrap value is very good.

Disadvantages

(i). It is liable to corrosion.

(ii). It is unsuitable for track circuiting areas.

(iii). During service it develops cracks at rail scats.

(iv). Due to slopes at two ends it is liable to become centre bound.

(v). It can be used only for rails, for which it is manufactured.

(vi). It requires more fittings in number.

(vii). More ballast is required than other types of sleepers.

3.3.7.2 Design criteria

The steel sleepers should fulfill the following conditions:

(i). They should be able to maintain perfect gauge.

(ii). The rails should be fixed in sleeper easily and without moving sleeper longitudinally.

(iii). The rail should have sufficient bearing area on the sleepers.

(iv). They should he sufficiently heavy for stability and should not be pushed out easily from their position.

(v). Packing and tamping should not damage their edges.

Design features of steel sleeper

For each rail section two alternative types of sleepers have been designed as per details given below:

(i). In this type of sleeper the lugs or jaws are pressed out of the plate itself to accommodate the foot of rail and the key as shown in Figure. In this type of sleepers there are many maintenance problems as follows:

(a) The pressed up lugs give way due to movement of the keys.

(b) Due to vibrations and impact of the moving loads.

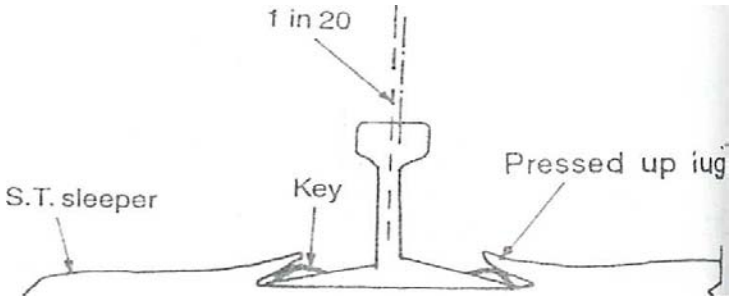

Figure 3.3 ST. Sleeper with pressedul lug

In order to over come the above detects. the second type of design of sleepers has been adopted. Whose features are given below.

(ii). Second type steel through sleeper.

In this type of sleeper, two holes are punched in the plate on either side of the plate to accommodate specially designed loose lugs or jaws. The rails are held in position with the help of two standard keys driven either in the pressed up lugs or in the loose jaws. The adjustment of the gauge to the extent of ±3mm is done by proper driving of the keys. In double line sections the keys are driven in the direction of traffic. It is an acceptable type of sleeper for use with long welded rails due to its lateral stability and its adaptability for use with elastic fastenings.

3.3.7.3 Classification of steel sleepers.

Steel sleepers are classified into the following two categories.

1st quality sleepers.

All steel sleepers conforming to Indian Railways classifications T-9 are classified as 1st quality sleepers.

Second quality sleepers.

Sleepers not accepted as 1st quality sleepers and free from the following defects are classified as second quality trough sleepers.

Defects

(i) Sleepers having deep groves or cut or heavy scale tilling.

(ii) Sleepers having twists.

(iii) Inward tilt at rail seat beyond the limits of 1 in 15 to 1 in 25.

(iv) Deep guide marks at heads and blisters etc.

3.3.7.4 Maintenance of steel sleepers

During maintenance of steel trough sleepers following problems have been encountered.

(i). Loosening of keys. The keys get loose due to the bending up of pressed up lugs or due to wear at rail seat.

(ii). Holes get elongated during the use.

(iii). Steel trough sleepers tend to become centre bound if due care in not taken in packing.

(iv). Sometimes due to over driving of keys, the alignment of steel sleepered track is disturbed.

3.3.7.5 Specification for steel sleeper in Bangladesh

Scope of work

New BG steel trough sleeper with adequately designed M.S Steel pad plate welded as per Drawing, for 90 lbs. 'A' rails or 90 lbs. "R" rails to suit Elastic Rail Clip as per drawing . BG steel trough sleeper shall be as per specification & Drawing.

Anti-Vandal or anti-pilferage arrangement on the pad plate to prevent coming out of the clip while assembly laid on the track is required. The manufacturer will ensure the anti-pilferage arrangement on the pad plate to suit clips sample of those will be supplied during manufacture of the sleepers and pad plates as per drawing. Preferably, the anti pilferage feature shall not be visible from the surface and it shall not be possible to remove the clip by hammer easily. If above pad plates do not suit the elastic rail clip as specified in Para-B, pad plates to such as to suit ERC

Performance requirement

The sleeper assembly should meet the following requirements.

(i). Gauge : 1676 mm with tolerance of ± 1.5mm.

(ii0. Axle load : 22.50 Tons.

(iii). Speed pf Train

a) Passenger train : 120 kmph

b) Goods train	:	75 kmph.
(iv). Rail Section	:	90 lbs. 'A' or 90 lbs. "R" rails or 90 lbs. "R" rails.
(v). Cant of rail Seat	:	1 in 20
(vi. Fastening	:	Anti-Vandal Elastic rail clip type e-1811AV as per Drawing .

3.3.7.6 Specification for steel trough sleepers in Bangladesh

Forward

The steel trough sleeper shall have suitable base plate with anti-vandal or anti-pilferage arrangement and to enable fixing of 90 'A' rails to the sleeper with e-clip arrangement as per Drawing.

Dimension

All sleepers will be manufactured as per specification IRS-T-9-70 or any superior specification. The sleeper shall conform to the dimensions shown in the Drawing, and requirement as mentioned.

Chemical composition

Chemical composition of steel sleeper itself and the pad plate should conform to Grade St. 42SB2 of IS : 2830 - 1964 or British Standard or equivalent or superior . The bars from which the sleepers are manufactured shall show the following requirement.

Copper	-	0.2% to 0.3% alloyed with steel
Carbon	-	0.25% max.
Silicon	-	0.5% max.
Sulphur	-	0.05% max.
Phosphorus	-	0.05% max.
Manganese	-	1.6% max.
UTS	-	420 - 580 Mpa.
Elongation	-	20% min

Manufacture of ordinary track sleeper

Track sleepers are to be made from flat or slightly dished steel plates or from a rolled through steel section. The steel be manufactured in accordance with one of the following processors: Thomas, Bessemer, siemens martin (basic), Siemens Martin (acid), electric or in a converter blown with oxygen, according to the choice of Engineer. Except with the prior approval of the Purchaser, sleeper made from plates 10mm in thickness and over shall be pressed while hot. The rail seats shall be pressed exactly to drawing dimension and unless otherwise shown or specified shall be perfectly flat. Sleepers shall be pressed to the shape shown on the drawing and the dies shall be of such form that an exact cant in wards of 1 in 20 is given to the rail seat, or the base plates shall be such that they provide an exact inward cant of 1 in 20. In no case shall a cant sleeper than 1 in 19 or flatter than 1 in 21 be permitted. All burrs on the rail seat and on the underside of the lug hole shall be carefully removed. The finished sleepers must present a clean surface, smooth and free from blow-holes flaws, cracks, folds, surface pitting or defects of any kind. Edges of the sleepers shall be without sharp comers.

Gauging of track sleepers

A sleeper shall be selected for inspection at frequent intervals during manufacture. All burrs having been removed and the approved gauges tried, short pieces of rail shall be fitted to the sleeper with the approved accessories in order to ascertain that the sleepers are satisfactory in every respect. All sleepers shall give correct gauge within a tolerance of ± 1.5 mm. The sleepers shall be gauged for thickness under the rail seat and on the two sides of the trough under the rail, to ensure that the section in the vicinity of the rail seat has not been reduced in pressing to shape. The rails required for gauging and testing the sleepers shall be obtained by the supplier at his own expense, and shall fit the approved rail templates. It is considered that the inspection of sleepers at night cannot be carried out in a satisfactory manner, for this reason all sleepers shall be inspected during day light only and sleepers made during a night shift shall not be accepted unless at least 2 separate inspection benches are provided so that the sleepers made at night may be kept entirely separate from those made during the day. All sleepers shall be perfectly cold

before they are inspected. The Supplier must take such steps as desired by Inspecting Officer(s) to ensure that rejected sleepers are not resubmitted for inspection.

Protection

After acceptance by the Inspecting Officer(s), the sleepers shall after satisfactory removal of scale, be dipped hot into a solution made of three parts by quantity of coal tar and one part of tar oil, or of such proportion of coal tar, tar residue and oil as will give a hard adherent and non-brittle coating. The coating shall not be brittle when cool neither tapped with the edge of a knife nor shall it be affected by water. Before the sleepers are dipped, they have the scale thoroughly cleaned off from them with wire brushes; wire brushes intended to be used inside of the sleeper shall be specially made to fit the internal shape of the sleeper so that the scale can be property removed. The brushing shall be done in a manner which shall be satisfactory to the Inspecting Officer(s).

Permissible variation

The standard weight of sleepers are shown on the drawings. If the standard weight is not shown or stated it shall be determined by the Inspecting Officer(s) when the samples have been approved. Sleepers weighing more or less than 2% of the standard weight shall be rejected. Over weight or underweight sleepers which are within the tolerance may be accepted provided their dimensions are in accordance within the standard drawings and provided the excess deficit of materials does not effect the gauge, tilt of rails or fit of rail and fastenings. Should payment be made by weight the calculated weight shall be paid for and no extra payment shall made for over weight than standard.

Variations shall be limited to :

(i) Weight : Not exceeding ± 2% standard weight

(ii) Width of sleeper top at rail seat :+ 0 mm

-12 mm

(iii) Width of sleeper at bottom : ± 3mm

(iv) Width across tall end : ± 6mm

(v) Depth of sleeper : ± 3mm

(vi) Length of sleeper : ± 25mm

(vii) Thickness at rail seat : + 0.5mm
- 0.0mm

(viii) Flatness of rail seats : No convexity on rail seat shall be permitted.

The weight of sleeper is to be taken after they have been dipped. A deep up to maximum of 1mm may be allowed. Three percent of sleepers from each days manufacture shall be weighted separately; and if in the opinion of the Inspecting Officer(s) the weight is unsatisfactory, he may order further sleepers to be weighted.

3.3.8 Cast Iron Sleepers

Cast iron sleepers have been extensively used in Indian Railways due to their long life and non susceptibility to corrosion.

3.3.8.1 Advantages and disadvantages

Advantages of cast iron sleepers

Following are the advantages of cast iron sleepers.

(i) They are easy to manufacture.

(ii) They are lesser liable to crack at rail seats.

(iii) Their useful life is higher of the order of 50 to 60 years.

(iv) They provide high lateral and longitudinal stability to the track.

(v) They are lesser liable to corrosion.

(vi) These sleepers form a good track for light traffic upto a speed of 110 kmph as they form a rigid track subjected to vibrations under moving loads with out any damping.

(vii) Their scrap value is high.

Disadvantages of cast iron sleepers

Following are the disadvantages of cast iron sleepers.

(i) Gauge maintenance is difficult as tie bars get bent up.

(ii) They provide lesser lateral stability.

(iii) They are not suitable for circuited tracks.

(iv) They need larger number of fittings.

(v) They are more susceptible to breakage and damage if handled roughly.

(vi) The rail seat, wear out quickly resulting in loosening keys.

(vii) The cantilever ends of rails are long which result in hogging of the rail ends and deterioration of ballast under the joint, resulting replacement of sleeper.

(viii) Heavy intensities of traffic and greater speeds more than 110 kmph will cause loosening of keys packing and development of high creep etc. necessiciating replacement of sleeper.

(ix) Correct gauge maintenance is difficult due to slight play between tie bars and their shockets and also due to bending of the bars.

3.3.8.2 Classification of cast iron sleepers

Cast iron sleepers can be divided into two categories as follows:

(i). Cast iron pot type sleeper

(ii). Cast iron plate type sleeper

Cast iron pot type sleeper

This type of sleepers consist of two hollow pots or bowls of circular or elliptical shape placed Inverted on the ballast section. The two pots are connected by a tie bar of section 5em x 1.25 cm with the help of gibs and cotters and slight adjustment of gauge ±3mm can he done by changing their positions.

The length of the tie bar is 2.62 m. weighing 13.6 kg. The rail is placed on the top of the pot in a rail seat with a cant of I in 20 and held in position with a key. Each pot has two holes for ballast packing and inspection. The effective bearing area of a pot sleeper under each rail support is 2320 sq. cm (0.232 m\ 111: weight of the pot type sleeper is 114 kg.

The pot type cast iron sleeper suffers from the following disadvantages due to which their use is obsolete now on Indian Railways.

(i) These sleepers can not be used on curves sharper than 4° on B.G.
(ii) Most of the fittings arc hidden and their inspection and maintenance is very difficult.

Cast iron plate sleepers (CST-9) sleepers.

It is called CST-9 (Central Standard Trial-9) sleeper, because it is the 9th of the series designed and produced by central standard office. This sleeper is a combination of pot, plate and box sleeper. It consists of two triangular inverted pots on either side of the rail seat, a central plate with a projected keel and a box on the top of the plate. The two cast iron plates are connected by a tie bar with the help of 4 cotters. The rails arc held to the sleeper by two way key provided at each rail scat on the gauge face side. The gauge can be adjusted upto ±5mm by changing the relative positions of the four cotters. This is the standard sleeper and is extensively used on the Indian Railways.

The rail seat of CST-9 sleeper is 11.5 cms or 115 mm wide along the length of the rail. This narrow bearing reduces the rocking of the sleeper under the wave motion of the rail. The sleeper is well designed to provide a firm support to the rail. It also provides a fairly good lateral and longitudinal stability to the rail. The sleeper provides bearing area approximately equal to the effective area of a standard B.G. wooden sleeper i.e. 4650 cm^2 for both the plates. The CST-9 plates arc available with reverse jaws known as (T-443 type). These plates serve as anti sabotage measure, if few of these plates are provided in each rail length. Generally 3 reverse jaw CST-9 sleepers are provided per rail as anti sabotage measure. The weight of CST-9 sleeper assembly along with fastening for B.G. is 102 kg and for M.G. 58 kg. The rail seat has a cant of 1 in 20.

Limitations of CST-9 sleeper

Though CST-9 sleeper is one of the most popular sleepers on Indian Railways, however it has certain limitations with the modern track

(i). The sleeper docs not have flat bottom, hence it is not suitable for mechanical maintenance with tie tampers.

(ii). The CST-9 sleepers have not been found suitable specially on long welded rails track on the breathing lengths due to the rigidity of fastenings.

(iii). The rail seat also wear out quickly resulting in loosening of the keys.

(iv). The sleeper has limited longitudinal and lateral strength to hold the long welded rail in the breathing length.

(v). Due to the less metal under the rail seat, the shocks and vibrations are directly transmitted to the ballast, resulting in poor retention of packing. This requires frequent inspection.

Though many improvements have been tried on the existing CST-9 sleepers, but no sleeper has been approved as yet due to one or the other short comings.

Cast Iron sleeper with bitumen macadam filling

Recently a new design of cast iron sleeper with bitumen macadam filling in the bowl has been developed by Indian Railways institute of Advanced Track Technology. The important features of the sleeper are as follows:

(i). The sleeper consists of iron shell of 10 mm thickness weighing about 50-60 kg with bitumen fill of about 40 kg in each bowl. The total weight of the sleeper is about 210 kg.

(ii). The sleeper is flat bottom and heavy.

The advantages of this new sleeper have been found as follows:

(i) The sleeper being heavy, provides better stability and maintainability of the track.

(ii) It can prove a standard sleeper for long welded rail track structure.

(iii) As it has flat bottom, it can be well maintained by Tie Tamping machines or M.S.P.

(iv) Though heavy, but it can be laid manually. It is an extra advantage. It is still under trial.

3.3.9 Concrete Sleepers

The evolution of concrete sleepers has taken place due to shortage of timber, economical considerations coupled with the changing of traffic pattern. Initially the wooden sleepers were used on all Railways of the world, but due to shortage of timber and high cost of wooden sleepers gave fillip to the quest for alternate material for sleepers. With he development of concrete technology in 19th century, cement concrete established its place as a versatile building material. In the year 1877 Mr. Monnier a French Gardner and inventor of reinforced concrete, suggested the use of R.C.C. for making sleepers for railway track. However much progress could not be achieved till 2nd world war (1939-45). After the war due to the extensive research carried out by French and other European Railways modem track was born and heavier rail sections and long welded rails came into existence. In the late 1950s the AAR under the guidance of E. J. Ruble, Research Engineer-Structures, and G.M. Magee, Assistant Vice-President-Research, joining with Florida Pre-Stressed Concrete, Inc., and the Portland Cement Association, became active in designing and developing a tie suitable for the heavy wheel loads and severe climatic conditions of North America. The first test installations were made in 1960 on the Seaboard Airline and the Atlantic Coast Line (now the Seaboard Coast Line).The necessity of a heavier and better type of sleeper, which could be used on the modern track safely, was felt. These conditions gave rise to the development of concrete sleepers.

3.3.9.1 Advantages and disadvantages

Advantages of concrete sleepers

Following advantages have been observed of concrete sleepers:

(i). Concrete sleepers being heavy give more elastic modulus, strength and stability to the track. They are specially suitable for long welded rail track due to great resistance to the buckling of the track.

(ii). Concrete sleepers with elastic fastenings maintain better gauge, cross level and alignment. It retains packing also very well.

(iii). Concrete sleepers being flat at bottom are best suited for modern methods of track maintenance like mechanical maintenance and measured should packing (M.S.P.)

(iv). Concrete sleepers can also be used in track circuited areas as concrete is poor conductor of electricity.

(v). Concrete sleepers neither are susceptible to attack by vermin, corrosion, nor they are inflammable.

(vi). The life of concrete sleepers is very long about 50 to 60 years. Thus rail and sleeper renewals can be matched, which is a very big economical advantage.

(vii). Concrete sleeper can he manufactured from local materials also.

Disadvantages of concrete sleepers

Following disadvantages have been observed of concrete sleepers:

(i). Being heavy their handling and laying is difficult and costly. Mechanical devices have to be used which involve heavy expenditure.

(ii). At the time of derailment the concrete sleepers are damaged heavily.

(iii). There is no scrap value of concrete sleepers.

(iv). The sleepers are not suitable for beater packings.

(v). The concrete sleepers should be maintained by heavy "ON TRACK" tampers.

3.3.9.2 Design considerations

The concrete sleepers are designed on two different concepts:

(i). The sleeper is considered as a beam, which acts as a rigid, stiff and continuous beam supported n a firm and unyielding bed. This is known as German concept of concrete sleeper design.

(ii). The sleeper is considered as consisted of two separate blocks connected by a tie bar resting on a resilient ballast bed. This is known as French concept of concrete sleeper design. The first concept is German concept, and the design is based on the static loading, while the latter concept caters for slight differential settlement of ballast support. The

calculations based on latter concept are complicated and difficult and design is evolved on an empirical basis.

In the design of the sleeper following factors have been considered.

(i) Forces acting on the sleepers.

(ii) Effects of the geometrical form including shape size and weight.

(iii) Effects of the characteristics of the fastenings used.

(iv) Provision of failure against derailment.

3.3.9.3 Prestress theory

Prestressed concrete ties were introduced with widespread use in Europe and Britain, where tie timber was scarce, soon after World War II. Several million beam-type ties are in use in West Germany, Britain, Russia, and Mexico. A modified design of block tie, the RS composite tie, is standard on the French Railways and those using French technology. Prestressing combines less weight with resistance to bending moment failure. Bending moments can cause hairline cracks to form as the lower fibers of a tie member are stressed in tension, leading to failure. In a prestressed tie several metallic strands are inserted near the base, where bending is greatest, and are stressed or stretched away from the tie midpoint. After the concrete has hardened, the strands are severed at the tie ends and tend to contract. Cracking tendencies in the tie are now restrained; if hairline cracks do form, the prestressing restraint holds them tightly together. The success of' prestressing is dependent upon the bonding between the concrete and prestressed members. (Hay W. William 1982).

