A PROJECT REPORT

ON

"IMPROVISATION AND FABRICATION OF RAKE TEST RIG USED FOR AIR BRAKE LEAKAGE TESTING IN RAILWAYS"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

SHAIKH MUSTAQ IBRAHIM	**15ME104**
RAEEN SADDAM MD SHAUKAT	**15ME91**
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RAZA MOHD NADEEM ASLAM	**15ME93**

UNDER THE GUIDANCE OF
PROF.RIZWAN SHAIKH

DEPARTMENT OF MECHANICAL ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
SCHOOL OF ENGINEERING & TECHNOLOGY
Plot No. 2 & 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

AFFILIATED TO

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CERTIFICATE

This is certify that the project entitled

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

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SHAIKH MUSTAQ IBAHIM
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Project I Approval for Bachelor of Engineering

This project entitled ***"IMPROVISATION AND FABRICATION OF RAKE TEST RIG USED FOR AIR BRAKE LEAKAGE TESTING IN RAILWAYS"*** by ***Shaikh Mustaq Ibrahim, Raeen Saddam Md Shaukat, Siddiqui Rameez, Raza Mohd Nadeem*** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. .....
2. .....

Supervisors

1. .....
2. .....

Chairman

.....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

The air brake is the standard train brake used by railways all over the world, and to test the braking system single car test rig is used. It is based on the simple physical properties of compressed air. The Rake Test Rig performs the braking test at Twin Pipe Braking system of coaches. Rake Test Rig used has two pressure gauges that are Feed pipe gauge and Brake pipe gauge. The existing test rig used at workshop has many numbers of conventional joints, complex construction and its weight. The improvisation and Redesigning in test rig construction is implemented to overcome the existing problems and the brake testing procedure is also studied. The improvised design and construction made the test rig more accurate than existing and problems were found to be completely resolved..

Keywords:
Testing procedure, Brake pipe, Feed pipe, resdigned and improvised RTR.

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Chapter 1

ABOUT INDIAN RAILWAYS

1.1 Introduction to Indian Railway

hIndian railways (IR) is the stated owned railway company of India Indian railway has a monopoly on the country's rail transport. It is also one of the largest and busiest rail networks in the world, transporting under 5 billion passengers and almost 650 million of freight actually. IR is the world's largest commercial or utility employer, with more than 16 million employees.

The Indian Railways route length network is spread over 115,000 km, with 12,617 passenger trains and 7,421 freight trains each day from 7,349 stations plying 23 million travellers and 3 million tonnes (MT) of freight daily. India's railway network is recognised as one of the largest railway systems in the world under single management.

The railway network is also ideal for long-distance travel and movement of bulk commodities, apart from being an energy efficient and economic mode of conveyance and transport. Indian Railways was the preferred carrier of automobiles in the country with loading from automobiles traffic growing 16 per cent in 2017-18.

INDIAN RAILWAYS	
Headquarters	New Delhi
Railway Minister	Piyush Goyal
Network	67,368 km(route) 93902 km (running track) 121407 km (total track)
Foundation	1845-present
Track gauges	Broad meter, narrow
Revenue	Rs. 1.874 trillion (US $26 billion) (2017–18)
Chairman Railway Board	Vinod Kumar Yadav

Table 1.1: About Indian Railways

1.1.1 History

A plan for a rail system in India was first put forward in 1832,but no further steps were taken for more than a decade.In 1844,the governor-general of India.Lord Hardingeal lowed private entrepreneurs to set up a rail system in India.Two new railway companies were created and the east India Company was asked to assist them.Interest from investors in the UK led to the rapid creation of a rail system over the few next years.

The first train in India becomes operation on 1852-12-22 and used for the hauling of construction material in rookie.A year and a half later,on 1853-0.4-16,the first passenger train service was inaugurated between Boribunder Bombay and Thana.Covering a distance of 34km (21miles),it formally heralded the birth of railways in India.

The British government encouraged new railway companies backed by private invest or sundera scheme that would guarantee anannual return of five percent during the initial year of operation.Once established,the company would be transferred to the government,with the original company retaining operational control.There out emileage of this network was about 14,500km (9,000)miles by 1880,most lyradiating in ward from the three major cities of Bombay, madras and Calcutta.By 1895,India had started its own locomotives and in 1896s ends engineers and locomotives to help build the Uganda railway.

Soon various independent kingdoms built their own rail system and the network spread to the region that becomes the modern day states of Assam, Rajasthan and Andhra Pradesh. A railway board operated under aegis of the department of commerce and industry and had time in its history; the railways began to make a tidy profit. In 1907, almost all the rail companies were taken over by the government.

The following year, the first electric locomotive appeared. With the arrival of the First World War, the railway was used to meet the needs of the British outside India. By the end of the First World War, the railways had suffered immensely and were in a poor state. The government took over the management of the railways and removed the link between the financing of the railways and other government revenues in 1920, a practice that continue to date with a separate railway budget.

1.1.2 Government Initiatives

Few recent initiatives taken up by the Government are:

1. As of December 2018, the Government of India is considering a High Speed Rail Corridor project between Mumbai and Nagpur.
2. As of November 2018, Indian Railways is planning to come out with a new export policy for railways.
3. The Government of India is going to come up with a 'National Rail Plan' which will enable the country to integrate its rail network with other modes of transport and develop a multi-modal transportation network.
4. A 'New Online Vendor Registration System' has been launched by the Research Designs & Standards Organisation (RDSO), which is the research arm of Indian Railways, in order to have digital and transparent systems and procedures.
5. The Government of India has signed an agreement with the Government of Japan under which Japan will help India in the implementation of the Mumbai-Ahmedabad high speed rail corridor along with a financial assistance that would cover 81 per cent of the total project cost.

