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Identify Fracture Problem on Railway Track & determined various condition of stresses acting on track

[1]Amit Tiwari, [2]Dr. Neeraj Kumar

[1]Ph.D (Scholar), [2]Prof.& HOD, Department of ME, Suresh Gyan Vihar University, Jaipur (Raj) India.

Abstract - In this paper our major focus on identify reason or area where fractures occurring on railway track. We found that due to high or low speed of train most of the places some fracture are shown due to continues acting cyclic loading, as well as climatic condition are also responsible for this problem such as winter season in which the properties of steel is generally shrinking due to this stress concentration at particular area caused fracture which as shown in track. Whereas during rainy season generally problem we faced that the area affect by corrosion on railway track it is due to carbon composition present in steel. Due to corrosion the track material property is destroy for that during the train moving the track at different speeds when this corrosion area come to contact with stress it suffer from fracture at different form which is discuss in paper by showing diagram. We also discuss some major Factor affecting on track by which fracture problem increased, Effect of various stresses on track and Fracture and corrosion problem occur according to season wise.

Key Words: Identify Fracture Problem, Various Stress act on Track and Technique of reducing Fractures.

I. FRACTURES PROBLEM ON RAILWAY TRACK

The railway track structure is subjected to high stresses under the influences of stresses the track have certain limitation to bearing load after that they are start to deformation where shown by crack on track. Major rail maintenance problems are fatigue fracture, severe wear and plastic deformation of rail heads.

Fatigue fracture is caused by cyclic loading of very heavy axle loads which generate high wheel/rail contact shear stresses. At present, these defects are detected by the extensive use of ultrasonic detection methods and regular visual inspections by track inspectors.

If a fatigue defect is not detected, a rail break will occur leading to a possible derailment. The fracture problems comes also during winter season due to low temperature climatic condition because steels are shrinking and elongation in length by nature at low temperature during this time high speed train moves on track the stresses generate and its also depend upon that condition of steel structure having capacity to bear load some internal crack are occur inside the track and this will repairing through thermite welding but it observed that this technique is not be useful for along time after some time same problem creat or finally track inspections person takes decision for replacement of track, this is a major losses for railway sector now a days so we need to manufacturing a better composite mater for solving this problem and increased long life of railway track.

Welding Methods used for Resolving of Fracture

Electro slag welding (ESW), electro gas welding (EGW) and Thermite Welding are the most common methods for single pass welding of steel materials of increased thickness. If multi pass welding is technologically required, there is a possibility to apply one arc welding method or a combination of several methods (SMAW, GMAW, FCAW or SAW). If considering productivity and quality of the weld, all mentioned methods have their advantages and shortcomings. The methods ESW and EGW are characterized by high productivity, but due to overheating of weld metal and surrounding zone, they do not assure necessary mechanical properties of welded joints.

Technique of reducing Fracture by Non—Welded Rail Joints

Non-welded rail joints may be classified as either:

a) Permanent rail joints (including glued insulated joints and expansion joints) intended for use in track where special inspections or speed restrictions are not required.

b) Temporary joints intended for temporary jointing of rails to permit short term passage of trains generally at reduced speed and requiring special inspections when in use.

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II. LITERATURE REVIEW

[1] V.L.Markine, A,P.de.Man, C.Esveld (2010): In this paper the procedure for design of a railway track is presented Each track structure is characterized by its components dimensions and mechanical properties such as stiffness and damping it is measuring b excitation testing method. The mechanical behaviour of a track is analysed using 2D & 3D finite elements model.

[2] John Rudlin, Angelique Raude, Uwe. Volz, Antonietta LoConte (2012): In this paper there are three alternative methods of crack detection corrosion assessment for railway axle inspection. First method is the exposed body of the axles and can be carried out automatically. Second Method is for hollow axles of high speed train and its aims to increase the speed of inspection and improved crack detection reliability. Last third method is for the improvement the measurement of corrosion. The Ac thermography methods is able to detect cracks in axles.

[3] D S Hoddinott (2004): In this paper electrical arcing, corrosion and stress corrosion cracking had initiated the fatigue crack. The most NDT method should be used to identify crack in each area of axles where crack have been to occur.

