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CHIEF CONSIDERATIONS AFFECTING THE DESIGN AND USAGE OF RAILWAY SLEEPERS IN INDIA

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Object of the paper is to bring to the notice of engineers in general and railway engineers in particular the fundamentals of the design and usage of the various types of sleepers in India. An ideal sleeper should be able to distribute load over the ballast evenly in addition to maintaining the correct guage between a pair of rails. It should be strong and stiff engough to function as a beam with adequate lateral strength to resist the track distortion under the influence of lateral flange forces. Resistance to creep and adequate bearing area are additional desireable features of a sleeper. It must also be light in weight to facilitate transportation and should be resistant to corrosive effects of the environment. A good sleeper should have the least number of fittings. Basically sleepers are either rigid (one piece) or semi-rigid (the double block).

Wood, steel, cast iron and plain or reinforced concrete are common materials used for sleepers. Wood sleepers are generally preferred over metal sleepers whereas concrete sleepers are rarely used. Metal sleepers are more frequently used in some countries. Apart from technical and economic considerations, prejudices appear to influence selection of a particular material for manufacturing sleepers. In a few countries use of metal sleepers is relatively common. Metal sleepers are more susceptible to environmental attacks than wooden sleepers which have added advantage of better insulation and quieter movement of trains. Excessive weight, higher risks of their demages in

case of derailments, and higher maintenance cost are among the disadvantages of the metal sleepers.

Design of a sleeper is influenced by theoratical as well as practical considerations. Theoretical aspects include behaviour of track and sleeper under load, dispersion of sleeper load through ballast, sleeper spacing and strength of track, relationship between sleeper spacing and axle load, sleeper spacing in relation to the rail joint and impact, effect of sleeper dimensions on its load bearing capacity, effect of the width of rail bearing upon sleeper stability and the lateral strength of track. The designer must treat a sleeper as a beam on elastic supports. The pressure underside a sleeper spreads at an angle of 45 degrees. Sleeper section is a function of its spacing which differs for various axle loads. A sleeper placed close to a rail joint increases the useful life of rail by preventing its repeated bending. Design of sleeper and rail fastenings have an important effect on the lateral strength of the track.

Practical design considerations vary for different types of sleepers. For cast iron sleepers, the weight of the plate, shape and bearing area of sleeper and the effect of tie bar on the lateral stability of a sleeper deserve due consideration. The weight of cast iron sleeper is generally believed to contribute to the stability of the track against wave motion. Its shape practically enhances its ability to hold ballast. Salient practical features of a steel trough sleeper include its waisted shape and provision of baffle which significantly contribute to the compactness of the sleeper. A wood sleeper should be capable of seasoning without excessive splitting, be amenable to treatment, should have sufficient compressive strength and adequate hardness to withstand rail abrasion. Average life of different types of wood sleepers in India is for deodar 18 to 21 years, chir 16 to 18 years, fir and kail: 14 years and other untreated soft wood sleepers 12 years. In America and Britain average life for a treated wood sleeper is over 25 years. Causes of low life of wood sleepers in India are the inadequate section, insufficient treatment, improper protection against mechanical wear, spike killing of wood and defective system of sleeper replacements.

Economic benefits of using wooden sleepers can be enhanced by relaxation of the existing sleeper specifications, exploring type of wood not being tried at present, use of half round sleepers of sal, teak and chir etc. Standardisation of two to three different sections of sleepers

for any particular guage and accelerated seasoning and care in handling can also contribute to the economical use of wood sleepers. Economic considerations alone decide the type of sleeper to be used. The relative merits of any two sleepers shoudl be determined purely from economic considerations based on their intial prices and on their probable lives in the track under identical conditions of service. For this purpose a common criteria of annual cost of a sleeper has been adopted. The annual cost of a sleeper is the sum of the interest charges on the initial cost, the depreciation charges and the maintenance charges.

Total track mileage in India is equally served by wood and metal sleepers. Use of metal sleepers is advocated for economic reasons and due to nonavailability of quality wood sleepers in India which, in the opinion of the author, is not justified. The past record shows that popularity of a particular type of sleeper changes with time. In the beginning good wood for sleepers was in abundance but due to indiscriminate cutting of trees and nondevelopment of other forests, wood has become short, and attention was attracted by metal sleepers. During the last 15 years suitable types of steel and cast iron sleepers have been evolved. With proper efforts to implement author's recommendation, wooden sleepers can regain their lost place.