ISSUES ON MAINTENANCE AND MODERNIZATION TO INCREASE SAFETY AGAINST DERAILMENT OF THE RAILWAY TRANSPORT

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REZUMAT. Lucrarea de față evidențiază importanța întreținerii , reparației si modernizării căilor ferate pentru evitarea cauzelor ce duc la apariția deraierilor si a defecțiunilor suferite de materialul rulant.

Cuvinte cheie: siguranța circulației, calitate, durabilitate, deraiere.

ABSTRACT. This paper highlights the importance of maintenance, repairs and modernization of railways to avoid the causes of the appearance of damages suffered by the rolling stock and railway derailment .

Keywords: traffic safety , quality , sustainability , derailment

1. GENERAL CONSIDERATIONS

The components of the process of rail transport are:
− railways;
− locomotive;
− wagons .

Rail transport is an economical and efficient way both in financial terms and the space . A double railway line can carry more passengers at the same time than a four lines highway .

The Romanian railway infrastructure is state property and is composed of all elements necessary for the provision of public rail service , safely .

Infrastructure management is performed by the National Railway Company „C.F.R." SA which provides operators with full railway network to carry, safely and by ecological standards, passengers or goods.

2. ANALYZING THE CRITERIA OF SAFETY AGAINST DERAILMENT

To emphasize the main technical causes of the derailment, the guiding capacity of vehicles must be considered .

Important to note is that while running the axle mounted on rail, at the points of contact between them , it appears a system of forces.

The ratio of the forces that tend to produce and those who oppose the derailment, must be kept within certain limits. In some cases this system of forces is responsible of the boarding on track of the bandage rim and following the derailment of the axle.

Forces that appear are of two types:
– vertical forces;
– horizontal forces.

After the studies conducted by researchers as Nadal, Wagner, Heumann it has been found that the downward vertical forces prevent derailing while the horizontal forces favors it .

Derailment is influenced by:

− the friction coefficient between the bandage rim and railroad μ_b whose growth favors the derailment by reducing stability ;

− the angle of attack α case in which the values greater than 1 degree increase the danger of derailment ;

− effective load on the wheel *Q*, at whose growth , the stability is increased .

− the angle of inclination of the bandage rim β, whose growth improves the stability ;

− radius of the curve *R*;

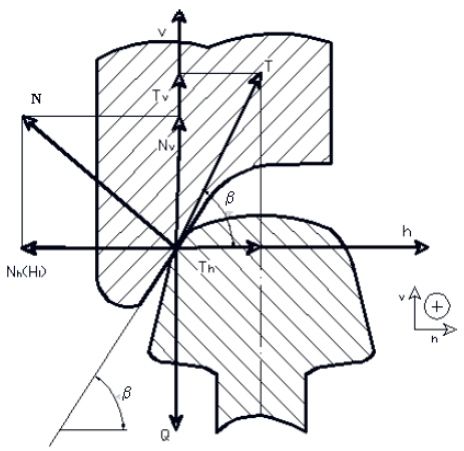
− velocity *v*;

− wheel diameter *D*; if the wheel diameter increases, the derailment occurs more easily;

If the friction coefficient is increased, a method of control is the lubrication of the bandage rim thereby reducing wear and risk of derailment. In this case, the vertical load will be transmitted only through the driving point B .

According Nadal's criterion , it is assumed that, the driving wheel will attack the railway at an relatively small α angle , and the contact between wheel and rail is realized only through the driving point , when the wheel tends to derail . As a reaction from the vehicle on the wheel we have the *Q* and *Y* forces and from the railway, the normal force *N*.

These are exemplified in the figure below :



For the derailment do not occur , the wheel has to come down from this position back to the position when the contact is made in two points .

When the wheel goes down , friction occurs along the bandage rim.

$$T = \mu_b \, N$$

where μ_b is the coefficient of friction between rail and bandage rim .