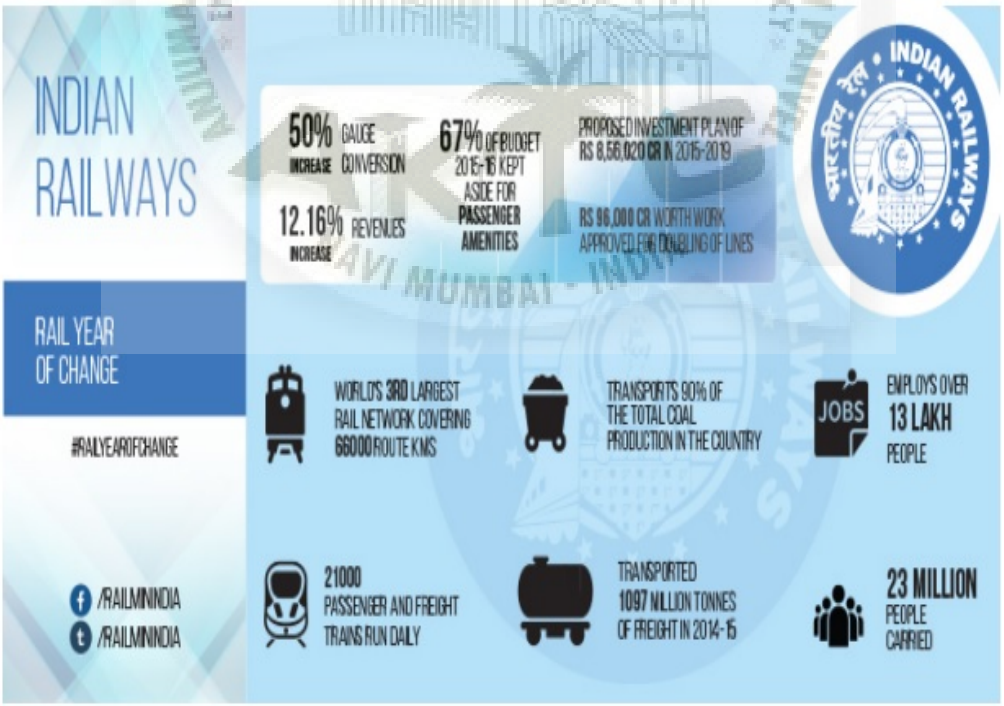

Figure 1.1: Indian Railway current year plan

1.1.3 Zonal Details

Sr.No.	Railway Zone	Zone Head-quarters	Railway Divisions
01	Northern Railway	Delhi	Delhi, Ambala, Firozpur, Lucknow NR, Moradabad
02	Northeast Frontier Railway	Guwahati	Alipurduar, Katihar, Rangiya, Lumding, Tinsukia
03	Eastern Railway	Kolkata	Howrah, Sealdah, Asansol, Malda
04	South Eastern Railway	Kolkata	Adra, Chakradharpur, Kharagpur, Ranchi
05	South Central Railway	Secunderabad	Secunderabad, Hyderabad Vijayawada, GuntakalGuntur, Nanded
06	Southern Railway	Chennai	Chennai, Tiruchirappalli, Madurai, Palakkad, Salem, Thiruvananthapuram
07	Central Railway	Mumbai	Mumbai, Bhusawal, Pune, Solapur, Nagpur
08	Western Railway	Mumbai	Mumbai WR, Ratlam, Ahmedabad, Rajkot, Bhavnagar, Vadodara
09	South Western Railway	Hubballi	Hubballi, Bengaluru, Mysuru,
10	North Western Railway	Jaipur	Jaipur, Ajmer, Bikaner, Jodhpur
11	West Central Railway	Jabalpur	Jabalpur, Bhopal Kota
12	North Central Railway	Allahabad	Allahabad, Agra, Jhansi
13	South East Central Railway	Bilaspur	Bilaspur, Raipur, Nagpur SEC
14	East Coast Railway	Bhubaneswar	Khurda Road, Sambalpur, Waltair
15	East Central Railway	Hajipur	Danapur, DhanbadMughalsarai, Samastipur, Sonpur
16	Konkan Railway	Navi Mumbai	Navi Mumbai
17	Kolkata Metro Railway	Kolkata	Kolkata

1.2 INTRODUCTION TO MATUNGA RAILWAY

The Carriage Workshop, Matunga was set up in 1915 as a repair workshop for broad gauge and narrow gauge coaches and wagons of the erstwhile Great Indian Peninsular (GIP) Railway. The workshop covers a triangular piece of land/area of 35 hectares, including a covered area of about 11 hectares, skirted by the Central Railway suburban corridors on the east and the Western Railway corridors on the west.

The workshop now carries out Periodical Overhaul (POH) and heavy corrosion repairs of main line as well as EMU coaches. Last year i.e. in 2009-10, a total of 3182 coaches consisting of 2207 Non AC, 341 AC coaches and 634 EMU coaches were attended. For the year 2010-11 target is 1884 Non AC, 360AC and 720 EMU coaches.

The workshop is certified with ISO 9001/2000 and ISO 14001/1996 since 2001 & 2002 respectively. It was last re-certified for ISO 9001-2000 in 2007 & ISO 1400-2004 in 2008

Now the workshop is going one step ahead to adopt Integrated Management System covering ISO: 9000, ISO: 14000 & ISO: 18000 (Occupational Health and Safety Assessment Series). The system is likely to be implemented by July 2011.

