A primary requirement for the routes in the corridor is that they should in future permit the conveyance of containers of all types and sizes being used in international trade. Such conveyance should be free of technical obstacles from one rail system to another and from one mode to another.

The practical implications of this requirement are that:

1. The limiting dimensions of structures throughout this network should be sufficient to allow unrestricted passage of wagons conveying the highest and widest containers used in international trade - i.e. the structure gauge adopted for the network should provide adequate clearance for such containers carried at normal running speeds;

2. The maximum allowable axle loads throughout this network should be sufficient to allow conveyance of such containers in trainloads of economic size and configuration. In practice, this would mean that axle loads would need to be sufficient for the conveyance on a single wagon of the equivalent of two (and in some cases three) twenty foot containers loaded up to or near their maximum payload or for the operation of locomotives of adequate power rating\(^1\);

3. The maximum allowable line speeds throughout the network must be consistent with the realization of commercial speeds which are competitive with those of alternative transport modes (bearing in mind that maximum line speed is only one of the factors influencing commercial speed, other important ones being operational and border crossing stopping times, signalling system performance, infrastructure condition, and motive power and rolling stock condition and performances).

This chapter provides an assessment of these technical requirements and the extent to which they are met on the networks in the corridor.

### 3.1 Structure gauge and loading gauge

The structure gauge sets dimensions within which no outside structure may protrude and prescribes minimum height and width distances between structures and track centre.

The loading gauge sets dimensions beyond which no part of the cargo may protrude. These are maximum dimensions in relation to the track centre. The loading gauge thus

\(^1\) In the majority of cases, it is likely to be the axle loading of locomotives, rather than that of the container wagons, which will provide the overall axle load constraint for the system.
prescribes the maximum width and height of a wagon or of a cargo, i.e. a container, secured on a wagon.

However, in practice, the above-mentioned definitions are applied with due consideration given to basic principles of physics regarding vehicles in movement, most notably in curves where the central part of a vehicle tends to be pushed inwards and the end and corner parts of the vehicle tend to be pushed outwards. This is particularly important when commercial requirements lead to the development of faster rolling stock.

Usually, the width imposed by the loading gauge is not a constraint for the transportation of containers. Problems arise with the height measured from the top of the rail to the top of the load. While the centre part of the load does not normally constitute a problem, the top outside edges do, as the standard loading gauge does not have a rectangular top section but a slanting shape. This is crucial in the case of containers as (a) containers have a cubic shape which tend to occupy a large volume of the loading gauge and (b) containers are getting bigger.

To allow for vertical and lateral movement of wagons due to track irregularities or vehicle dynamics on curved track sections, a clearance of about 40 cm between the outside dimensions of wagons and their loading and the inside dimensions of structures typically has to be allowed.

The use of low profile wagons (i.e. wagons with wheels of small diameter or with dropped centre sections) can sometimes be used to overcome structure constraints without the need to expand the inside dimensions of structures, thereby avoiding expensive investments.

The dimensions and physical weight of ISO and non-ISO containers most commonly used in international movements are shown in Table 3.1. To determine the readiness of the Trans-Asian Railway to provide efficient container movements throughout its various components, it is therefore imperative to assess the extent to which each individual railway system along the North-South corridor can accommodate the most widely used ISO and non-ISO containers.

(i) Assessment of the structure and loading gauge situation in Armenia, Azerbaijan, Kazakhstan, Russian Federation, Turkmenistan, Uzbekistan

Until the break-up of the former Soviet Union, the railways of these countries formed part of the then Soviet Railways. In other words, their design standards are those which were developed and enforced in the days of the Soviet Union and are therefore common to all.

These technical standards were often more generous than those adopted by most other European and Asian railways and there is currently no restriction on the railways of these countries (now forming the Commonwealth of Independent States, or CIS) to the movement of ISO and non-ISO containers.