[4] Abdulhaq Hadi Abed Ali, Atheer Naji Hameed, and Sinan Khaleel Ibrahim (2013): In this paper the basic purpose for the railway components to transfer resulting stresses safely to earth natural layer. The author used track 3.1 program developed by US army crops engineer to calculate the rail bending stresses and tie bending stresses as well as shear stresses or layers reaction on load hanging from the train. From the results obtained it is noted that the rail bending stresses is less when increasing the thickness of the insulating layer.

[5] Yuan qing Wang, Hui Zhou, Yong jiu Shi, Bao rui Feng (2011): In this paper brittle fracture occur frequently in rails and thermal welded joints. Some test are carried our such as uniaxial tensile test, charpy test and three point bending test at low temperature to investigated mechanical properties and fracture toughness of U71Mn and U75V rail steels and their thermite weld. The ductile indicated of U71Mn and U75V rail steel and their thermite welds all decrease as the temperature decrease.

[6] Carey Leroy Walters (2014): In this paper contribution to understanding the phenomenon by presenting both ductile to brittle fracture transition data and fatigue crack growth rate cure for modern high strength steel based plate materials. Finally suggestion that fatigue at lower shelf temperature may have a higher rate than in the transition or upper self-temperature for region I and II of the da/dN verses Δk curve.

[7] Bagtong, L.and Xiulin (2015): The optimization model based on the decision network method is effective in minizing rail management cost through rational planning of maintaince and replacement policy for rails in the whole track.

The fracture and cracks problem are described have all occurred in the mid –span section of track at or near the centre of the vechicle. These are the very serious matter facing by railway department during inspection. Non mid span fracture and cracks are normaly caused by axle bearing problem.

Rail guide trains are subjected to severe contact stresses at the wheel, where each wheel passage reshapes the railhead profile due to wear extreme level of stress concentration also induce surface and subsurface fatigue crack in railheads.

Figure 1: Typical example of broken rails (Surface Crack)

In some condition the ductile steel becomes brittle and can lead to rail breaks due to capacity exceedence under rail bending. While cracking of the rail head is very complex, other part of the rail (e.g. rail web bolt hole) and joint bar are subjected to stress levels within the elastic limit of the material. The life of these components can be estimated from the theory of linear fracture mechanism.

Figure 2: Typical example of broken rails (Surface Crack)

Impact of Stresses due to Fracture problem occurring:

1. Fatigue fractures are caused by the cyclic loading of very heavy axle's load which generates high wheel/rail contact shear stress. At present now these defects are detected by ultrasonic detection methods and regular visual inspection.

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2. The static load is the dead weight of the train, while other side dynamics component which is known as the dynamic increment and its depending on the train speed and track conditions.
3. The dead wheel load can be taken as the vehicle weight divided by the number of wheels, where static load from the dead weight of the train often rang from about 53 kN for light rail passenger services.
4. Crack initiation is preceded by plastic deformation of the patch of the rail that is in contact with the wheel.