Figure 1.2: Matunga Railway Station

Figure 1.3: Matunga: Mumbai's First "All Women" Railway Station Enters Limca Book

Figure 1.4: Matunga Station Chugs into Record Book for being Inddia's First all women Staffed station

1.3 Carriage Workshop, Central Railway, Matunga

The Carriage Workshop, Matunga was set up in 1915 as the repair workshop for broad gauge and narrow gauge coaches and wagons of the erstwhile Great Indian Peninsula (GIP) Railway. The covers the triangular piece of the land/area of 35 hector, including a covered area of about 11 hectares, skirted by the Central Railway Suburban Corridors on the east and Western Railway corridors on the west. The strength of the employee is not more than 8200 approx. The total no. of section is about 33 including 07 no. of electrical. The total no. of the machinery plant is about 1161. The consumption of electricity is about 6,00,000 unit per month.

Main activities for the year 2017-18

ACTIVITIES	TARGET(Per Month)
POH of Mail/Express/Passenger Coaches	203 Coaches per month including 33 AC coaches per month
POH of EMU Coaches	68 Coaches per month
68 Coaches per month	271 Coaches per month

1.3.1 A Few Firsts of Matunga Workshop

1. RETRO FITMENT OF FLOORING IN LAVATORIES OF PASSENGER COACHES WITH NON-TOXIC IN-SITU FLOOR.
   In order to improve cleanliness and hygiene of the toilets in coaches. Epoxy flooring is being provided. Matunga is the First Zonal Workshop on Indian Railways to start Epoxy Flooring in Toilets on a programmed basis since Sept'2010.

2. FIRST ZONAL WORKSHOP ON INDIAN RAILWAYS TO START CUSHIONING IN UNRESERVED COACHES FROM OCT. 2008.
   Provision of cushioned seats in all GS/SLR coaches during POH has been carried out.

3. FIRST ZONAL WORKSHOP ON INDIAN RAILWAYS TO PROVIDE ALL COACHES WITH BOGIE MOUNTED AIR BRAKE SYSTEM BY THE END OF JAN.2011.
   The bogie mounted brake system is not only more reliable but also gives faster braking and release of brakes thus making trains faster.

4. FIRST WORKSHOP TO IMPLEMENT PAYMENT TO CONTRACTORS SUPPLIERS THROUGH NEFT FROM 15TH JULY 2010.

5. FIRST ZONAL WORKSHOP ON INDIAN RAILWAYS TO START CLEANING OF BOGIES BY GRIT BLASTING IN 2004.
   This has improved the safety standards of Rolling stock by enabling better examination.

6. FIRST ZONAL WORKSHOP IN INDIAN RAILWAYS TO PROVIDE CONSULTANCY FOR ISO 9001:2000 CERTIFICATE TO ANOTHER UNIT. (Kalyan Freight Depot in the year 2003)
7. FIRST RAILWAY UNIT IN WHICH MORE THAN 3500 WORKERS, SUPERVISORS, UNION OFFICIALS AND OFFICERS took pledge on the New Year day against PASTING OF POSTERS on walls on 1st January, 2003.
8. . FIRST ZONAL RAILWAY WORKSHOP TO CONVERT ALL ARMES AND 'A' CLASS ARTS INTO AIR BRAKE IN THE YEAR 2002.
9. FIRST RAILWAY COACHING WORKSHOP IN INDIAN RAILWAYS TO CONVERT 100YEAR 2002
10. FIRST ZONAL RAILWAY WORKSHOP IN INDIAN RAILWAYS TO GET ISO-14001 CERTIFICATION IN THE YEAR 2002.
11. IMS (Integrated Management System) Certification in 2015.
12. IMS, ISO 50001, ISO 3834, 5S and Green Co.

1.3.2 Notable Accomplishments

- Coaches for Heritage Special.
- Lifeline Express.
- Deccan Odyssey.
- Retro fitment of DC to AC/DC EMU (Siemens).