Initial designs

It is useful to know the concepts that governed early U.S. tide designs in order properly to evaluate the more recent revisions. In the late 1960S increasing timber Costs (and possible scarcity) and the success of prestressed ties in Europe led the AAR to secure experience in design, manufacture, and use. Later the Portland Cement Association, the

American Concrete Institute, the Canadian National, and the AREA'S Special Committee on Concrete Ties joined in the effort.

From several early designs the so-called Type E was selected for in-track testing. The de0 sign was based on equal bending moments at the axle load. The cross section was that of a truncated prism 8 in. wide

The tie bottom was slightly concave under the rail and the tie section was wedge shaped at the midpoint in lieu of bending strength equal to that at the rail and in the erroneous belief that it would reduce center binding. Four bright $\frac{7}{16}$ in. wire strands were prestressed to 64,000 lb. Granite rock aggregate formed the concrete. The ties resisted a 150,000 lb in. rail seat bending moment and sustained 2×10^6 cycles of repeated load, which gave a bending moment of 200,000 lb in., weight was about 620 lb.

The rail was held by direct fixation to a padded bearing area that had a shoulder and a 1:40 cant cast in the concrete. (With indirect fixation tie plate and pad are bolted to the tie; lugs or clips attached to the plate hold the rail). Bolts that held stainless steel clips were threaded into tubular inserts cast in the tie. Double-coil washers compensated for bolt tension lost to compression of the pads under the rail.

The type E design and subsequent revisions experienced a variety of failures-honeycombed concrete, the spelling of rail seat shoulders, midsection cracking, crushing beneath the rails, tie-end splitting from improperly set bolt inserts, bolt breakage, and bolt and insert pullouts. Insufficient strength in bonding between concrete and pretension members was indicated by failure of cracks to close.

Revised specifications

Not only was a need shown for great care in manufacture but also a need for specifications to counter the sources of failure. The several agencies eventually devised a revised set of specifications. To insure better bonding between concrete and reinforcing strands gentle release (in contrast to sudden release) of tension is recommended. Prestressing is increased by about 2501°, from 64,000-81,600 lb. With bright reinforcing strands the average length required for transfer bonding was about 16-18 in. Deformed or

chemically treated strands will reduce the bonding length to 8-11 in, when combined with gentle release. Lacking special tensioning material, rusted wire can serve as an alternative; the impact factor is increased from 50 to 150%. A wheel load distribution of 60% is assumed and the bottom is flat throughout. Fastening embedment is deepened and pullout resistance increased from 10,000 to 12,000 lb. Flexural strength at 30-in. spacing is increased to 300,000 lb in. under the rail seat, where reinforcing has been added, and to 200,000 lb in. in tie-center negative bending.

Prestress concrete sleeper's fastenings

Blocks or wood sunk in the concrete under the rail to which plate and rail were attached by conventional spiking. Today's procedures start with a foundation element or insert sunk into the concrete. Clips, lugs, or coiled friction grips of various designs are held in or bolted to the inserts and bear on top of rail base, holding it to gage and providing (usually) rail anchorage. Note that AREA specifications now require such inserts sunk to a minimum depth of $2\frac{3}{4}$ in., with a pullout restraint of 12,000 lb.

A common procedure makes a rigid connection between rail and tie so that they perform as a unit. Use of direct fixation fastenings introduces a new concept in U.S. track design, that is, to attach the rail positively to the tie in contrast to the cut spike and wood tie system, where the rail is free to rise from the tie and experience reverse bending. Under heavy axle loads there is the likelihood with concrete ties and direct fixation of wave action sufficient to cause ties to rise before and behind the wheel, that is, to pump. It is argued that concrete tie weight is sufficient to overcome any pumping action. The debate continues.

For those who wish to avoid possible pumping action and insure freedom of vertical rail movement, "rail-free" fastenings are available. These are lug-type fasteners with $\frac{1}{8}-\frac{3}{16}$ in. clearance between the top of the rail base and the underside of the lug. Flexible clips with elastic bolt washers may offer some vertical freedom. Rail-free fastenings require the use of anchors.

Insulation in bonded territory is achieved by setting the rail on a hard, plastic or rubberized pad and coating the fastening with an epoxy or fiberglass material. The trackman's ideal in fasteners is simplicity a one-piece device. Direct-fixation fasteners are seldom this simple. Usually two or three separate pieces are involved. In addition to simplicity, a good fastener must secure the rail against lateral play and rollover; also, it must exercise longitudinal restraint of 2400 lb per tie per rail or more in lieu of rail anchors.

There appears to be a definite relation between the stiffness of a hold-down device and the stiffness of the tie pads. A soft pad in combination with a rigid fastening can compress under load, thereby unloading the rigid fastening with loss of anchoring force. Here a hard pad would be preferable. Soft pads with elastic-type clips have been successful under moderate traffic loads, but they tend to permit excessive lateral movement and wear under heavy loads. Hard pads used with elastic clip fasteners under heavy traffic loads place more strain on the tie, only obvious damage to the concrete tie but, if contacted by the wheels, loss of fit and of proper elasticity in elastic inserts. The inserts should be renewed or at least thoroughly inspected even through apparently undamaged. Cracks in the concrete may originate at the point where insert holders are cast in the tie.

Recent experience

Concrete ties that meet AREA specifications are undergoing tests in numerous localities and test sections; both foreign and domestic designs are included. With a relatively small tonnage accumulation in most of the test sections, experience with recent designs has been favorable. Some crushing and movement of pads has been noted, as well as the skewing of plates and breakage of plastic insulators, but line and surface remain good .

Concrete ties useful in reducing rail corrugations and prolonging rail life under heavy unit trains in mountain territory. Rail can be replaced without disturbing ties or ballast; rail life is increased by 2-4 years. All curves over 4° are being laid with concrete ties. Where rail on wood ties must be changed frequently, the pulling and redriving of spikes

every two or three years destroys the bond between spike and tie, leading to spike-killed ties and plate cutting.

Experience has shown the need for a strong stable ties and absorb stress, especially if a hard tie pad is used. The spacing is generally in the 24-27 in. range, the closer spacing for curved track. Spacing is a function of tie length and of the bending strength at rail seats and centers. Experience is indicating that a 24-in spacing is required for ties meeting strength requirements t I or 30-in. spacing. The matter is still undergoing review.

3.3.9.4 Permissible locations for laying of concrete sleepers

Due to heavy weight and rigidity of structure, concrete sleepers are not suitable for yielding formations, fish plated joints and places where uniform packing can not be achieved. Concrete sleepers generally are laid at those locations where long welded rails are permissible. Concrete sleepers should not be laid at the following locations:

(i) On new formations on embankments unless specially compacted.

(ii) Any rock cutting unless a minimum depth of 30 cm of ballast cussion is provided.

(iii)Un-ballasted lines in yards.

(iv)Curves having radius less than 500 meters.

(v)Troublesome formations.

(vi)Near ash pit and other such locations where driver habitually drops fire.

(vii)At locations where excessive corrosion is expected.

(viii)(a) Un-ballasted bridge

(b) On arch bridges, where height is limited

(c) On slab bridges, where the ballast cushion between the top of the slab and the bottom of sleeper is less than 30 cms.

Generally concrete sleepers should not be laid with fish plated track.

If unavoidable, at joints wooden sleepers should be used. Concrete sleepers should be used on long welded rails.

3.3.9.5 Maintenance of concrete sleepers

For the maintenance of concrete sleepers following points should be kept in mind.

(i). Normally concrete sleepers should be maintained with heavy `on track tampers`.

(ii). Between two fully boxed stretches of the track only 30 sleeper spaces should be opened at a time.

(iii). To give a good riding surface, the-concrete sleepers should be fully and well compacted. In case of mono block concrete sleepers centre binding should be avoided. For this purpose 80 cm central portion of the sleeper should not be hard packed.

(iv). To prevent the corrosion of the exposed ends of the pre-stressing wires. both ends of the sleeper should be painted with suitable anti corrosive paint periodically. In case of two block sleeper, tie bars should be examined every year and the affected portion should be painted.

(v). As far as possible, the laying and maintenance of the concrete sleepers should be done by mechanical equipment.

(vi). The elastic rail clip should be driven properly to ensure the lag of the clip to be flush with the end face of insert. Over driving and under driving should be avoided as this will cause eccentric loading on the insulations resulting in variation of the load and their displacement.

(vii). To ensure that no creep develops in any portion of the concrete sleeper track, proper watch should be exercised.

(viii). When ever causal renewal of concrete sleepers required, normal precautions required for long welded rails track should be adopted, special attentions should be paid to Rubber pads, Insulating liners etc.

(ix). It must be ensured that rubber pads remain in their correct positions. If it is found that rubber pads have developed a permanent set, then they should be replaced by a new ones.

(x). Insulating liners. The cracking and breaking of Nylon or composite insulating liners-used with Pandrol clips should be checked periodically. To prevent damage, adequate care should be taken at the time of driving the clip.

3.3.10 Comparison of Different Types of Sleepers

The comparison of wooden sleeper, steel sleeper, cast iron sleeper, concrete sleeper are given in the table 3.3. From the table the relative advantages and disadvantages of one kind of sleeper over another type can be easily determined.

Table3.3: Comparison of different types of sleepers

Si. No.	Characteristics	Wooden Sleepers	Steel Sleepers	C.I. Sleepers	Concrete Sleepers
1.	Service life	12-15 years	40-50 years	40-50 years	50-60 years
2.	weight of sleeper for B.G.	83 Kg	79 Kg	87 Kg	267 Kg
3.	Handling	Manual. No damage to sleepers while handling	Manual. No damage to sleepers while handling	Manual. Liable to break if handled rough	Mechanically handled gets damaged if handled rough
4.	Gauge adjustment	Difficult	Easy	Easy	No Gauge adjustment possible
5.	Track Circuiting	Best	Difficult insulating pads are necessary	Difficult insulating pads are necessary	Mechanical maintenance only
6.	Type of maintenance	Manual or Mechanical maintenance	Manual or Mechanical maintenance	Manual	Mechanised maintenance only
7.	Cost of maintenance	High	Medium	Medium	Low

8.	Damage by corrosion or vermin	Can be damaged by while ants	No damage by vermin or white ants, but corrosion possible	Can be damaged by corrosion	No damage by vermin or white ants or corrosion
9.	Suitability for fastening	Suitable for elastic fastening and conventional fastening	Suitable for elastic fastening and conventional fastening	Suitable for conventional fastening only	Suitable for elastic fastening
10.	Suitability to track	Suitable for all routes	Suitable for all routes	Not suit1ble for highspeed routes	suit1ble for high speed routes
11.	Track elasticity	Good	Good	Good	Best
12.	Creep	Excessive Creep. Large number of anchors required to prevent excessive creep.	Less Creep	Less Creep	Creep is minimum
13.	Scrap value	Low scrap value	Higher scrap value than wooden sleeper	High scrap value	No scrap value

3.4 TRACK FITTINGS AND FASTENING

Due to the ease in handling and economy in transportation, the rails are manufactured in certain fixed lengths. In order to make a long and continuous rail track, lengths are jointed together. Thus there is need of joints.

3.4.1 Rail Joints

A rail joint is the weakest part of the track. In order to provide provision for expansion and contraction of rails due to variation in temperature, certain gap is provided at each joint. This gap causes break in continuity of rails in horizontal as well as in vertical plane, forming the weakest point of the track. The joint also causes severe blows to the passengers due to the moving of wheels over this gap. These blows loosen the compaction of ballast under the sleeper bed and make the maintenance of joints difficult. The fittings used to connect rails
become loose and cause heavy wear and tear of the track materials. It has been observed that joints need about 30% extra maintenance than the plain track.

3.4.2 Requirements of Ideal Rail Joints

An ideal joint should possess the following characteristics:
(i). The rail joint should be capable to hold the two ends of rails as near as possible and at the same time at the same level and in the same straight line.
(ii). An ideal joint should have the same strength and stiffness as the rails, which have been jointed together.
(iii). The rail joint should provide space for expansion and contraction due to variations in temperature.
(iv). The joint should be such that any rail could be replaced without disturbing the whole track.
(v). The joint should he capable 10 adjust the surface contact between the rails and fish plates.

(vi). The initial cost of the joint and its maintenance cost should be minimum.

(vii). The maintenance should be easy.

3.4.3 Types of Rail Joints

Depending upon the position of joints and sleepers. rail joints may be classified as follows:

According to position of joints. In this group following two joints may be classified:

(a) Square joint

(b) Staggered joint

3.4.4 Requirements of an Ideal Fastening

An ideal fastening should possess the following characteristics:

(i). It should be cheap and durable.

(ii). It should be easy to fix and adjust.

(iii). It should be capable to absorb shocks and vibrations.

(iv). It should be capable to protect the sleeper from the action of vertical and horizontal forces.

(v). It should be capable to give sufficient insulation to the electrified track.

(vi). It should be capable to resist creep.

(vii). It should be capable to get correct initial gauge and maintaining the gauge subsequently.

(viii). It should contain less number of components.

(ix). It should be able to resist corrosion.

(x). It should have sufficient strength to resist damage due to derailment.

(xi). Its design should be such, that it could be removed only by special tools. It should safeguard against sabotage.

(xii). It should not be too rigid, and should possess high torque resistance.

(xiii). It should not affect rail or sleeper adversely in any way.

(xiv). It should be capable to hold the rail in correct position, level and alignment.

3.4.5 Fastening of Rails

The devices used to connect rails and sleepers together to form the track are known an fastenings.

Following devices are used as fastenings to keep the rails in their correct position.

(i) Fish plates

(ii) Bolts

(iii) Chairs

(iv) Keys

(v) Bearing Plates

3.4.6 Fish Plates

The function of a fish plate is to hold two rails together both in horizontal as well as in vertical planes. At each joint a pair of fish plates is used Holes are drilled through the plates and web of rails.

Figure3.5 Fish Plates, Nuts and Dog Spikes in a Broad Gauge Rail Track.

3.4.6.1 Specification for fish plates in Bangladesh

Serial No. T-1-49

These specifications are issued under the fixed serial No.T-1-49, the final number indicates the year of adoption as standard.

Quality and chemical composition of steel:

The steel for the fishplates shall be of the best quality made by the Acid or Basic open Hearth, duplex or Acid Bessemer process and shall snow on analysis that in chemical composition it conforms to the following limits:

Carbon from	0.30 to 0.42 percent
Manganese	not to exceed 0.80 Percent
Silicon	Not to exceed 0.15 Percent.
Phosphorus	Not to exceed 0.06 Percent
Sulphur	Not to exceed 0.06 Percent

Manufacture:

All ingots used in the manufacture of the fishplates shall be kept in a vertical position in the furnace and no bled ingots shall be used. They shall be cogged down into blooms and sufficient crop removed to ensure soundness. Each section of fishplate shall be accurately rolled to its respective templates

Sawing to length:

All fishplates shall be sawn within 1/16 inch above or below the specified length and the ends shall be square. All bouts caused the saw shall be removed.

Freedom from defects:

All fish plates shall be of uniform section throughout, straight and smooth on all bearing surface, sound and free from twist, blisters, flaws, lines, cracks and defects of every kind.

Holes in Fish plate:

The bolt holes in the fishplate shall be either drilled or hot punched as specified by purchaser. If the holes are to drilled the fishplates shall be made perfectly straight along the lines of fishing, for the full length of the plate before drilling is commenced. It the hole are to be punched, the punching of all holes shall be done at one stroke of the machine before the fishplates have cooled to below a red heat from the rolling temperature and the fish plates shall them, whilst still hot, be strengthened by gradual pressure between block the full length of the fish plate. The holes shall be clean, without burns on either side, accurate in pitch and in the positions specified A tolerance of plus 0.8 mm on the size of the holes shall be permitted.

The contractor shall prepare nipple gauges for each section of fish plates ordered for testing the accuracy of the fishing planes and bolt holes. The gauge shall be made of cast iron accurately planned to represent the fishing of the rail with the fishplates are to be used and fitted with suitable steel suds for testing the accuracy, of the bolt holes. All nipple gauge shall be approved by the Inspecting Officer prior to use every fish plates shall be placed on its respective nipple gauge and any fishplate which fails to fit the gauge may be rejected.

Notches for Dog spikes or coach screws:

The notches for Dog spikes or coach screws may be punched hot or cold. All burrs caused by the punching shall be removed. The accuracy of the notches shall be tested by nipple gauge hinged to the bolt nipple gauge in order that the fishplates may be gauged at one setting.

3.4.6.2 Specification for fish bolts and nuts in Bangladesh

Serial No. T-3-83 These specifications are issued under the fixed serial No. T-3-83 the final number indicates the year of adoption as standard or the year of last revision.

Quality of material:

The steel used in the manufacture of the fish bolts and nuts shall be made the Acid or Basic Open-Hearth, Duplex or Acid Besmear Process and shall not shown on analysis more than 0.06 percent of Sulphur or of Phosphorus, Samples selected by the purchaser or by the Inspecting Officer from the bars as rolled shall be subjected to the following mechanical and chemical tests and fish bolts or nuts shall be made until the materials intended for their manufacture has been approved.

Quantity of fish bolts and nuts:

The fish bolts and nuts shall conform to the dimensions shown on the drawings. The bolt heads shall be formed by upsetting the bar when hot. They shall be concentric, square with the shank and cleanly and properly finished without pin or flues. The nuts shall be hot longed from the solid the holes being truly central and the faces square with the axis of the holes. Unless otherwise specified the bearing faces of the nuts shall be faced true in a machine. All screw threads shall be cut to the standard dimensions of British Standard with worth (B,S,W) screw threads reproduced in the tables .

Test for finished fish bolts and nuts:

From each batch of fish bolls and nuts samples at the rate of one per thousand but not less than ten from any batch, shall be selected by the Purchaser or by the Inspecting Officer and subjected to the following tests:

First test: The nut shall be screwed on to the fish bolt until it is flush with the end of the fish bolt and a spanner of the kind mentioned hereafter shall then be affixed to the nut in a horizontal position and weighted, as specified below.

Second Test: The nut shall then be screwed further on to the fish bolt until the end of the fish bolt projects four threads beyond the face of the nut and the spanner weighted as

before shall be again similarly applied to the nut. Under each test the nut shall carry neither less nor more than the minimum and maximum weight respectively specified in the following:

Diameter of fish bolt (Inch)	Test weight in lbs.	
	Minimum	Maximum
Up to ¾	3	12
13/16 and 7/8	4	16
15/16 and 1	5	20

The spanner shall weigh 10 lbs. and the distance between the center of the nut and the point of suspension of the test weight shall be 3 feet.

3.4.7 Fittings For Wooden Sleepers

3.4. 7.1 Spikes

The device used to hold the rails to the wooden sleepers are known as spikes. They can be used with or without bearing plates below the rails.

Requirements of a good spike

A good spike should have the following characteristics:

(i). It should be cheap.

(ii). It should be such that it could be easily fixed and removed.

(iii). It should be able to hold rail in position properly and should have enough resistance to motion to retain its position.

(iv). It should be able to maintain proper gauge.