(ii) Assessment of the structure and loading gauge situation in Finland

The loading gauge standard adopted by Finnish Railways are such that the Finnish Railway component of the corridor, i.e. the line section between Helsinki and Vainikalla, at
the border between Finland and the Russian Federation, can accommodate both ISO and non-
ISO containers.

Table 3.1 Dimensions of most commonly used ISO and non-ISO containers

<table>
<thead>
<tr>
<th>Freight container designation</th>
<th>External height</th>
<th>External width</th>
<th>External length</th>
<th>Maximum gross weight (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ft</td>
<td>in</td>
<td>mm</td>
<td>ft</td>
</tr>
<tr>
<td>ISO 1 A</td>
<td>8</td>
<td>00</td>
<td>2,438</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 AA</td>
<td>8</td>
<td>06</td>
<td>2,591</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 BB</td>
<td>8</td>
<td>00</td>
<td>2,438</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 BB</td>
<td>8</td>
<td>06</td>
<td>2,591</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 C</td>
<td>8</td>
<td>00</td>
<td>2,438</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 CC</td>
<td>8</td>
<td>06</td>
<td>2,591</td>
<td>8</td>
</tr>
<tr>
<td>ISO 1 D</td>
<td>8</td>
<td>00</td>
<td>2,438</td>
<td>8</td>
</tr>
<tr>
<td>Non-ISO (1)</td>
<td>9</td>
<td>06</td>
<td>2,896</td>
<td>8</td>
</tr>
<tr>
<td>Non-ISO (1)</td>
<td>9</td>
<td>06</td>
<td>2,896</td>
<td>8</td>
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<td>Non-ISO (1)</td>
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<td>2,896</td>
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<td>Non-ISO (1)</td>
<td>9</td>
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<td>2,896</td>
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<tr>
<td>Non-ISO (2)</td>
<td>9</td>
<td>06</td>
<td>2,896</td>
<td>8</td>
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<tr>
<td>Non-ISO (2)</td>
<td>9</td>
<td>06</td>
<td>2,896</td>
<td>8</td>
</tr>
<tr>
<td>Non-ISO (2)</td>
<td>9</td>
<td>06</td>
<td>2,896</td>
<td>8</td>
</tr>
</tbody>
</table>

(1) High cubes  
(2) Super high cubes

(iii) Assessment of the structure and loading gauge situation in the Islamic Republic of Iran

The structure and vehicle gauge applicable to all 1,435 mm gauge lines in the Islamic Republic of Iran indicates that super high cube containers would certainly, and that high cube containers would probably, infringe the structure gauge, if carried on standard flat wagons, while ISO containers of 8ft 6in height would infringe the vehicle gauge of the network. However, the latter may be carried since there would be greater than 40 cm clearance between the outside dimensions of the wagon with its container load and the inside dimensions of structures.

On the railway system of the Islamic Republic of Iran, the most critical structure limitations are to be found between Tehran and Djulfa, more precisely between Tehran and Tabriz, where mountainous terrain has required extensive tunnelling. It is understood that there are a number of tunnels in the section Km 427.6 - Km 497.25 (distances measured from Tehran), ranging in length from 537 to 1,726 metres.

In view of the important role of the Islamic Republic of Iran in offering transit to the Persian Gulf to a number of countries, most significantly to the landlocked countries of Central Asia, it can be assumed that when traffic justifies such investments, palliative
measures, such as the adoption of low-floor rolling-stock, will be adopted by the Iranian Islamic Republic Railways.

(iv) Assessment of structure and loading gauge situation in South Asia

**India**

For the purpose of an earlier ESCAP study\(^2\), Indian Railway, in its Country Report, indicated that all nominated TAR links in India – among which the Attari - New Delhi and New Delhi - Mumbai sections of the north-south corridor in India – conform with the structure and vehicle gauge standards specified for the TAR network. Restrictions applying to the dimensions of vehicles (and their loads, as applicable) throughout the Indian Railway network were given as follows (with the assumption that these restrictions apply in respect only of the broad gauge, i.e. 1,676 mm, network):

- Maximum width 3,250 mm (10ft 8ins)
- Maximum height above rail level at track centre 4,140 mm (13ft 7ins)
- Maximum height above rail level 3,530 mm (11 ft 7ins)

While both high cube and super high cube containers would infringe this vehicle gauge if carried on standard height (1,000 mm) wagons, they are classified as «over dimensional consignments» and are permitted to move, but at a maximum speed of 75 km per hour.

