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SITUATIONAL ASSESSMENT OF COST-BENEFIT ANALYSIS OF LUBRICATION IN CURVES

Ali Samet Ayvaz
Rail Systems Machinery Technology Department, Samsun University Samsun, Turkey
alisamet.ayvaz@samsun.edu.tr

Mohammad Alalou
Department of Civil Engineering Ondokuz Mayis University, Samsun, Turkey
mohamadalou@live.com

ABSTRACT:

One of the most important problems of the Railway Operations is the wear problems that occur in the rails under load and momentum. Many businesses in the world have developed different solution methods on this issue and the same methods are still applied. Noise is also the bleeding wound of many railway operators, regardless of or dependent on wear and fatigue problems. Noise, especially in the curves, adversely affects human and environmental health. In this report, we will examine the factors caused by these 2 problems and examine the solution methods with their costs.

Keywords: Railway, Cost-Benefit, Lubrication, Curves.

I. INTRODUCTION:

With the completion of the 2nd Stage of Samsun HRS line, our Main Line consists of 28 + 700 m double track rails. The section between the Warehouse Fields, level crossings and Büyük Cami-Kılıçdede stations consists of Ri60 grooved rails. The remaining part of the line consists of S49 mushroom rails.

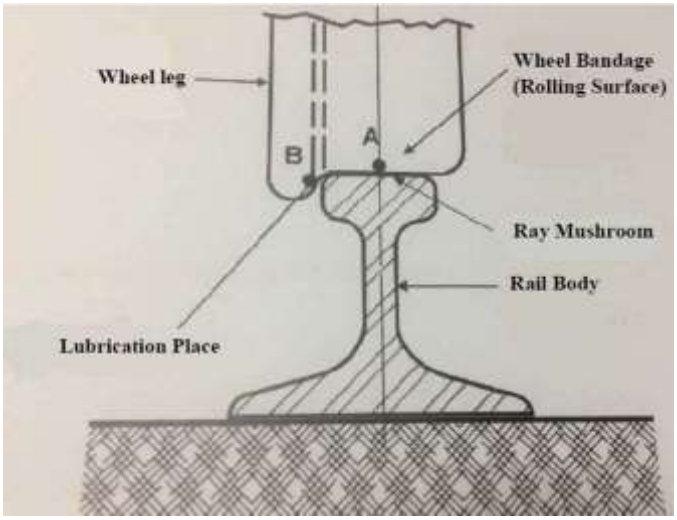

Fig. 1. S49 Rail-Wheel Relationship

Fig. 2.

II. WEAR AND FATIGUE TOLERANCES

Fatigue is the gradual decrease in the mechanical strength of a material when the stress caused by the effect of continuous loads reaches the fatigue limit. This does not happen with stresses below the fatigue limit. The material, whose strength decreases over time, breaks at lower strengths than the breaking stresses corresponding to the initial loading. In the fatigue test, the rail or weld is continuously loaded up to a fatigue stress of at least 2 million times and no cracks are required.

The cause of fatigue in metals is the spaces between the crystals that have been found from the beginning. When stresses and loads reach the fatigue limit, voids spread, expand, and cause the material to deteriorate without visible deformations.

Visible deformations in the rail profile are examples of wear. Apart from this, invisible wear between 0.10-2.00 mm can be read with Line Maintenance Tools or laser-optical equipment.

The maximum vertical wear tolerance depends on the maximum train speed and line traffic load.

Maximum vertical rail wear values according to British Railways;

TABLE I. MAXIMUM VERTICAL RAIL WEAR VALUES

Above 160 km/h	9 mm
120-160 km/h	12 mm
80-120 km/h	15 mm
Below 80 km / h	18 mm

Maximum vertical rail wear values according to German Railways;

TABLE II. MAXIMUM VERTICAL RAIL WEAR VALUES

19 MGT-25000 tons-above 140 km/h	12 mm
1.75-7.5 MGT-20000 tons-below 140 km/h	20 mm
0-1.75 MGT	26 mm

According to the BoStrab standard, the vertical wear tolerance of the S49 rail is 25 mm. Vertical rail wear is proportional to total tonnage. The vertical wear rate for 900A rails is 1mm/100MGT if there is buden lubrication.

According to British Railways, the point that makes an angle of 26 degrees with the rail axis 3mm above the lowest point of the rail cork is used as the reference point in lateral wear tolerance.

The total vertical and lateral wear of the rail cork should not reach 25mm.

