ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

TRANS-ASIAN RAILWAY ROUTE REQUIREMENTS:

PRELIMINARY STUDY ON DEVELOPMENT OF TRANS-ASIAN RAILWAY IN THE SOUTHERN CORRIDOR OF ASIA-EUROPE ROUTES

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CONTENTS

I. INTRODUCTION

Since the mid-1980s the developing economies of the ESCAP region have recorded growth of gross domestic product (GDP) and trade at much higher rates than those of the world. The region has experienced not only rapid increases in output and trade, there is also an increasing number of tourists visiting many of the developing countries with about 80 million arrivals in 1994. In addition, the ending of the cold war and the prevalence of peace and stability in the region have contributed significantly to the spirit of regional economic cooperation. Consequently, increasing demand is being placed on intraregional and interregional land transport linkages.

The development and strengthening of intraregional and interregional transport and communications linkages is therefore among the major objectives for Phase II (1992-1996) of the Transport and Communications Decade for Asia and the Pacific, which, in the field of land transport in Asia, is being achieved through the implementation of the Asian land transport infrastructure development (ALTID) project.

The integrated ALTID project [comprising Trans-Asian Railway (TAR), Asian Highway (AH) and Facilitation of Land Transport] was endorsed by the Commission at its forty-eighth session (1992) as a priority project for Phase II of the Decade to assist in providing reliable and efficient intraregional and interregional land transport linkages.

In view of scope of the project and limited resources available, the adopted ALTID implementation strategy features a step-by-step approach with ESCAP finalizing several activities in 1995. These include: (i) a feasibility study on connecting rail networks of China, Kazakhstan, Mongolia, the Russian Federation and the Korean Peninsula; and (ii) a study of requirement for future development of the Trans-Asian Railway in the Indochina and ASEAN subregion.

The ESCAP secretariat also undertook in 1995 a preliminary Trans-Asian Railway route requirements study for connecting the rail networks in the SAARC region (Pakistan, India, Sri Lanka and Bangladesh with connection to Nepal) and the Islamic Republic of Iran. The route network thereby created is referred to as "TAR Southern Corridor". The inputs provided by national experts of the participating countries have been consolidated by ESCAP to prepare a background paper for consideration by the Expert Group Meeting.

Key outputs of the preliminary study as presented below are: proposed TAR networks in Bangladesh (broad gauge), India, the Islamic Republic of Iran and Pakistan as a part of TAR network in the Southern Corridor linking South Asia with Europe as well as Central Asia; physical requirements (loading/structure gauge and axle load); and commercial requirements (transit times) of the TAR Southern Route; proposed follow up actions.

II. FORMULATION OF TAR NETWORK IN THE SOUTHERN CORRIDOR

A. CRITERIA

In order to determine routes within the TAR Southern Corridor, the following two sets of criteria should be taken into account:

1. Recommendations made by the Economic and Social Commission for Asia and the Pacific at its forty-eighth session (April 1992) concerning the principles of the project which were as follows:

In regard to the principles of the project as far as road, rail and road-cum-rail routes are concerned, it was recommended that existing and potential trade flows should be the main criteria, which could include, where appropriate:

(a) Capital-to-capital links (for international transport);

(b) Connections to main industrial and agricultural centres (links to important origin and destination points);

(c) Connections to major sea and river ports (integration of land and sea transport networks); and

(d) Connection to major container terminals and depots (integration of rail and road networks).

2. Recommendations contained in the "Outline Plan for the Development of Transport Sector in the ECO Region", adopted by the Transport Ministers of the ECO member countries in October 1993. Adoption of these recommendations is important since the Islamic Republic of Iran, Pakistan as well as the Central Asian Republics are members of the Economic Cooperation Organization (ECO) as well as of ESCAP.

In order to expand and integrate national railway networks to permit transportation by rail from one end of the region to the other, the Outline Plan suggests, among other things, the following with regard to the ECO railway network:

(a) Interconnection of the railway routes of the ECO member states through the completion of missing links in the railway route in the ECO region by the year 2000; and

(b) Identification of the financing sources and commencement of planning and construction of the following railway lines: Kushka (Turkmenistan) - Hirat (Afghanistan) - Kandahar (Afghanistan) - Chaman (Pakistan); Serakhs (Turkmenistan) - Meshad (Islamic Republic of Iran); Kerman (Islamic Republic of Iran) - Zahedan (Islamic Republic of Iran) - Mirjaveh (Islamic Republic of Iran); Meshad (Islamic Republic of Iran) - Bafq (Islamic Republic of Iran); and Bandar Turkaman (Islamic Republic of Iran) - Ghizil Atrak (Turkmenistan) - Ghazanjagh (Turkmenistan).

B. TAR NETWORK IN COUNTRIES OF THE SOUTHERN CORRIDOR

Based upon the criteria mentioned in the previous section, the following country by country routes could be considered essential for the formulation of the TAR network.

1. Islamic Republic of Iran

In terms of the formulation of the TAR network, the Islamic Republic of Iran is situated in a strategic location.

First, it borders Turkmenistan, and completion of the construction of rail links from Tedjen (Turkmenistan) - Serakhs (border) - Fariman/Meshad (Islamic Republic of Iran) in May 1996 has realized the so-called Silk railway which links Europe, the Islamic Republic of Iran, Central Asia and China.

Second, since it has rail connections with Azerbaijan, it is possible to connect the TAR in the Southern Corridor with Europe via the Caucasus region.

Third, upon completion of the above-mentioned Tedjen-Meshad railway link Central Asian Republics have access to seaports in the Islamic Republic of Iran and to the other countries of the Southern Corridor via the Islamic Republic of Iran as well as Turkey.

Finally, upon completion of Kerman-Zahedan line an uninterrupted TAR route will be in place, linking Europe and Central Asia with South Asia via the Islamic Republic of Iran.

The proposed TAR routes in the Islamic Republic of Iran are as follows:

Route IR1 Razi-Sofian-Tehran-Bafq-Kerman----Zahedan-Mirjaveh

This route begins from the Iranian border with Turkey and traverses the country in a southeasterly direction to Mirjaveh on the border with Pakistan. The route, which measures 2,703 km, passes through Tehran and forms an Iranian section of main TAR southern route.

The route is non-electrified (with the exception of a small section near Sofian), and single tracked, but there is a missing link of 545 km between Kerman and Zahedan. However, construction of this missing railway link is under consideration. After completion of this missing link, the gauge in the section between Zahedan and Mirjaveh will be altered from 1,676 mm to 1,435 mm. Upon completion of the project, Mirjaveh will become the break-of-gauge point between standard and broad gauges.

Route IR2 Julfa-Sofian

The route starts from Julfa on the Iranian border with Azerbaijan and continues until Sofian on route IR1. This electrified single-track route, albeit a short one at 117 km, is connected with Europe through the Caucasus region. Julfa is the break-of-gauge point between standard (1,435 mm) and broad (1,520 mm) gauges.

Route IR3 Serakhs-Fariman-Tehran

This route begins from Serakhs on the Iranian border with Turkmenistan and traverses the country in a southwesterly direction to Tehran on route IR1 via Fariman. It constitutes a part of the "Silk Railway", which connects China and the Central Asian Republics with Europe via the Islamic Republic of Iran. This 1,052 km route is non-electrified and single-track. Serakhs is a break-of-gauge point between standard (1,435 mm) and broad (1,520 mm) gauges.

Route IR4 Bafq-Bandar Abbas

This 616 km route originates from Bafq on route IR1 and continues in a southerly direction until the port of Bandar Abbas. This largely double-tracked, non-electrified route was completed in March 1995, and when route IR3 is connected with Turkmenistan railway system the Central Asian Republics will have access to the coast by rail. In this study, this line is considered one of the main TAR southern routes.

Route IR5 Fariman-----Bafq

The completion of this planned 645 km route would serve as a shortcut for Central Asian Republics to the seaport of Bandar Abbas.

Map-1 indicates all of the routes mentioned above.

Major features of the routes (section by section) are reflected in Tables 2-1, 2-2, 2-3, 2-4 and 2-5.

Map–1

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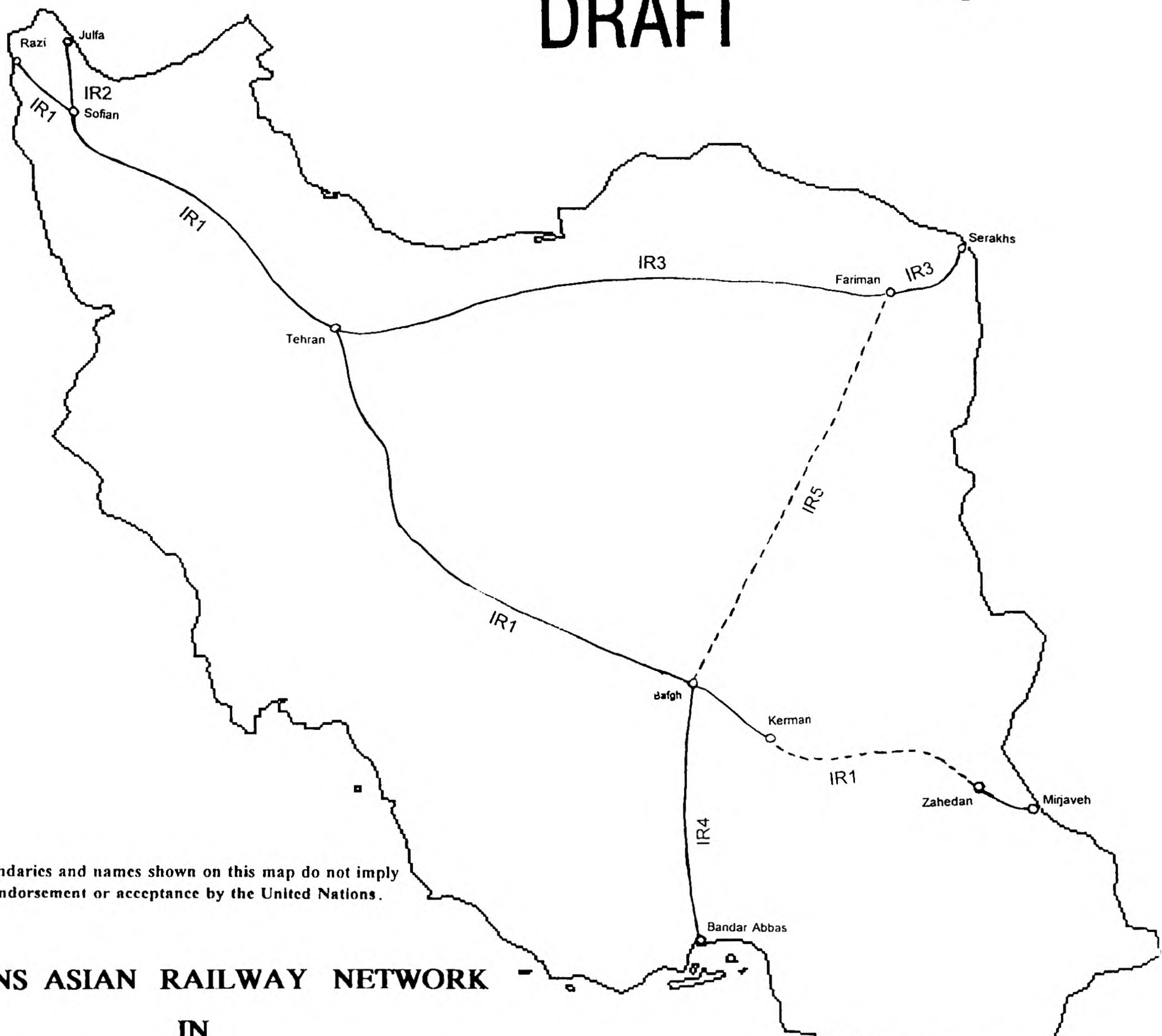