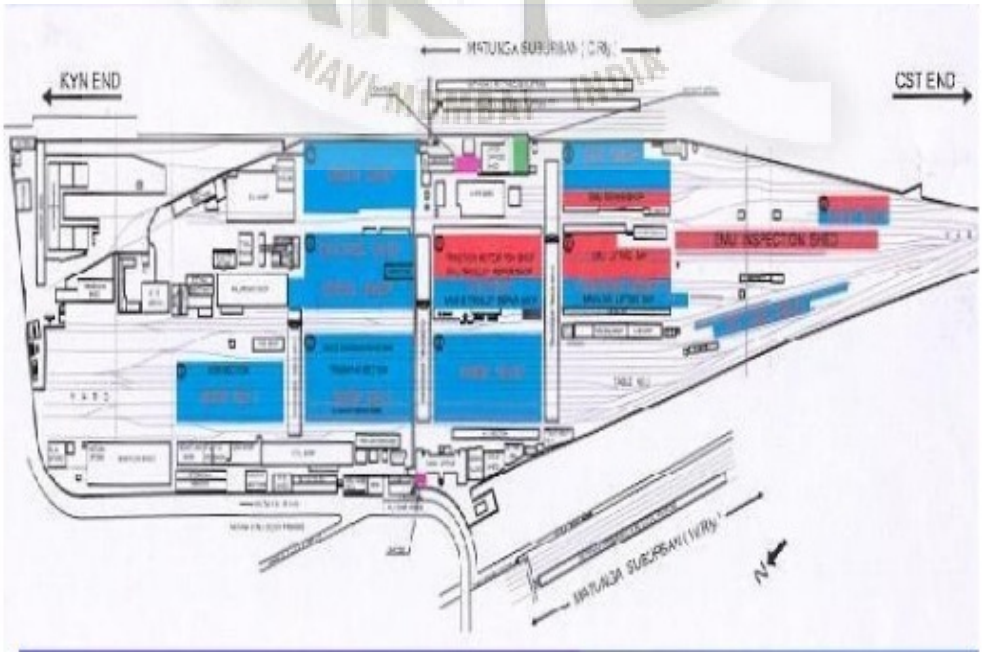

Figure 1.5: Matunga Workshop Layout

1.3.3 Innovations by Matunga workshop

- Headstock Manipulator and Fixture.
- Gravity Conveyor System.
- Motorized Bearing and Axle Box Extraction System.
- Roof Leakage Testing by sprinkling water on the Roof.
- BSS/Brake Block Hanger Testing and Painting Integrated Workstations.
- Provision of Venturi type Ventilators and Relocating body side windows of kitchen area.
- Provisions of Model Room for ERRU training.
- Commissioning Variable Voltage Variable Frequency Drive on alternator testing beds. Regular
- Training of Matunga Staff at Basic Training Center.

1.4 Processes Involved in Carriage Repair Workshop:

POH (Periodic Overhaul) - 18days process.

1. RECEIVING THE COACH FROM YARD:
   The coach to be repaired is received from the yard. 1 car means 8 coaches.
2. . SHUNTING OF COACH:
   Each coach to be separated into two parts:
   A. Shell
   B. Trolley
3. . PRE-INSPECTION AND CLEANING UNDER FRAME AS WELL AS WATER TANK ATTENTION:
   Parts to be repaired and the under frame along with water tank are also cleaned.
4. UNLOADING OF MECHANICAL AND ELECTRICAL COMPONENT:
   All the components which function on electrical and mechanical energy are unloaded.
   e.g.: Fans, seat, trolley, battery, doors, etc. These components are removed in order to reduce the weight of coach as well as for their repair and maintenance work.
5. LIFTING OF COACH:
   The coach is lifted at a higher position by using a lifting crane and is separated from trolley
6. TROLLEY WILL BE SENT TO TROLLEY SHOP:
   The parts of the trolley are further sub-divider into 2 sections: into 2 sections:

   A. Wheel to and fro wheel shop: Here the wheel is repaired by first checking its diameter which should not be less than 830mm.

   B. Springs to and fro smithy shop: Here the springs are inspected having any cracks, abrasion, and corrosion. If the cracks are invisible to naked eye then bosh cleaning tank is used. It there are any cracks in the spring then the spring is thrown away and a new spring is used.

7. TR/ML (Trolley/Main Line) repair shop:
   All the other bogey components are sent to this shop for repairing.
8. A newly repaired Coach is obtained.

9. LOWERING THE COACH:
   Here all the repaired parts of the coach are assembled together and the coach is lowered and assembled with the bogey.

10. PAINTING
    Layers of various paints are applied to the coach. Anti-corrosive paints are used. This process requires 9 days.

11. INTERIOR FURNISHING:
    This step includes furnishing of interior coach which includes seats, walk-through etc.

12. LOADING AND UNLOADING OF MECHANICAL COMPONENTS:
    In this step all the electrical and mechanical components which were unloaded earlier are loaded back to their original place after their testing and maintenance.

13. AIR BRAKE TESTING:
    Air brake testing is done which is the most important part of this POH. It is a 1-day process. Twin pipe graduated air brake system is used.

14. . FINAL INSPECTION BY NTEX (NEUTRAL TRAIN EXAMINER):
    The organizing committee is NCO (Neutral Control Organizing). NTRX will always do the final inspection of the newly obtained coach.

15. DISPATCH TO TRAFFIC:
    After its final inspection the train is dispatch for its use.

STAFF STRENGTH OF MATUNGA WORKSHOP

Table 1.3: STAFF STRENGTH OF MATUNGA WORKSHOP

Supervisors	Skilled Technicians	Supporting Staff	Total
584	5790	1361	7719

Figure 1.6: Organization Chart

Chapter 2

INTRODUCTION

Brake is an essential feature in order to retard and stop the railway vehicle within minimum possible time. The Air Brake system of the coaches are brought at maintenance depot, on every round trip should be tested by using a 'Rake Test Rig'. The source of compressed air supply to the test rig is through a compressor installed in the sick lines. The rake test rig works on three stages.

1. Charging stage.
2. Application stage.
3. Release stage.

Figure 2.1: Rake test rig

The test rig performs test at braking system of coaches, as it has a pipe arrangement that are followed by air reservoir to the palm couplings. The Test rig has two different pressure gauges that are FEED PIPE gauge and BRAKE PIPE gauge. The brake pipe and feed pipe run throughout the length of the coach. Brake pipe and feed pipe on consecutive coaches in the train are coupled to one another by means of respective hose couplings to form a continuous air passage from the locomotive to the rear end of the train. Both pressure gauges show the amount of air pressure supplied during testing and these FP (Feed Pipe) and BP (Brake Pipe) pressures are maintained at 6.0Kg/cm2 and 5.0Kg/cm2 respectively. A Test rig has arrangement of Main Reservoir, no of Isolating cocks, A9 Valve, Pressure Reducer and various pipe connections through which various test can be done.

Chapter 3

LITERATURE SURVEY

3.1 Literature Review Paper:

Maintenance Manual for BG coaches of ICF design
Author: S. Dhasarathy
December 1995

Maintenance Manual for BG Coaches was last published in December,1995. Several changes in maintenance and operational system like Bogie Mounted Brake System, enhanced capacity drawgear, fire retardant upholstery and running of 24 coach trains etc. have taken place which have been incorporated in this manual.

There is no other national or international journal paper or any kind of information available on internet on the topic Rake Test Rig. The Maintainance Manual for BG coaches of ICF design is the only manual available on railway's official site.