Types of Spikes

The common types of spikes are as follows

(i) Dog spikes

(ii) Round spikes

(iii) Screw spikes

(iv) Elastic spikes

(i) Dog spikes

They are used for fixing rails with wooden sleepers. The number of spikes to be used depends on the location. The section of dog spike is square. The diameter of dog spike is 16mm. The length depends on its use. The lower end of dog spike may be either pointed, blunt or chisel shaped. Experiments have shown that pointed dog spike has the best holding power and blunt end dog spikes comes second and chisel shaped spike has the least holding power.

Following points should be noted in connection of Dog spikes:

1. Driving. The position of fixing (driving) spike plays an important role in determining the holding power of me spikes. If the spikes arc placed opposite to each other, they have a tendency to split the sleeper and will have less holding power. Thus the staggered driven spikes have greater holding power.

2. Blows. During driving operations the blows should be central and regular, otherwise larger holes will be produced. This will reduce the holding power.

3. Bore Holes. The diameter of the hole in which the spike is to he driven should be slightly less than the diameter of the spike. It will result in greater holding power.

4. Number of Spikes. Generally the number of dog spikes is two for each rail joint. For heavy and high speed traffic 3 to 4 spikes may be used. In the later case two dog spikes should be fixed on the out side of the rail while one or two dog spikes are to be fixed on

the gauge side of the rail. On curves also 3 to 4 spikes are essential to bear the side thrust. In bridge sleepers 4 dog spikes per rail joint should be used.

5. Augers. Holes should be bored vertically right through the sleeper with the help of 13 mm auger. This will prevent accumulation of rainwater and subsequently decay of sleeper. If the spike is not vertical, the connection will become loose and gauge will be widened. Thus verticality of dog spike is essential.

6. Plugging. Due to the passage of more vehicles, dog spikes become loose, When the dog spike becomes too loose, it is taken out and the hole is plugged with a solid piece of wood. Then a new hole is bored and the dog spike is re-driven there. Holes plugged in this way are called spike killed holes. When the number of spike killed holes becomes large. the sleeper is rejected and replaced. Such rejected sleepers arc called spike killed sleepers.

Holding power. The holding power of dog spike is 50% that of a screw spike. but these are preferred due to their cheapness, easy fixation and extraction and better holding of the gauge. The holding power of a pointed dog spike at bottom is maximum.

(ii) Round spikes

They are used for fixing rails with wooden sleepers using anti-creep bearing plates.

(iii) Screw spikes

These spikes can resist lateral thrust better. They have holding power twice that of dog spikes. Thus Indian railways have developed this class of spikes in two diameters, one 20 mm dia spikes and the other 22 mm diameter spikes. This type of spikes can be used on high speed trunk routes to obtain better life of the sleepers. The 20 mm dia spikes are known as plate Screws and are used in place of round spikes for fixing anti-creep bearing plates. The 22 mm dia spikes are called rail screws and are used for fixing rails with or without hearing plates. They are also used on bridges and platform lines. Now the use of plate screws and rail screws has been recommended in preference to round and dog spikes to conserve the life of wooden sleepers.

(iv) Standard spikes

These arc used for cast Iron chairs only to fix them with the timber sleepers.

(v) Elastic spikes

These spikes give a better grip with the foot of the rail and result in reduced wear and tear of rail, less noise and less creep. To prevent corrosion clastic spikes should be galvanized.

3.4.7.2 Specification for dog spikes in Bangladesh

Quality of material

The bars from which the Dog spikes are manufactured shall of Class VII steel in accordance with P.R.S Specification No M 8 and shall be subject to the tests contained therein. No spikes shall be made there from until the materials has been approved by the Purchaser or by the Inspecting Officer.

Test for finished spikes

From each batch of Spikes, test- spikes at the rate of one per thousand, but not less than ten from any batch, shall be selected by the Purchaser or by the Inspecting Officer and subjected to the following tests:

a) Hammering Test:

Not less than two test spikes but not more than one tenth of the total number is above twenty, shall withstand without fracture, being hammered cold until the angle of Junction of head and Shank is not less than 135 (o).

b) Cold bent Test:

All the remaining test spikes or at the discretion of the purchaser or of the Inspecting Officer, any number not less than a quarter, shall withstand without fractures, being bent cold through 180(0) until the internal radius is not greater than 1.1/2 the thickness of the shank.

Margin under or overweight:

No spikes more than 3 percent above or below the calculated weight will be accepted and no payment will be made for any weight in excess of the calculated weight then only the actual weight shall be paid for.

Marking:

The spikes shall be distinctly stamped on the top of the head with the maker is initials or mark and with such other marks as may be specified by the Purchaser.

3.4.7.3 Bolts

(a) Fang bolt. This is an alternative to round spikes. Fang bolts have proved more effective. But their fixing and removal is difficult. Fang holts are employed for fastening slide chairs to the sleepers under the switches. These are used in locations where gauge is to be preserved.

(b) Hook bolt. Hook bolts are used to fix sleepers to girders of the bridges. For each sleeper usually two hook bolts are quite adequate.

3.4.7.4 Chairs

Chairs are used to hold the double headed and bull headed rails in position. Invariably chairs are made of cast iron and they help in distributing the load from rails to sleepers. A chair is consisted of two jaws and a rail seat. The web of the rail is held tightly against the inner jaw of the chair and a key is driven between the rail and the outer jaw of the chair. The chairs are fixed with the sleepers, by means of spikes. The right hand side jaw is outer one. The shape of chairs depends upon the type of rails used.

3.4.8 Fittings for Steel Trough Sleepers

3.4.8.1 Loose jaws

Loose jaws as shown in Figure, are used for holding the rail to the steel trough sleepers with the help of keys. In the older type of trough sleepers pressed up lugs were provided, which were damaged, deformed or cracked easily. These problems of sleeper failure have been solved by stantdardising the spring steel loose jaws. These jaws can he easily replaced when ever necessary. These are manufactured from spring steel and the weight of one such jaw is about 288 gram.

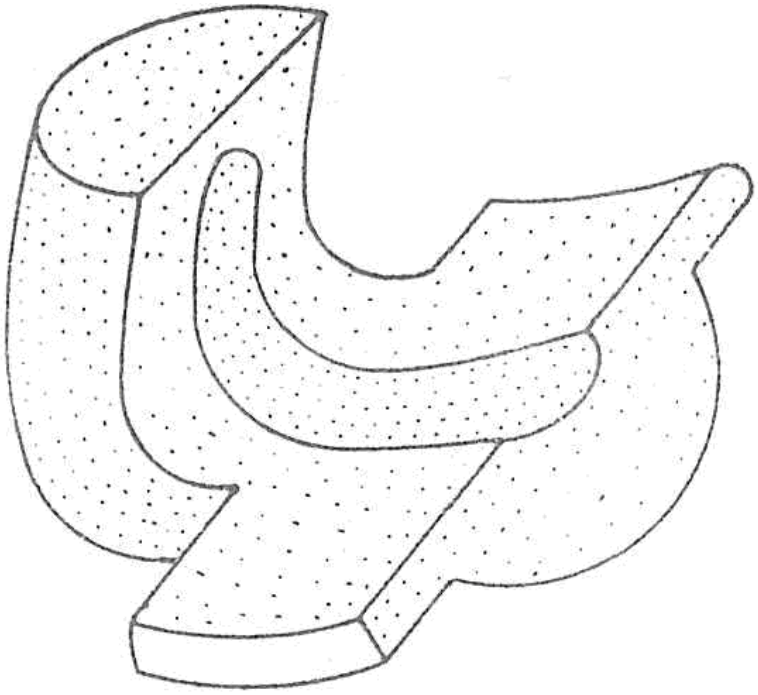

Figure3.6. Spring steel loose Jaw

3.4.8.2 Two way keys

These keys are used universally with trough, pot and CST-9 sleepers. A two way taper is provided in both sides of the keys and as such the keys can he driven in either direction. These keys are manufactured from a special rolled section. The length of the keys is about 190 mm for B.G. with a taper of 1 in 32. A gauge variation of' ± 3mm can be adjusted by altering the length of drive of these keys.

3.4.8.3 Mota singh liner

During actual service life holes in trough sleepers get elongated due to wear and tear caused by the moving loads. Mota singh liner has been found quite effective to overcome the problem of elongation of holes, when used with loose jaws.

3.4.9 Fitting of Cast-Iron Sleepers

3.4.9.1 Cotters

Cotters are used for fixing the tie bars with cast iron sleepers on Indian Railways. Following four types of cotters are used. They are classified based on the method of their splitting.

(i) Centre split cotter

(ii) Side split cotter

(iii) Solid end split cotter

(iv) Bent plate cotter

Their overall dimensions, taper etc. are by and large same, they only differ in the method or their splitting. The length of a cotter is 152 mm and weight about 363 grams.

3.4.9.2 M.S. tie bar

M.S. Tie bars are used for holding two plates of CST-9 sleepers together. The normal length or a tie bar for B.G. is 2720 mm and 1870 mm for M.G. The section of B.G. tie bar is 50 mm x I3 mm and that of M.G. 45 mm x 10 mm.

3.4.10 Elastic Fastenings

3.4.10.1 Necessity for elastic fastening

The main or primary purpose of a fastening is to fix the rail with the sleeper. The fixing of the rail to the sleeper may be done directly or indirectly with the help of fastening, but in the process of fixing, the fastening is subjected to severe vertical, lateral and longitudinal forces. The forces which are predominantly dynamic increase rapidly with the increase in moving loads and speeds. In addition moving loads generate vibrations mainly due to geometric irregularities of the track and the forces developed by the imbalance in the rolling stock. The traditional rigid fastening which has fulfilled its task for quite some time to certain extent is not able to meet the challenge of heavy dynamic forces effectively. These rigid fastening become loose under heavy dynamic forces of high frequency vibrations of the order of 800 to 1000 cycles per second developed even at an moderate speed of 100 kmph. The old rigid fastening is unable to hold the rail to the sleeper firmly with a constant pressure for a good long time. The old rigid fastening become loose due to the shocks and vibrations caused by fast moving loads. This gives rise to the development of interplay between the components of the track. Thus the parameters of the track get affected and its rapid deterioration starts. Thus there is a need of such a fastening which can safeguard the track parameters and dampen the vibrations. An elastic fastening is a possible answer for this problem.

3.4.10.2 Requirements of an elastic fastening

An ideal fastening should possess the following characteristics:

(i). It should be cheap and have a long life.

(ii). It should hold gauge well.

(iii). It should provide sufficient elasticity to the track to absorb vibrations and shocks caused loads.

(iv). It should he able to keep the track parameters well maintained.

(v). For the lateral stability, it should offer sufficient resistance to lateral forces.

(vi). It should be able to offer adequate resistance to longitudinal forces which cause creep.

(vii). It should have least maintenance. It should be of fix and forget type for least maintenance.

(viii). It should not loose its properties with time. It should he able to be reused.

(ix). It should have as few parts as possible, which are easy to manufacture, lay and maintain.

(x). It should be easy to manufacture, laying and maintain.

(xi). It should be free from sabotage.

(xii). It should be able to be used on all types of sleepers such as wooden, concrete, steel etc.

(xiii). It should have sufficient toe load which should not reduce under service.

3.4.10.3 Elastic rail clip or pandrol clip.

It is a standard type of elastic fastening on Indian Railways. It is a permanent type i.e. fix and forget type of fastening. It needs minimum maintenance. The clip is made from Silico-Manganese spring steel bar of 20.60 mm diameter and given heat treatment. It exerts a toe load of 710 Kg for nominal deflection of 11.4 mm. The toe load is quite adequate to ensure that no relative movement between the rail and sleeper i.e. developed. The pandrol clip can be driven with the help of an ordinary hammer of about 2 kg weight. It docs not require any special tool. To ensure that correct load is exerted, the pandrol should be driven to such an extent that the outer lag of the clip flushes with the outer face of the cast iron. This clip can be fixed on wooden. steel. cast iron or concrete sleepers. Fig. 3.7 & 3.8 show pandrol clip or lie rail clip.

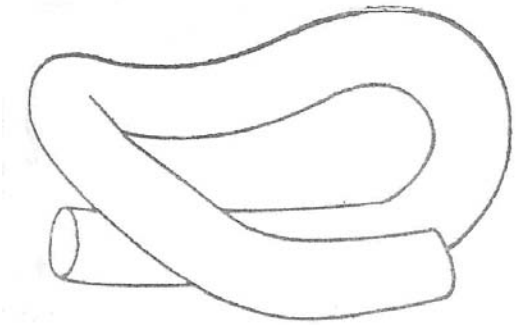

Fig. 3.7. Pandrol clip or Elastic rail clip

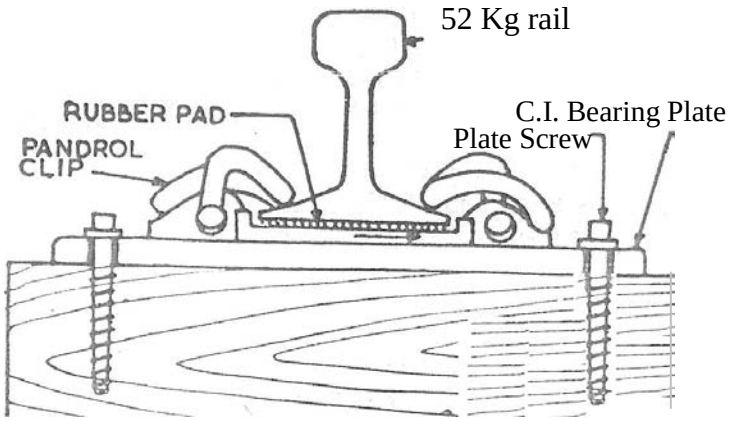

Fig. 3.8. Pandrol clip with wooden sleeper

(a) Wooden sleepers.

In case of wooden sleepers, a steel or cast iron base plate is provided with dog spikes or preferably with screw spikes. The base plate has grooves on both sides in which pandrol clip can be fixed by driving it with the help of an ordinary hammer. To provide necessary cushion a rubber pad is also provided.

(b) Steel sleepers.

In case of steel sleepers, a steel plate normally is welded on the sleepers having grooves on both sides where pandrol clips can be fixed. In pandrol clip with slide plates on ST sleepers, following difficulties have been experienced.

(i) Tolerances are not easily maintained.

(ii) The sleeper already laid in position has to be taken out from the track and taken to work shop for alternation.

To overcome the above short comings, recently a modified loose jaw has been developed which can be used with existing holes on steel trough sleepers to accommodate the pandrol clips.

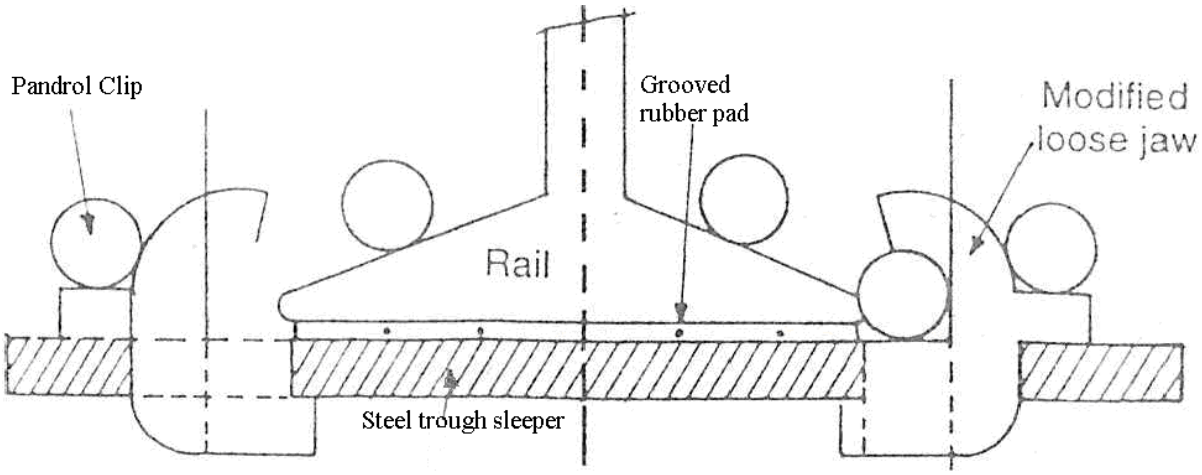

Figure3.9. Pandrol dip with Modified Loose Jaw on ST sleeper

The loose jaws are usually manufactured from Silico-Manganese steel and suitably heat treated. For reducing the wear at rail seat and dampening the vertical vibrations a rubber pad has been provided in the design of the loose jaw.

(c) Cast iron sleeper.

In case of cast-iron sleepers the design of the sleeper has been slightly modified to suit the pandrol clip and a new type of sleeper has been evolved.

(d) Concrete sleeper

In case of concrete sleeper, malleable cast iron inserts are inserted directly into the sleepers during their manufacture. The pandrol clip is fixed in the holes of cast iron insert. A 4.5 mm thick grooved rubber pad also has been provided under the rail seal to make it more elastic. For insulation, insulated liners also have been provided.

Draw backs of pandrol clips

Following draw backs have been noticed of the pandrol clips.

(i). Gauge adjustment is not possible.

(ii). The pandrol clip has a point contact, which causes indentation on the foot of the tail due to heavy toe load and small contact area.

(iii). It does not provide sufficient safe guards against theft or sabotage as it can be taken out by ordinary hammer.

(iv). During service period it gets seized in the malleable cast iron insert.

3.4.10.4 Double shank elastic spike

Double shank elastic spike is also known DS-18 spike. It is manufactured from silico-Manganese spring steel and hardened. Essentially it consists of two 14mm square laminated shanks, which are driven into the pre bored holes of wooden sleepers and hold the rail to the sleepers. The spike exert a toe load of 1500 to 1800 kg and has a initial toe deflection of 15 mm. After initial driving to the full extent the spike undergoes permanent set of 1 to 4 mm at the toe. This spike is still in experimental stage, but has a bright future for use as an elastic fastening with wooden sleepers. However this spike can not be used with metal or concrete sleepers.

3.4.10.5 Lock spike

The lock spikes are manufactured by M/S Lock spike, London. The spike is an improvement on conventional dog spike or round spike for use on wooden sleepers. The Lock spike type L.G.-20 has been tried on Indian railways. The length of the spike is 165 mm and diameter 16mm. 14 mm diameter holes are bored in hard wood sleepers and 2 mm diameter holes in soft wood sleepers. Though this sleeper is still in trial stage, but appears to have a good future.

3.4.10.6 Spring steel clips

These clips have been used on prestressed concrete sleepers. The assembly consists of a double classic fastening. On this assembly the rail rest on a grooved rubber pad and is held vertically by a pair of spring clips at each rail set. The clip is pressed by a nut tightened on a 22 mm bolt inserted from under side of the sleeper. The nut is tightened to a torque of about 13.7 kg-m. The manufacturers claim that with this torque a creep resistance of one tonne per pair of clip is obtained. This clip is also under experimental stage.