In case of limit equilibrium , the equations of balance of the forces on vertical and horizontal are :

$$Y + T\cos\beta - N\sin\beta \leq 0$$
$$N\cos\beta + T\sin\beta - Q = 0$$

From these relations, forces *Y* and *Q* can be deduced as following :

$$Y \leq N\sin\beta - T\cos\beta = N(\sin\beta - \mu_b\cos\beta)$$
$$Q = N\cos\beta + T\sin\beta = N(\cos\beta + \mu_b\sin\beta)$$

Thus, the criterion of safety against derailment, according to Nadal , is :

$$Y / Q \leq (\mathrm{tg}\beta - \mu_b) / (1 + \mu_b \mathrm{tg}\beta)$$

Noting $\mu_b = \mathrm{tg}\varphi$ then :

$$Y / Q \leq \mathrm{tg}(\beta - \varphi)$$

Nadal's criterion admits that $\beta = 60°$ and $\mu_b \approx 0{,}25$ and so it results:

$$Y / Q \leq 1{,}0$$

This method is considered overtaken, recently being developed more complex methods that take into account the slope of running surface, forces acting on the mounted axle, friction forces on both wheels and influence of the discharges from the leading wheel .

3. THE GLOBAL IMPACT OF SEVERAL SERIOUS RAILWAY ACCIDENTS

The causes that have generated most of railway accidents, especially derailments, were:

– mechanical errors of the operators;

– infrastructure design errors;

– wheel wear and the occurrence of faults in the mounted axle, due to vibration and other factors, followed by breaking them;

– rolling stock design errors;

– lack of regular repairs;

– high degree of the infrastructure wear.

Eschede, GERMANY 1998. The accident from Eschede, Germany 1998 is known as the worst rail accident in Germany. The causes which have generated the accident are still grounds for debate and analysis.

In the accident was involved a high speed train and the result was 101 dead and 88 wounded.

The train ran over two switches a few hundred meters before the accident, the frame stuck in the floor hit the guide rail located between the two rails and detached it from the rest of the structure, also penetrating the floor. Ascension of the axle caused the wheels to lose contact with the rail and derailment .

Following the derailment, the wheels have attained mechanical parts of the next switch, caused the change of the travel direction and starting with the rear bogie of the third wagon,the train followed the modified travel direction .

The train left the track and hit, with the speed of 200 km / h, pillars of a bridge .

The locomotive has been detached from the rest of the train and it stopped at three kilometers distance .

The result was that the bridge and the railway were destroyed, the wagons had derailed starting with the fourth and the train stopped in a pile of contorted iron, caused by the crash of the previous wagons .

The accident happened mainly due to the wheel wear and other mechanical defects . According the maintenance report it was found that eight passengers and conductors had accused a unusual noise and vibrations from the bogie with the defective wheel, but it was not replaced .

• *Because of the difficulties encountered by the team of Extrication, following the accident at Eschede the newly built trains are equipped with windows that have weaknesses to be broken easily* .

Tokyo, JAPAN, 2000. The tragedy took place 400 km from the capital Tokyo, and resulted in 54 deaths and 417 injured after a train has derailed and collided violently with an apartment flat complex .

The train with 580 passengers, jumped of the rails and hit the lower floors of a block of 9 floors, as a result of the non-respecting speed limit .

The accident occurred at a curve, after a straight way, with high speed limit. According to passengers, it appears that the employee did not reduce speed sufficiently to enter the curve .

Because of the failure to comply with the criterion of safety against derailment, the train was thrown off the railway due to increasing centrifugal force .

This incident led to endless investigations of R.T.R.I (Railway Technical Research Institute) and M.O.T. (Ministry of Transportation) to determine the precise cause..

Carcea, ROMANIA 2009. On September 21, 2009 in a village called Carcea, just minutes after leaving the Craiova stop, the accelerated train 1692 has derailed after a number of screws that fixed the railway had been disassembled .

At the accident scene it had been observed that the railway was greased with oil and the screws were not deformed, therefore the assumption was that the train derailment was caused due to intentional acts .

After the incident 13 passengers needed medical care.