Survey based on worker's review:

1. Test Rig used in railway's workshop has conventional joints which may cause leakage.
2. To avoid this leakages to modernize or to improvise the existing conventional/traditional test rig, we plan to minimize the no. of joints & also leakages if any.
3. Difficulties faced by the workers while moving the test rig on to the working area due to heavy weight construction.
4. To reduce scaling of tank.
5. Use of better light weight materials in fabrication process so as to minimize the total weight of the test rig.
6. Use of wheels for smooth movement.

Material Survey:

1. Use of brass isolating cocks in place of mild steel isolating cocks.
2. Use of smaller diameter pipes in place of larger diameter.

Chapter 4

METHODOLOGY

4.1 Step 1 : Connection of wheel with axle

Two canvas wheel are used to provide motion initially this two wheel are connect with an axle so that it can carry a load of whole test rake.To prevent the horizontal motion or slide of wheel on axle two stopper are weld on both side of wheel. Axle should be must strong to carry the load of test rake.

Canvas wheel are used since it have good anti-fade characteristics which avoid more tear and wear of wheel. Size of wheel is about 200mm in diameter and 25mm in thickness and axle of 20mm diameter solid rod of length 500mm.

Figure 4.1: Wheel and axle

4.2 Step 2 : Bending of pipe

By using hydraulic die. bend the pipe in required frame this die are work on the principal of Pascals law (in one chamber fluid are pressed by manually motion of handle this energy are used to bend the pipe in circular arc as per the die used) at two place bend are provided as shown in the figure .

The first bend is of ninety degree to fully wear the load Of test rake while the other bend is just less than of ninety degree as per the comfortable to move the rake.

Figure 4.2: Bend Pipe

4.3 Step 3 : Connection between bend pipe and axle

Bend pipe and axle cannot be connect directly by arc welding because both have circular surface during this condition a point contact are form if we weld such surface contact it can't able to wear high load of test rake to avoid such a problem we provide a two extra flat plate on axle on that bend pipe are weld in order to get a strong weld joint between bend pipe and axle. As shown in the figure how connection are provided between axle and bend pipe by using flat plate .

Figure 4.3: Base Frame

4.4 Step 4 : Mounting of cylinder on frame

After the welding of bend pipe on axle cylinder are mount on the frame by using screwed Bolt joint between semi-circular and rectangular strip clamps at two place as shown in figure one at the lower side and other is at upper side to hold the cylinder during the motion of test rake from one coach to other coach.

Figure 4.4: Cylinder Mounting

4.5 Step 5 : Welding of rectangular plate

To mount A9 valve and pressure reducer valve , Rectangular plate are welded on upper side of the bend pipe as shown in the figure.

Rectangular plate should have same size as the gape between two pipe so that it can easily fit and weld to provide a sufficient strong joint.

Figure 4.5: Welding of Rectangular plate

4.6 Step 6 : Cutting of rectangular plate

To fit the A9 valve on rectangular . Rectangular shape are made by arc cutting process as shown in the above figure.
Four hole are also made on plate for joining A9 valve with help of screw Bolt joint. At a same time Pressure reducer valve are also mount on the same plate for that we weld two bolt on the other side of the plate as shown in step number 7

Figure 4.6: Cutting

4.7 Step 7 : Mounting of A9 and Pressure reducer valve

After making square shape whole in rectangular A9 valve are mount in that by using four nut and bolt at the same time other side of plate we put pressure regulator valve in welded bolt as shown in above figure.

Figure 4.7: Valves

4.8 Step 8 : Isolating Cock and piping arrangement

In this step different length of 10mm pipe ,elbow, I.C. and T-joint are arrange as per the connection requirement . The first connection is taken from a cylinder. Four I.C. is used for different type of test is to be performed like sensitive, insensitive and leakage test. Initially all I.C. are in off position during a charging state after that a lower I.C. get open and leakage test are performed the compressed air passes through the passage and it show the reading on gauges.

Figure 4.8: Piping Arrangement For Isolating Cocks

4.9 Step 9 : Palm coupling

To make a connection between test rake and boogies flexible pipe are used having palm coupling at end of each pipe (feed and brake pipe) Pipe should be properly tight to avoid leakages if any their

Figure 4.9: Palm Couplings

4.10 Step 10 : Gauge connection

Two gauge are connected to show the reading of feed and brake pipe . If their is no any leakage the pressure will remain constant. Presence of any leakage leads to drop in pressure which is indicate by feed and brake gauge.

Figure 4.10: Gauges

4.11 Step 11 : Final connection

After all the connections finally we connect the flexible pipe having palm coupling at each end as shown in figure two flexible pipe are used for outlet purpose while the third is for inlet purpose.

Figure 4.11: Final Assembly

Chapter 5

System Design

5.1 System Requirements Definition

In this section, the steps related to Single Car Rake Test Rig (RTR) System design is explain in detail. These project aim to reduce the different factors that can affect the testing and cause the major damage. For this project and for design a system a CAD model is designed using Autodesk Inventor a computer-aided design application for 3D mechanical design, simulation, visualization, and documentation to get the basic idea about the machine/ instruments /system.

5.2 Software used

Autodesk Inventor 2019 for design and creating a reference model. Autodesk Inventor 2019 for analysis of various factors like pressure impact, stresses that may occur during testing and weak points in the design.

STEPS USED FOR SYSTEM DESIGN ARE AS FOLLOWS

5.2.1 1. Design of a system in CAD model

For this purpose we have used Autodesk Inventor 2019 as it covers a wide are for design and quite feasible and easy to understand.