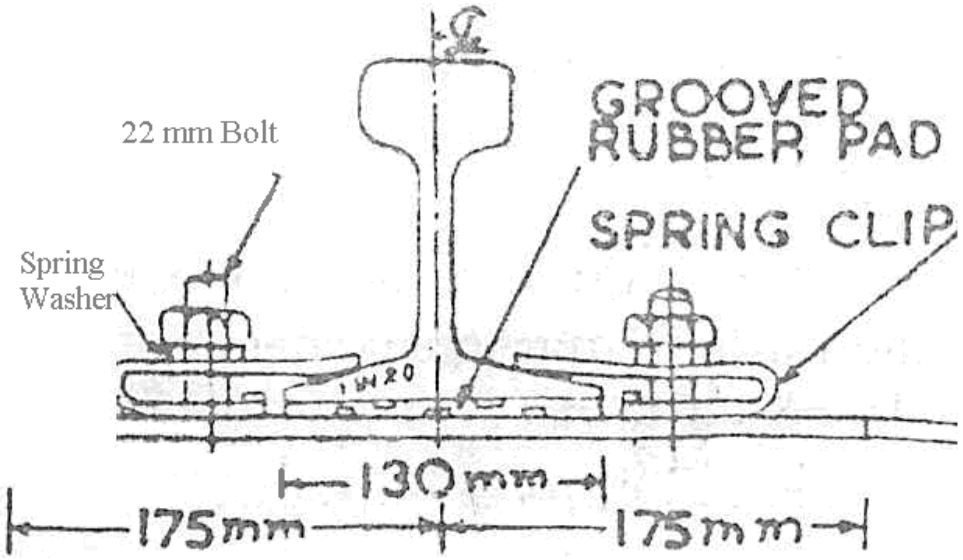

Figure3.10. Spring steel clip

3.4.10.7 Sigma clip for cast-iron sleepers

This is a special type of elastic fastening to be used on CST-13 type sleepers. The assembly consists of a grooved rubber pad underneath the rail as shown in Figure. One sigma clip and a pin passes through a transverse hole in the sleeper. The clips is also manufactured from Silica Manganese spring steel bar of 16 mm dia, and suitably heat treated. The designed toe load of this clip per rail seat is 2000 kg with the toe def1ection of 7mm. For insertion and extraction of this clip special tools are needed. This is also under trial at present.

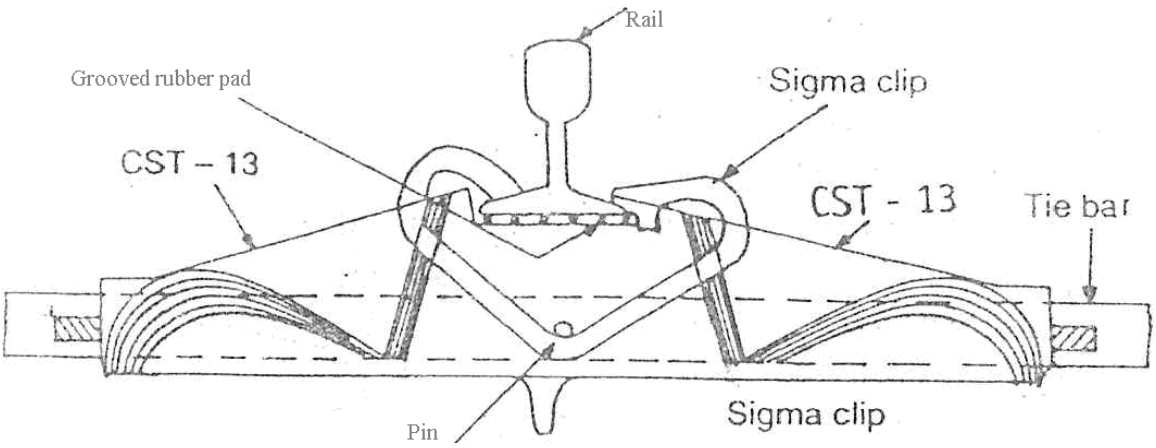

Figure3.11. Sigma clip

3.4.10.8 New Resilient clip RD-3

To overcome the draw backs of pandrol clips (elastic rail clips) RDSO has developed recently a new resilient clip for use on concrete sleepers in place of conventional pandrol clips. The new RD-3 clip is of U shape. It is not only economical in material content but also gives improved performance in terms of toe loads.

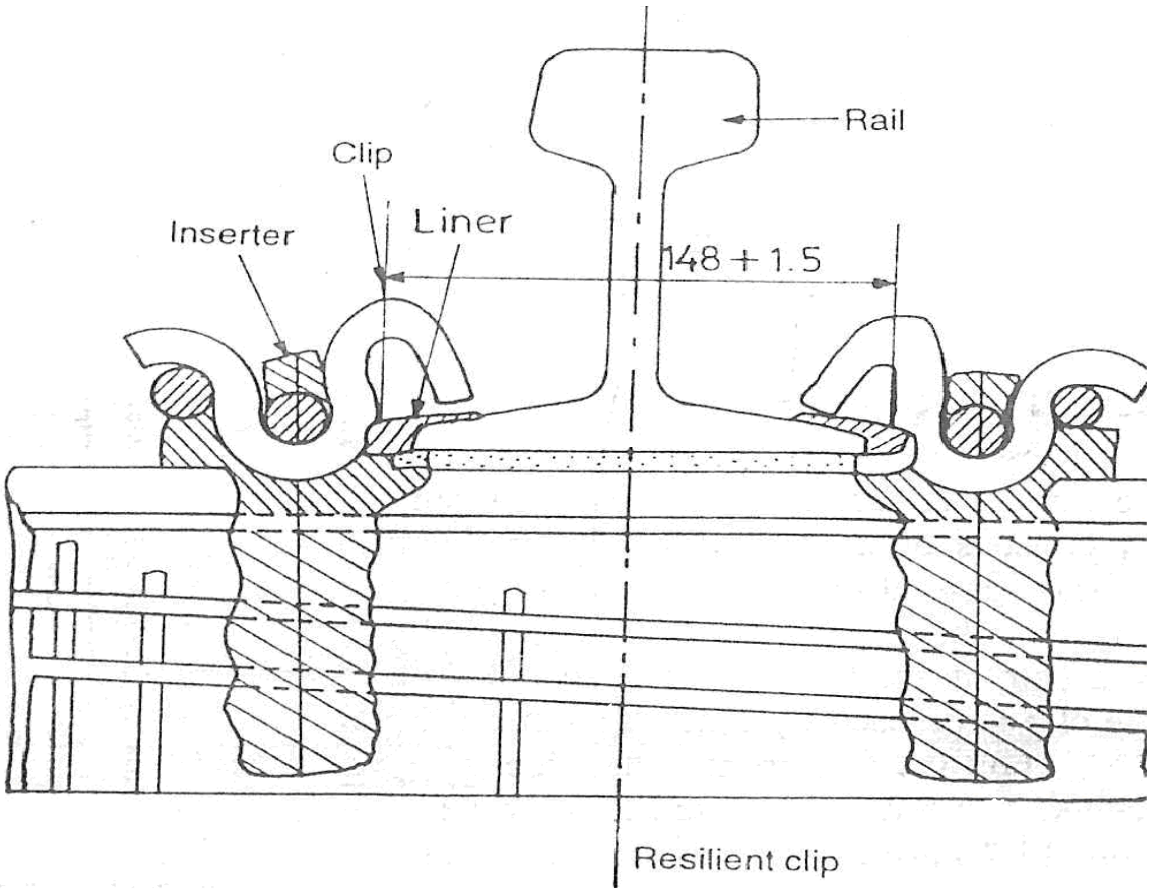

Figure3.12. RD-3 Resilient clip

The advantages of New Resilient RD.-3 clip

Following are the main advantages of RD-3 clip.

(i). Its shape is simple.

(ii). In normal conditions it exerts a toe load of 1000 kg.

(iii). It is easy to manufacture.

(iv). It is difficult to pilferage.

(v). It can be fitted in all types of sleepers viz, wooden, steel, concrete.

(vi). Light in weight. and as such it is economical in material.

(vii). Good creep resistant.

3.4.10.9 Specification for anti-vandal elastic rail clip type e1811av in Bangladesh

Introduction

Anti-vandal Elastic Rail Clip type-e1811AV shall be manufactured from Silicon manganese Spring Steel as rolled bars (dia 20.6 mm) to Grade 55 SI 7 to 1S: 3195-1992 shall be used in the manufacture of clips. The technical specification of as rolled steel bars related to supply condition of the bars in the as rolled and straightened condition for hot forming.

Technical specification of the raw materials

(a) Silicon Manganese Spring Steel as rolled bars (dia 20.6 mm) to Grade 55 si7 of IS:3195-1992 shall be used in the manufacture of clips. The technical specification of as rolled steel bars relates to supply condition of the bars in the as rolled and straightened condition for hot forming.

(b) Steel shall be manufactured by any process of steel making except the Bessemer process. It shall be followed by secondary, refining or vacuum melting.

(c) The size, of ingots, billets or continuous cast billets for any given size of finished steel product shall be such that a minimum reduction ration of 16.1 from the minimum cross sectional area of the ingot billet or continuous cast billets to the maximum cross sectional area of the product is ensured.

(d) The raw material may be inspected by the Purchaser/his inspection agency for inspection of clips at his discretion. The inspection will be carried out in accordance with JS: 228 or spectrographically, IS 4163-1982, IS 1500-1983 and IS 6396-1983.

Manufacture of clips

(a) The clips shall be manufactured from as rolled silicon-manganese spring steel rounds as per technical specification (reference Para 3.(a),(b), (c) & (d) by hot forming shall be subsequently oil hardened and tampered to give uniform hardness across the section. The clips shall conform to the requirements of the Drawing No. CE/VV/1666(R) and tests stipulated hereinafter

(b)MARKING: All clips shall bear stamping to indicate month and last two digits of the year of manufacture and initials of the firm.

(c) Lot And Sample Size For Testing:

(i) For the purpose of testing the number of clips manufactured from the same Heat No. of the raw material, heat treated in a similar manner in a day subject to a maximum of 10,000 nos. using continuous type temperature controlled furnace of clips manufactured in one shift in a day and heat treated in a similar manner shall form a lot for testing.

(ii) The test samples for different tests shall be drawn at random from each lot.

(iii) The clips shall be offered for inspection as per letter given in 10.

Testing for procurement of elastic rail clip

PLACE OF TESTING:

All tests required in case of raw materials of Elastic rail clips and of manufactured Elastic rail clips as per technical specification laid in 1 & 3 must be carried out in Bangladesh University of Engineering and Technology (BUET), Dhaka or any other place in Bangladesh as selected by the Engineer, on behalf of the Project Director, Bangladesh Railway, Rajshahi.

Warranty

The period of Guarantee of the works shall be 12 (twelve) months from the date of acceptance of the Materials/equipment. The Supplier shall warrant for this period of guarantee that the works executed by the supplier under the contract shall be of the kind and quality described in the contract documents and shall be free from defects and materials/equipment's shall be suitable for the intended use by the Purchaser.

Should any equipment/materials prove defective and not in conformity with the requirements of the contract during the period of guarantee, the Supplier shall at his own expense replace the equipment/materials upon a written notice of such defects and satisfactory proof thereof given by the Purchaser to the Supplier.

3.4.11 H.M. Fastening and NABLA Fastening

Elastic rail clip (Pandrol clip) used on Indian Railways have been found to suffer from the following limitations.

(i). The elastic rail clip does not permit the inter changeability of 52 kg rails by 60 kg rails. Thus when ever the traffic requirements demand the replacement of 52 kg rails on concrete sleepers by 60 kg rails, the sleepers also have to be replaced or costly special steel alloy rails have to be used.

(ii). Elastic rail clip can be easily removed from the track.

(iii). Elastic rail clips get jammed/rusted in the insert and tend to loose the designed toe load.

Thus there are only above two proven fastening in the world which permit the interchangeability of 52 kg rail by 60 kg rail.

3.4.11.1 H.M. fastening

The H.M. fastenings can be used for 52 kg rail as well as for 60 kg rail by using suitable size of angled guide plates and insulating shims as per German design.

This fastening basically consists of four coach screwes, which are tightened against the plastic dowels of the PRC sleepers and press the W. clip assembly to give desired toe load. The weight of each clip is about 510 grams and can give a toe load of one tonne. The gauge is maintained with the help of an angled guide plate. A thin insulated shim is placed between the angled plate and concrete sleepers. A grooved rubber pad is provided below the rail seat to give necessary dampening effect and resistance to the lateral movement of rails.

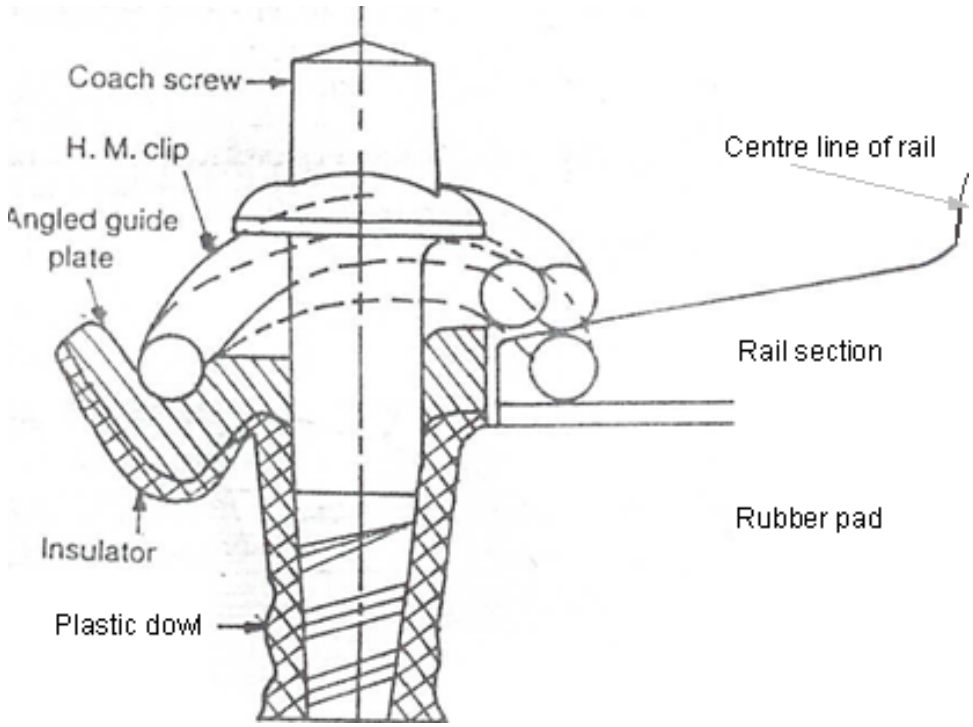

Figure3.13. H.M. Fastening

3.4.11.2 NABLA fastening

It can be used for 52 kg rail as well as for 60 kg rail. It is French designed. Basically this fastening consists of four screw bolts tightened over steel helical inserts with intervening steel clips and plastic insulators. A grooved rubber pad is placed below the rail seat of PRC sleeper to give dampening effect and resistance to lateral movements of rails. The gauge is maintained with the help of a single plastic insulator. Each assembly weighs about 490 grams and can give a toe load of 1 tonne and creep resistance per rail seat of about 2 tonnes.

Both the above fastenings are imported by Indian Railways and put to use on trial basis under Indian conditions. NABLA fastening is considered better than H.M. fastening due to the following considerations.

(i). Wear and corrosion is less in NABLA fastening as the clamping force is applied via a strong inverting insulating bearing made of processed nylon.

(ii). The NABAL helical insert is made of steel which offers greater resistance to extraction.

(iii). The components of NABLA fastening are more precise and ensure better gauge which is maintained by a single bearing.

(iv). This fastening is stronger.

(v). The defective parts of NABLA fastening can be changed easily and faster as the nut screw bolts only are necessary to be loosen.

(vi). The mounting of fastening can be carried out easily and rapidly.

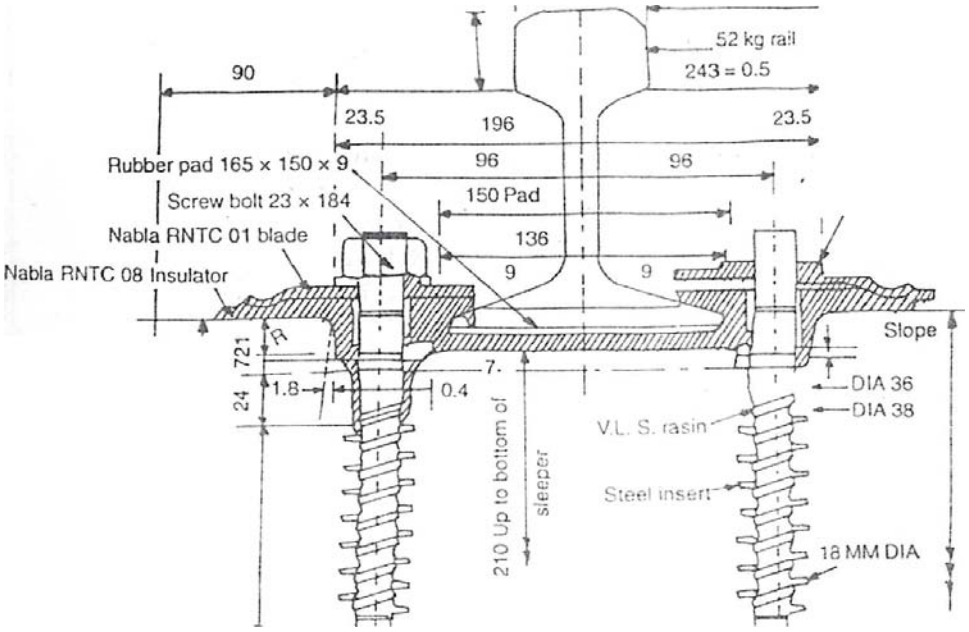

Figure3.14. Nabla Fastening

3.4.11.3 Triple elastic fastening

This fastening has been developed recently. The manufactures claim that this fastening provides triple elasticity to the track. This new fastening provides initial toe load, creep load and lateral elasticity to take care of vertical and lateral vibrations of the track.. Some details of this fastening arc as follows:

(i). This clip is made out of 16mm dia silomanganese spring steel bar.
(ii). The weight of this clip is about 500 grams.
(iii). The clip has been designed for a toe deflection of 1.8mm to 2.0mm with a creep load of about 800 to 1000 kg per clip.
(iv). This fastening is of self tensioning type and does not become loose or wear off.
(v). This fastening provides a separate gauge check and rail stop in the insert. These are definite advantages over other elastic fastenings.

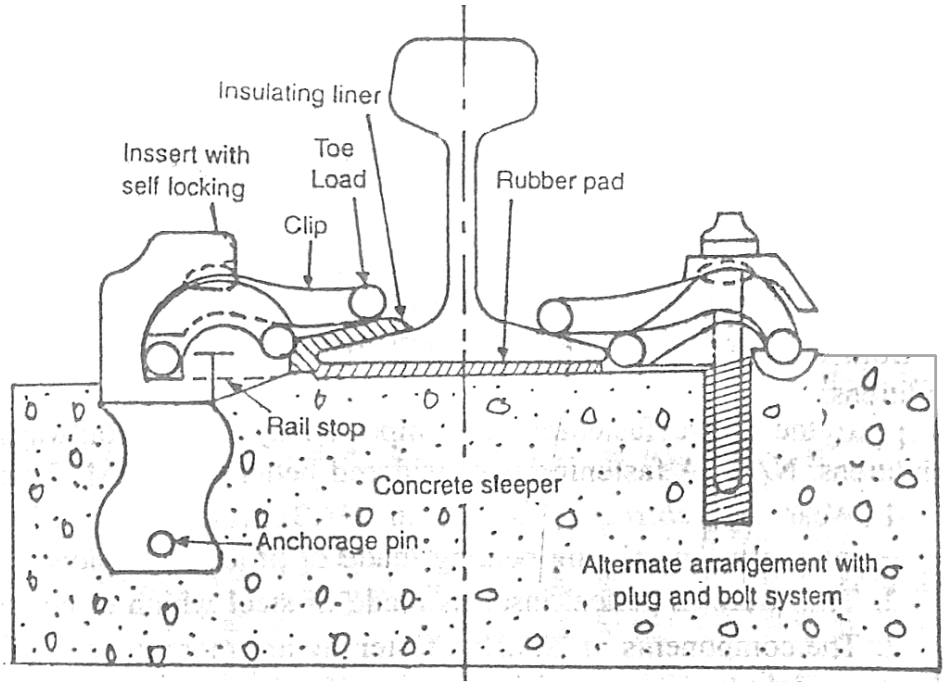

Figure3.15: Triple Elastic Fastening

3.4.11.4 Fastening per sleeper

Table3.4 The number of various fittings and fastenings per sleeper for different types of sleepers

Type of sleeper	Ordinary fastening per sleeper	Nos.	Elastic fastening per sleeper	Nos.
1. wooden sleeper	Bearing plates	2	C.I. bearing plates	2
	Dog spike	8	Plate screws	8
	Screws	8	Pandrol clips	4
	Keys for C.I. anti creep bearing plate	4	Rubber pads	2
2. Concrete sleeper	No of ordinary fastenings used	----------	Pandrol clips	4
			Nylon liners	4
			Rubber pads	2
			M.C.I inserters	4
3. Steel trough	Keys	4	Modified loose jaws	4
	Loose jaws	4	Pandrol clips	4
			Rubber pads	4
4. CST-9	Plates	2	Pandrol clips	4
	Tie bars	1		
	Cottors	4	Rubber pads	2
	Keys	4		

3.4.12 Turnouts

Turnout is an arrangement of points and crossings with lead rails by means of which the rolling stock may be diverted from one track to another.