**Pakistan**

According to the same study\(^3\), structure dimensions impose restrictions on the movement of super high cube containers at only two locations on the routes which continue the corridor on Pakistan Railways. They are as follows:

- a tunnel at Km 263 between Spezand and Sibi provides clearance of only 29 cm between the inner tunnel wall and the top corners of super high cube containers loaded on wagons of 1200 mm height. In this case, the vehicle gauge infringement is 5.1 cm, and

- a tunnel at Km 1608 between High Attock City and Peshawar restricts the clearance available for super high cube containers loaded on wagons of 1200 mm height to 36.8 cm. In this case, the vehicle gauge infringement is 6.3 cm.

It should be noted, however, that these restrictions appear with the use of 1,200 mm high wagons, when in fact the floor height of the standard BKF container flat wagons in use in Pakistan is only 1,105 mm. Use of lower profile wagons would in both cases allow passage of high profile containers with only minimal speed restrictions.

\(^2\) “Development of the Trans-Asian Railway: Trans-Asian Railway in the southern corridor of Asia-Europe routes”, New York, 1999, p. 82.

Assessment of structure and loading gauge situation in South-East Asia

**Malaysia and Singapore**

ISO standard containers of a height of 8 ft and 8 ft 6 in fit within the KTM structure gauge, even when mounted on standard container flat wagons of 1,010 mm floor height. In the case of 8 ft high containers, the clearance between the shoulder of the container and the structure gauge limit is about 37 cm, while in the case of 8 ft 6 in high containers, clearance is about 25 cm. ISO containers of both height dimensions are regularly transported between Port Kelang (Malaysia) and Bangkok (Thailand) under the framework of the container landbridge launched by the railways of the two countries in July 1999, so that the actual structure dimensions along this main line clearly pose no obstacle to the through movement of these containers.

Meanwhile, non-ISO containers of 9 ft 6 in height infringe the KTM structure gauge when mounted on standard container flat wagons. If such containers could be conveyed on low level wagons with a floor height of 700 mm, a clearance of 21 cm would be available, which on some parts of the network is likely to be too small a margin for safe operation. Alternatively, conveyance of such containers on low level well-type wagons would provide clearance of 37 cm between the shoulders of containers and the inside surfaces of structures. This is sufficient for safe operation.

In Malaysia, four tunnels prohibit the movement of high cube containers north of Ipoh. These tunnels range in length from 90 to 340 metres, and it is understood that the presence of solid rock strata beneath the sleepers at both locations could rule out track lowering as an option.

Otherwise, high cube containers of 45 ft length and 9 ft 6 in height are frequently carried in the section between Singapore and Ipoh (mostly on services linking Port Kelang with Ipoh ICD and Singapore with Pasir Gudang Port, east of Johor Bahru). To comply with structure gauge limitations on these sections, Indian built BCF container flat wagons with a floor height of 850 mm are used. (These wagons, however, provide insufficient clearance for passage of high cube containers through the above-mentioned tunnels).

Finally, it must be noted that electrified line sections between Kuala Lumpur and Padang Besar may constitute future restrictions to the movements of high cube containers.

**Thailand**

ISO containers of 8 ft height, mounted on standard container flat wagons, fit within the minimum structure gauge of the State Railway of Thailand (SRT), although with little safety margin. In the case of ISO containers of 8 ft 6 in height, the dimensions of the wagons and their loads are barely within the minimum structure gauge. However, on the link between Padang Besar (at the border between Malaysia and Thailand) and Bangkok, the structure gauge has been enlarged to permit passage of containers with a height of up to 9 ft (2.74 metres).