2. Finalizing of the system.

As this step is important because the system that is going to be design should be easy to manufacture, all the parts used in the manufacturing should be easily available. For this step we have take the help of our project guide and also the technician in the manufacturing plant to understand the problem that may occur and we try to overcome those problems and design our new and improves system is as shown below.

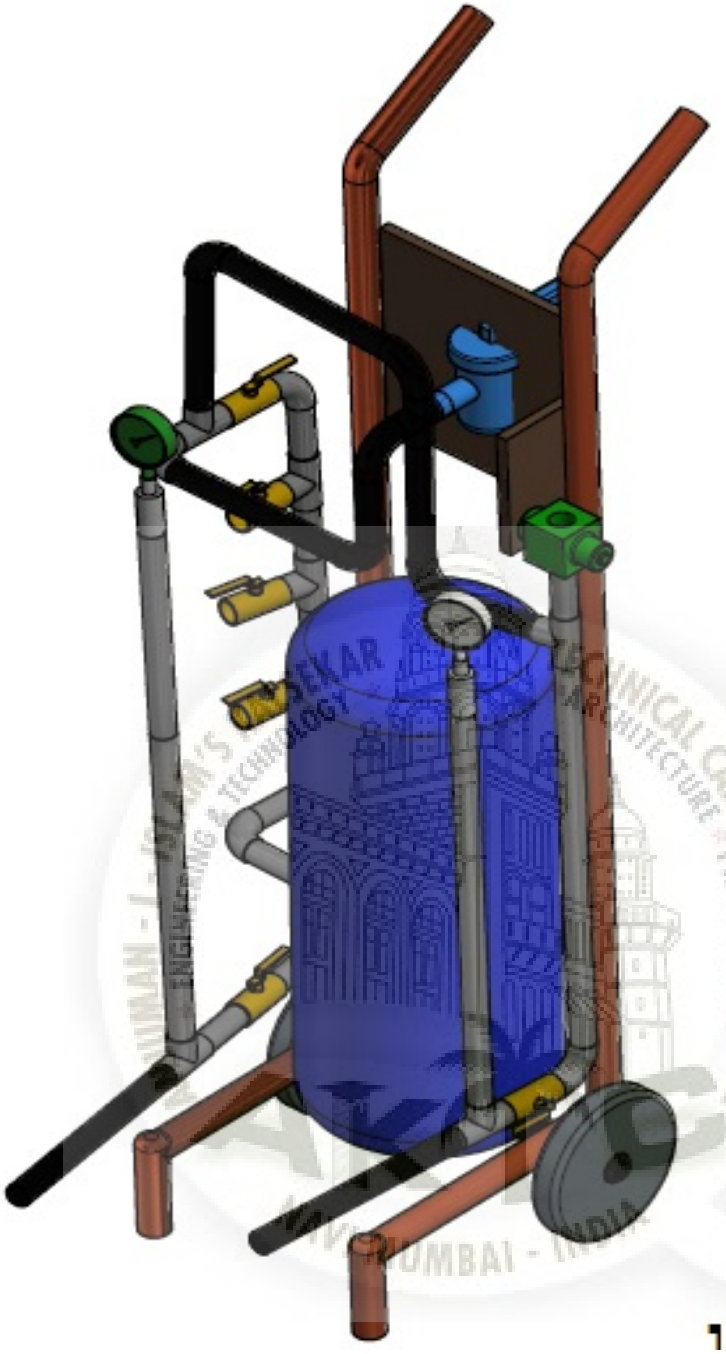

Figure 5.1: 3D Model of Rake Test Rig

3. Components of a Rake Test Rig:

The Rake Test Rig has connection of pipe joints and a frame on which the mentioned components are mounted. The Test rig also consist of a wheel arrangement for easy movement.

The following components are mentioned as follows.

a. Main Reservoir:

A 40L tank is mounted on the frame in order to store the compressed air and supply it at a required quantity during testing.

b. A9 Valve:

The valve is a variable pressure reducing valve. Its duty is to send pilot air for charging/ exhausting B.P. pressure through relay valve for releasing and application of loco and formation brake. In release condition it charges BP at 5.0 Kg/cm2 (max). The BP pressure can be varied by moving its handle. The handle has 5 distinct positions. The pressure will reduce when the handle is moved to application zone.

c. Isolating Cock:

A 8mm Ball type Isolating Cocks are used to provide facility for cutting- off of air supply.

d. Pressure Reducer valve:

This will control the Output pressure to the desired level. This valve is fitted at the outlet of limit the Brake Cylinder pressure.

e. Gauges:

Two different Pressure Gauges of FP and BP are mounted in rake test rig which indicates the amount of pressure drop in feed pipe and brake pipe during leakage.

f. Palm Couplings:

Two palm couplings for BP and FP are connected from the test rig followed by a flexible pipe. These palm couplings are used to couple the rake test rig with wagons during testing.

4. Fabrication of Rake Test Rig:

The Fabrication of the RTR done in the Matunga railway workshop, where all the necessary tools and equipments were arranged. After the completion of the Rake Test Rig,the modified RTR was used for testing of Brakes and found to be working successfully.