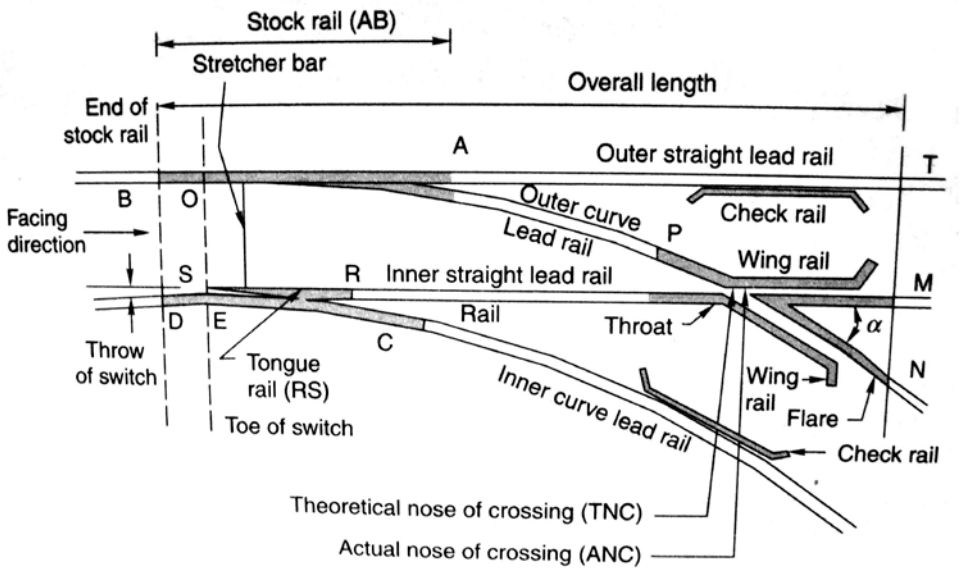

Figure3.16 Constituents of a turnout.

Tongue rail: It is a tapered movable rail, made of high carbon or manganese steel to withstand wear. At its thicker end, it is attached to a running rail. A tongue rail is also called a switch rail.

Stock rail: It is the running rail against which a tongue rail operates.

Points or switch: A pair of tongue and stock rails with the necessary connections and fittings forms a switch.

Crossing: A crossing is a device introduced at the junction where two rails cross each other to permit the wheel flange of a railway vehicle to pass from one track to another. Figure 3.17 represent crossing in a BG track.

Figure3.17 Track changing arrangements (crossing) in BG tracks.

Figure3.18 Track changing arrangements (Turn out) in DG tracks.

Switches: A set of points or switches of the following main constituents:

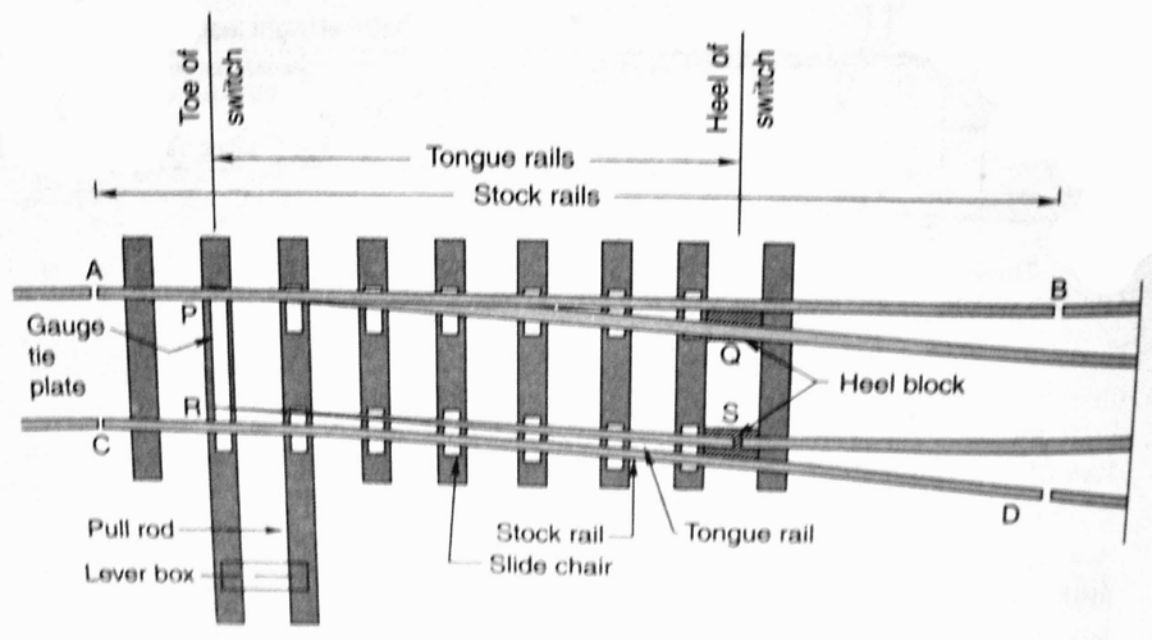

Figure3.19 Details of a switch.

(i) A pair of stock rails, AB and CD, made of medium manganese steel.

(ii) A pair of tongue rails, PQ and RS, also known as switch rails, made of medium manganese steel to withstand wear. The tongue rails are machined to a very thin section to obtain a snug fit with the stock rail.

(iii) A pair of heel blocks which hold the heel of the tongue rails is held at the standard clearance or distance from the stock rails.

(iv) A number of slide chairs to support the tongue rail and enable its movement towards or away from the stock rail.

(v) Two or more stretcher bars connecting both the tongue rails close to the toe, for the purpose of holding them at a fixed distance from each other.

(vi) A gauge tie plate to fix gauges and ensure correct gauge at the points.

Figure3.20 & 3.21 Broad Gauge Switches at Rajshahi Station.

Specification for turnouts in Bangladesh

Quality of materials

The bearing and tie plate, slide chairs, switch stops, fang bolts and spherical washers shall be made from Class II Steel in accordance with Castings in accordance with P.R.S. Specification No. M5. Switch stops may also be made from re-rolled rails.

The heel, distance and throat bolts shall be made from Class II Iron Castings in according with P.R.S. Specification No. M14.

All bolts other than fang bolts shall be made from steel of the quality specified for fish bolts in P.R.S. Specification No T3. The rivets for mild steel slide chairs shall be made from Class VII Steel to P.R.S. Specification No M8 and shall be in accordance with P.R.S. Specification No H 5.

The spring washers shall be in accordance with P.R.S. Specification No H 20.

Ordinary washers shall be in accordance with P.R.S Specification No H2.

Testing of materials:

Imported materials.

The materials or components if imported, such materials or components will be inspected and passed in the country of origin before dispatch to Bangladesh by an internationally recognized reputed Govt. Testing Institution/Agency nominated by the Employer. In case of necessity in the opinion of Employer, Employer reserve the right to arrange further testing in Bangladesh University of Engineering & Technology, Dhaka or any other recognized Govt. Institution/ Organization in Bangladesh as nominated by the Employer.

Local materials:

In the case of material produced in Bangladesh, identifiable test certificates, issued by the Bangladesh University of Engineering & Technology, Dhaka or any other recognized Institution/ Organization in Bangladesh as nominated by the Employer showing that the relative specification has been complied with, will be accepted.

3.5 BALLAST

3.5.1 Introduction

The ballast is a layer of broken stones, gravel or any other granular material placed and packed below and around sleepers for distributing load from the sleepers to the formation. It provides drainage as well as longitudinal and lateral stability to the track.

3.5.2 Function of Ballast

The ballast serves the following functions in a railway track.

(i). Provides a level and hard bed for the sleepers to rest on.

(ii). Holds the sleepers in position during the passage of trains.

(iii).Transfers and distributes loads from the sleepers to a large area of the formation.

(iv). Provides elasticity and resilience to the track for proper riding comfort.

(v). Provides the necessary resistance to the track for longitudinal and lateral stability,

(vi).Provides effective drainage to the track.

(vii). Provides an effective means of maintaining the level and alignment of the track.

Figure3.22 Depth of Ballast in a BG Track.

3.5.3 Properties of Track Ballast

(i). The ballast should be clean and graded crushed stone aggregate with hard, dense, angular particle structure providing sharp corners and cubical fragments with a minimum of flat and elongated pieces. These qualities will provide for proper drainage of the ballast section. The angular property will provide interlocking qualities which will grip the sleeper firmly to prevent movement. Excess flat and elongated particles could restrict proper consolidation of the ballast section.

(ii). The ballast must have high wear and abrasive qualities to withstand the impact of traffic loads without excessive degradation. Excessive abrasion loss of an aggregate will

result in reduction of particle size, fouling of the ballast section, reduction of drainage and loss of supporting strength of the ballast section.

(iii). The ballast particles should have high internal shearing strength to have high stability.

(iv). The ballast material should possess sufficient unit weight to provide a stable ballast section and in turn provide support and alignment stability to the track structure.

(v). The ballast should provide high resistance to temperature changes, chemical attack, exhibit a high electrical resistance and low absorption properties.

(vi). Ballast material should be free from cementing properties. Deterioration of the ballast particles should not induce cementing together of the degraded particles.

(vii). The ballast material should have less absorption of water as excessive absorption can result in rapid deterioration during alternate wetting and drying cycles.

(viii). The ballast gradation should be such that it allows development of necessary compressive strength, meet density requirements of the ballast section, uniform support, elasticity and provide necessary void space to allow proper runoff of ground water. It should reduce deformation of the ballast section from repeated track loadings.

3.5.4 Factors Influencing Design of Ballast And Sub Ballast

(i). Total static and dynamic loads coming on the track

The design of the ballast and sub-ballast should be such that they are able to successfully transmit all the loads coming on the track superstructure to the sub grade without any failure of the sub grade.

To understand the effect of the increase in axle load, traffic density etc. on track performance, it is necessary to understand the mechanism by which settlement occurs. A part of track settlement is attributed to ballast breakdown, its orientation and lateral creep. But most of the settlement is due to vertical settlement of the underlying sub grade. With increase in axle loads, stresses induced into sub grade increases proportionately which lead to increase in rate of settlement of sub grade. Though with increase in traffic density, stresses in sub grade do not increase but rate of settlement increases due to increased frequency of load application.

(ii). Speed of the trains

The speed of the trains affects the Dynamic Augment which in turn alters the magnitude of the load coming on the track. It has been observed that the stresses do not increase with speed but higher speeds call for better maintenance standards (tolerances).

(iii). Resilience/elasticity/flexibility of track structure for good running behaviour

Running of trains causes vibrations which are transmitted to the track through rail-wheel interaction. These vibrations influence the performance of the various track components. The ballast and subballast should be such that it absorbs the vibrations and transfers minimum disturbance to the sub grade.

(iv). Drainage

The ballast should be able to drain the track system as drainage is the first and prime consideration in the track maintenance and performance of a ballast material. A wet ballast section reduces the shearing strength of the assembly of ballast particles and dirty, moist ballast sections will support the growth of vegetation, reduces the drainage capability of the ballast material. The most important factor in contractive and expansive sub grade soil conditions which are prone to cause pumping conditions in the track section.

(v). Durability

The material should be such that it does not create fines that may fill the voids between the particles thereby inhibiting drainage. Further, excessive abrasion loss of an aggregate will result in reduction in particle size, fouling of the ballast section and loss of supporting strength of ballast section.

(vi). Cementing Properties

Some of the powdery fines of carbonate materials have a tendency to cement together and clogging action could occur. Further, cementing reduces resiliency and provides undesirable distribution of track loads and in most instances results in permanent track deformations. Cementing also interferes with track maintenance. So, a ballast material should be free of cementing properties.

(vii). Stability

To provide track stability, the ballast must perform several well defined functions. The ballast must sustain and transmit static and dynamic loads in three directions (transverse, vertical and longitudinal) and distribute these loads uniformly over the sub grade.

(viii). The ballast and sub ballast material should be such that it should be possible to get well compacted ballast and sub ballast section to provide a stable and uniform areas for the distribution of the track loads throughout the ballast section.

(ix). Uniform support to the super structure and distribution of track load to the sub grade.

(x). Ease in maintainability of the track parameters like, alignment, cross level and grade. It should allow retention of the track parameters.

(xi). The sub-ballast must be sufficiently impervious to divert most of the water falling into the track to the side drains to prevent saturation of the sub grade which could weaken/soften the sub grade and contribute to failure under load.

3.5.5 Depth of Ballast and Conventional Granular Sub ballast

Almost all leading world railways provide a layer of sub-ballast along with ballast. However, there is wide variation in the practices followed in different countries of the world. The depth of ballast and sub ballast which are in use on the various railways around the world are shown in the table 3.4.

Table3.5 Depth of Ballast and sub-ballast used around the world

S.N.	**RAILWAY SYSTEM**	**DEPTH OF**	
		BALLAST (MM)	**SUB-BALLAST (MM)**
1	Australia	200-300	150
2	England	225-375	Variable
3	France	150-350	Variable
4	Japan	300	200
5	Swedish Railways	240	90
6	USA	300	300

Studies conducted at FAST (Facility for Accelerated Surface Trials, Pueblo USA) have demonstrated that track geometry correction requirement both for alignment and profile variations were least for test sections having ballast depth 300mm and these increased for test sections having ballast depth both lower (150 mm) and higher (450mm) than 300mm.

3.5.6 Specifications for Ballast in India

(Existing specification for 22.82 axle load and 150 kmph speed)

(i). Type of material: Rock

(ii). Basic quality: Ballast should be hard, durable and as far as possible angular along edges/corners, free from weathered portions of parent rock, organic impurities and inorganic residues.

(iii). Particle shape: Ballast should be cubical in shape as far as possible. Individual particles should not be flaky and should have generally flat faces with not more than two rounded/sub rounded faces.

(iv). Mode of manufacture: Ballast should be Machine crushed.

(v). Aggregate abrasion value:30% Maximum. (Relaxable to 35% on technical and/or economic grounds).

(vi). Aggregate impact value: 20% Maximum. (Relaxable to 25% on technical and/or economic grounds).

(vii). Water absorption: 0.5% Maximum. 1% Maximum.

(viii). Size and gradation: Retained on 65 mm sq. mesh sieve - 5% maximum.
Retained on 40 mm sq. mesh sieve - 40%-60%.
Retained on 20 mm sq. mesh sieve - Not less than 98% for Machine Crushed Ballast.

(ix). Depth of ballast: Up to 350mm

(x). Depth of sub-ballast of conventional granular particles: Nil

(xi). Width of shoulder : 350 mm on straight
Width of ballast : 500 mm on curves.

3.5.7 Specifications for Ballast in Bangladesh

General requirement

The ballast shall be composed of crushed stone from Maddypara hard rock mine. The ballast must be hard, dense, strong, angular and durable particle structure providing sharp corners and cubical fragments with a minimum of flat and elongated pieces, free from clay, shale or an excess of dust or other undesirable substances or materials. The ballast must have high wear and abrasive qualities to withstand the impact of traffic loads track maintenance by heavy tamping machines without excessive degradation. The ballast must also provide high resistance to temperature change and chemical attack, have low absorption properties, and should be free of cementing properties.

Quality requirements

a) Stability and Resistance to Breakdown.

b) Deleterious Substance: Deleterious substances shall not be in prepared ballast in excess of the following amounts:

Soft and friable particles	2% by weight
Material finer than No.200 sieve	1% by weight
Moisture (when paid for by weight)	0.5 by weight.

The percentage of soft particles shall be determined in accordance with the current ASTM method for test designation C-127.

c) Stability and Resistance to Breakdown.

The crushed rock ballast materials shall meet or exceed the following limits:

i) The Los Angeles Abrasion test value (LAA) shall meet the requirements-.

LAA < 30% weight loss.

ii) Resistance to abrasion as determined by the Los Angeles Abrasion Machine shall be determined in accordance with the current ASTM method for test.

iii) Bulk Specific Gravity BSG of the ballast shall be greater than or equal to 2.60, while the water absorption shall not exceed 1.5%. Bulk specific gravity and absorption shall be made in accordance with the current ASTM method for test.

iv) Flakiness index of the ballast shall be in between 22-25.

Ballast grading requirement

The grading of ballast shall be determined by test with laboratory sieves having square openings and conforming to ASTM specifications.

No. 4 sieve shall conform to ASTM current standard specifications, designation E-11. Sieves coarser than No. 4 shall conform to the requirements outlined in ASTM current Standard Method for Sieve Analysis of Aggregates for Concrete, designation C-136.

Crushed rock ballast shall conform to the following gradation:

Normal Sieve Size	% Finer Than Each Sieve (By Weight)
60	100
50	80-100
40	60-80
20	15-50
10	0-10
No.4	0-1

Sieve analysis shall be made in accordance with the current ASTM method for test. Ballast particles shall be angular to sub-angular. At least 75% of the particles by weight shall have two or more fractured faces and at least 98% by weight shall have one fractured face. Less than 10% by weight of the particles shall be thin or elongated such that the length of the particles is more than 3 times the average thickness.

3.6 REQUIREMENTS OF AN IDEAL TRACK OR PERMANENT WAY

A good track should provide comfortable and safe journey at the maximum permissible speed with minimum maintenance cost. To achieve these objectives the track should meet the following requirements.

(i). The gauge of the track should be correct and uniform.

(ii). The alignment of the track should be correct. There should be no kinks and irregularity

(iii). In straight reaches the rail levels should be the same while on curves proper transition curve should be provided between straight and the curve.

(iv). The rails should have perfect cross levels. On curves the outer rail should have proper super elevation to take into account the centrifugal forces.

(v). The gradient should be uniform and as gentle as possible. The change of gradient should be followed by a vertical curve to give smooth ride.

(vi). In order to absorb shocks and vibrations of the moving train the track should be resilient and elastic.

(vii). The drainage system of the track should be perfect, so that the stability of the track is not affected due to water logging.

(viii). The friction between the wheels of the rolling stock and rails should be minimum.

(ix). The track should be designed in such a way that the load of the train should be distributed uniformly over it.

(x). Adequate provision of repair, replacement and renewal of damaged portion should be provided.