On standard height container flat wagons, high cube containers infringe the SRT minimum structure gauge by a substantial margin, and even with the expanded structure gauge between Padang Besar and Bangkok, movements are clearly restricted by 6 bridges.
Other countries in South-East Asia

In view of the long term possible connections of the railways of ASEAN countries, the structure and loading gauge situation in countries other than Malaysia, Singapore and Thailand is summed up hereafter for the links shown in Map 12.

Do the structure and loading gauge dimensions permit the conveyance by rail of containers of specific heights in the following countries?

<table>
<thead>
<tr>
<th>Height (feet/metres)</th>
<th>Cambodia</th>
<th>Myanmar</th>
<th>Viet Nam</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 ft (2.44 metres)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>8 ft 6 in (2.59 metres)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>9 ft 6 in (2.90 metres)</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: The above assessment assumes the operation of standard height (1,010 mm) container flat wagons.

3.2 Axle-load

Restrictions on axle-load are imposed by the maximum permissible vertical forces on track and structures, most notably on bridges. All the countries along the corridor are used to carrying heavy industrial and/or mining products and can therefore accommodate container block trains without any problem, as the latter are relatively light.5

(i) Assessment of axle load situation in Armenia, Azerbaijan, Finland, Kazakhstan, Islamic Republic of Iran, Russian Federation, Turkmenistan, Uzbekistan

Container wagons commonly used in the countries concerned are as a rule designed to carry a maximum of three TEU. Although the extreme case would involve the carriage of three 20 foot containers, each loaded to their maximum gross weight of 24 tonnes, in practice, there is little demand for the transportation of containers at or near their maximum gross weights and, in the case of 20 foot containers, even containers loaded with dense commodities rarely weigh in at more than 18 tonnes. When this figure is used for calculation, and given that axle-load standards in the railways in the corridor range from 20 to 23 tonnes, the following picture emerges concerning the tare weight of wagons:

i. On line sections with an axle-load of 23 tonnes, this leaves a maximum wagon tare weight of 38 tonnes7.

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4 Here the countries considered are those on the main land of the Asian continent, i.e. Indonesia and the Philippines have not been included.
5 In practical terms, given the relative ‘light’ weight of container trains, it is the axle loading of locomotives rather than that of container wagons which may provide an axle load constraint for certain rail systems. This may typically be the case on metre gauge railway systems or lines. However, no such railway or line are part of the routes making up the corridor. A problem may start to appear only in South-East Asia.
6 It must be noted that on new lines, the railways of the Islamic Republic of Iran implement a new 25 tonnes axle load standard.
7 Tare weight = 23 x 4 – (18 x 3) = 38 tonnes, where 23 is the permissible axle-load, 4 the number of axles, 18 the gross weight considered for each 20 foot container and 3 the number of TEU.
ii. On line sections with an axle-load of 22.5 tonnes, this leaves a maximum wagon tare weight of 36 tonnes;  

iii. On line sections with an axle-load of 20 tonnes, this leaves a maximum wagon tare weight of 26 tonnes;  

These figures are all well above the tare weight of container wagons in operation on the railways in the corridor and it can therefore be safely inferred that axle-load does not pose a constraint to container movements through the corridor.

(ii) Assessment of axle load situation in South Asia

India

The axle load limitation in force on the Attari - New Delhi and New Delhi - Mumbai sections which continue the north-south corridor in India is currently 20.32 tonnes as is the case on all broad gauge sections nominated by India as part of the Trans-Asian Railway network through its territory. It must be noted that Indian Railway has long term plans for the upgrading of its broad gauge trunk lines to permit axle loading of up to 22.1 tonnes.