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TRANS ASIAN RAILWAY NETWORK
IN
THE ISLAMIC REPUBLIC OF IRAN

Table 2-1. Route IR1 Razi-Sofian-Tehran-Bafq-Kerman----Zahedan-Mirjaveh

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Razi~Kerman	2,066	1,435	1	No	20	A small section near Sofian electrified
Kerman~Zahedan	545	-	-	-	-	Construction being under consideration
Zahedan~Mirjaveh	92	1,676	1	No	20	Gauge conversion to 1,435 mm planned

Table 2-2. Route IR2 Julfa-Sofian

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Julfa~Sofian	117	1,435	1	Yes	20	

Table 2-3. Route IR3 Serakhs-Fariman-Tehran

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Serakhs~Fariman	164	1,435	1	No	20	
Fariman~Tehran	888	1,435	1	No	20	

Table 2-4. Route IR4 Bafq-Bandar Abbas

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Bafq~Bandar Abbas	616	1,435	1 or 2	No	20	

Table 2-5. Route IR5 Fariman------Bafq

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Loading gauge	Remarks
Fariman~Bafq	645	-	-	-	-	-	Construction is under consideration

2. Pakistan

The proposed TAR Routes in Pakistan are as follows:

Route PK1 Koh-i-Taftan - Spezand - Rohri - Lahore - Wagah

This route commences in Koh-i-Taftan on the border of Pakistan with the Islamic Republic of Iran and traverses the country in an easterly direction until Rohri where it joins another line from Karachi. From Rohri, the route continues towards the northeast via Lahore to Wagah on the border with India. The line which constitutes the portion of Pakistan of the main TAR southern route is mostly non-electrified single track in the 972 km section from Koh-i-Taftan to Rohri while the 800 km section to the Indian border from Rohri is double-tracked more than half of the way (double tracking on section Lahore-Ladhram is in the process of being sanctioned), and partially electrified.

Route PK2 Chaman-Spezand

The 195 km non-electrified single-track route from Chaman on the border of Afghanistan with Pakistan continues southward until it reaches Spezand on route PK1. This route would also provide Afghanistan with access to the seaport of Karachi by rail.

Route PK3 Karachi-Rohri

The 480 km non-electrified double-track route from Karachi continues northward until Rohri on route PK1, and provides access to the seaport of Karachi.

Map-2 shows each route mentioned above.

Major features of the routes (section by section) are reflected in Tables 2-6, 2-7 and 2-8.

TRANS ASIAN RAILWAY NETWORK
IN
PAKISTAN

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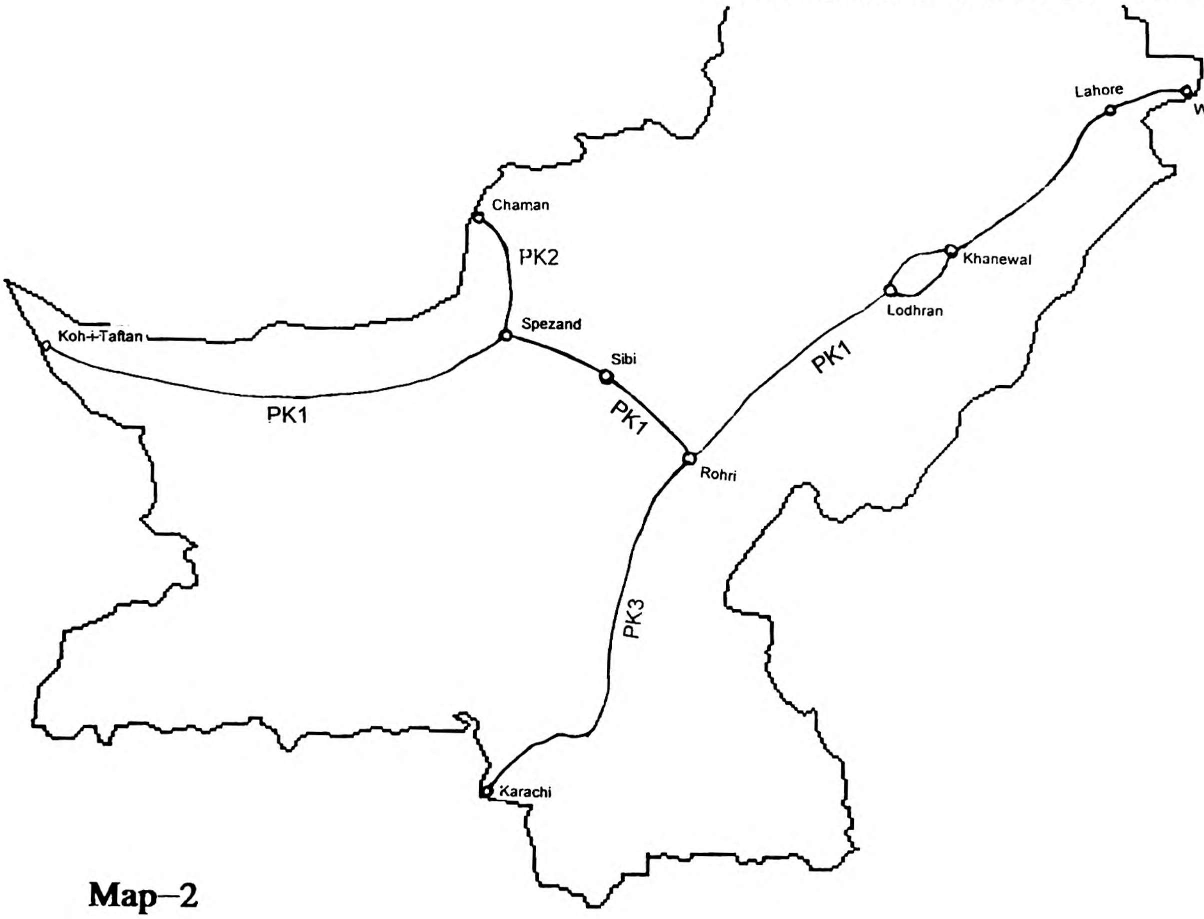

Map–2

Table 2-6. Route PK1 Koh-i-Taftan-Spezand-Rohri-Lahore-Wagah

Section	Lengt h (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Koh-i-Taftan~ Spezand	612	1,676	1	No	17	
Spezand~Sibi	116	1,676	1 or 2	No	17.5	
Sibi~Rohri	244	1,676	1	No	17.5	
Rohri~Lodhran	365	1,676	2	No	22.5	
Lodhran~Khanewal (via Loop)	136	1,676	1 or 2	No	22.5	
Lodhran~Khanewal (via Chord)	91	1,676	1	No	22.5	
Khanewal~Lahore	285	1,676	1 or 2	Yes	22.5	
Lahore~Wagah	23	1,676	1 or 2	No	22.5	

Table 2-7. Route PK2 Chaman-Spezand

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Loading gauge	Remarks
Chaman~Spezand	190	1,676	1 or 2	No	17.5	Fig. 3	

Table 2-8. Route PK3 Karachi-Rohri

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Karachi~Rohri	480	1,676	2	No	22.5	

3. India

The proposed TAR routes in India are as follows:

Route IN1 Attari-Ambala-Delhi-Sitarampur-Naihati-Gede (or Calcutta)

The 1,974 km line passing through Delhi on the main TAR southern route from Attari on the Indian border with Pakistan, to Gede on the border with Bangladesh, traverses the country in a southeasterly direction and also can be connected to the port of Calcutta for traffic to/from Nepal. The line is double-tracked (partially triple or quadrupled tracked) with the exception of a short single-tracked section between Attari and Amritsar, and is electrified over eighty percent of the entire route.

Route IN2 Delhi-Itarasi-Nagpur-Ballarshah-Vijayawada-Madras-Erode-Tuticorin

The 2,980 km route from Delhi on route IN1 traverses India in a southerly direction via Madras to Tuticorin, two major seaports in the region. The electrified line is double-tracked (partially triple-tracked) with the exception of the 360 km non-electrified single-track section between Erode and Tuticorin.

Route IN3 New Delhi-Mathura-Kota-Ratlam-Baroda-Bombay

The 1,676 mm gauge route starts from New Delhi on route IN1, and continues to the southwest through Mathura, Kota, Ratlam and Baroda until it reaches the seaport of Bombay. This route provides an efficient rail access to the ports of Bombay including Jawaharlal Nehru Port (deep sea port) with increasing calls of mother vessels.

Route IN4 Raxaul-Sitarampur

The 1,676 mm gauge route originates in Raxaul on the Indian border with Nepal and runs to the southeast until Sitarampur on route IN1. The route provides Nepal with access to seaports of India.

Map-3 shows each of the above-mentioned routes.

Major features of the routes (section by section) are reflected in Tables 2-9 and 2-10.

Table 2-9. Route IN1 Attari-Ambala-Delhi-Sitarampur-Naihati-Gede

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Attari~Amritsar	28	1,676	1	No	18.8	
Amritsar~Ludhiana	135	1,676	2	No	18.8	
Ludhiana~Ambala	105	1,676	2	No	20.55	
Ambala~Delhi	197	1,676	2	Yes	18.8	partially electrified
Delhi~Ghaziabad	20	1,676	2	Yes	?	
Ghaziabad~Mughalsarai	760	1,676	2	Yes	21.9	
Mughalsarai~Sitarampur	452	1,676	2 or 3	Yes	21.9	
Sitarampur~Saktigarh	138	1,676	4	Yes	21.9	
Saktigarh~Naihati	65	1,676	2	Yes	21.9	
Naihati~Gede	79	1,676	2	Yes	21.8	partially electrified

Table 2-10. Route IN2 Delhi-Itarasi-Nagpur-Ballarshah-Vijayawada-Madras-Erode-Tuticorin

Section	Length (km)	Gauge (mm)	Number of track	Electrified or not	Axle load (t)	Loading gauge	Remarks
Delhi~Ballarshah	1,280	1,676	2	Yes	?	Fig. 2	partially 3 tracks
Ballarshah~Madras	1,000	1,676	2	Yes	?	Fig. 2	
Madras~Erode	340	1,676	2	Yes	?	Fig. 2	
Erode~Tuticorin	360	1,676	1	No	20.3	Fig. 2	