Type of Stresses Effect on Railway

1. Bending stress
2. Ballast surface stress
3. Tie bending stress
4. Tie reaction
5. Subgrage Stress

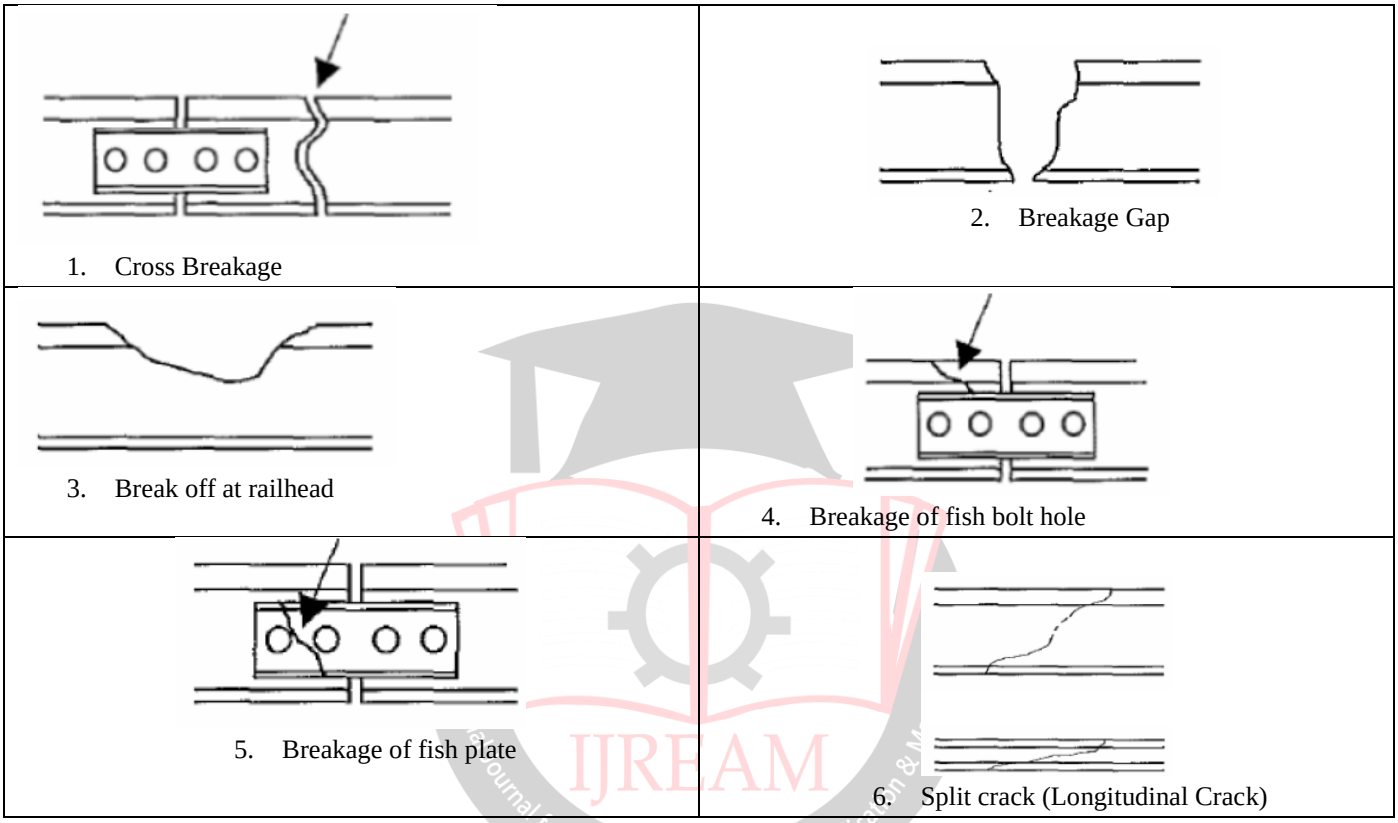
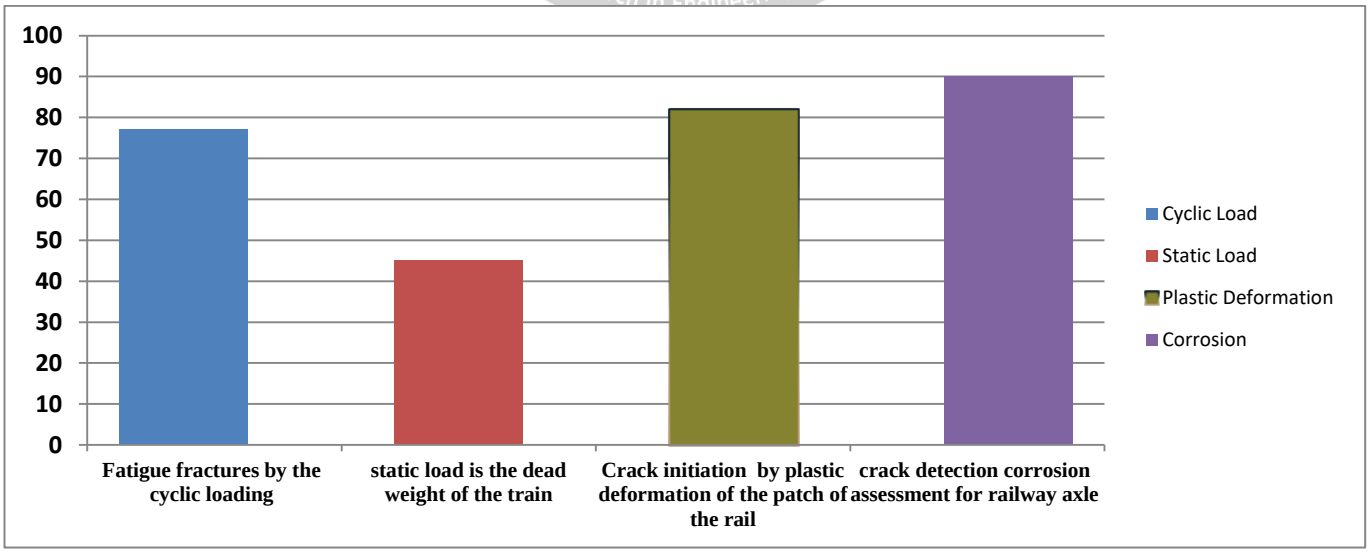