4. CURRENT STATUS OF RAILWAY INFRASTRUCTURE IN ROMANIA

The railway infrastructure in Romania is severely damaged, fact confirmed also by the accidents that took place recently .

Lately, due to lack of funds and personnel to carry out repairs to the railway, took place speed limit reduction. If you notice the speed limit reduction, it means that the railway and the embankment are unsafe .

For railway maintenance, time that should intervene is 4 years, for replacing the rails . If the replacement is not done, the railway ages and deteriorates .

In addition to these „repairs“, the designated employees, must verify daily the safety condition of the line and report any defects . To avoid accidents, however, it has been preferred to adopt lower speed limits, which has repercussions on other plans .

Due to the low speed limits, Romania will lose the „Pan-European“ corridor, on January 1, year 2010 . The running speed on the IV-th Pan-European Corridor will reach 160 km / h toward 140 km / h as is currently, representing a condition imposed by the European Union.

Union leader "Iron Road" claims that Romania will lose money from transit fees because no one carrier will not accept to travel at speeds of 30-40 km/h.

Deplorable condition of rail infrastructure has consequences also from the financial point of view .

5. PROCEDURES OF VERIFYING AND REHABILITATION OF THE RAILWAY INFRASTRUCTURE

In the Remise of C.F.R. from Mogosoaia, you can find the newest and modern vehicle of maintenance and detection of irregularities on the rail .

The automotive of diagnosis of track and contact line, amounting to 5,000,000 euros, is fully computerized, equipped with antennas, cameras, sensors and powerful projectors is unique in Romania.

As equipment and method of operation is among the newest means of verification of the railway in Europe .

The system shows with great precision, places where repairs are needed to be made, where defects or damages can be found, it shows the wear sections or the sections in which speed or total restraints are necessary.

Measuring frequency of 25 to 25 centimeters, regardless the speed of rolling of the vehicle during the operation.

Accuracy and the efficiency of the measurements is very high, and there is no defect that can not be reported .

Thus, by many measures it determines the wear degree of the railway and applies safety measures.

The vehicle also determines the performance of the electrical line which supplies with electricity the railway .

The data received are sent to the computer system that processes and displays them in real time on monitors which are studied by specialists in rail and power lines .

6. AIMS AND CONCLUSIONS

According the support of European Union, the railway carriers from Europe will try to attract travelers from cars to wagons .

Among the major reasons that led to encouraging the establishment of a network of high-speed train is reducing environmental impact .

Rail transport has an energy efficiency six times better than a car and three times better than a ship and needs only 25% of space needed a road traffic road with the same capacity .

For high-speed trains to travel safely it is required that the telecommunications system to ensure a maximum efficiency, so that among the above upgrades, it is necessary to be made other improvements to rail .

To go among the States of the European Union, upgrades of the stations must be made, so far in Romania are only 12 "Eurostations" including Suceava, Oradea, Arad, Sighisoara, Brasov, Galati and 30 other stations are included in the framework of this program .

CFR Infrastructure will make investments to create lines of high speed railways, where the passenger trains to move up to 160 km / h and the freight ones up to 120 km / h .To boost the rail transport in countries like Switzerland and Germany were introduced fees high enough to heavy trucks for road transport, example that should be followed by Romania .

In the near future, in addition to the proposals to modernize the rail infrastructure and rolling stock.

The following periodical maintenance stages are necessary:

– study by non-destructive methods (optical, ultrasound etc.) of the states of stress, the wear of railway and rolling stock;

– anointing the lateral side of the bandage rim;

– periodical re-profiling of the conical profile;

– stringent measures for acts of indiscipline and training of the employers.

7. CONCLUSIONS

Of those presented it can be said that, the maintenance and modernization of rolling stock and railway, is a necessity.

To avoid derailment it is very important to check the state of wheels and railway line, and report any defects detected.

Following the accidents that occurred, there have been taken into account some steps to improve the rolling stock in order to protect passengers in case of accident, and the rescue action to be made fast.

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