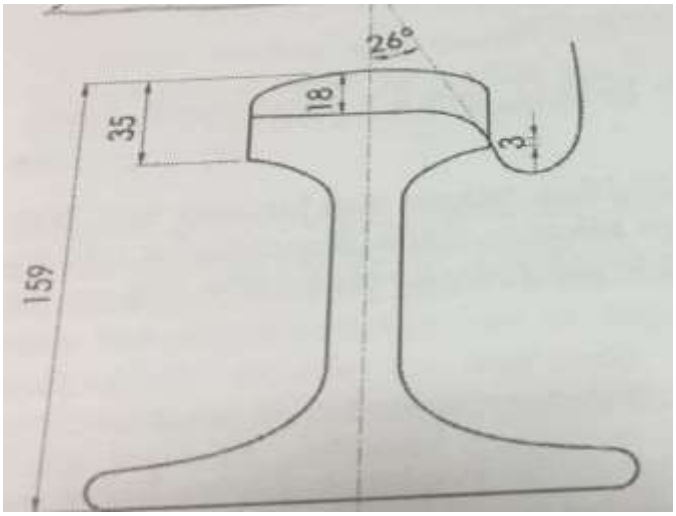

Fig. 3. Lateral and Vertical Wear Criteria According to British Railways

In our main line, we do not have a zone where the total lateral-vertical wear reaches 25 mm. Although we do not have a wear measuring device or vehicle, periodic control of the pulleys is carried out in the scissors and curve areas.

III. WHEEL - RAIL CONTACT:

Our S49 and Ri60 rails in the main line and warehouse area are of R260 - 900A quality. In other words, they have 260 BHN Brinell Hardness.

There are 3 different tram models serving in our business. Of these models,

- Wheel Budeni 290 BHN on Ansaldo Breda tram
- Wheel Budeni 305-320 BHN on CNR tram
- Wheel Budeni 305-320 BHN on Durmazlar Panorama tram they have their hardness.

The fact that the rail is harder than the wheel causes more wear of the wheel, and the harder the wheel than the rail causes more wear of the rail. In the enterprises, the desired rail is also the least level of wear on the wheel. It is useful to pay attention to these rail wheel stiffness criteria in line manufacturing and when choosing the vehicle to work on the line.

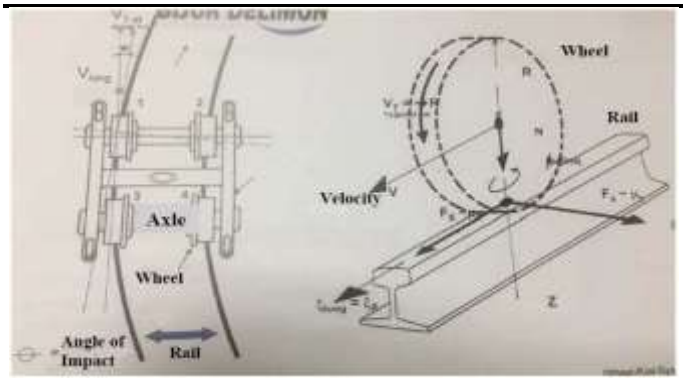

Fig. 4. Bogie Team Movement on the Cross

As seen in the figure above, the Bogie team oscillates on the curve. There can be many reasons for the abrasion and squeaking noise that occurs on the curve. These;

- Speed difference of wheels on inner and outer tracks
- The swing of the wagon on the track
- Skid
- Sudden Braking
- Laterally controlled or uncontrolled sliding
- Geometric error on the screen
- Exceeding Speed Limits
- It can be listed as the absence of the Transition Curve.