Chapter 6

System Testing:

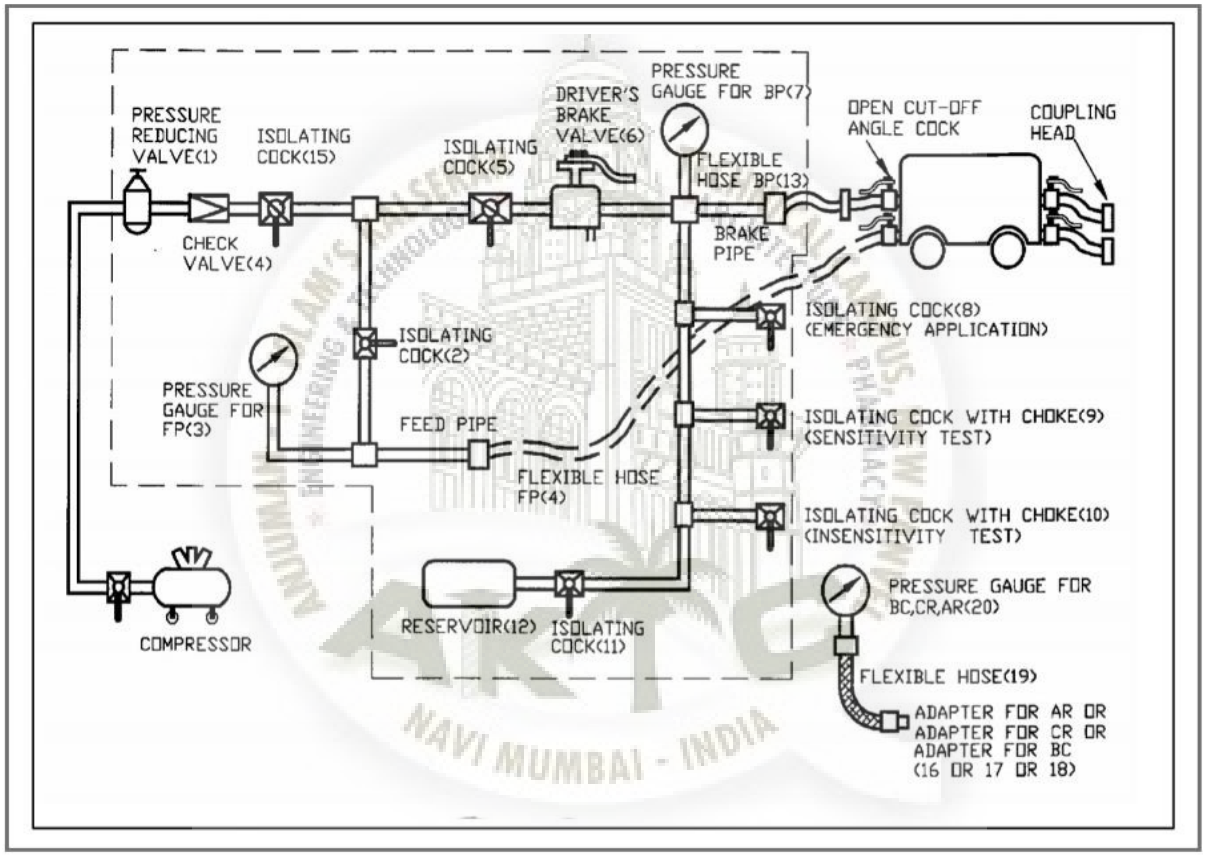

Figure 6.1: 3D Model of Rake Test Rig

6.1 Procedure for Brake Testing:

1. Place the coach on the pit line for single car test (Brake Test).
2. Arrange the single car test rig device near the coach.
3. Ensure adequate air supply so that steady pressure is maintained at the inlet of single car test device.
4. Close isolating cock of the distributor valve and the pipe connected between the compressor and Single Car Test Device (SCTD).

5. Open cut off angle cocks of both BP and FP on both ends of the coach
6. Connect the near end of coach under test, to the test rig by connecting both brake pipe (BP) and feed pipe (FP) through coupling heads.
7. Open isolating cock (2) and (5) of the test rig that are connected to feed pipe and brake pipe of the coach. Open isolating cock (15) also.
8. Blow air into both BP and FP to scavenge the pipes.
9. Open dirt chamber of the Dirt Collector and clean the accumulated dirt and moisture, after cutting off air supply. Re-assemble the dirt collector. Connect dummy coupling to BP and FP hose coupling on the far end of the coach. Close isolating cock (2) and (5).
10. Connect pressure gauges on Auxiliary reservoir and brake cylinders.
11. Open isolating cocks (2) and (5) of the test rig that are connected to feed pipe and brake pipe of the coach.
12. Close the isolating cocks (8),(9),(10) and (11) of the Test rig. pen isolating cock of the distributor valve.
13. Open the BP and FP angle cocks of the near end of the coach.
14. Close both angle cocks at the other end of the coach.
15. Keep the driver's Brake valve handle in release position and charge the system. Check BP and FP pressures of the test rig and these should be 5 +/-0.1 kg/cm2 and 6 +/-0.1 kg/cm2 respectively.

    Wait for 3 minutes to ensure stabilized pressure.
16. Before conducting the tests it is important to ensure that the entire Test Rig is pressure tight.

6.2 TESTING OF BRAKE APPLICATIONS USING RAKE TEST RIG.

Rake Test Rig is used for testing the braking system of Train coaches.Since the testing also done for its applications.Various Brakes applications and its testing procedure are explained below.

TESTS

1. Leakage Test.
2. Sensitivity and Insensitivity Test
3. Brake Application and Release Test.
4. Graduated Application and Release Test.
5. Emergency Brake Application Test.
6. Passenger Emergency Valve Test.
7. Guard emergency valve test.

6.2.1 Test1: Leakage Test

- Close cock (5) of the test rig and record the drop in BP pressure for 3 minutes. The drop should not exceed 0.2 kg/cm2 in one minute
- Close FP cock (2) and record the drop. It should not exceed 0.2 kg/cm2 in one minute.
- Joints/connections to sub-assemblies. It should be tested with soap water for ascertaining leakage. Any leakage found should be rectified.