TRANS ASIAN RAILWAY NETWORK IN INDIA

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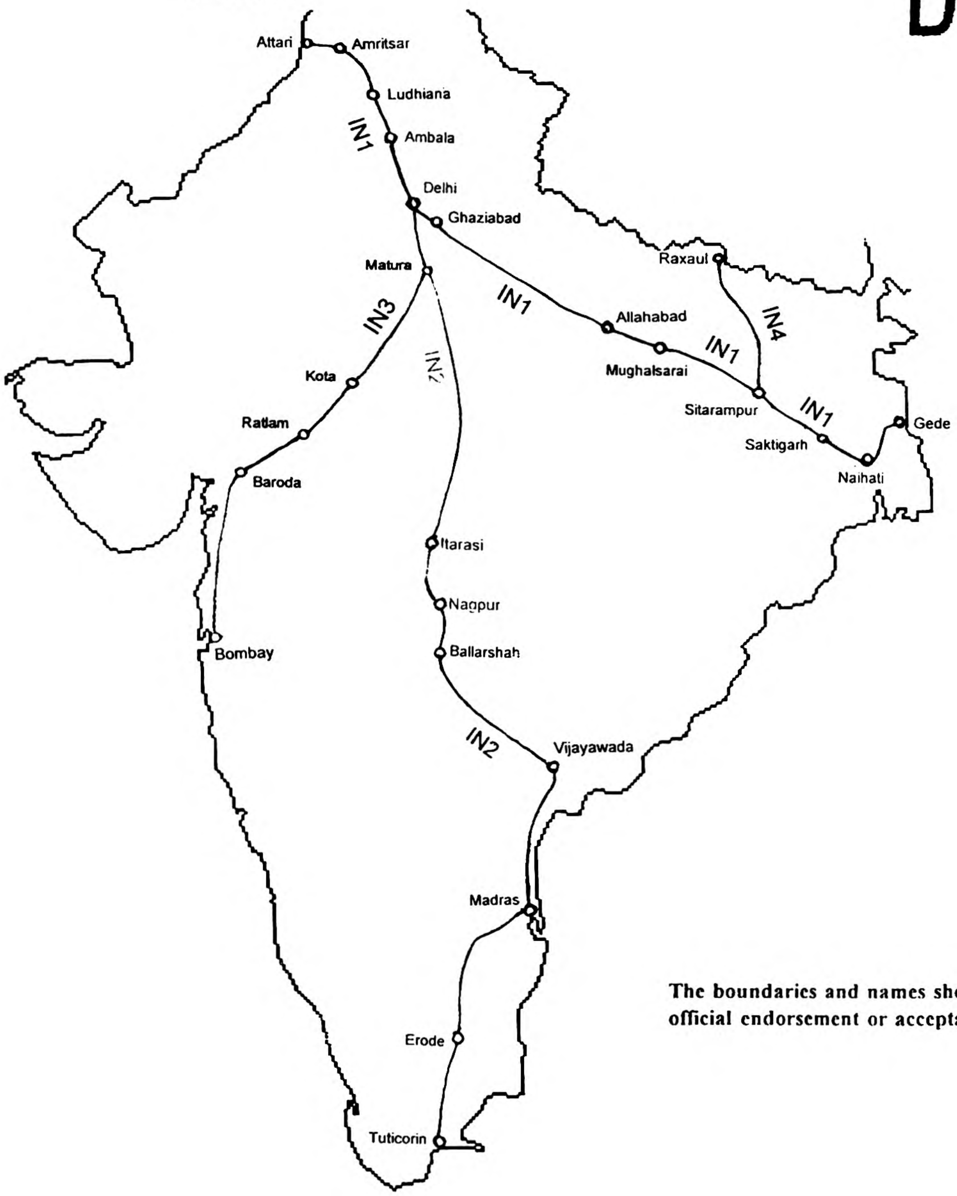

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Map–3

4. Sri Lanka

Since Sri Lanka is an island country, possible TAR routes in Sri Lanka could be connected with mainland TAR routes with ferry services. In this study a route Colombo-Polgahawela-Medawachi-Jalaimannar is proposed as a TAR route keeping also in view the planned development of the TAR section Madras-Tuticorin in India with ferry services between India and Sri Lanka.

Major features of the route is reflected in Table 2-11.

Table 2-11. Route SL1 Colombo-Polgahawela-Medawachi-Jalaimannar

Section	Length (km)	Gauge (mm)	Number of track	Electrified or not	Axle load (t)	Remarks
Colombo~Jalaimannar	335	1,676	1 or 2	No	16.5	

5. Bangladesh

This study does not consider the linking of the Southern Corridor with the Trans-Asian Railway in the Indo-China and ASEAN subregion. However, it should be noted that this is possible via the metre gauge systems of northeastern Bangladesh, northeastern India and Myanmar.

The proposed TAR Routes through Bangladesh considered in this study are as follows:

Route BN1 Darsana-Ishurdi-Shirajgang----Jagannathgang Ghat-Tongi-Dhaka

The route originates in Darsana on the Bangladesh border with India and runs to the northeast until Shirajgang, located on the west bank of the Jamuna River. The river interrupts the route for 40 km until Jagannathgang Ghat (on the east bank of the Jamuna River), after which the line continues first to the north, and then to the southeast until Dhaka. The non-electrified broad gauge section between Darsana and Shirajgang is single-tracked for the first 80 km until Ishurdi and double-tracked for the following 83 km until Shirajgang. The non-electrified metre gauge section from Jagannathgang Ghat to Dhaka is single-tracked for 192 km until Tongi, and double-tracked for the final 23 km. With the completion of the road/rail Jamuna River Bridge and a new metre gauge rail link from the east bank of the Jamuna River to Dhaka, the current metre gauge section between Jagannathgang Ghat and Dhaka will most likely be reduced by approximately 100 km.

Route BN2 Tongi-Chittagong-Dohazari

The 432-km non-electrified metre-gauge route from Tongi on route BN1 passes through the seaport of Chittagong and continues southward until Dohazari. The route which has both single and double tracked sections links Chittagong to the interior of Bangladesh.

Map-4 indicates each route in Bangladesh.

Major features of the routes (section by section) are reflected in Tables 2-11 and 2-12.

Table 2-12. Route BN1 Darsana-Ishurdi-Shirajgang----Jagannathgang Ghat-Tongi-Dhaka

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Darsana~Ishurdi	80	1,676	1	No	22.5	
Ishurdi~Sirajgang	83	1,676	2	No	22.5	
Sirajgang~Jagannathgang Ghat	40	-	-	-	-	Jamuna River
Jagannathgang Ghat~Tongi	192	1,000	1	No	13	Length will decrease upon completion of the new line
Tongi~Dhaka	23	1,000	2	No	13	

Table 2-13. Route BN2 Tongi-Chittagong-Dohazari

Section	Length (km)	Gauge (mm)	Number of tracks	Electrified or not	Axle load (t)	Remarks
Tongi~Dohazari	432	1,000	1 or 2	No	13	

TRANS ASIAN RAILWAY NETWORK IN BANGLADESH

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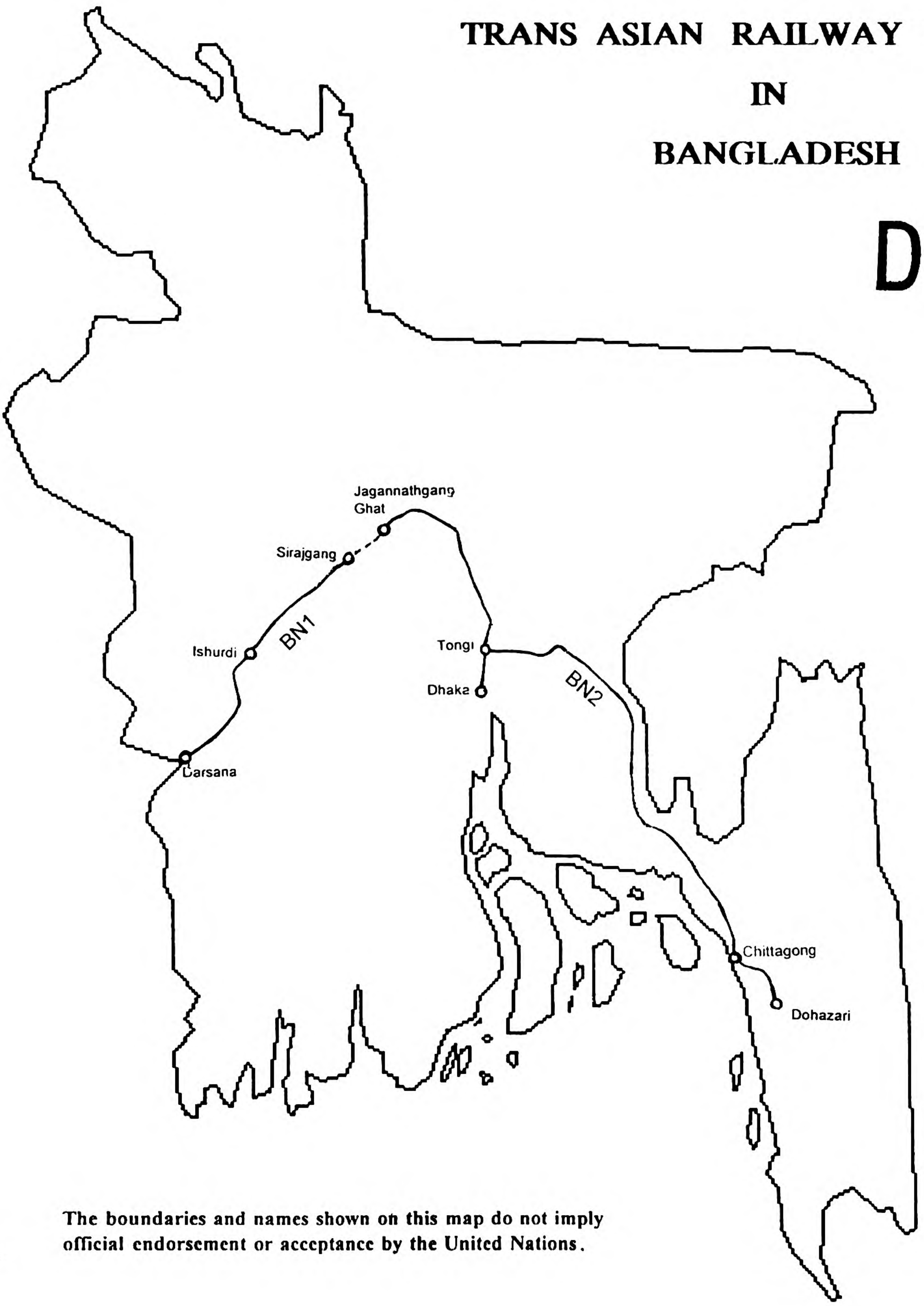

Map—4

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C. CONCLUSIONS ON MAIN TAR ROUTES IN THE SOUTHERN CORRIDOR

Map 5 shows the network of the TAR in the Southern Corridor consisting of routes described above, country by country.

This network was identified on the basis of proposals received from national experts from Bangladesh, India, Islamic Republic of Iran, Pakistan and Sri Lanka, as well as the discussions at the ad hoc expert group meeting held on 6-8 December 1995 in Bangkok.

A brief description of the two main TAR southern routes is provided below.