(xi). The track should possess sufficient lateral rigidity and stiffness so that it may withstand the lateral thrust and maintain' its stability due to variation of temperature and centrifugal force.

(xii). The track should possess high resistance to the damage at the time of derailment.

(xiii). Joints, points and crossings should be designed and maintained properly.

(xiv). The track should possess anti theft and sabotage qualities.

(xv). The structure of the track should he such that not only its initial cost is low, but its maintenance cost is also minimum.

(xvi). Special attention should be given for the design of super elevation and radii on curves. These should he maintained properly.

3.7 Capacity of Railway Track

The capacity of railway track is defined as the maximum number of trains that can run safely on any given length of the track per hour. In actual practice it is some what less due to safety considerations as speed of train, control and signaling system etc. The maximum number of trains which can be handled in a yard per day is known as terminal capacity.

Measures to increase the track capacity

The track capacity can be increased by adopting the following measures.

(i). The speed of all trains should be kept same. This can be achieved by providing uniform gauge and traction. The speed of trains can be increased by using diesel or electric traction.

(ii). All sections should be made of equal lengths.

(iii). To alert the driver regarding the position of the section ahead, multi aspect signaling may be adopted. This will help the driver to proceed with confidence at speed.

(iv). The speed of trains can also be increased by removing speed restrictions and making modifications in the existing track.

(v). The length of sections may decreased by providing additional crossing sections.

(vi). Reduction in stoppage time of trains will increase the track capacity.

(vii).To run the longer trains, the length of loops or crossing sections should be increased.

(viii). To meet the present requirements, existing yard facilities should be improved.

(ix).The sections and yards not provided with interlocking devices, should be interlocked.

(x). For quick shunting operations, additional operating facilities should be provided.

(xi). Traffic control on B.G. and M.G. should be centralised.

(xii). To permit higher speeds on main track routes, inter locking standards should be revised.

(xiii). Proper and new sophisticated safety measures be adopted.

3.8 MATERIALS REQUIREMENT PER KM LENGTH OF TRACK

Quantities of different materials required to lay one km track can be calculated as follows:

(i). No. of rails per km length = (1000 x 2)/(rail length)

For B.G. track 60 kg and 13.0 m length of rail recommended

$\therefore$ No. of rails per km length = 2 x1000/13 = 154.0

(ii). Weight of rail per km length

= No of rails x wt of rail per unit length x length of rail

= 154 x 13 x 60

= 120.120 kg

(iii). No. of sleepers per km = (No. of rails per km/ 2) x (1.0936 x length of rail+ x) gives sleeper density. On B.G. track the sleeper density is taken as

= (rail length + 7) = (13 + 7) = 20

Taking sleeper density as 20.

No. of sleepers per km track =(154/2) x 20 = 1540

(iv). No. of fish plates per 1 km of track length

= No of rails per km x 2

= 154 x 2

= 308 No.

(v). No. of fish bolt = 4 x No. of rails per km length

= 4 x 154 = 616 No.

(vi). No. of bearing plates = 2 x No. of sleeper per km length

= 2 x 1540 = 3080 No

(vii). No. of labour required to lay one km track (with 8 hour shift)

= Total tonnage + 20%

3.9 TRACK RENEWAL

3.9.1 Introduction

To keep the track safe and in good running condition and also to reduce the cost of maintenance, track renewal is adopted on all railway. Changing of rails, sleeper, fastenings etc. is known as track renewal or relaying of track. The track renewals may be complete track renewal, through sleeper renewal and through rail renewal etc. Indian railways spends crores of rupees every year on track renewal. As the track renewal is a costly proposal, it should be taken in hand after proper planning and detailed scrutiny at various levels of administration.

3.9.2 Necessity of Relaying the Track

Relaying of railway track is necessary due to one or more than one of the following reasons:

(i) The existing track is to be replaced by heavier sections to meet the requirements of increased Intensity of traffic, higher axle loads and higher speeds.

(ii) When old but serviceable materials of main lines are to be replaced by new materials and the released materials of the main lines are used on some branch lines of lesser intensity of traffic or on a siding or loop.

(iii) When the track components such as rails, sleepers, ballast, fastening etc. are completely won out.

3.9.3 Points to be Kept in Mind at the Time of Relaying of Track Operations

At the time of relaying operations of the track, following points should be born in mind:

(i). The planning of various operations should be done in such a way that the traffic is least affected and there is no risk for the passing trains. No traffic should be blocked.

(ii). The length of track to be relayed should be such that it can be easily completed during the working hours of the day and no speed restrictions are imposed on night trains. Normally this length should not exceed more than 1.5 km as far as possible.

(iii). The replacement of rails, sleepers and ballast simultaneously is more economical than their replacement separately.

(iv). The required materials and equipments should be brought by train and laid conveniently along the portion of the track to be relayed before the commencement of the actual operation.

(v). In order to allow the trains to pass with restricted speeds fastenings of the alternate sleepers should be removed. Fittings should not be disturbed before hand.

(vi). Super elevation on curves and alignment of the track should be done carefully.

(vii). The replaced material from the track should be taken back to stores through empty material trains.

(viii). For relaying the track at points and crossings complete set of point and crossings should be assembled on an elevated platform. The old sleepers are first replaced by new sleepers and then new set of points and crossings assembled is replaced by the old one. Finally gauging, aligning and packing is done as usual.

(ix). To complete the work within the stipulated time period, adequate number of labourers should deployed at a time.

(x). The sequence of relaying operations must be decided fully well in advance in the office taking factors into consideration.

(xi). On Indian railways for relaying one kilometer of track nearly 600 to 700 men are required for B.G. track and 500 to 600 men for M.G. track.

3.9.4 Classification of Track Renewal Works

Broadly track renewal or relaying can be classified into the following groups:

(i). Complete track renewal (C.T.R).In this case all components of the track over a particular length are renewed at a time. Necessary recoupment of ballast and provision of full ballast cushion is also done along with C.T.R. operation.
(ii). Through rail renewal (T.R.R). In this case entire lot of rails from point to point is replaced.
(iii). Through sleeper renewal (T.S.R). In this case all sleepers or entire lot of sleepers from point to point is replaced and necessary replacement of ballast and provision of full ballast cushion is also done along with the T.S.R.
(iv). Through cum causal renewal. In this case in some portion of the track through renewal is done and the remaining portion causal renewal is carried out.
(v). Causal renewal. In this case renewal of some unserviceable rails or sleepers or both generally is carried out with serviceable released rails and sleepers of similar type from some other track..
(vi). Spot renewals. In this case all unserviceable rails or sleepers or both are generally replaced with new materials in specified lengths. As far as possible, spot renewals of rails should be avoided.
(vii). Primary renewals. In this case all new permanent way materials are used.

3.9.5 General Principles of Track Renewals

Following are the general principles of track renewal:
(i). Track renewal should be planned to derive the maximum benefits such as removal of speed restriction permission of higher axle loads, introduction of higher speeds and reduction in the maintenance cost.
(ii). As far as possible complete track renewal should be planned on trunk routes and main lines at a time. Separate renewal of rails and sleepers should be avoided.

(iii). Primary renewals are generally carried out on important high density traffic routes.

(iv). Track renewals should be planned in reasonably long length preferably in a continuous block section.

(v). No track renewal should be planned purely on the basis that the existing track is below the prescribed standards.

(vi). The rail section should be so adopted that renewal on the basis of gross million tonne of traffic (G.M.T.) carried should not be earlier than 20 years.

(vii). The selection of sleepers should be done to suit the local conditions such as poor formation or susceptibility to corrosion etc.

(viii). Along with complete track renewal and through sleepers renewals, deep screening of ballast should also be done and full ballast cushion provided as per standard specified for that section.

(ix). The capacity to execute the renewal work in a particular section should be assessed accurately based on the physical resources available.

(x). Track renewal should be planned in a systematic way with an objective of long term planning in mind.

3.9.6 Criteria for Rail Renewals

Following criteria has been adopted for rail renewals:

(i) Rail failure or incidence of rail fracture.

(ii) Wear of rails.

(iii) Maintainability of track to the prescribed standards

(iv) Service life of rail.

(v) Plan based renewals..

Rail failure

At the time of rail renewals this factor should be given top priority as it involves the safety of the traffic. If on a particular section there are a number of rail failure or incidence of rail fractures, the renewal of rails should be adopted. In such situations ultrasonic testing of rails should be carried out and the decision for renewal of rails should be based on the results of such ultrasonic tests. If the rail failures on a section in a year is 4% or cumulative failure 10% then rail renewals should be adopted. The figures of 4% and 10% are just tentative figures.

Maintainability of track to the prescribed standards

There may be situations where due to local conditions like curves, steep gradients high speeds heavy axle loads wear of rails etc. the rail renewal becomes necessary before reaching the rail life for renewal. The renewal is adopted under the following conditions.

(i). Disproportionate cost of maintenance of track in safe condition.

(ii). Poor running quality of track in spite of extra efforts of maintenance of the track.

(iii). Poor condition of rails due to battering, hogging, scabbing, wheel bums, excessive corrosion of rail etc.

Service life of rails

The service life of a rail depends directly on the gross million tonnes (G.M.T.) of traffic carried by it. Due to the passage or moving loads, alternating stresses are created in the rail section. The number of reversal on stresses is directly related to G.M.T. carried by rails. Majority of rail fractures originate from the fatigue cracks, which depend on the total G.M.T. carried. The renewal of the track is considered after it has carried the minimum total traffic as shown in table. Table3.6 shows the service life of different type of rails.

Table3.6: Service life of rails

Gauge	B.G.	B.G.	B.G.	B.G.	B.G.	M.G.	M.G.
Rail section	60 kg	60 kg	52 kg	52 kg	90R	75 R	60R
G.M.T. carried	800	550	525	350	250	150	125

Sections with low traffic density.

Gauge	Rail see/ion	Traffic density	Age/criteria for renewal
B.G.	52 kg/m	Below 10 GM.T.	Not less than 45 to 50 years
	90R	Below 8 G.M.T.	
M.G.	15-R-.	Below 2.5 G.M.T.	do
	60R	Below 2.5 G.M.T.	do

3.9.7 Age of Sleepers

The service life of sleepers is prescribed as follows:

(i) Wooden-10 years

(ii) CST-9 & steel sleepers- 20 years for A, B and C routes and 25 years for D & E routes.

(iii) The condition of sleepers and rails is the ultimate criteria for the track renewal.

(iv) Cast iron and concrete sleepers-Their age is taken as 40 to 50 years.

Plan Based Renewals

With the objective of modernisation of the track structure on selected routes in the quickest possible time, the track renewals may be planned even if it has not attained its service life i.e. pre matured renewal of track may be planned.

3.9.8 Renewals of Sleepers

A sleeper is considered unserviceable when it is not able to either to hold the gauge or retain packing. Resleepering is justified when the percentage of unserviceable sleepers is 30% on trunk and main routes and 35% on other lines. The resleepering should be done in continuous stretches and the serviceable released sleepers should be used for causal renewals.

The different kinds of sleepers should be replaced under following conditions:

(i) Wooden sleepers. Wooden sleepers are considered unserviceable in case they are split, broken, burnt or rounded under side with rail seats deeply cut. They are also considered unserviceable when they become spike killed or spikes loose the gripping power or there is general deterioration in the structure of the sleepers as a whole due to attack by insects etc. Generally the life of wooden sleeper is taken as 10 years.

(ii) Steel sleeper. Steel sleepers become unserviceable when there is excessive corrosion; rail seats or legs have cracked or holes in sleepers have elongated to such an extent that they are unable to hold loose jaws, keys and elastic rail clips etc. The life of steel sleepers is taken as 40 to 50 years.

(iii) Cast iron sleepers. Cast iron sleepers are considered unserviceable when the rail seat or the sleeper plate has cracked or broken or the wear of lugs and rail seat is so excessive that the sleeper has lost the grip on rail and keys have become loose resulting in the creep. These sleepers are also considered unserviceable when the tie bars have excessively corroded. The average life of cast iron sleepers is taken as- 40 to 50 year.

CHAPTER-4

ROLLING STOCKS AND ITS STATUS IN BANGLADESH

4.1 ROLLING STOCK

Rolling stock is the collective term that describes all the vehicles that move on a railway. It usually includes both powered and unpowered vehicles. However, the term is sometimes used to refer only to non-powered vehicles; specifically, excluding locomotives, which may be referred to as running stock or motive power.

4.2 LOCOMOTIVE

A locomotive is a railway vehicle that provides the motive power for a train. The word originates from the Latin loco – "from a place", Latin motivus, "causing motion", and is a shortened form of the term locomotive engine, first used in the early 19th century to distinguish between mobile and stationary steam engines.

Traditionally, locomotives pull trains from the front. Increasingly common is push-pull operation, where a locomotive pulls the train in one direction and pushes it in the other, and can be controlled from a control cab at the other end of the train.

4.2.1 Classification of Locomotives Based on Motive Power

Motive Power

Locomotives may generate their power from fuel (wood, coal, petroleum or natural gas), or they may take power from an outside source of electricity. It is common to classify locomotives by their source of energy.

4.2.1.1 Steam

In the 19th century the first railway locomotives were powered by steam, usually generated by burning coal. Because steam locomotives included one or more steam engines, they are sometimes referred to as "steam engines". The steam locomotive remained by far the most common type of locomotive until after World War II.

Steam locomotives were in regular use until 2004 in the People's Republic of China, where coal is a much more abundant resource than petroleum for diesel fuel. India switched over from steam-powered trains to electric and diesel-powered trains in the 1980s, except heritage trains. In some mountainous and high altitude rail lines, steam engines remain in use because they are less affected by reduced air pressure than diesel engines

4.2.1.2 Diesel locomotive

A Diesel locomotive is a type of railroad locomotive in which the prime mover is a Diesel engine. Several types of Diesel locomotive have been developed, the principal distinction being in the means by which the prime mover's mechanical power is conveyed to the driving wheels (drivers). By the mid 20th century the Diesel locomotive had become the dominant type of locomotive in much of the world, offering greater flexibility and performance than the steam locomotive, as well as substantially lower operating and maintenance costs. Currently, almost all Diesel locomotives are Diesel-electric.

Diesel-mechanical

A diesel-mechanical locomotive uses a mechanical transmission in a fashion similar to that employed in highway vehicles.

Diesel-electric

In a Diesel-electric locomotive the Diesel engine drives an electrical generator whose output provides power to the traction motors. There is no mechanical connection between the engine and the wheels. The important components of Diesel-electric propulsion are the diesel engine (also known as the prime mover), the main generator, traction motors and a control system consisting of the engine governor, and electrical or electronic components used to control or modify the electrical supply to the traction motions, including switchgear, rectifiers, and other Motor controller devices such as Inverters, load resistors or other components.

Diesel-hydraulic

Diesel-hydraulic locomotives use hydraulic transmission to convey the power from the diesel engine to the wheels. On this type of locomotive, the power is transmitted to the wheels by means of a device called a torque converter. To match engine speed to load speed over the entire speed range of a locomotive some additional method is required to give sufficient range. The diesel-hydraulic locomotive has two distinct advantages over the the diesel-electric. First, it is lighter for the same power output. This is particularly important for usage on branch lines allowing only smaller axle loads, which had been the case in Germany for a long time. Main lines, built for higher axle loads, had already been electrified over there which, e.g., was not the case in the US where diesel locomotives were used on main lines as well. Secondly, the factor of adhesion is better meaning higher starting tractive effort relative to the locomotive weight. This is because in a diesel-electric all driven axles are driven by individual electric motors and can lose grip individually whereas in a diesel-hydraulic all axles are interconnected via shafts and universal joints. Thus, all axles must rotate at the same speed which makes individual slipping of axles impossible.

Diesel-steam

Steam diesel hybrid locomotive can use steam generated from a boiler or diesel to power a piston engine. The Cristiani Compressed Steam System used a diesel engine to power a compressor to drive and recirculate steam produced by a boiler; effectively using steam as the power transmission medium, with the diesel engine being the prime mover. Additionally diesel fuel can be used as a medium to power a steam boiler, as is done with fuel oil.

India has Diesel electric and diesel hydraulic locomotives. The power of these locomotives vary from 2600 HP to 700 HP. These locomotives are manufactured in India. For example, for high speed broad gauge Mixed Traffic rolling stocks , Power- 2600 HP, V16, Turbocharged ,Air Braked Diesel Locomotives are used. Such locomotives were designed by Alco of the 60's now manufactured by Diesel Locomotive Works, Varanasi (DLW). For their branch line Mixed Traffic rolling stocks , Power- 2000 HP, Vacuum Braked, Diesel Locomotives are used. For broad gauge Freight rolling stocks, Power- 3100 HP, Air Braked, Diesel Locomotives are used. Diesel Locomotive Works, Varanasi (DLW)., India developed this loco in 1994. For broad gauge Shunting rolling stocks, Power- 700 HP, Vacuum Braked, Diesel Hydraulic Locomotives are used. German "Man" design of the 60's now manufactured at Chittaranjan Locomotive Works(CLW).

In England among the Diesel locomotives, Diesel-electric, Diesel-hydraulic, Diesel-mechanical loco are used. Some 150-370 Hp diesel-mechanical/ diesel-electric Shunter are used for Shunting operation. 650 Hp diesel-hydraulic locomotive built by British Railways for short distance trip freight work. Diesel-electric locomotive built by British Railways/ Clayton/ Birmingham RC&W/ Beyer Peacock/ North British / English Electric are used. The power of these Diesel-electric locomotives vary from 800-3300 HP. Diesel-hydraulic locomotive built by British Railways/ North British are used. The power of these Diesel-hydraulic locomotives vary from 2200-2700 HP

4.2.1.3 Diesel's advantages over steam

Diesel engines slowly eclipsed those powered by steam as the manufacturing and operational efficiencies of the former made them cheaper to own and operate. While initial costs of diesel engines were high, steam locomotives were custom made for specific railway routes and lines, and as such economies of scale were difficult to achieve.

Diesel locomotives offer significant operating advantages over steam locomotives. They can safely be operated by one person, making them ideal for switching/shunting duties in yards and the operating environment is much more attractive, being much quieter, fully weatherproof and without the dirt and heat that is an inevitable part of operating a steam locomotive. Diesel engines can be started and stopped almost instantly, meaning that a diesel locomotive has the potential to incur no costs when not being used. Steam locomotives require intensive maintenance, lubrication and cleaning before, during and after use. Preparing a steam locomotive for use can take many hours, especially if the locomotive is being fired from cold.

Maintenance and operational costs of steam locomotives were much higher than diesel counterparts even though it would take diesel locomotives almost 50 years to reach the same horsepower output that steam locomotives could achieve at their technological height. Annual maintenance costs for steam locomotives accounted for 25% of the initial purchase price. Steam engines also required large quantities of coal and water, which were expensive variable operating costs.

4.2.1.4 Electric

An electric locomotive is a locomotive powered by electricity from an external source. Sources include overhead lines, third rail, or an on-board electricity storage device such as a battery or flywheel system. Electrically propelled locomotives with on-board fueled prime movers, such as diesel engines or gas turbines, are classed as diesel-electric or gas turbine electric locomotives because the electric generator/motor combination only serves as a power transmission system.