6.2.2 Test2: Sensitivity and Insensitivity Test:

- Open cocks (2), (5) and (11) of the test rig, to fully charge the system including the reservoir
- Close cock (5) and open cock (9) to reduce the air pressure in the BP choke at the rate of 0.6 kg/cm2 in 6 seconds.
- Check sensitivity by recording the time within which brakes get applied.
- Close cock (9), after the test.
- Open cock (5) and charge the air brake system till brakes are released.

- Close cock (5) and now open cock (10) to reduce the air pressure in the BP choke at the rate of 0.3 kg/cm2
- Check the insensitivity by recording the time within which the brakes do not apply.
- Close cock (10) and (11) of the test rig, after the test.

6.2.3 Test3:Brake Application and Release Test:

- Open cocks (2) and (5) of the test rig, and charge the system for 5 minutes.
- Keep brake application to full service position by driver's brake valve on the test rig.
- Record the Brake Cylinder (BC) filling time for BC pressure rising from 0 to 3.6 kg/cm2. The filling time should be between 3 to 5 seconds.
- Record the maximum BC pressure when it get stabilized, which should be 3.8 +/-0.1 kg/cm2.
- Record the BC piston stroke and check that brake blocks are binding on wheels. Piston stroke should be between 85 to 130 mm.
- Release the brakes through driver's brake valve by charging the BP to 5kg/cm2, after conducting the test.
- Record the draining time of both the cylinders for BC pressure dropping from 3.8 to 0.4 kg/cm2. This should be between 15 to 20 seconds. The piston should reach initial position and brake blocks should gets released fully.

6.2.4 Test4 : Graduated Application and Release Test:

- Charge the brake pipe and feed pipe at 5 kg/cm2 and 6 kg/cm2 respectively.
- Apply brake in steps by driver's brake valve handle and record the Brake Pipe Pressure (BP) and the Brake Cylinder (BC) pressure.
- BC pressure should rise in steps and BP pressure should decrease in steps.
- Release the brakes in steps by driver's brake valve handle and record the BP and BC pressure.
- BC pressure should decrease in steps and BP pressure should rise in steps. When the BP pressure rises to 4.85 kg/cm2 the BC will get fully released.

6.2.5 Test5 : Emergency Brake Application and Release Test

- Charge fully the Air Brake system of the coach by opening cock (5) of the test rig.
- Open cock (8) for emergency application.
- Record the Brake Cylinder (BC) pressure and check for any leakage in BC for 5 minutes.
- Pull the manual release handle for a short time (about 10 seconds).
- Check BC pressure drops to zero.
- Close cock (8) and open cock (5) of the test rig, after the test is over.

6.2.6 Test6: Passenger Emergency Valve Test:

- Open cock (5) and (2) of the test rig and charge the brake pipe and feed pipe at 5 kg/cm2 and 6 kg/cm2 respectively.
- Pull the alarm chain from inside the coach.
- Observe alarm disc rotates situated on the end wall.
- Observe air exhaust with hissing sound from (pilot valve) PEASD and PEAV that are connected to the Brake Pipe (BP).
- Observe partial brake gets applied.
- Observe that the Micro/limit switch operates and indication lamp on the coach glows.
- Observe the drop in brake pipe pressure on the test rig.
- Reset the alarm signal disc with the help of resetting key or with the fixed key.
- Hissing sound should stop and brakes should get released.

6.2.7 Test7: Guard's Emergency Van Valve Test:

- Open cock (5) and (2) of the test rig and charge the brake pipe and feed pipe at 5 kg/cm2 and 6 kg/cm2 respectively.
- Close cock (5) and then operate guard's Valve handle.
- Observe the air from Brake Pipe (BP), exhausts with hissing sound and the brakes in the guard van gets applied depending on exhaust of air.
- Reset the handle and observe the exhaust of air stops.

- Observe and not e the drop in BP pressures on test rig.
- Observe simultaneous drop of BP and FP pressure gauges provided in guard's Van.
- Close the Guard's van valve.
- Observe standard safety precautions.

Chapter 7

Conclusion and Future Scope

7.1 Conclusion

- The test rig used at coaches to check the leakage in feed pipe, brake pipe and under-frame air brake piping by using the compressed air.
- Rake Test Rig modification eliminated the leakage of compressed air.
- Adopting the improved RTR has made the testing of brakes at coaches more efficient and leakage problems can be identified without considering any losses through main reservoir mounted on test rig.
- The model of test rig found to be user friendly.
- Using improved rake test rig is simpler and time saving and it is easily portable.
- This rake test rig is more accurate than existing and the weight was found to be minimized
- All mentioned brake application tests were found successful when tested.

7.2 Future Scope

1. Digital gauge can be used to show reading.
2. M.S tank can be replace by steel tank in order to reduce weight
3. Four wheel test rake for easy locomotive
4. To avoid elbow joint bend pipe can use as more as possible
5. Sensors can use to determine the position of leakage.

References

[1] *Air Brake System-Maintenance Manual for BG coaches of ICF design.*

[2] *Procedure of Rake Testing for Freight Stock-IRCAMTECH/GWL/M/Rake Testing/FRT/2-8*

[3] *en.wikipedia.org/wiki/Railway airbrake.*

[4] *Handbook on Air Brake system for Freight stock.*

Achievements

1. Publications

   (a) *IMPROVISATION OF SINGLE CAR RAKE TEST RIG (RTR) USED TO TEST BRAKING SYSTEM IN TRAIN COACHES*, Shaikh Rizwan, Raza Mohd Nadeem, Shaikh Mustaq,Raeen saddam,Siddiqui Rameez,Journal of Emerging Technologies and Innovative Research, April 2019,Volume 6, Issue(http://www.jetir.org/papers/JETIR1904263.pdf)