Route (1): Turkey-Tehran-Lahore-New Delhi-Calcutta-Dhaka-Chittagong

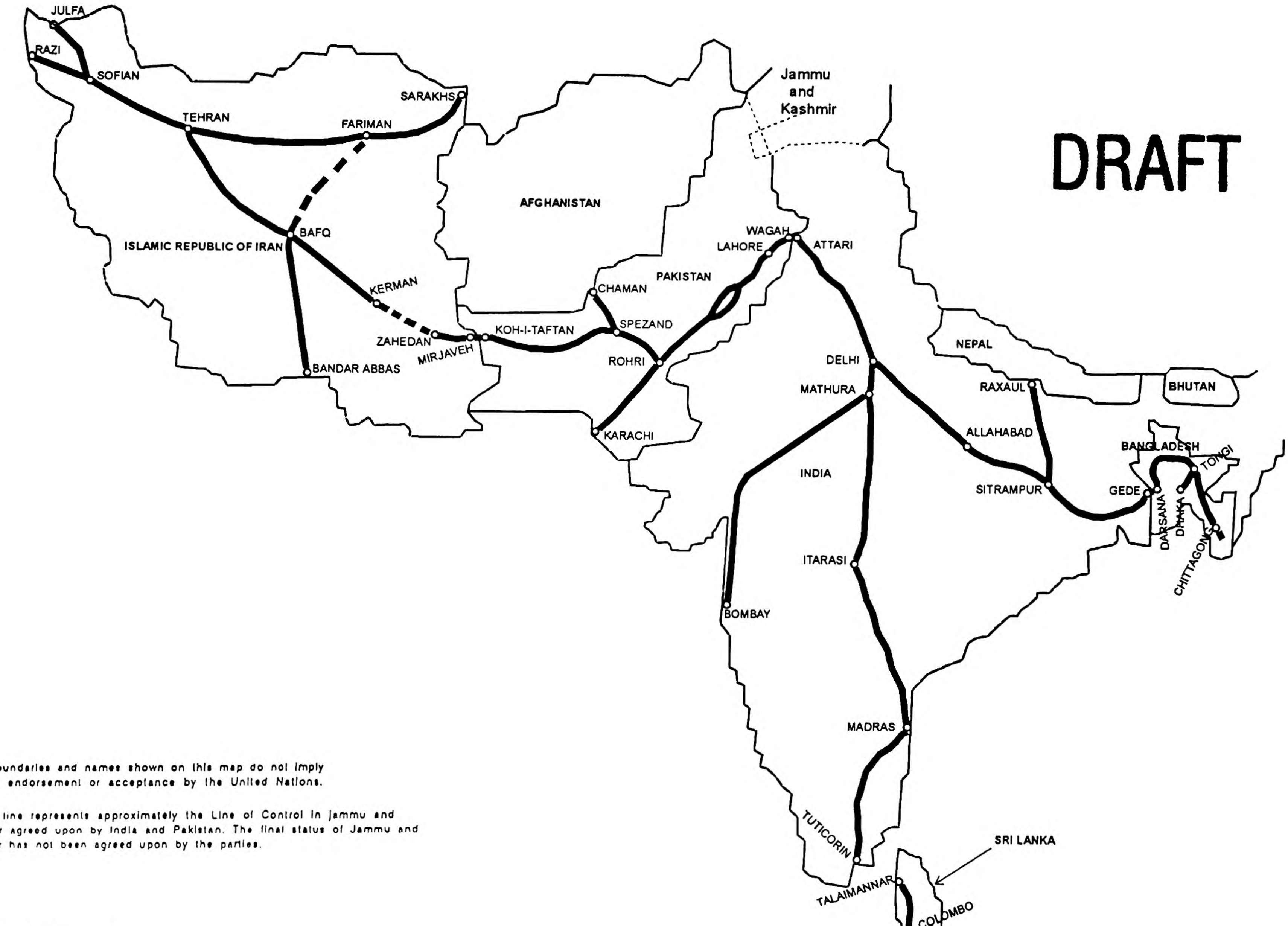
According to country reports provided by the Islamic Republic of Iran, Pakistan, India and Bangladesh, this route starts at Razi on the Turkish border of the Islamic Republic of Iran. It traverses the Islamic Republic of Iran in a southeasterly direction via Tehran up to Kerman. Over a distance of 545 km between Kerman and Zahedan, there is a missing railway link.

At Zahedan, the railway route begins mainly in an easterly direction. After passing the Iranian-Pakistani border, it traverses Pakistan, India and the western part of Bangladesh before reaching Shirajgang in Bangladesh, which is located on the west bank of the Jamuna River. After a short missing link over the Jamuna River (construction of a road-cum-rail bridge is under way), the railway route continues from the east bank of the Jamuna River and goes mainly in a southeasterly direction up to Dohazari via Dhaka and Chittagong. Dohazari is the eastern most point on this railway route, and from Dohazari to Myanmar there is a long missing link.

Since Chittagong is a principal port city, it is practical in this study to consider Chittagong as the eastern extremity of this main TAR southern route (Total length : 7,200 km).

As mentioned above, this route has two missing links. However, since completion of a new line is expected in future in both sections, the missing links will disappear. Three kinds of gauges are utilized on this route, namely broad gauge, standard gauge and metre gauge, and there are two break-of-gauge points.

PROPOSED TRANS ASIAN RAILWAY NETWORK IN THE SOUTHERN CORRIDOR



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Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not been agreed upon by the parties.

MAP - 5

This route passes Tehran (capital of the Islamic Republic of Iran), New Delhi (capital of India) and Dhaka (capital of Bangladesh) and is connected with Europe through Turkey.

Route (2): Almaty-Tashkent/Ashgabad-Serakhs-Tehran-Bafq-Bandar Abbas

This route starts from Serakhs on the Iranian border with Turkmenistan. It traverses the Islamic Republic of Iran in a southwesterly direction up to Tehran via Fariman. The section between Serakhs and Fariman (164 km) was already completed in May 1996. From Tehran to Bafq this route follows the same route as Route (1). From Bafq to Bandar Abbas the route goes in a southerly direction, following a new line which was completed in March 1995. Bandar Abbas is a seaport and the end of this route (Total length: 2,500 km). Serakhs is a break-of-gauge point, since in Turkmenistan 1,520 mm gauge is used while in the Islamic Republic of Iran - a standard gauge. When the section between Fariman and Bafq is completed, the length of this route will be greatly reduced and therefore a large reduction of the transit time might be expected.

III. PHYSICAL REQUIREMENTS OF TAR SOUTHERN ROUTES

As indicated above, loading gauge and axle load constitute, the main physical requirements for container transport on the Trans-Asian Railway.

A. LOADING/STRUCTURE GAUGE

While structure gauge sets dimensions within which no outside structure may protrude and prescribes minimum height and width distances between structures and track centre, loading gauge sets dimensions beyond which no part of the loaded rolling stock may protrude. The loading gauge thus sets maximum width and height of a flat wagon loaded with containers[1].

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 end and corner parts of the vehicle tend to be pushed outwards.

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[1] Types and related dimensions of containers are reflected in Table 3-1.

For the transportation of containers by rail, the width limitations imposed by the loading gauge is usually not a constraint. Problems arise with the height measured from the top of the rail to the top of the load. Even in a case when the centre part of the load may not constitute a problem, the top corners may do, as the standard loading gauge does not usually have a rectangular top section, but a slanting or round shape. This is crucial in the case of container transport as: (a) containers have a cubic shape which tends to occupy a large volume of the loading gauge; and (b) there is a trend to introduce containers of bigger size. When it comes to deciding on the suitability of structure gauge and loading gauge of the countries concerned for transportation of containers, the test consists in comparing the size of structure and loading gauge with the size of flat cars loaded with containers. The largest containers to be carried are the non-ISO 'Super High Cubes' containers with an external width of 8 ft 6 in (2,591 mm) and a height of 9 ft 6 in (2,896 mm). The findings of the study for 8 ft, 8 ft 6 in, 9 ft and 9 ft 6 in high containers are presented below.

Table 3-1. Dimensions of most-commonly used ISO and non-ISO containers

Freight container designation	External height			External width			External length			Maximum gross weight (tonnes)
	ft	in	mm	ft	in	mm	ft	in	mm	
ISO										
1 A	8	00	2,438	8	00	2,438	40	00	12,192	30
1 AA	8	06	2,591	8	00	2,438	40	00	12,192	30
1 B	8	00	2,438	8	00	2,438	30	00	9,125	25
1 BB	8	06	2,591	8	00	2,438	30	00	9,125	25
1 C	8	00	2,438	8	00	2,438	20	00	6,058	24
1 CC	8	06	2,591	8	00	2,438	20	00	6,058	24
1 D	8	00	2,438	8	00	2,438	10	00	2,991	10
Non-ISO										
(1)	9	06	2,896	8	00	2,435	48	00	14,630	35
(1)	9	06	2,896	8	00	2,435	45	00	13,716	35
(1)	9	06	2,896	8	00	2,435	40	00	12,192	35
(1)	9	06	2,896	8	00	2,435	20	00	6,058	35
(2)	9	06	2,896	8	06	2,591	53	00	16,150	35
(2)	9	06	2,896	8	06	2,591	48	00	14,630	35
(2)	9	06	2,896	8	06	2,591	45	00	13,716	35

(1) High cubes
(2) Super high cubes

1. Loading/Structure Gauge Applicable in the Islamic Republic of Iran and the South Asia Countries

There are three different track gauges along the main TAR Southern Routes, the broad, standard and metre gauges.

As far as the each participating country is concerned, structure/loading gauge restrictions on container transport are shown in Table 3-2. In this connection it should be noted that the results are based on the assumption that containers will be transported on flatcars of 1.2 m height.

Table 3-2. Possibility of rail transportation of containers in the Islamic Republic of Iran, Pakistan, India, Sri Lanka and Bangladesh - loading gauge requirements

Country	Gauge	Height of containers	Does Loading gauge permit ?
Islamic Republic of Iran	SG	9'6" 9' 8'6" 8'	No No Yes Yes
Pakistan	BG	9'6" 9' 8'6" 8'	No No No Yes
India	BG	9'6" 9' 8'6" 8'	No Yes Yes Yes
Sri Lanka	BG	9'6" 9' 8'6" 8'	No No No Yes
Bangladesh	BG	9'6" 9' 8'6" 8'	No No Yes Yes
	MG	9'6" 9' 8'6" 8'	No No No No

* "Yes" means that the dimension of container loaded on freight wagon does not exceed the dimensions of loading gauge, and "No" means to the contrary.