Figure3: Common types of rail break



Graph1: Factor affecting on track by which fracture problem increased.

It is shown that what are the factors affected on railway track due to this fracture problem developed, during investigation we found that various type of stresses acting on track for this fracture or crack are shown in various areas on track basically due to

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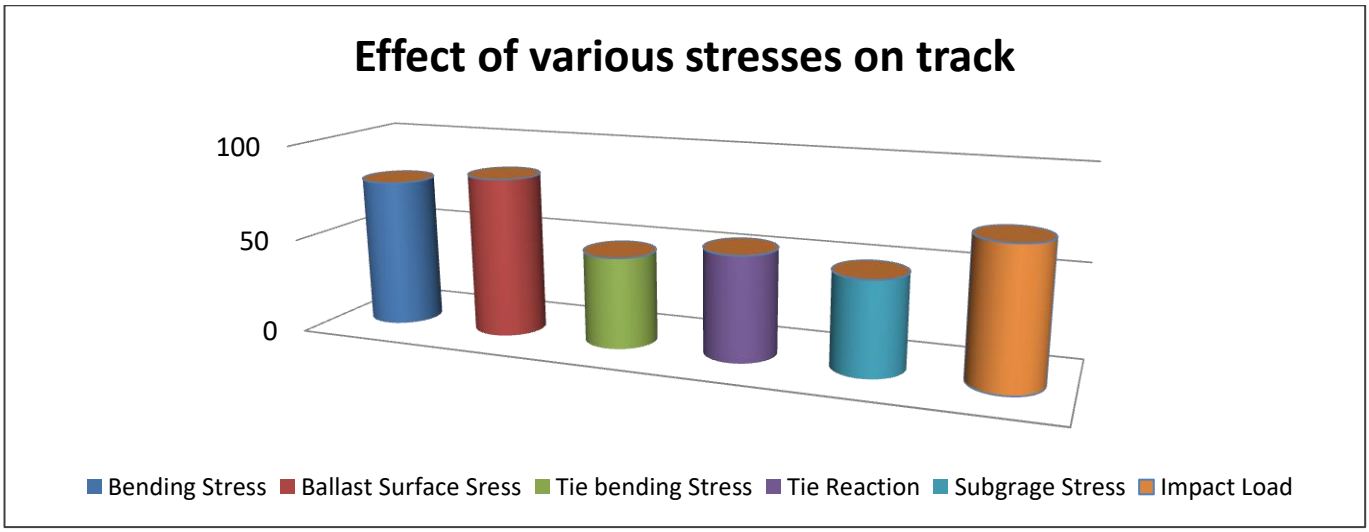
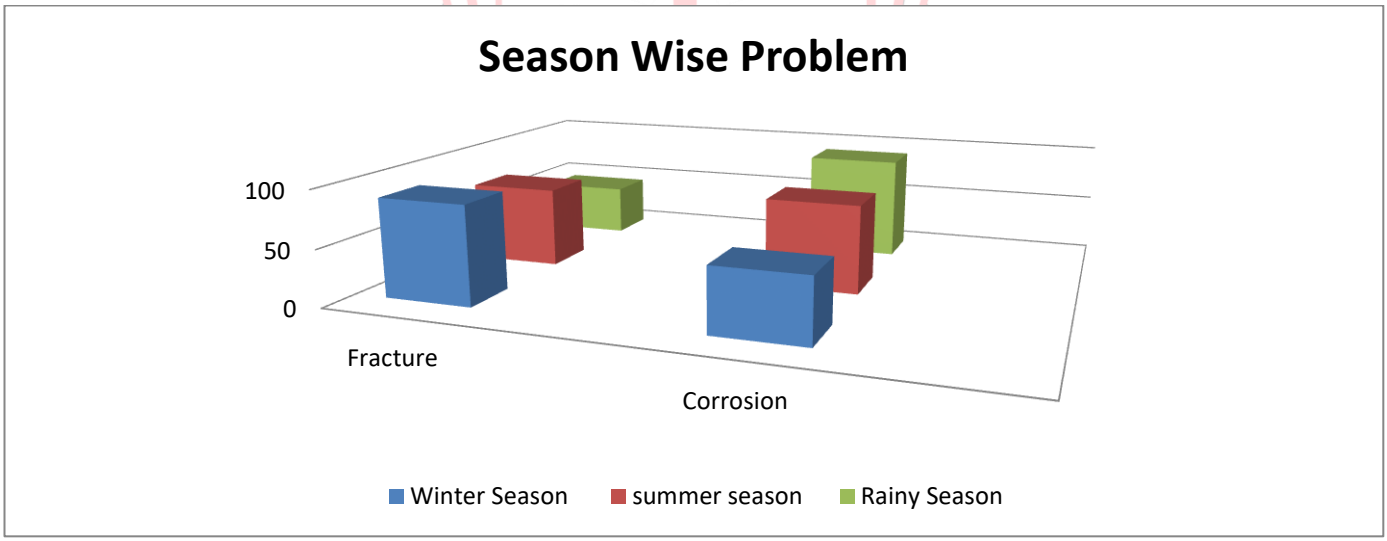
continuously repeated cyclic loading more stresses generate and while the weakest portion is affected and may be possible crack are occur due this we need to weld the track by thermite welding process. Some where we also found one more reason is to increasing corrosion rate on track it is also one of the reason for generate fracture or crack due to weakness of track material.



