

## **4. RECOMMENDED MINIMUM STANDARDS AND REQUIREMENTS FOR FUTURE TAR NETWORK**

As mentioned in Section 4 of Volume 2, the primary objective of this study is to recommend minimum technical standards for the future rehabilitation of the existing TAR network, and the new construction of missing links in this network. The recommendations were made in the context of achieving the required operational objectives for the TAR network so as to be more competitive with other transport modes operating in TAR corridors.

### **4.1 Principal Railway Route Design Parameters**

#### **4.1.1 Outline Gauge**

The minimum clearance is required for the transport of all types of containers including the non-ISO high-cube containers with a maximum gross weight of 35 tonnes and the maximum dimensions of 2,896 mm in height, 2,591 mm in width, and 13,716-16,150 mm in length. The platform height of standard container flat wagons is normally 1,010 mm above the rail level. The **vehicle gauge** which is defined as the limiting dimensions, measured from the centreline of the track, beyond which any part of a vehicle or its load may not protrude, should at least accommodate the minimum clearance mentioned above.

The vehicle gauge is static in nature as it implies stationary trains. For moving trains, the vehicle gauge needs to be expanded to allow for dynamic effects such as track irregularity, vehicle vibration, lateral movement of wheel, wearing of wheel, and unbalanced loads on wheels. Generally, 600-800 mm should be added to the width of the vehicle gauge, and 300-400 mm to the height. This is called the **structure gauge** or a safe minimum clearance for moving trains. For tunnels, 200 mm is normally added to the all-around dimensions of the structure gauge to allow for construction tolerances and future repair. This being the case, a minimum height or clearance above rail of 4,300 mm would be required to transport high-cube containers of 9 ft 6 ins height on standard container flat wagons with a platform height of 1,010 mm. For electrified and/or standard gauge track, the structure gauge needs to be expanded further.

#### **4.1.2 Maximum Permissible Axle Load**

Locomotive weights and container transport requirements were the two major factors being considered when evaluating the suitable axle load limits in the TAR corridor. More up-to-date locomotives generally come with six axles and a gross weight of 90 tonnes which is equivalent to having an imposed load on track of 15 tonnes per axle. Similarly, standard container flat wagons carrying two ISO 20 ft containers will have a gross weight of 54 tons, or an average load per axle of 13.5 tons. Therefore, it is recommended as in Volume 2 that, a maximum permissible axle load of 15 tonnes should be made standard for the narrow-gauge TAR network.

An axle load of 15 tonnes should be regarded as the minimum target for any track rehabilitation program aimed at strengthening the existing track structure to carry heavier loads. There may be cases where the conditions of the track or bridges are so bad that it would be more economical to undertake renewal or replacement work. If so, it might be advisable to consider specifying an axle load of greater than 15 tonnes, say 18 or 20 tonnes. This applies also to the future construction of new lines or missing links.

### **4.1.3 Competitive Schedule Speeds**

Dividing the total distance between origin and destination by the elapsed time between departure and arrival gives the magnitude of the schedule speed. Two components make up the schedule speed, that is, the stopping time at stations or crossing loops for various reasons, and the running time. In Volume 2, emphasis has been given to the competitiveness of the rail container transport. Container block trains and passenger trains should be scheduled to operate at similar speeds. A maximum speed of **70 km/hour** was recommended although higher speeds in the order of 90-100 km/hour were preferable for long-term planning. Beside heavy capital investments required to upgrade all associated facilities for higher speed operation, a joint road-rail policy should be established to settle the issue of road crossings which has been one of the major obstacles for trains to achieve faster speeds.

#### **Other Standards**

In addition to the clearances, axle load and schedule speed specified earlier, the following physical standards are highly recommended:

#### **4.2.1 Uniform Maximum Length for Freight Trains**

To achieve operational economies, the composition of container block trains should comprise **30 bogie flat wagons**. Together with a locomotive and a brakevan, the train length would measure approximately 450 metres, thus requiring a **minimum siding length of 500 metres** for crossing purposes.

#### **Compatible Design Standards for Locomotives and Rollingstock**

Locomotives and rollingstock operating within the TAR corridor should share compatible standards to allow a smooth passage of trains across the national borders. Considerations are given to the braking system design and efficiency, coupler type and height above rail level, container mounting fixtures, and materials handling system for loading and unloading of wagons. Air brakes are more efficient than the conventional vacuum brakes. AAR type automatic couplers are considered standard. They come with 50 tonne draft capacity and a height of 850 mm above rail level. Mounting fixtures should be capable of accommodating both 8 ft-0 in and 8 ft-6 in container widths.

#### **4.2.3 Compatible Track, Structures and Signalling System Design Standards**

To accomplish a maximum speed of 70 km/hour, or preferably 90-100 km/hour, for container freight trains, it is essential to have a strong, rigid and durable track with long usable life and less routine maintenance cost. Continuous long-welded rail should be utilized to enhance smooth riding comfort, and reduce wheel and rail wear. Heavy (50-60 kg/metre) rails are necessary for stability and endurance. Sixty kg/metre rail in particular, being the normal weight of rail for 1,435 mm gauge track, is highly recommended for any track renewal work. If it happens in the future that a conversion from metre to standard gauge is justifiable, it is likely that any 60 kg/metre rail used for track renewal could be re-used following gauge conversion, since the normal service life of this rail under passing tonnages typically encountered in the subregion exceeds 30 years. Elastic rail fastening systems, preferably of the "fit-and-forget" and anti-vandalism type with resilient bearing pads and durable insulators, if applicable, are equally desirable to help reduce rail creep and gauge widening and also increase the lateral stability of the rails. Monoblock prestressed concrete sleepers or ordinary reinforced concrete two-block sleepers of adequate design and structural shaped steel

embedments are sturdy and currently more economical to use than timber. Sleepers should be spaced at 600-700 mm (or 1,429-1,667 pieces to each track kilometre), and uniformly laid to be suitable for future mechanized track maintenance. Granite or other good quality ballasts of 250 - 300 mm thickness are generally required to provide track stability, better load distribution to the road bed, and to protect against mud-pumping. Proper drainage systems should be installed to get rid of excess water which is the prime cause of track deterioration.

All temporary bridge crossings should be made permanent, utilizing concrete rather than steel construction. Steel bridges require considerable routine inspection and maintenance inputs, which will prove to be less economical in the long run. A problem frequently encountered with steel bridges of the through trussed type is that their upper chord members infringe the structure gauge. Concrete bridges are heavier requiring costlier abutments, but do not impose structure gauge infringement problems. Modern prestressed concrete bridges are slim and much lighter than the conventional reinforced concrete bridges. They can be precasted in segments at the factory, and transported to sites for erection, especially if their span lengths do not exceed 18 metres. To maintain an ample clearance underneath the bridge deck, the girder depths can be minimized by introducing U-shaped "cast-in-place" prestressed concrete sections. Ballasted-track bridges are more commonly employed to avoid problems associated with weak formation of the approaches, and differential settlement of the abutments.

As to standards for railway signalling and telecommunications systems, the **tokenless** absolute block system is recommended together with multiple-phase colour-light signals, all-relay interlockings, train dispatching telephones and train radio. Step-by-step conversion from mechanical interlocking to electro-mechanical and, finally, to all-relay interlocking may not be feasible due to the shortage of spare-parts and skilled workers to undertake the conversion, and the costly inspection and maintenance of the old systems. It should be noted also that modern solid-state signalling has replaced the electrical/relay system in many advanced railways. For telecommunications, transmission trunk lines employing the fibre-optic cables offer enormous channel capacity, and are more reliable than the microwave or wire-cable transmission systems.