Given that the container flat wagons most commonly used on the broad gauge networks of India and Pakistan have a length of 45 ft (13.7 metres), a tare weight of 20-21.5 tonnes and a payload capacity of about 43.5 tonnes (giving a maximum gross weight of 63-65 tonnes and an axle load of 15.75-16.25 tonnes), the axle load applied by Indian Railway does not constitute a constraint to the smooth and efficient operation of container movements.

Pakistan

The axle load limits currently in force on the line sections continuing the north-south corridor on Pakistan Railways are shown hereafter:

- Koh-i-Taftan / Spezand 17.27 tonnes  
- Spezand / Sukkur 17.78 tonnes  
- Sukkur / Wagah 22.86 tonnes  
- Rohri / Karachi 22.86 tonnes  
- Lahore / Peshawar 22.86 tonnes

In general, the light axle load sections are concentrated to the west of Spezand where the railway traverses arid mountainous terrain. However, even these sections pose no restriction on the movement of containers loaded on conventional 2 TEU wagons. Here again, given that the container flat wagons most commonly used on the broad gauge networks of India and Pakistan have a length of 45 ft (13.7 metres) and a tare weight of 20-21.5 tonnes and a payload capacity of about 43.5 tonnes (giving a maximum gross weight of 63-65 tonnes and an axle load of 15.75-16.25 tonnes), this light axle load does not constitute a constraint to

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8 Tare weight = 22.5 x 4 – (18 x 3) = 36 tonnes, where 22.5 is the permissible axle-load, 4 the number of axles, 18 the gross weight considered for each 20 foot container and 3 the number of TEU.

9 Tare weight = 20 x 4 – (18 x 3) = 26 tonnes, where 20 is the permissible axle-load, 4 the number of axles, 18 the gross weight considered for each 20 foot container and 3 the number of TEU.
the smooth and efficient operation of container movements. Indeed, in that particular case, the major disability associated with light axle loads on some sections of Pakistan Railways is that they require the use of light locomotives and the double heading of trains on a fairly long distance.

(iii) Assessment of axle load situation in South-East Asia

**Malaysia, Singapore, Thailand**

The container wagons in predominant use throughout the route linking Singapore to Thailand through Malaysia is of 12.8 metres and are capable of carrying a maximum of two 20 ft containers or one 40 ft container. If, as already indicated earlier, one considers the maximum payload of these wagons to be approximately 36 tonnes (calculated as 80 per cent of the maximum allowable gross weight of one 20 ft ISO container, multiplied by 2) and a wagon tare weight of 14 tonnes (giving a maximum gross load of 50 tonnes), the axle load over 4 axles is equivalent to 12.5 tonnes.

In this case, however, one needs to consider that the heaviest locomotives in use in the ASEAN region are operated by the railways of Malaysia and Thailand and have a maximum gross weight of 90 tonnes spread over 6 axles, i.e. an axle load of 15 tonnes. This clearly indicates that the standard for the maximum permissible axle load needs to be established at 15 tonnes.

Malaysia, Thailand and Singapore conform with this minimum requirement. In fact, in Malaysia, the axle load prevailing on major trunk lines is 16 tonnes and on new structures have recently been designed to withstand an axle load of 20 tonnes, a parameter that Malaysia plans to progressively extend throughout its system.

**Other countries in South-East Asia**

In other countries of South-East Asia, due to the fact that the political events of the 1970’s and 1980’s resulted in rail infrastructure maintenance being left unattended, the present condition of track and structures has deteriorated to the extent that axle load limitations actually lower than the original design have to be imposed to ensure the safe passage of trains.

In Cambodia, the axle load on the Poipet - Phnom Penh section is 10 tonnes. In Myanmar, the axle load applied to the existing main lines is 12.5 tonnes and in Viet Nam the axle load on the Hanoi - Ho Chi Minh City main line is 14 tonnes between Hanoi and Danang and 12 tonnes between Danang and Ho Chi Minh City.