* SG: standard gauge (1,435 mm)

* BG: broad gauge (1,676 mm)

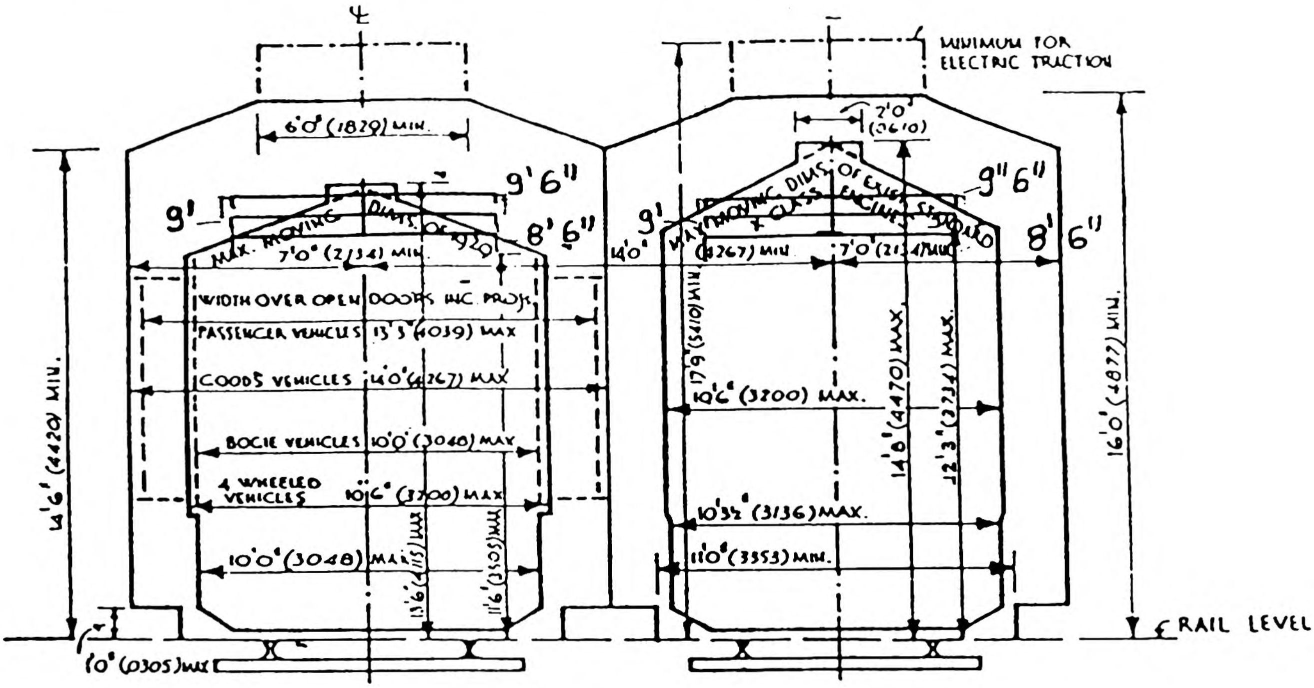
* MG: meter gauge (1,000 mm)

* Height of flat cat: 1,200 mm

* Source of dimensions of moving/structure gauge (Figure 1-Figure 5):

- Jane's World Railways (1988-9): Bangladesh (MG), India, Pakistan, Sri Lanka;
- Jane's World Railways (1972-3): the Islamic Republic of Iran, Turkey;
- Internal information of Bangladesh Railways: Bangladesh (MG)
- Feasibility Study on Connecting Rail Networks of China, Mongolia, Kazakhstan, the Russian Federation and the Korean Peninsula: Europe, Kazakhstan, ESCAP, 1995;
- Participating countries' papers (inputs to the study by national experts), 1995.

Figure 1 Loading/structure gauge of Bangladesh



Scale: Broad Gauge

1000 mm

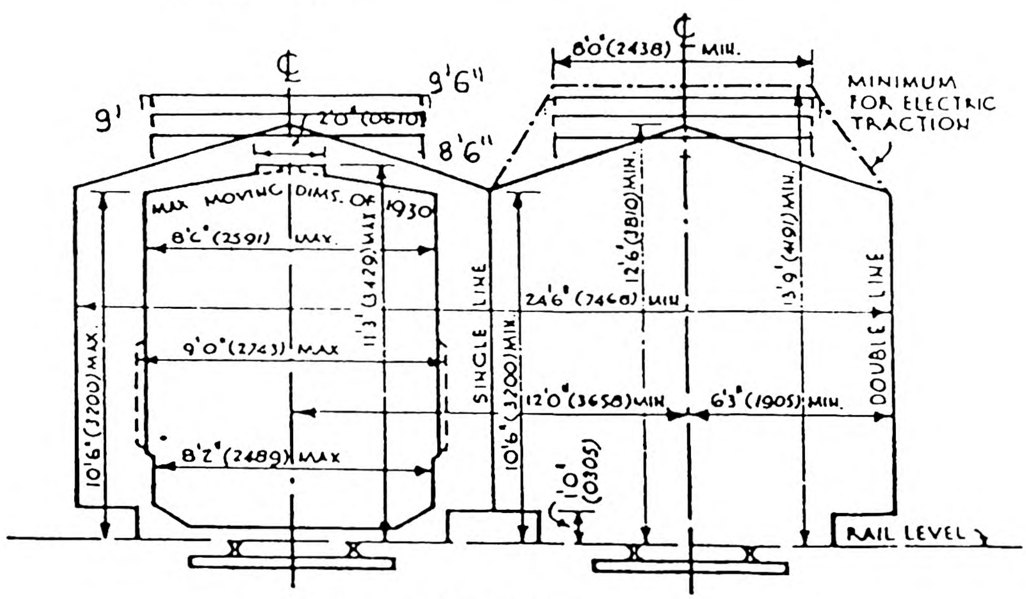
2438 mm 8'

3791 mm 8'6" + 1200 mm

3944 mm 9' + 1200 mm

4096 mm 9'6" + 1200 mm

Study of container gauge for ISO containers carried by wagon with platform height of 1200 mm (above the top rail level)