Graph2: Effect of various stresses on track

During study we found that various stresses are affected on track where the ballast surface stresses are play important role to destroy track or generate fracture or crack. After ballast surface stress the bending stress is responsible for fracture it is also shown discuss in figure number 3. So the conclusion is for increasing fracture or crack on railway track this two stresses are more affected track materials so if we will reduce this fracture problem we need to reduce this stresses and increasing material strength by addition of composite material as per track properties.



Graph3: Fracture and corrosion problem occur according to season wise

In this graph we discuss about the fracture or corrosion rate increase or decrease according to changing of season because season is also responsible for this problem such as during winter season we found that fracture problem is generally showin in track because during this season the properties of steel goes to shrink due to this stresses are more occurring on track, where as corrosion rate increasing during rainy season because track are directly affected to water and its maily chances to decreasing material property so we need to develop such material those properties is not affected by water or any acidic substance for prevention corrosion problem on railway track.

III. CONCLUSION

1. Fatigue fracture is caused by cyclic loading of very heavy axle loads which generate high wheel/rail contact shear stresses.
2. Bending stress, Ballast surface stress and Subgrage Stress are play important role to increasing fracture zone in which ballast surface stress is major part for failure.
3. During inspection the corrosion properties is highly responsible to decrease track material strength by which material get weak in nature and life cycle of track is reducing rapidly.

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4. The fracture problems comes also during winter season due to low temperature climatic condition because steels are shrinking and elongation in length by nature at low temperature during this time high speed train moves on track the stresses generate.
5. Electro slag welding (ESW), electro gas welding (EGW) and Thermite Welding are the most common methods for single pass welding of steel materials of increased thickness but after a certain time track will permanent replaced due to cintionusly cyclic load act on track the stress generated and last the some portion on track affected by fracture again.
6. The fracture and corrosion problem also affected according to season such as during winter fracture are major caused and suring summer corrosion are major caused to destroyed track material.

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