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10 The railways of Thailand operate a limited number of wagons of 14.8 metres able to carry one single 45 ft container as an alternative to two 20 ft containers.
3.3 Commercial speeds

Commercial speed, or the speed derived by dividing the distance travelled between ultimate origins and destinations by the total time taken to cover this distance, is one of the principal factors influencing mode choice decisions. Commercial speed itself is influenced by numerous factors falling into three main categories, namely: technical, operational and institutional.

Technical

Factors which may be classified under this heading include the design and standard of maintenance of the permanent way, signalling, motive power and rolling stock, all of which will have an influence on the maximum speeds which will be permitted on individual lines. Attainment of target commercial speeds will depend in part on the percentage of the journey which may be run at or near maximum permissible speeds.

Operational

Factors of this type include delays to the passage of trains resulting from the need to satisfy operational requirements, such as wagon loading/unloading, train marshalling (assembly/disassembly), brake and other safety checks, wagon number taking, locomotive fuelling and servicing, crew change, bogie exchange or other forms of inter-gauge transfer of rolling stock;

Institutional

Delays to trains at national borders resulting from completion of customs and border security formalities are examples of the effect of institutional influences on train commercial speeds.

In establishing technical standards for the corridor, due regard should be given to the first of these factors - i.e. a desirable maximum speed for freight trains which will be compatible with the attainment of a commercial speed competitive with alternative transport modes or more simply to shippers’ requirements.

One requirement for container block-train operation in the corridors making up the Trans-Asian Railway network is that trains should cover a distance of 1,000 km per day. This target requirement implies an average commercial speed of 40 km/h.

The real capabilities of the railways in the corridor to achieve such a speed are, however, unequal from one rail system to another.

If one considers that the commercial speed\(^{13}\) of container block trains will be around 65\% per cent of the running speed which in turn is often only 70 per cent\(^{14}\) of the maximum

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13 Essentially, the difference between commercial and average running speeds is that the former include an allowance for stationary time for loading/unloading freight, for carrying out operational checks, transshipment at break-of-gauge stations or train servicing and for completing border crossing formalities. Average running speeds include no allowance for stopping time unless trains stop in the middle of block sections due to mechanical failure.

14 Those figures are averages, it being understood that performances vary from one railway to another. In fact, the percentage value kept here for calculation is higher than is normally the case for freight trains on the basis
permissible speed, achieving commercial speeds of 20 km/h, 30 km/h or 40 km/h would thus require maximum permissible speeds of, respectively 44 km/h, 56 km/h or 88 km/h.

On the railways along the above-mentioned Central Asian routes in the corridor, the maximum permissible speed for freight trains are reportedly as follows:

- Armenia n.a.
- Azerbaijan n.a.
- Finland 100 km/h, giving a commercial speed of 45.5 km/h,
- Islamic Republic of Iran 60 km/h, giving a commercial speed of 27.3 km/h,
- Kazakhstan 60 to 80 km/h, giving a commercial speed of 27.3 to 36.4 km/h,
- Russian Federation 80 to 90 km/h, giving a commercial speed of 36.4 to 41 km/h,
- Turkmenistan 60 to 80 km/h, giving a commercial speed of 27.3 to 36.4 km/h,
- Uzbekistan 60 to 80 km/h, giving a commercial speed of 27.3 to 36.4 km/h.

Although no information was made available for Turkmenistan and Uzbekistan, it can reasonably be assumed that the speed indications for Kazakhstan are also applicable to the railways of these two countries. On Iranian railways, while the average speed for freight trains through the system is 60 km/h, it is worth observing that the Mashad - Bafq section under construction is designed for a speed of 100 km/h for freight trains and the Kerman - Zahedan section, also under construction, has a design speed of 120 km/h for freight trains. This seems to indicate a policy by the Iranian Islamic Republic railways to upgrade existing lines for higher speeds when track renewal work is carried out in future. Finally, it must be noted that scheduled freight trains running between Bandar Abbas and Sarakhs cover the 2,535 km distance in 84 hours, giving a commercial speed of 30 km/h.