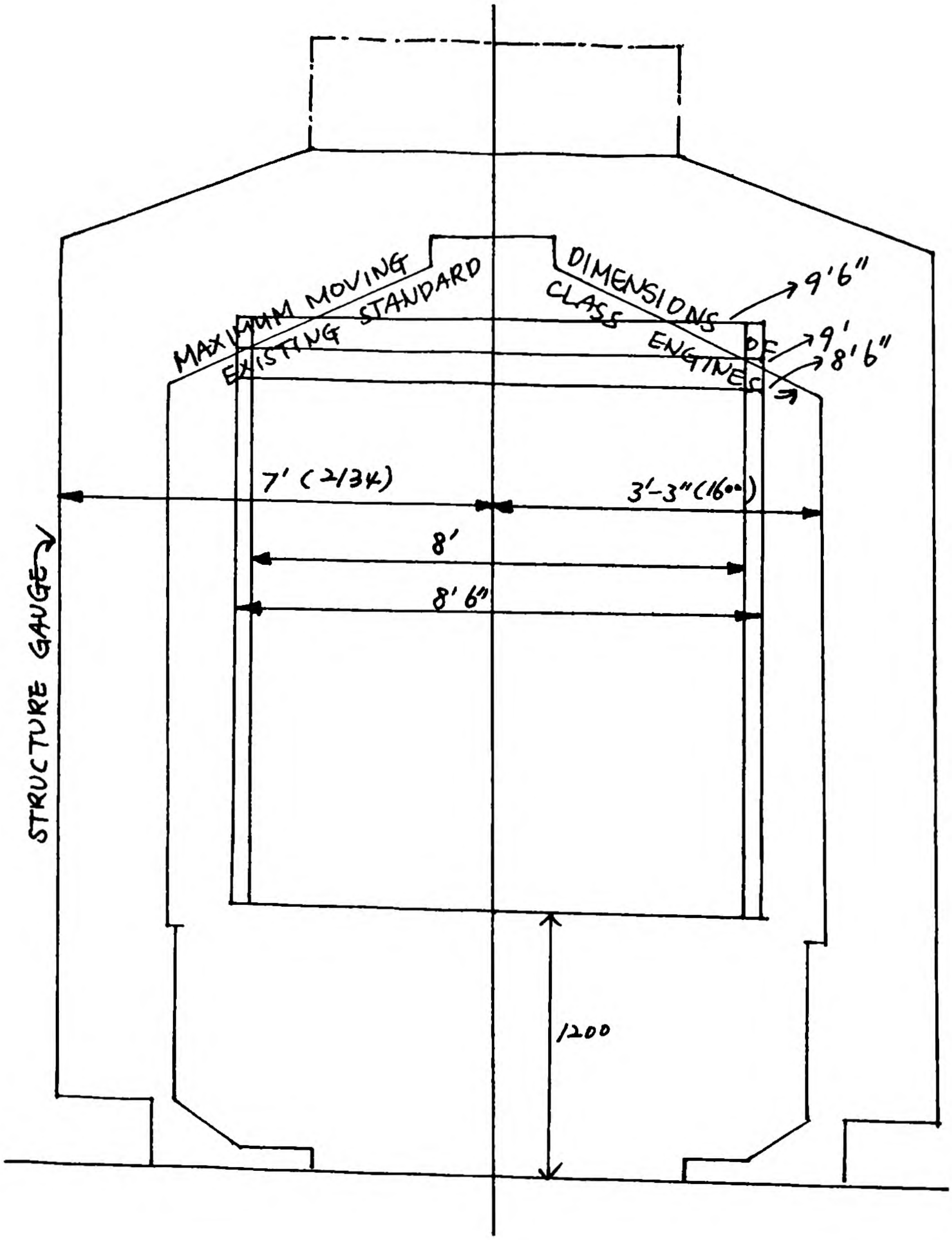


Scale: Metre Gauge

Same as Broad Gauge

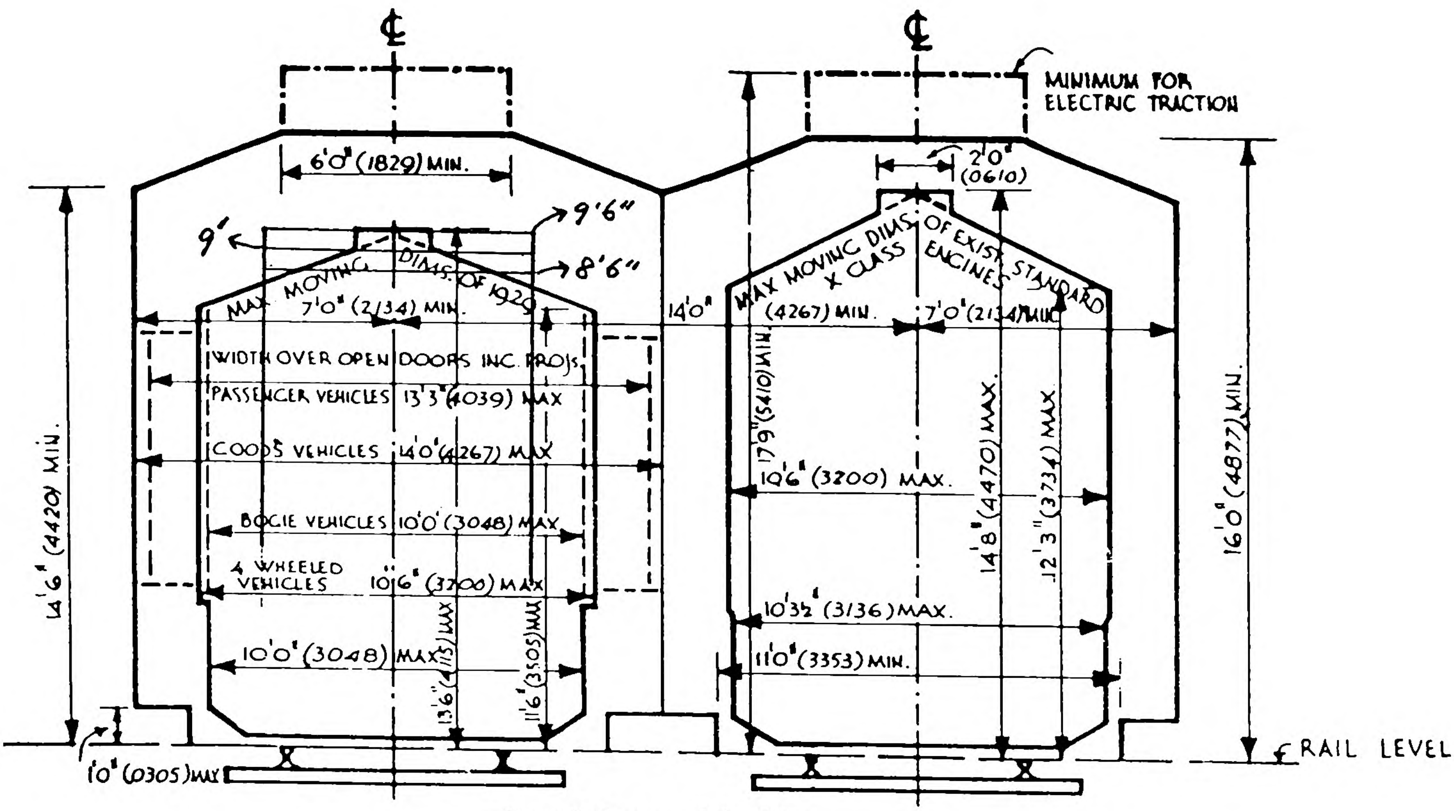
Structure gauge and Moving dimensions

Figure 2 Loading/structure gauge of India



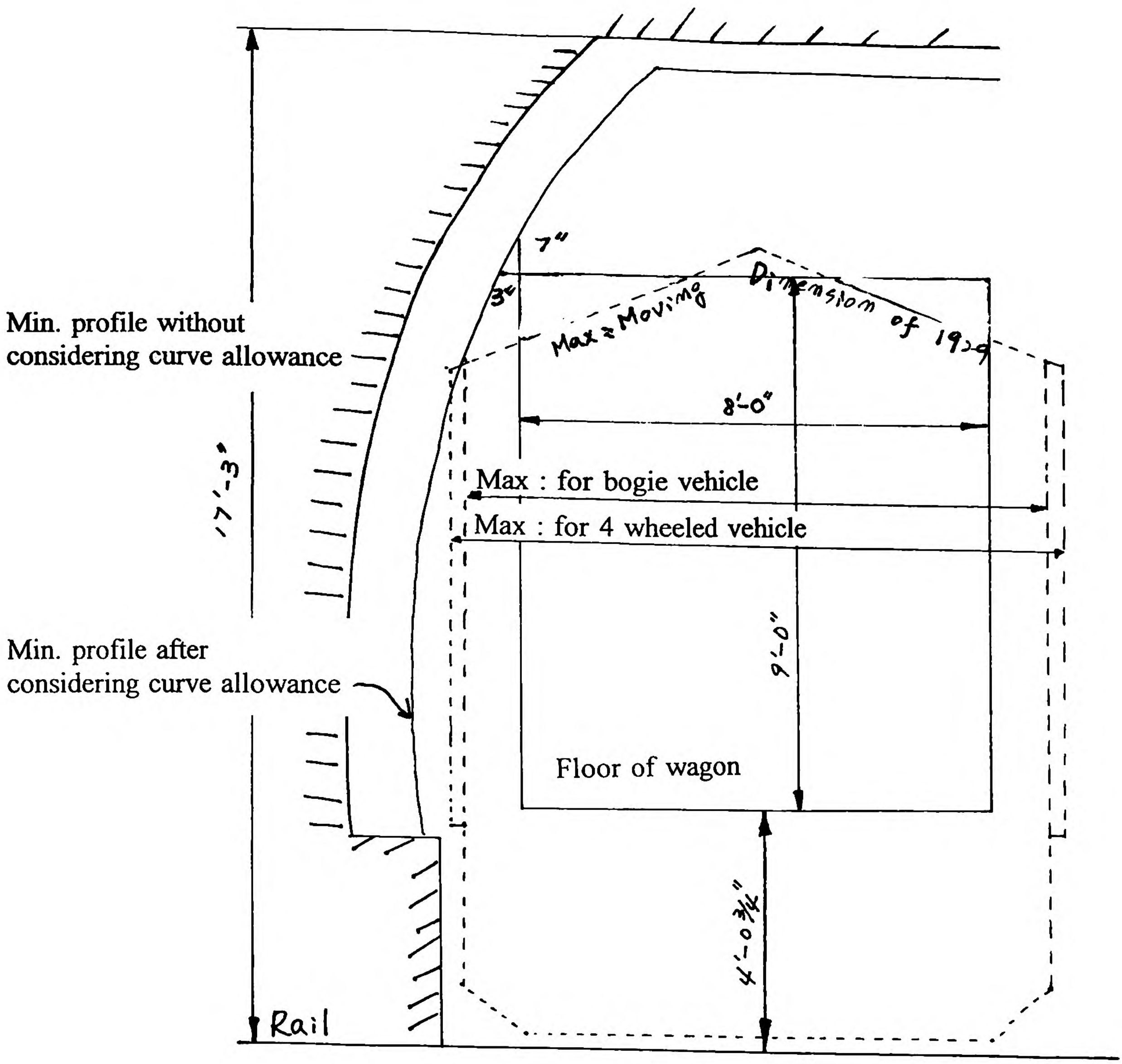
Broad gauge
Figures in mm

Figure 3 Loading/structure gauge of Pakistan



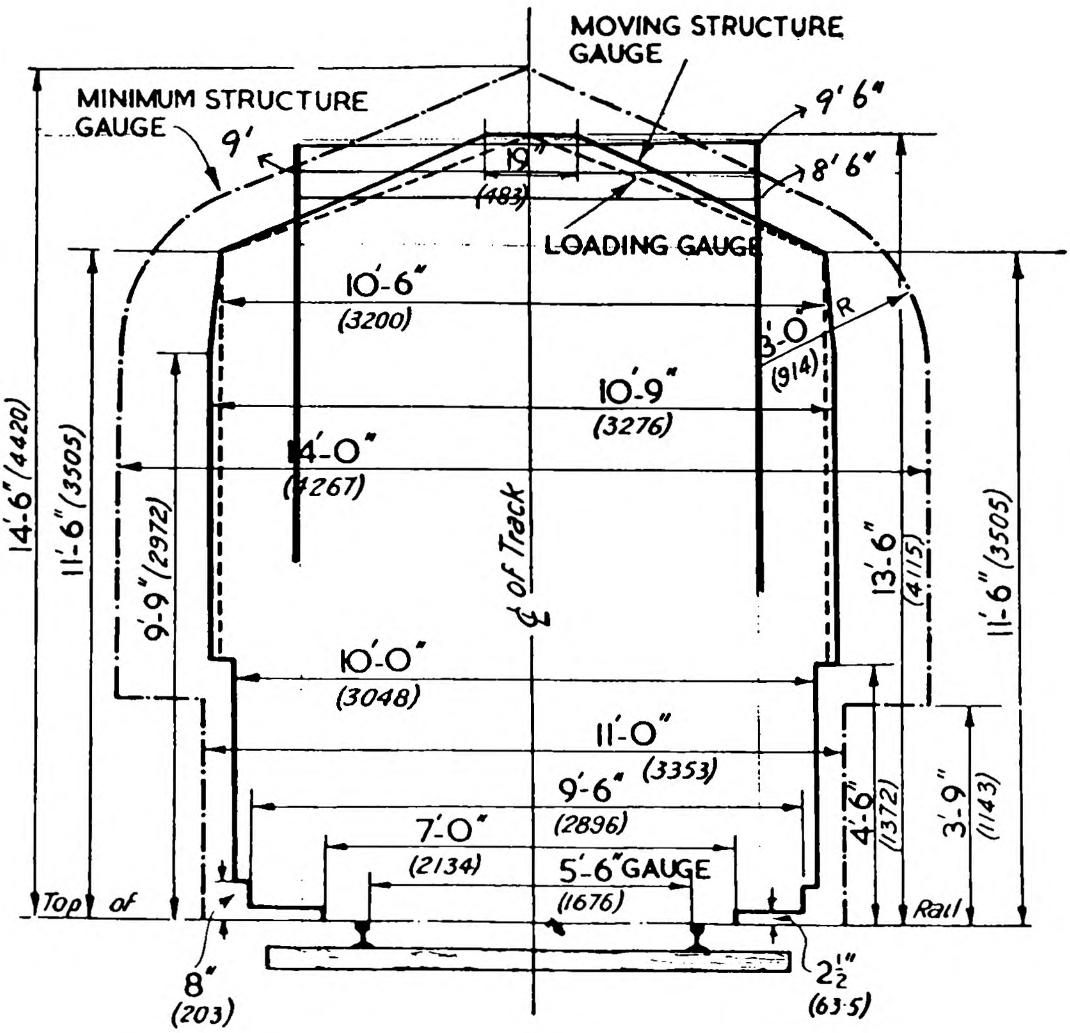
Broad Gauge—5 ft. 0 ins.

Figure 3-1 Structure gauge in Sibi-Quetta-Chaman and Sibi- Kohi Taftan section



Broad gauge
Figures in mm

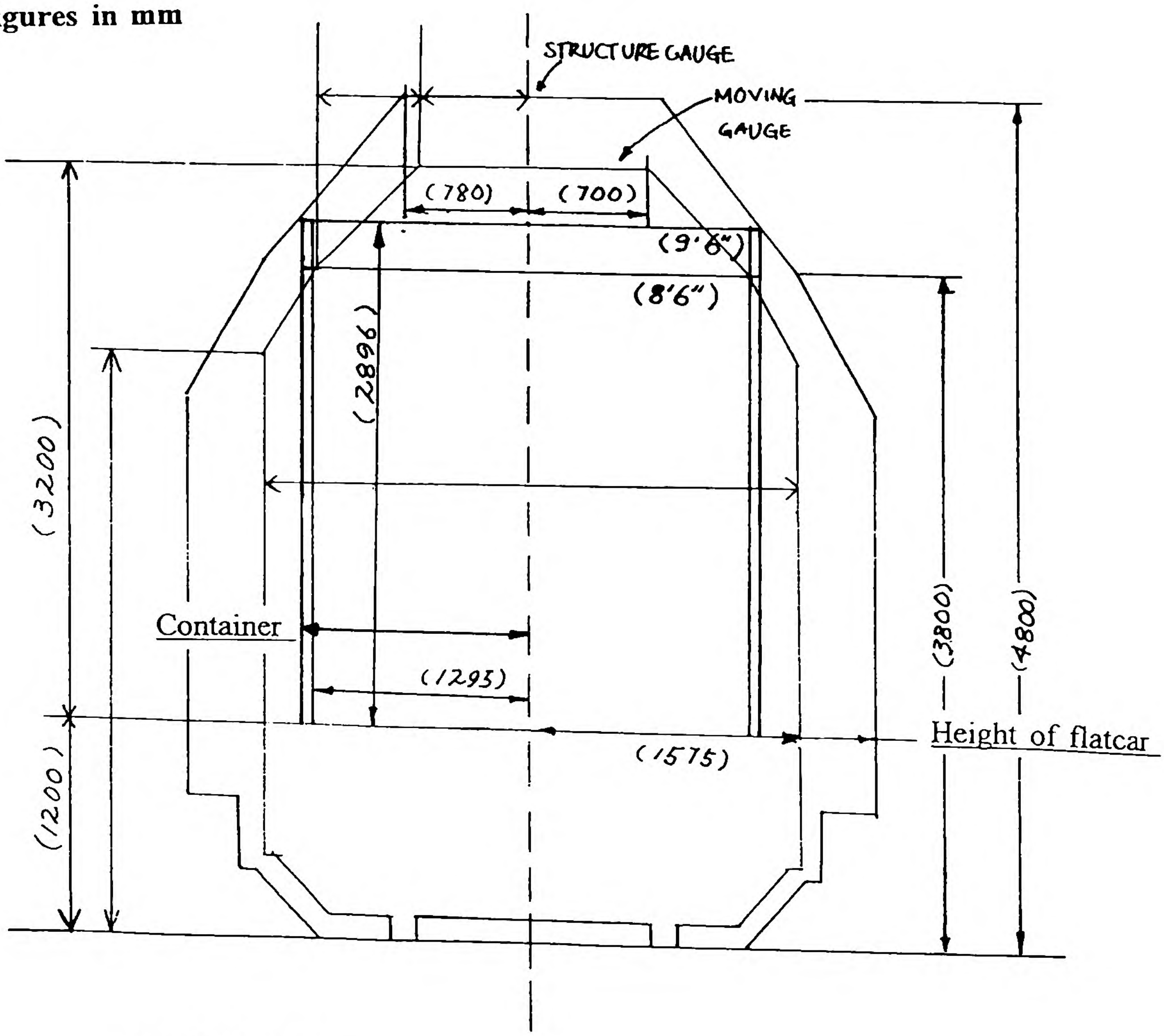
Figure 4 Loading/structure gauge of Sri Lanka