Characteristics

One advantage of electrification is the lack of pollution from the locomotives themselves. Electrification also results in higher performance, lower maintenance costs, and lower energy costs for electric locomotives. Electric locomotives are also quiet compared to diesel locomotives since there is no engine and exhaust noise and less mechanical noise. The lack of reciprocating parts means that electric locomotives are easier on the track, reducing track maintenance. Power plant capacity is far greater than what any individual locomotive uses, so electric locomotives can have a higher power output than diesel locomotives and they can produce even higher short-term surge power for fast acceleration. Electric locomotives are ideal for commuter rail service with frequent stops. They are used on all high-speed lines, such as ICE in Germany, Acela in the US, Shinkansen in Japan and TGV in France. Electric locomotives are also used on freight routes that have a consistently high traffic volume, or in areas with advanced rail networks.The chief disadvantage of electrification is the cost for infrastructure (overhead power lines or electrified third rail, substations, control systems). It should also be noted that diesel locomotives have little power compared to electric locomotives, given the same weight and dimensions. For instance, the 2,200 kW of a modern British Rail Class 66 were already met in 1927 by the electric SBB-CFF-FFS Ae 4/7 (2,300 kW), which is even a bit lighter. However, for low speeds tractive effort is more important than power, which is a reason why diesel engines are competitive for slow freight traffic (as it is common in the US), but not for passenger or mixed passenger/freight traffic

In the United States it was estimated that it cost as much to electrify a railroad as it cost to build it in the first place. Overhead lines and third rails require greater clearances, and the right-of-way must be better separated to protect the public from electrocution, as well as from trains which approach much more quietly than diesels or steam. For most large systems the cost of electrifying the whole system is impractical, and generally only some divisions are electrified. In the United States only certain dense urban areas and some mountainous areas were electrified, and the latter have all been discontinued. The junction between electrified and unelectrified territory is the locale of engine changes.

Electrification is widespread in Europe. Due to higher density schedules the operating costs of the locomotives are more dominant with respect to the infrastructure costs than in the US, and electric locomotives have much lower operating costs than diesels. In addition, governments were motivated to electrify their railway networks due to coal shortages during the First and Second World War. The recent political developments in many European countries to enhance public transit have led to another boost for electric traction. High-speed trains like the TGV, ICE, AVE and Pendolino can only be run economically using electric traction, and the operation of branch lines is usually less in deficit when using electric traction, due to cheaper and faster rolling stock and more passengers due to more frequent service and more comfort.

In England among the Electric locomotives, 3rd rail DC electric locomotive built by British Railways are used. The power of these DC Electric locomotives vary from 1470-2552 HP. Overhead AC electric locomotive were built by Birmingham RC&W with BTH equipment/ Metropolitan Vickers/ English Electric/ North British, with GEC equipment/ British Rail, with Brush or GEC equipment. The power of these locomotives vary from 2900 HP to 6090HP. Former gas turbine locomotive converted to 2500 HP overhead AC electric locomotive. Dual system (overhead AC or 3rd rail DC) electric locomotive built by Brush are also used. The power of these loco are 6760 HP.

India switched over from steam-powered trains to electric and diesel-powered trains in the 1980s. In India both AC and DC type of electrified train systems operate today. 1500 V DC based train system is mostly operating in Mumbai area. It is being converted to 25 kV AC system. Rest of the India where routes are electrified mostly operates under 25 kV AC overhead wire. As of 2006, Indian railways haul 60% of freight and 50% of passenger traffic with electric locomotives. For example, for high speed broad gauge passenger rolling stocks, AC Traction, Power-5300 HP, Air Braked Electric Locomotives are used. And for broad gauge Freight rolling stocks, AC Traction, Power- 4400 HP, Vacuum & Air Braked, Electric Locomotives are used. For broad gauge Mixed Traffic rolling stocks, Dual Voltage Traction(AC Traction/ DC Traction), Power- 4700 HP , Air Braked, Electric Locomotives are used.

4.2.2 Classification of Locomotives Based on Utilisation

The three main categories of locomotives are often subdivided in their usage in rail transport operations. There are passenger locomotives, freight locomotives and switcher (or shunting) locomotives. These categories determine the locomotive's combination of physical size, starting tractive effort and maximum permitted speed. Freight locomotives are normally designed to deliver high starting tractive effort—needed to start trains that may weigh as much as 15,000 tons—and deliver sustained high power, at the sacrifice of maximum speed. Passenger locomotives develop less starting tractive effort but are able to operate at the high speeds demanded by passenger schedules. Mixed traffic locomotives are built to provide elements of both requirements. They do not develop as much starting tractive effort as a freight unit but are able to haul heavier trains than a passenger engine.

Most steam locomotives are reciprocating units, in which the pistons are coupled to the drivers (driving wheels) by means of connecting rods. Therefore, the combination of starting tractive effort and maximum speed is greatly influenced by the diameter of the drivers. Steam locomotives intended for freight service generally have relatively small

diameter drivers, whereas passenger models have large diameter drivers (as large as 84 inches in some cases).

With diesel-electric and electric locomotives, the gear ratio between the traction motors and axles is what adapts the unit to freight or passenger service, although a passenger unit may include other features, such as head end power or a steam generator. Some locomotives are designed specifically to work mountain railways, and feature extensive additional braking.

4.3 LOCOMOTIVES IN BANGLADESH

Bangladesh Railway now owns basically two types of locomotives viz. Diesel Electric (DE) & Diesel Hydraulic (DH). The total fleet as on 30th June2007 comprised 253 Diesel Electric (68 BG, 158 MG) and 32 Diesel Hydraulic (9 BG & 23 MG) locomotives.

The existing main line locos are all DE type manufactured by ALCO (USA), MLW/Bombardier Inc. (Canada) & Hitachi (Japan) for BG and General Motors (USA/Canada), MLW (Canada), Hitachi (Japan), ABB Henschel (Germany), DLW (India) and Hyundai (S. Korea) for MG.

For the improvement of rail the Present Government has taken various initiatives. The collection of 21 Metre gauge locomotives; development of the Pahartoli railway workshop, projects are going on and will be completed within 2012.

Collection of 47 DE locomotives are the significant achievement of the present government.

4.3.1 Locomotive Performance

During the year 2006-2007, average distance travelled by a Metre Gauge Locomotive was 172 kilometres per day. Average kilometrage travelled by a locomotive all engine actually in use was 239 kilometres per day . Average distance covered by a goods locomotives actually in use, was 175 kilometres per day. Year-wise position of BG locomotive are shown in table 4.1.

During the year 2006-2007, average distance travelled by a Broad Gauge Locomotive was 163 kilometres per day. Average kilometrage travelled by a locomotive all engine actually in use was 295 kilometres per day . Average distance covered by a goods locomotives actually in use, was 178 kilometres per day.Having no other alternatives, the loco in use have to pay extra duty.

The lifetime of a rail locomotive is 20 years. But only 28% of total engines of Bangladesh are of age less than 20 years. Most of the rest are above 40 years aged. The age of the locomotives are shown in the table4.2. The classwise locomotives are shown in the table4.3. Because of these old engines, and having no many extra engines delay occurs in rail movement.

Table4.1:Year-wise position of BG locomotive:

Year (July- June)	Engine kilo-metres per day per engine on line	Engine kilometres per day per engine in use		Percentage of average number of engine under or awaiting repairs daily to average total number on line	Hours workd per day per engine available for use
		All Engines	Goods Engines		
1969-70	130	230	154	8.3	10.3
1996-97	181	261	116	19.1	12.8
1997-98	182	267	135	19.3	13
1998-99	166	261	149	21.2	11.5
1999-00	169	253	150	22.8	11.6
2000-01	173	253	141	23.4	13.5
2001-02	157	259	159	20.5	14.7
2002-03	156	262	152	19.9	14.7
2003-04	163	279	160	18.5	11.4
2004-05	162	289	162	24.8	12.3
2005-06	165	283	166	24.5	12.5
2006-07	163	295	178	26.0	13.0
2007-08	183	285	169	26.2	16.2

Figure 4.1: BG Loco-6404, BED-26

[ALCO\ DLW, INDIA, 2600 HP, Built Year-2001, Present Holding-13]

Figure 4.2 : BG Loco-6003, BEA-20

[ALCO, USA, 2000 HP, Built Year-1966, Present Holding-17]

Figure 4.3 : BG Loco 6007, BEA-20

Figure4.4: BG Loco 6015

Figure4.5:BG Loco6310, BEB-22

[ALCO/ BOMBAR, CANADA, 2250 HP, Built Year-1981, Present Holding-12]

Figure4.6:MG Loco-2708, MEL-15

[GM/ HANSEL, GERMANY, 1500 HP, Built Year-1995, Present Holding-21]

Figure4.7:MG Locomotive2225, MEG-9

[GM, USA, 875 HP, Built Year-1960, Present Holding-36]

Figure4.8: MG Loco2225,

Figure4.9: MG Loco2603, MEG-15

[GM, CANADA, 1500 HP, Built Year-1988, Present Holding-16]

Figure4.10: MG Loco2915, MEI-15

[GM/HYUNDAI/ROTEM, KOREA, 1500HP, Built Year1999/2005, Present Holding-19]

Figure4.11: MG Locomotive at running state (people moves dangerously on loco)

Figure5.12: Loco2301, MEM-14

[ALCO, CANADA, 1380 HP, Built Year-1969, Present Holding-21]

4.4 RAILWAY CARRIAGE

Railway carriage is a vehicle on a rail transport system (railroad or railway) that is used for the carrying of cargo or passengers. Cars can be coupled together into a train and hauled by one or more locomotive. Passenger cars can be self propelled in which case they can be single or multiple units. Such uses can generally be divided into the carriage of passengers and of freight. "Revenue" cars are basically of two types: passenger cars, or coaches, and freight cars or wagons.

4.4.1 Passenger Cars or Coaches

A passenger car (known as a coach or carriage in the UK) is a piece of railway rolling stock that is designed to carry passengers. The term passenger car can also be associated with a sleeping car, baggage, dining and railway post office cars.

Up until about the end of the 19th century, most passenger cars were constructed of wood. As locomotive technology progressed in the mid-19th century, trains grew in length and weight. Passenger cars, particularly in America, grew along with them, first getting longer with the addition of a second truck (one at each end), and wider as their suspensions improved. Cars built for European use featured side door compartments, while American car design favored what was called a "coach", a single long cabin with rows of seats, with doors located at the ends of the car. Early American sleeping cars were not compartmented, but by the end of the 19th century they were. The end platforms of all passenger cars changed around the turn of the 19th century. Older cars had open platforms between cars. Passengers would enter and leave a car through a door at the end of the car which led to a narrow platform. Steps on either side of the platform were used for getting on or off the train, and one might hop from one car platform to another. Later cars had enclosed platforms called vestibules which allowed passengers not only to enter and exit the train protected from the elements, but also to move more easily between cars with the same protection. The introduction of vestibule cars, which

for the first time allowed easy movement from car to car, aided the adoption of dining cars, lounge cars, and other specialized cars.

Now that passenger cars were lighter, they were able to carry heavier loads, but the size of the average passenger that rode in them didn't increase to match the cars' new capacities. The average passenger car couldn't get any wider or longer due to side clearances along the railroad lines, but they generally could get taller because they were still shorter than many freight cars and locomotives. So the railroads soon began building and buying dome and bilevel cars to carry more passengers.

The higher clearances in North America enabled a major advancement in passenger car design, bi-level (double-decker) commuter coaches that could hold more passengers. High-speed trains are made up of cars from a single manufacturer and usually of a uniform design. Often tilting and high-speed cars are left in "trainsets" throughout their service. For example, articulated cars cannot be uncoupled without special equipment because the individual cars share trucks. This gives modern trains a smooth, coherent appearance because all the cars and often the engines share a similar design and paint scheme.

4.4.2 Car Types

Traditionally the passenger car can be split into a number of distinct types. The most basic division is between cars which do carry passengers and "head end" equipment. The latter are run as part of passenger trains, but do not themselves carry passengers. Traditionally they were put between the locomotive and the passenger-carrying cars in the consist, hence the name.

Some specialized types are variants of or combine elements of the most basic types. Also the basic design of passenger cars is evolving, with articulated units that have shared

trucks, with double-decker designs, and with the "low floor" design where the loading area is very close to the ground and slung between the trucks.

Passenger-carrying types

Coach

The coach is the most basic type of passenger car, also sometimes referred to as 'chair cars'.

Two main variants exist: 'Open', with a centre corridor; the car's interior is often filled with row upon row of seats like that in a passenger airliner, other arrangements of the 'open' type are also found, including seats around tables, seats facing windows (often found on mass transit trains since there is increase standing room for rush hours), as well as variations of all three. Seating arrangement is typically [2+2]. The seating arrangements and density, as well as the absence or presence of other facilities depends on the intended use - from mass transit systems to long distance luxury trains.

The other variant is the 'Compartment car', in which a side corridor connects individual compartments along the body of the train, each with two rows of seats facing each other.
In both arrangements carry-on baggage is stowed on a shelf above the passenger seating area. The opening into the cars is usually located at both ends of the carriage, often into a small hallway - which in railway parlance is termed a vestibule. In India normal carriages often have double height seating, with benches (berths), so that people can sit above on another (not unlike a bunk bed), in other countries true double decker carriages are becoming more common.

The seats in most coaches until the middle of the 20th century, were usually bench seats; the backs of these seats could be adjusted, often with one hand, to face in either direction so the car would not have to be turned for a return trip. The conductor would simply walk down the aisle in the car, reversing the seat backs to prepare for the return trip. This arrangement is still used in some modern trains.

Dining car

A dining car (or diner) is used to serve meals to the passengers. Its interior is split with a portion of the interior partitioned off for a galley, which is off-limits to passengers. A narrow hallway is left between the galley and one side wall of the car for passengers to use. The remainder of the interior is laid out with tables and chairs to look like a long, narrow restaurant dining room. There is special personnel to perform waitstaff and kitchen duties.

Sleeping car

The sleeping car or sleeper (often wagon-lits) is a railroad passenger car that can accommodate all its passengers in beds of one kind or another, primarily for the purpose of making nighttime travel more restful. The first such cars saw sporadic use on American railroads in the 1830s and could be configured for coach seating during the day. Some of the more luxurious types have private rooms, that is to say fully- and solidly-enclosed rooms that are not shared with strangers.

In the United States today, all regularly-scheduled sleeping car services are operated by Amtrak. Amtrak offers sleeping cars on most of its overnight trains, using modern cars of the private-room type exclusively. In Canada, all regularly scheduled sleeping car services are operated by VIA Rail Canada, using a mixture of relatively-new cars and refurbished mid-century ones; the latter cars include both private rooms and "open section" accommodations.

An example of a more basic type of sleeping car is the European couchette car, which is divided into compartments for four or six people, with bench-configuration seating during the day and "privacy less" double- or triple-level bunk-beds at night. Even more basic is the Chinese "hard" sleeping car in use today, consisting of fixed bunk beds, which cannot be converted into seats, in a public space. Chinese trains also offer "soft" or deluxe sleeping cars with four or two beds per room.

China's railways operate an extensive network of sleeper trains throughout the country with high ridership, covering all provincial capitals and many major cities. Many tracks are being upgraded and service speeds increased.

A major portion of passenger cars in the Republic of India are sleeper cars. With railways as the primary mode of passenger transport, sleeper cars vary from economical to First Class AC. Indian Sleeper Cars are usually in either 3-tier or 2-tier arrangements.
Japan has a number of sleeper car trains. Many routes are still popular despite curtailment after the arrival of a high speed rail system.

Head-end equipment

Baggage car

Although passengers generally were not allowed access to the baggage car, they were included in a great number of passenger trains as regular equipment. The baggage car is a car that was normally placed between the train's motive power and the remainder of the passenger train. The car's interior is normally wide open and is used to carry passengers' checked baggage. Baggage cars were also sometimes commissioned by freight companies to haul less-than-carload (lcl) shipments along passenger routes (Railway Express Agency was one such freight company). Some baggage cars included restroom facilities for the train crew, so many baggage cars had doors to access them just like any other passenger car. Baggage cars could be designed to look like the rest of a passenger train's cars, or they could be repurposed box cars equipped with high-speed trucks and passenger train steam and air connections.

Express car

Express cars carried high value freight in passenger consists. These cars resembled baggage cars, though in some cases specially equipped box cars or refrigerator cars were used.

Horse car

Specialized stock cars were used to transport horses and other high value livestock as part of passenger consists. Similar equipment is used in circus trains to transport their animals.

Prisoner car

In some countries, convicts are transported from court to prison or from prison to another by railway. In such transportation a specific type of coach, prisoner car, is used. It contains several cell comepartments with minimal interior and commodities, and a separate guard compartment. Usually the windows are of nontransparent opaque glass to prevent prisoners from seeing outside and determine where they are, and windows usually also have bars to prevent escapes. Unlike other passenger cars, prisoner cars do not have doors at the ends of the wagon.

Railway post office

Like baggage cars, railway post office (RPO) cars were not accessible to paying passengers. These cars' interiors were designed with sorting facilities that were often seen and used in conventional post offices around the world. The RPO is where mail was sorted while the train was en route. Because these cars carried mail, which often included valuables or quantities of cash and checks, the RPO staff (who were employed by the postal service and not the railroad) were the only train crews allowed to carry guns. The RPO cars were normally placed in a passenger train between the train's motive power and baggage cars, further inhibiting their access by passengers.

4.4.3 Specialized Types

Combine

A combine is a car that combines features of a head-end and a regular passenger car. The most common combination is that of a coach and a baggage car, but the combination of coach and RPO was also common. Combines were used most frequently on branch lines and short line railroads where there wasn't necessarily enough traffic to economically justify single-purpose cars. As lightweight cars began to appear on railroads, passenger cars more frequently combined features of two or more car types on one car, and the classic heavyweight combine fell out of use.

Control car (cab)

A control car (also known as a 'Driving Trailer' in Europe and the UK) is a passenger car which lets the train be run in reverse with the locomotive at the back. It is common on commuter trains in the US and Europe. This can be important for serving small towns without extensive switching facilities, dead-end lines, and having a fast turn around when changing directions in commuter service.

Double-decker or bi-level

As passenger car construction improved to the point where dome cars were introduced, some passenger car manufacturers began building double decker passenger train cars for use in areas that are more heavily populated or to carry more passengers over a long distance while using fewer cars. Cars used on long-distance passenger trains could combine features of any of the basic car types, while cars used in local commuter service are often strictly coach types on both levels.

Double decker coaches were tried in the UK (SR Class 4DD) but the experiment was unsuccessful because the restricted British loading gauge resulted in cramped conditions.

Troop sleeper

A "troop sleeper" was a railroad passenger car which had been constructed to serve as something of a mobile barracks (essentially, a sleeping car) for transporting troops over distances sufficient to require overnight accommodations. This method allowed part of the trip to be made overnight, reducing the amount of transit time required and increasing travel efficiency. Troop kitchens, rolling galleys, also joined the consists in order to provide meal service en route (the troops took their meals in their seats or bunks). Troop hospital cars, also based on the troop sleeper carbody, transported wounded servicemen and typically travelled in solid strings on special trains averaging fifteen cars each.

Hospital car

A variety of hospital trains operate around the world, employing specialist carriages equipped as hospital wards, treatment rooms, and full-scale operating theatres.

Car technology

Passenger cars are as almost as old as railroading itself, and their development paralleled that of freight cars. Early two axle cars gave way to conventional two truck construction with the floor of the car riding above the wheels; link and pin couplers gave way to automatic types.

Several construction details characterized passenger equipment. Passenger trains were expected to run at higher speeds than freight service, and therefore passenger trucks evolved to allow superior ride and better tracking at those speeds. In the United States (and often in other countries) provision was made for passengers and train staff to move from car to car; therefore platforms and later vestibules were used to bridge the gap.

In later years a number of changes to this basic form were introduced to allow for improvements in speed, comfort, and expense.