This tends to indicate that on an end-to-end basis, a commercial speed of around 30 km/h can be achieved along the Central Asian routes, with the performances of some railways compensating for the others. While this speed may be below the 40 km/h target stipulated on other corridors of the Trans-Asian Railway (such as the Northern Corridor\(^\text{15}\)), it still is sufficient to offer competitive transit times with shipping on the Helsinki - Bandar Abbas route (see Chapter 5).

\(^{15}\) The Trans-Asian Railway Northern Corridor connects the railways of Belarus, China, Democratic People's Republic of Korea, Kazakhstan, Mongolia, Poland, Republic of Korea, and Russian Federation.
Along the Caucasus Route, the situation is more difficult to assess due to the lack of detailed information relating to Armenia and Azerbaijan. Political instability between the two countries in the early 1990’s and the effect of the collapse of the former Soviet Union in economic terms have reportedly had dramatic consequences on the state of the transport infrastructure in the region. In addition, given that very limited traffic, if any, is currently moving by rail, resources may be diverted to the maintenance needs of other main lines. In any case, to make the Caucasus route competitive with the other routes in the corridor, speed improvements would have to be accompanied by the actions required either to restore full operation through the Djulfa border point, or to develop the link through Astara (see above, Chapter 2, point 2.5.1).

Looking at the continuation of the corridor in South Asia from the perspective of the completion of the Kerman - Zahedan link, it must be noted that in India, the Attari - New Delhi and New Delhi - Mumbai sections are already capable of delivering freight train commercial speeds of 30 km/hour, suggesting that their maximum permissible speeds are of (or greater than) 70 km/hour.

In Pakistan, freight train speeds are limited mainly by the design of rolling stock. Vehicles equipped with vacuum brakes and plain bearings are in predominant use and, like all vehicles of this type, are limited to only 55 km/hour. The commercial speed for container block-trains between Karachi and Lahore is reportedly 20.3 km/h.16

Finally, in Malaysia, the maximum permissible speed of freight trains is limited to 56 km/h and their average commercial speeds are in the 19 to 26 km/h range. In Thailand, meanwhile, the maximum permissible speed for freight trains on all main lines is 70 km/h. The container landbridge jointly operated by KTMB and SRT provides a concrete example of commercial speed performances on these two railways. Container block-trains cover the 1,590 km distance between Port Kelang and Bangkok in 60 hours, giving a commercial speed of slightly under 27 km/h. It must be noted that, in Malaysia, most of the West Coast main line and, in Thailand, the entire link between Padang Besar and Bangkok are single track. This results in considerable *en route* stoppage time in crossing loops due to the need to wait for opposing trains.

In summary, although the movements of containers in the corridor can already be delivered at speeds that are satisfactory in terms of transit times, ways should be sought to further improve railway performances in this area. The commercial speed of containers in the corridor could be improved by a combination of two methods. First, stationary time can be reduced by conveying containers in unit or block trains operating to a fixed schedule which reduces the number of stops to those that are absolutely necessary for safe operation or organizational constraints (e.g. crew change, customs inspection). Second, running times can be reduced through an increase in train speeds. In this respect, once the idea of running containers in block-trains is accepted by all railways, these block-trains should be granted a running priority equal to those of intercity express passenger trains. The parallel scheduling of container trains and passenger trains would have the following advantages:

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16 Country Report of Pakistan prepared for the study “Development of the Trans-Asian Railway – Trans-Asian Railway in the southern corridor of Asia-Europe routes”.

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- an increase in line utilization,
- a reduction in locomotive and rolling-stock requirements due to faster turnaround times,
- a reduction in operating costs due to reduced rolling stock requirements as well as reduced manpower requirements and fuel,
- longer duration of track maintenance windows leading to the greater availability of optimum assets.

For such parallel scheduling to be achieved, maximum speeds of 90 to 120 km/h would have to be allowed for container trains in future. This would obviously have a number of financial implications for the railways, the most visible relating to a programme of rolling-stock improvement.

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