Broad gauge
Figures in mm

Figure 5 Loading/structure gauge of Islamic Republic of Iran

Figures in mm



Standard gauge
figures in mm

As shown in Table 3-3, 8 ft high containers can be transported in all the participating countries on the flatcars of 1.2 m height (except the MG section in Bangladesh).

As also reflected in Table 3-2, no railway system under consideration can accommodate 9 ft 6 in high containers and only the railway system of India can accommodate 9 ft high containers in view of restrictions imposed by the loading gauge.

However, according to the information provided by railway administrations of the participating countries, there is a possibility of transporting of even 9 ft or 9 ft 6 in high containers through railway systems of some of the participating countries owing to the following factors:

(a) It should be noted that even though the dimensions of trains loaded with freight (in this case containers) would exceed limitations set by loading gauge, as long as there is space of around 30-40 cm between the top of freight and structure gauge, freight can be transported (at least at possibly reduced speeds) without the risk of impacting outside structures;

(b) Another reason is that flatcars of less than 1.2 m height could be used for the purpose of conveyance of containers. For example, 4 wheeler[2/] wagons with a height of 0.86-0.94 m are use in Bangladesh for that purpose; and

(c) Also it should be noted that according to Railway Administration of Bangladesh between Chittagong and Dhaka (Meter Gauge section) even non-ISO containers of 9 ft 6 in high are being transported as overzized dimensions consignments (ODC) with restricted speed, and non-ISO 9 ft high containers can be transported on TAR routes in Pakistan except on section between Sibi and Spezand where speed restrictions and check up are necessary for up line direction.

[2/] This is not to suggest that the use of four wheel wagons is recommended for the transport of containers. Invariably stringent speed restrictions will be applied to the operation of 4 wheel wagons in order to limit track damage and this factor, combined with the fact that they can carry only a single 20 ft container makes them highly unsuitable for container transport.

(d) It should also be noted that, in some sections, structure/moving gauges are reduced because of sharp curves. With these factors taken into consideration, the possibility of rail transport of containers is reflected in the Table 3-3. As shown in the figure 3-2, in the sections of Sibi - Koh-i-Taftan and Sibi-Kerman in Pakistan, owing to very sharp curves, high profile traffic such as container trains loaded with 9 ft containers on standard high profile wagons cannot pass these sections. Also in the case of the Islamic Republic of Iran, it is reported that in the section of Mianee-Tabriz, owing to some restriction in loading gauge, non-ISO containers cannot be transported.

With these factors taken into consideration, the possibility of rail transport of containers is reflected in the Table 3-3.

Table 3-3. Possibility of rail transportation of containers in the Islamic Republic of Iran, Pakistan, India, Sri Lanka and Bangladesh - Structure gauge requirements

Country	Gauge	Height of containers	Does structure gauge permit ?	
Islamic Republic of Iran	SG	9'6"	No	
		9'	Yes	(No between Mianee-Tabriz)
		8'6"	Yes	
		8'	Yes	
Pakistan	BG	9'6"	No	
		9'	Yes	(No between Sibi-Spenzand up direction where speed restriction and check up are necessary)
			Yes	
		8'6"	Yes	
		8'		
India	BG	9'6"	Yes	(ODC)
		9'	Yes	
		8'6"	Yes	
		8'	Yes	
Sri Lanka	BG	9'6"	No	
		9'	No	
		8'6"	Yes	
		8'	Yes	
Bangladesh	BG	9'6"	Yes	(Not operational currently)
		9'	Yes	(Not operational currently)
		8'6"	Yes	(Not operational currently)
		8'	Yes	(Not operational currently)
	MG	9'6"	Yes	(ODC)
		9'	Yes	(between Chittagong and Dhaka)
		8'6"	Yes	(between Chittagong and Dhaka)
		8'	Yes	(between Chittagong and Dhaka)

* "Yes" means that the dimension of container loaded on freight wagon is under the dimension of structure gauge with some space of around 30-40 cm between them, and "No" means to the contrary.
* SG: standard gauge (1,432 mm)
* BG: broad gauge (1,676 mm)
* MG: meter gauge (1,000 mm)
* Height of flat wagon:
  - Bangladesh: 0.86-0.94 m; and
  - Others: assumed to be 1.2 m.
* ODC: Oversized dimensions consignments
* In Bangladesh, containers are being transported between Chittagong and Dhaka currently (MG section)

Summing up, it could be noted that though the railway loading gauge constitutes a main criterion for transportation of containers by rail, it appears that even 9 ft and 9 ft 6 in high containers are transported through the railways of some of the participating countries which gives ground for the following observations:

(a) Transportation of ISO 8 ft and 8 ft 6 in high containers on flatcars of 1.2 m height is possible on the railway systems of all the participating countries, including eastern part of Bangladesh (between Chittagong and Dhaka) where low profile flat wagons of 0.86-0.94 m height are used.

(b) Transportation of 9 ft containers on flatcars of 1.2 m height is possible on the railways of India, in the western part of Bangladesh and on some sections of the Islamic Republic of Iran and Pakistan. As to the Islamic Republic of Iran and Pakistan, such containers cannot pass the Mianee-Tabriz section in the case of the former and Sibi-Spezand section where speed restriction and check up are necessary for up line direction with no such additional requirements in down line direction in the case of the latter. As to the transportation of 9 ft containers in Bangladesh, though it is possible to transport 9 ft high containers on the railway system on broad gauge, currently they are transported only between Chittagong and Dhaka (MG section), on low floor wagons, and

(c) Transportation of 9 ft 6 in high containers on flatcars with a height of 1.2 m seems to be possible on the railways of India, the western part of Bangladesh. However, in practice it is reported that 9 ft 6 in containers are transported only in India and meter gauge section of Bangladesh by means of over dimensional consignment (ODC). In the case of Pakistan, according to the information by Pakistani Railway Administration, the possibility of transportation of 9 ft 6 in high containers should be studied with low floor container wagons as an option in view of the fact that revision of loading/structure gauges is not feasible.

2. Loading/Structure Gauge Applicable in Central Asia, Europe and Turkey

Central Asia

As far as the railway systems of Central Asian countries are concerned, they were constructed according to the railway standards of the former Soviet Union. Through the "Feasibility study on Connecting Rail Networks of China, Kazakhstan, Mongolia, the Russian Federation and Korean Peninsula" which was carried out by ESCAP in 1994-1995, it was found that the rail systems of the Kazakhstan and the Russian Federation deliver high cube containers. In that study it was also found that the loading and structure gauge of the railway systems of Russia and Kazakhstan are the same and that their loading gauge accommodates 9 ft 6 in high cube containers without a major problem (Figure 6).

It is assumed therefore that the railways of all the Central Asian Republics face no problem in the transportation of all types of containers including those of 9 ft 6 in height.

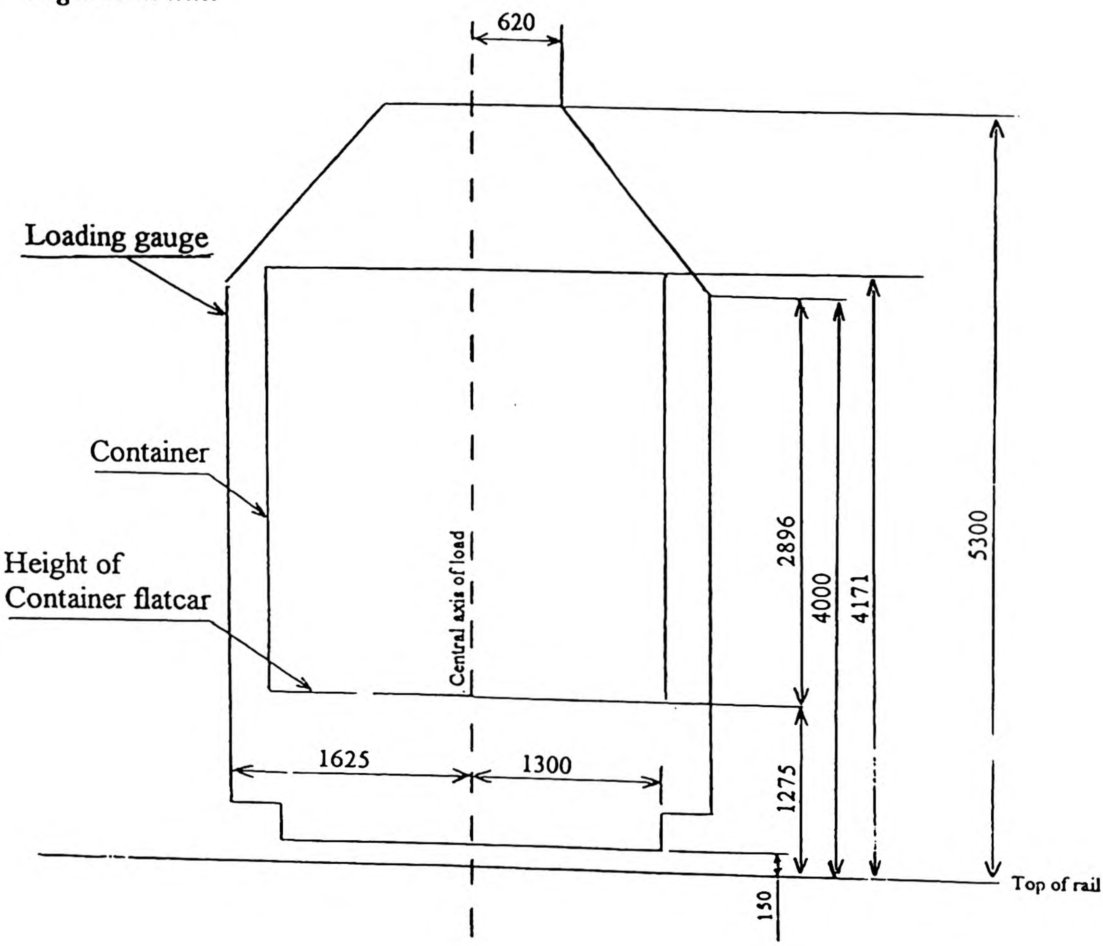
Europe

If container trains travel from Turkey to Western European cities they have to pass several countries which have different standards of railway loading/structure gauges. However in the case of Europe, with the development of international transport by railway, the International Union of Railways (UIC) initiated an Infrastructure Master Plan with the aim of establishing a homogeneous network of international railway lines linking the main centres of population, industry, commerce and recreation throughout Europe and Western part of the former USSR.