Articulated

Articulated passenger cars are becoming increasingly common in Europe and the US. This means that the passenger cars share trucks and that the passageways between them are more or less permanently attached. The cars are kept in "trainsets" and not split up during normal operations.

Articulated cars have a number of advantages. They save on the total number of wheels and trucks, reducing costs and maintenance expenses. Further, movement between cars is safer and easier than with traditional designs. Finally, it is possible to implement tilting schemes such as the Talgo design which allow the train to lean into curves. The chief disadvantage is that failure of a single car disables the entire set, since individual cars cannot be readily switched in and out of the consist.

Low-floor

Low-floor cars have their main passenger and loading floor directly on level with the loading platform, instead of having a step up to the passenger compartment as was traditional until around the 1970s. This is achieved by having a low-slung chassis with the "low floor" resting between the trucks, rather than resting completely on top with a simpler straight chassis design. This improved design is seen in many passenger cars today, especially double decker cars. The low floor enables access for bicycles, strollers, wheelchairs and those with disabilities, which is otherwise not always convenient or even possible with the traditional passenger car design.

4.4.4 Freight Cars

At the beginning of the railway era, the vast majority of goods wagons were four-wheeled vehicles of simple construction. These were almost exclusively small covered wagons, open wagons with side-boards, as well as flat wagons with and without stakes used. But over the course of time an increasing number of specialised wagons were developed.

Special wagons for specific purposes or wagons with special features were already being introduced around 1850 by private companies. Amongst these were tank wagons and numerous refrigerated vans.

In the early days of the railway goods trains still ran at top speeds of about 20 mph (32 km/h). However the introduction of through brakes using air pipes from the 1920s enabled higher speeds to be safely achieved.. Modern goods wagons are authorised for speeds up to around 75 mph (121 km/h) and are increasingly equipped with GPS receivers and transponders which provide location monitoring as required.

Types of goods wagon

The numerous types of goods wagon are categorised here based on their main design features and in accordance with the international UIC classification system:

Freight cars/ wagons or trucks exist in a wide variety of types, adapted to the ideal carriage of a whole host of different things. Originally there were very few types of cars; the boxcar / van, a closed box with side doors, was among the first.

Common types of freight cars include:

(i). Aircraft Parts Car

(ii). Autorack - (also called auto carriers) are specialized multi-level cars designed for transportation of unladen automobiles.

(iii). Boxcar (US), covered wagon (UIC) or van (UIC) - box shape with roof and side or end doors.

(iv). CargoSprinter - a self propelled container flatcar.

(v). Centerbeam cars

(vi). Coil car - a specialized type of rolling stock designed for the transport of coils of sheet metal, particularly steel.

(vii). Conflat (UK) - A flat truck for carrying containers.

(viii). Covered wagon (UIC), van (UIC) or boxcar (US) - fully enclosed wagon for moisture-susceptible goods.

(ix). Covered hopper - similar to open top hoppers but with a cover for weather and temperature-sensitive loads.

(x). Double-Stack Car (or well car) - specialized cars designed for carrying shipping containers. These have a "well" with a very low bottom floor to allow double stacking.

(xi). Flatcar (or flat) - for larger loads that don't load easily into a boxcar. Specialized types such as the depressed-center flatcar (aka "well car") exist for oversize items or the Schnabel car for even larger and heavier loads. With the advent of containerized freight, special types of flatcars were built to carry standard shipping containers and semi-trailers.

(xii). Gondola (US) - railroad car with an open top but enclosed sides and ends, for bulk commodities and other goods that might slide off.

(xiii). Hicube boxcars

(xiv). Hoppers - similar to gondolas but with bottom dump doors for easy unloading of things like coal, ore, grain, cement, ballast and the like. Short hoppers for carrying iron ore are called ore jennys in the US.

(xv). Lorry - An open wagon (UIC) or gondola (US) with a tipping trough, often found in mines.

(xvi). Lowmac (UK) - A low-floor wagon for carrying machinery.

(xvi). Modalohr Road Trailer Carriers.

(xvii). Open wagon (UIC) - railway wagon with an open top but enclosed sides and ends, for bulk commodities and other goods that might slide off.

(xvii). Refrigerator car (or reefer) - a refrigerated subtype of boxcar.

(xviii). Roll-block - a train designed to carry another railway train.

(xix). Side Dump Cars - used to transport roadbed materials such as, ballast, riprap, and large stone, and are able to unload anywhere along the track.

(xx). Slate wagon - specialized freight cars used to transport slate.

(xxi).Stock Car - for the transport of livestock.

(xxii). Tank car (US), tank wagon (UIC) (or tanker) - for the transportation of liquids or gases.

(xxiii). Tippler (UK), Gondola (US) (or Lorry) - An open wagon with no doors or roof which are unloaded by being inverted on a Wagon Tippler (UK) or Rotary car dumper (US). They are, used for minerals, such as coal, limestone and iron ore as well as other bulk cargo.

(xxiv). Transporter wagon - a wagon designed to carry other railway equipment.

(xxv). "Whale Belly" car, a tank car with a "belly".

The vast majority of freight cars fit into the above categories.

Non-Revenue Cars

(i). Cabooses (or guard's vans or brakevans) which attach to the rear of freight trains to order to watch the train and assist in shoving moves.

(ii). Clearance car, special car to check for obstructions.

(iii). Handcars, which are powered by their passengers.

(iv). Maintenance of way (MOW) cars, for the maintenance of track and equipment.

(v). Tower cars used to maintain overhead lines

(vi). Track tester

(vii). Rail car mover — some of which resemble HiRail trucks.

(viii). Railroad cranes

(ix). Road-rail vehicle

(x). Scale test car

(xi). Crew car or a Camp Car

Military cars

Military armoured trains use several types of specialized cars:

(i). artillery — fielding mixture of guns and machine guns

(ii). infantry — fielding machine guns, designed to carry infantry units

(iii). machine gun — dedicated to machine guns

(iv). anti-air — equipped with anti-air guns

(v). command — similar to infantry wagons

(vi). anti-tank — equipped with anti-tank guns, usually in a tank gun turret

(vii). platform — unarmoured, with purposes ranging from transport of ammunition or vehicles, through track repair or derailing protection to railroad ploughs for railroad destruction.

(vii).troop sleepers

During the Cold War, the Soviet Union fielded a number of trains that served as mobile missile silos. These trains carried the missile and everything necessary to launch, and were kept moving around the railway network to make them difficult to find and destroy in a first-strike attack. A similar Mobile Minuteman system was proprosed but not deployed in the United States.

4.5 RAILWAY CARRIAGE IN BANGLADESH

4.5.1 Coaching Vehicles

At the end of the year 2006-2007, BR had a totl of 1416 (BG=324, MG=1092) coching vehicles out of which 1385 (BG=310, MG=1075) are for conveyance of passengers and 31 (BG=14, MG=17) are for conveyance of luggage, parcels, mails etc. as well as for departmental use. Type Wise Passenger Coaching Vehicle and their number are shown in the table 4.5. The existing coaches are manufactured in Japan, UK, Scotland, India, Korea, Pakistan etc. The increasing passengers demand more numbers of rolling stocks and coaches. The damaged/ out of order coaches should be repaired and new coaches should be imported. The Mechanical Workshops o BR should be improved for cost savings and better passenger service.

The present government has taken 9 projects at a cost of about three thousand crore taka for the improvement of rail in Bangladesh. Out of that collection of a 60 M Ton MG Crane and a 80 M Ton BG Crane for the accident relief train, provide and install load monitoring device at both end of the Bangabondhu Bridge, Rehabilitation of 200 MG and 60 BG coaches, are among these projects. These projects have already been approved by the Executive Committee of National Economic Council (ECNEC). Figure 4.13 to 4.34 represent the various feature of the coaches use in Bangladesh.

Figure4.13: A Series of BG Coaches [Silk-City Express]. (The Latest Coaches from Indonesia)

Figure4.14: OutSide View of a BG Shovan Chair Coach (WEC-7315). [INDONESIA, Year Built-2007, Seat-92, Breath-10’8”, Height-12’9.5”, Axle Load-13 M Ton]

Figure4.15: Chairs of a BGShovan Chair Coach (WEC). [Window can be open partly.]

Figure4.16: OutSide View of a BG Air-Conditioned Chair Coach (WJCC-7205). [INDONESIA, Year Built-2007, Seat-80, Axle Load-13 M Ton]

Figure4.17: Inside View of a BG Air-Conditioned Chair Coach (WJCC).

Figure4.18: OutSide View of a Shovan Class Coach (WY-4216). [Window open fully] [DENMARK, Year Built-1992, Seat-104, Breath-10’8”, Height-12’9.5”, Axle Load-13 M Ton]

Figure4.19: A BG Composite Power Car with Shovn Class Coach.

Figure4.20: A Series of BG Coaches [Modhumoti Express]. { The Most Common BG Coaaches}

Figure4.21: BG Composite Shulov Class with Lugage and Guard Room (WYLR-3841). [PAKISTAN, Year Built-1979, Seat-48, Axle Load-13 M Ton]

Figure4.22: Inside View of a BG Dining Car (WCDE). [Attached with Madhumoti Express, Poor Condition and dirty.]

Figure4.23: OutSide View of a Shulov Class Coach (WY). [Some windows are damaged, colour of the coach is dirty]

Figure4.24: A Close View of a BG Second Class Coach (S-5243). [GERMAN, Year Built-1972, Seat-97, Axle Load-11.55 M Ton]

TABLE4.4: Type Wise Passenger Coaching Vehicle

TYPE	**BG**	**MG**
BOGIE CARRIAGE		
01. Fully Air-Conditioned (WJC)	--	10
02. Partial Air-Conditined (WJFC, JFC, JFS, JFY)	18	9
03. Shovan Air-Conditioned(WJFC)	--	7
04. Chair Car (WCC)	--	24
05. First Class Shovan Coupe (WFC, WFE, FC)	7	63
06. First Class Compartment (F)	1	--
07. Shovan Class (WE)	26	105
08. Shovan Sleeping Coaach (WES)	--	5
09. Shovan Chair Coach (WEC)	35	77
10. Shulov Class (WY,Y)	29	23
11. Second Class(S)	80	424
12. Composite First & Shulov Class (WFY,WFC)	6	--
13. Composite First & Second Class (FS)	11	2
14. Composite Dining Car with Sovon Class(WECDE, WECDS, WECCD)	7	13
15. Composite Dining Car with Sovon Class(WECDY, CDY, WCD)	5	7
16. Composite Dining Car with Guard Room (WCDR, WCD)	--	8
17. Composite Dining Car with Second Class(CDS)	--	2
18. Composite Shovan Chair, Shulov Class with Luggage & Guard Room (WELR, YLR, ER, WER, WYR)	34	34
19. Composite Shulov Class with Luggage & Guard Room (WYLR)	--	10
20. Composite Second Class with Luggage & Guard Room (SLR)	8	94
21. Composite Second Class with Postal van(SPP)	--	8
22. Composite Second Class with Guard Room(SR)	11	7
23. Composite Power Car with Shovan Class (WEPC, WECPCR, WECLR, WYPC)	24	45
24. Luggage Van (L) (VK)	--	63
25. Composite Power Car with Shulov Class (WEPC, WECPR, WECLR, WYPC)	24	45
26. Motor Van (VK)	--	10
27. Composite Power Car and Guard Room with Second Class (SPC, SPR)		
28. Ril Cars.(ZSZ)	--	17
TOTAL	310	1075

Figure4.25: OutSide View of a MG Shulov Class Coach (WY).

Figure4.26: InSide View of a MG Shulov Class Coach (WY). [Having no fan and the few lights]

Figure4.27: OutSide View of a MG Shovan Class Coach (WE).

Figure4.28: A MG Composite Second Class with Lugage Coach (CSLR)

Figure4.29: InSide Section of a MG Composite Second Class with Lugage Coach (CSLR). [Having No Fan, No Lugage Rack, Hard Vertical Sits]

Figure4.30: OutSide View of a MG Air-Conditioned Chair Coach (WJFC).

Figure4.31: OutSide View of a MG Shovan Chair Coach (WEC-7036). [Upakul Expres]

Figure4.32: Inside View of a MG Shovan Chair Coach (WEC). [Passengers demand more fans in a coach.]

Figure4.33: Out of Order BG Coach-5102,. [Quick Rehabilitations of the Coach Are Needed For Better Passenger Service.]

Figure4.34: Out of Order Coaches. [Quick Rehabilitations of the Coaches Are Needed For Better Passenger Service.]

4.5.2 Freight Wagons

At the end of year 2006-2007, Br had a total of 9473 (BG=1935, MG=7538) wagons comprising 6599 covered, 992 open and 1882 special type wagons. The Mechanical Workshops o BR should be improved for repairing and making freight wagons to be cost effective. Type Wise Freight Wagons and their number are shown in the table 4.6. Also Figure4.35 to 4.47 represent the different features of Freight Wagons of Bangladesh.

Figure4.35: Covered Wagons, Four-wheeled (C-28027)., India, Built-1976, Total Number-413

Table 4.5: Type-Wise Freight Wagons

	BG		MG	
	Unit	Four Wheelers	Unit	Four Wheelers
Covered Wagons-				
Four-Wheeled (C, CJ, XC, MCG)	751	751	4947	4947
Bogie (BC, BSC, BCFG)	452	904	400	800
Bogie Covered Fertilizer (BCF,BCFR)	--	--	49	98
Open Wagons- High Sided-				
Four-Wheeled (KC)	380	380	20	20
Bogie (BKC, SCT)	--	--	457	825
Open Wagons- Low Sided-				
Four-Wheeled (KL,KM)	26	26	62	62
Bogie (BKL)	--	--	47	64
Flat Wagons-				
Bogie (BFR,BFT,BKU,BFU,BFW,IBT,MBFR)	29	61	223	446
Four-Wheeled (FCT)	--	--	58	58
Bogie (BFCT Container)	--	--	212	424
Other Wagons-				
Petrol Tank Wagons-				
Bogie (BTP,WD)	--	--	81	162
Oil Taank Wagons-				
Bogie(BTK,BTL,BTO,BXTK,BTPR,BTPA)	143	286	457	914
Molasses Tank Wagons-				
Four Wherled(TM, BTM, TL)	77	152	--	--
Bogie(BTM)	--	--	26	52
Departmental Wagons-				
Four Wherled(KH,KN,TW,FD,BVG,ERL,XVH,VH)	28	28	127	127
Bogie(BKH)	49	98	372	758
TOTAL	1935	2686	7538	9757

Figure4.36: BG Flat Wagons, Bogie (BFT-10893). Year Built-1928, Total No-15

Figure4.37: BG Hopper Car

Figure4.38: Covered Wagons, Four-wheeled (Coming from India)

Figure4.39: Covered Wagons, Bogie (BC).

Figure4.40: Over view of rolling stocks carrying containers.

Figure4.41: Oil Tank Wagons Wagons, Bogie (BTO-40046), Japan, Built-1968, Total Number-97.

Figure4.42: MG Flat Wagons, Bogie (For Military & Departmental Use).

Figure4.43: MG Covered Wagons, Four-wheeled (CJ-54034).

Figure4.44: Two Covered Wagons, Four-wheeled (C- 28030 & C-28039) and A Departmental Wagons(VM-35120), Four-wheeled.

Figure4.45: Open Wagons- High Sided Wagons (KC-31694), Scotland,Built-1962, Total number-362.

Figure4.46: Flat Bogie Wagons (BFR-10561), Old, Built-1921, Total number-6.

Figure4.47: Four wheeled Open Wagons- Low Sided (KL-19013), Japan, Built-1964, Total number-19.

CHAPTER-5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Connectivity by rail in Bangladesh is limited. Bangladesh Railway is not connected with all the civil districts of the country. At the end of 2006-2007 only 44 out of 64 civil districts of the country could be connected by railway.

Gauge problem is very vital in Bangladesh. As of 2007, the total length of railroad is 2,835 km. Of that, 923 km are broad gauge tracks (mostly in the western region), while the remaining 1,822 km are metre gauge (1000 mm) tracks (mostly in the central and eastern regions). In some areas, the gauge problem is being tackled by providing dual gauge. But most of the areas have two different gauge. At the breaks of gauge passengers have to change their train, also laborers and mechanized facilities is needed to move goods and shipping containers from train to train.

After liberation, Rail way sector in Bangladesh has not improved much. The allocation for Bangladesh Railway is only below 20% of the allocation of Transport sector. Significant achievement by improvement of rail is the direct communication between Dhaka and Rajshahi over Bangabondhu Multipurpose Bridge.

Bangladesh would act as a bridge between East and West, if she connects with the Trans-Asian Railway (TAR).

Government advised by the Downer Group, closed 300 kilometer rail routes as stating them economically loss projects. At present many of the existing lines do not have sufficient sleepers, ballasts etc. The condition of rail routes over 1500 kilometer is very poor, due to lack of renewal, improper alignment, affected by flood, and timely maintenance. Allowable maximum speed of these rail routes vary from 15 to 95 kilometers per hour.

Bangladesh Railway carries below 5 percent of total goods and only 45.8 million passengers (4.59 billion passenger-kilometers) in a year.

Realizing the significance of rail Government now-a-days have increase the allocation for railway. The present government has taken 9 projects at a cost of about three thousand crore taka for the improvement of rail in Bangladesh.

Bangladesh Railway is in need of locomotives. Bangladesh Railway now owns basically only two types of locomotives viz. Diesel Electric (DE) & Diesel Hydraulic (DH). Above 70% locomotives are more than 20 years old. Due to lack of proper maintenance and repair facility, supply of spare parts, over running about 25% of the total locomotives become out of service. The Mechanical Workshops of Bangladesh Railway is not improved enough to repair the damaged/ out of order coaches quickly.

5.2 RECOMMENDATION FOR THE IMPROVEMENT OF RAIL IN BANGLADESH

Railway should provide easy connectivity throughout the country and with abroad. Railway in Bangladesh should provides social obligatory service. Inclusive growth and expansion of rail network to reach development to every corner of the country should be the core to developmental approach. Economically unviable projects need to be viewed with social perspective being economic necessity for backward areas and under privileged.

Government should take sufficient emphasis and financial support for the improvement of rail.

Track renewal should be done regularly.

Dangerous rail tracks should be converted into strong tracks by providing sufficient sleepers, ballasts and fastenings, long welded rails.

Gradually all the sleepers should be converted into prestressed concrete sleepers.

Where flood affect the rail tracks, proper protection work should be provided.

Rail alignment should be easy and as straight as possible.

In some junction station, extra rail tracks should be provided to avoid delay.

In some areas where the tracks are too busy, double line should be provided.

The existing metre gauge tracks should be converted into dual gauge.

For the improvement of locomotives, the out of order locomotives should be repaired immediately

For the repair and maintenance of locomotives, sufficient facilities should be provided.

Facilities should be built to manufacture locomotives locally.

There should be sufficient supply of spare parts of the locomotives.

Immediately a good number of locomotives should be exported.

The new locomotives should have more horsepower and good breaking capacity, so that the number of coaches in each rolling stock can be increased.

The condition of existing locomotives should be improved, so that it can run over 90 km per hour.

For the improvement of coaches and wagons, more facilities should be provided for the repair and maintenance quickly.

Number of coaches and wagons should be increased, so that each rolling stocks (especially the intercity trains) can run with more coaches, [Example- with 20-24 coaches.]

For the savings of money, some coaches and wagons should be fitted and built locally.

There should be a good supply of spare parts of the coaches and wagons.

A lot of coaches and wagons require small repair and maintenance work, these facilities should be provided.

The rolling stocks which run at night, should have more sleeping coaches and secured luggage carrying capacity.

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APPENDIX