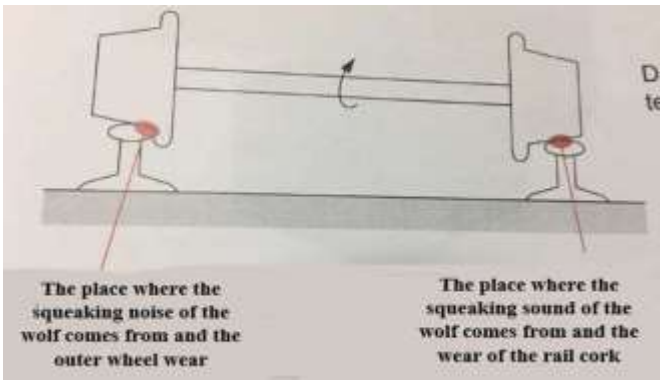

Fig. 5. Points of Wear and Noise

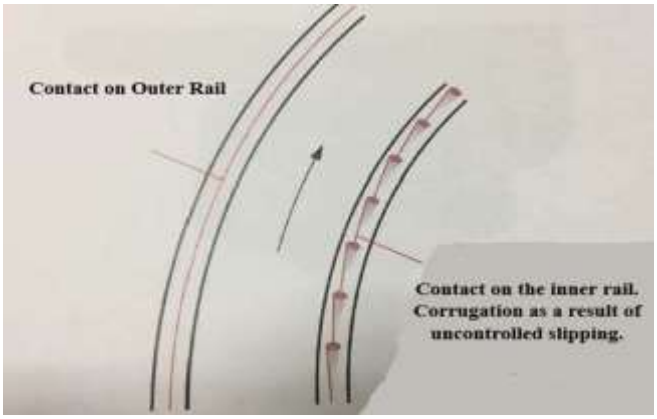

Fig. 6. Corrugation points

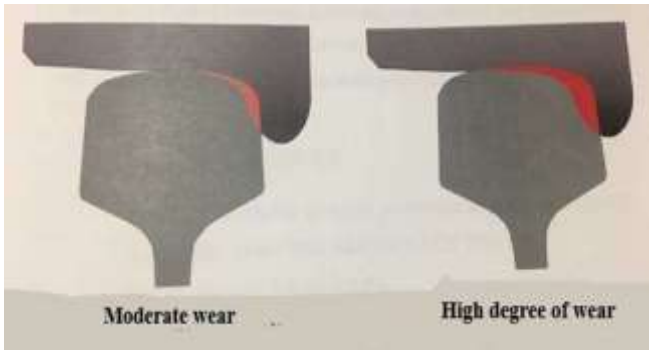

Fig. 7. Wear Points on Rail and Wheel

IV. COST ANALYSIS:

Given Cost Analysis for Lubrication Pump;

TABLE III. YEAR COST ANALYSIS FOR A CURP AREA WITH LUBRICATION PUMP

	Explanation	Amount	Unit price $	Amount $
1	Man/hour spent ontreatments	18	1.70	30.6
2	Oil consumption (kg)	12.5	16.95	211.88
3	Vehicle fuel consumption spent inmaintenance	600	0.07	42
4	Automatic Lubrication Pump Installation	1	6635.3	6635.3
		The Overall Total		6919.78

TABLE IV. YEAR COST ANALYSIS FOR A CURP AREA WITH MANUAL LUBRICATION

	Explanation	Amount	Unit price $	Amount $
1	Man/hour spent on treatments	120	1.70	204
2	Oil consumption (kg)	2	16.95	33.9
3	Vehicle fuel consumption spent inmaintenance	120	0.07	8.4
		The Overall Total		246.3

- The maintenance of the lubrication pumps is done every 15 days.
- A period of 15 minutes is foreseen for each lubrication pump maintenance.

- Lubrication pumps are calculated to be maintained by 3 people.
- Lubricating pump oil consumption was determined on the basis of 10 train 2 grams.
- The unit price of man / hour is calculated according to the monthly value of 282.35 $ / 180 hours.
- A period of 20 minutes is foreseen for manual lubrication in each curve area.
- Manual lubrication in the kurp areas has been calculated to be done with 3 people.
- In vehicle fuel consumption, the distance to the curve zone is approximately 5km. has been taken.
- Vehicle fuel consumption is calculated according to the value of

0.07 $ / km.

v. CONCLUSION:

Considering the cost of the automatic lubrication system, it is the ideal method for tram companies like us to continue to apply fixed flange lubrication from the vehicle and manual (with brush) lubrication systems together. Because there is no wear on the rails in the main line and our warehouse area above the tolerance values yet. In addition, the continuity of the line and tramway flanges with minimum wear can be ensured with the grinding and lubrication trainings that the Line Maintenance Team personnel will receive continuously.

Kayseray, Ankaray and Antalya Transportation companies have recently started to use the Automatic Lubrication System in their lines. When the data obtained from these plants were analyzed, it was seen that, for example, 1/6 of the oil consumption of the automatic lubrication system in a curve of R150 was consumed in 1 curve of similar radius in our line. In other words, it has been observed that our Line Maintenance Team consumes an average of 15% of the oil consumed by the Automatic Lubrication System with Manual Lubrication. This is because they have known how much oil to apply for many years and even where.

The Line Maintenance Team does not only focus on this job while lubricating the line on a curve, but also checks whether there are any adverse situations around the curve and the line (drainage channels - scissor motor and zone - scissor sliding pads). In other words, it always keeps the Maintenance and Repair Directorate up-to-date on whether there is a malfunction or a negative situation.

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