According to this plan, the UIC defined three standardized loading gauges known as Gauge A (GA), Gauge B (GB), and Gauge C (GC) as shown in Figure 7. The United Nations Economic Commission For Europe (ECE) adopted the "European Agreement on Main International Railway Lines" in 1985 to promote international railway transport. In the agreement it was stipulated that on new lines Gauge C (the biggest of the three gauges) should be chosen as only marginal investment cost is normally incurred. Most of the existing main European lines used for international traffic offer at least the UIC B Gauge.

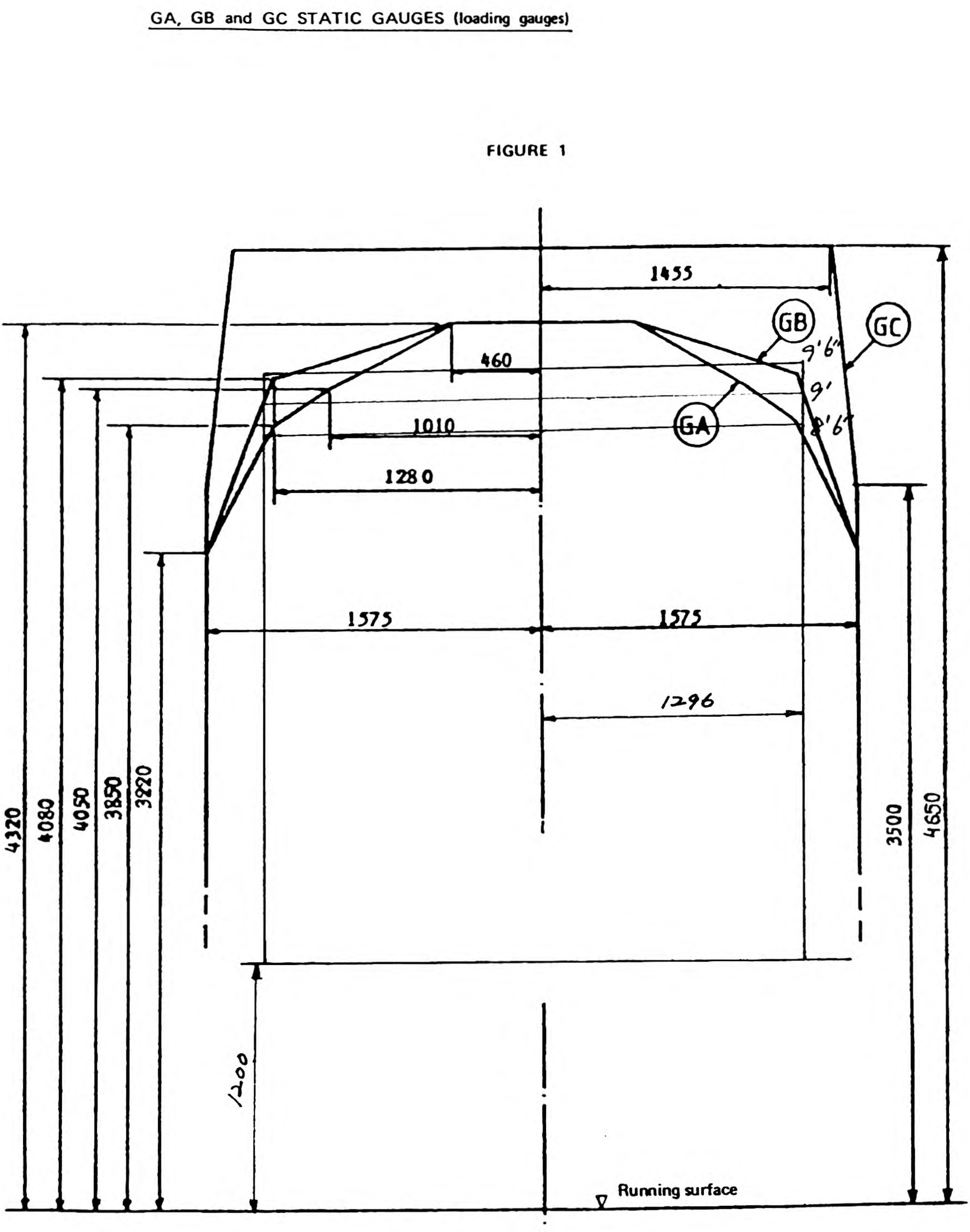
Figure 6 Loading gauge of Kazakhstan

Figures in mm



1522 mm gauge

Figure 7 Loading gauge of Railways in Europe



Standard gauge
figures in mm

The relationship between these different loading gauges and the possibility of accommodation of containers is shown below.

Table 3-4.

	Gauge A	Gauge B	Gauge B+	Gauge C
ISO containers	Yes (1)	Yes	Yes	Yes
High-cubes	No (2)	Yes	Yes	Yes
Super high cubes	No (2)	No (3)	Yes	Yes

(1) On conventional container flatbed (loading platform 1.18 m high)

(2) Yes on wagons with loading platform 0.94 m high

(3) Yes on wagons with loading platform 1.025 m high or less

Source: Feasibility study on Connecting Rail Networks of China, Kazakhstan, Mongolia, the Russian Federation and Korean Peninsula (ESCAP, 1994-1995)

Turkey

In the case of railways of Turkey (see Figure 8) the corners of 9 ft 6" containers loaded on flatcars with loading platforms of 1.2 m height, infringe the loading gauge limit and as there is not enough space between loading gauge and structure gauge, it seems that 9 ft 6 in high cube containers cannot be carried through the Turkish railway system. However, it appears that 9 ft high containers can be carried.

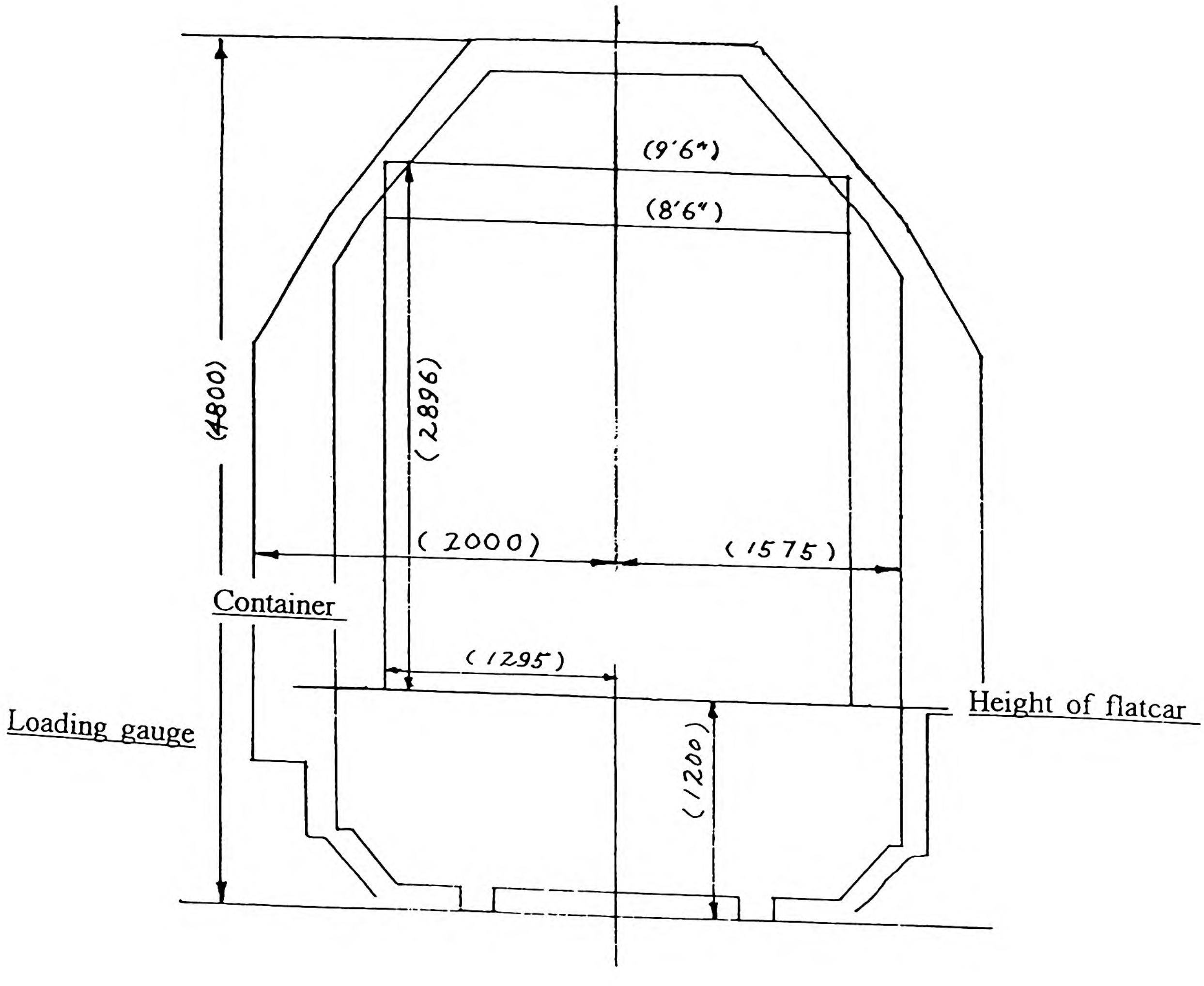
Accordingly, it may be noted that:

(a) Transportation of 8 ft6" and 9 ft containers ISO containers, on flatcars of 1.2 (1.18) m height is possible throughout all the railway systems of Central Asia and Europe and of Turkey; and

(b) Transportation of high cube containers of 9 ft 6 in height on flatcars of 1.2 m height is possible in Europe and in the Central Asian countries, but not in Turkey.

Figure 8 Loading/structure gauge of Turkey

Figures in mm



Standard gauge

3. Conclusion

In view of the above, it could be concluded that:

(a) There is no problem in transporting of 8 ft and 8 ft 6 in height ISO containers loaded on flatcars with a height of 1.2 m, from Dhaka to Europe and from Central Asia to Dhaka, if low profile flat wagons of 0.86-0.94 m height are used in the eastern part of Bangladesh (between Chittagong and Dhaka);

(b) Transportation of 9 ft high containers is possible only between Central Asia and the Islamic Republic of Iran (except the Mianee-Tabriz section) as well as between Pakistan (from Sibi) and Western Bangladesh through India. If low profile flat wagons of 0.86-0.94 m height are used it is also possible in eastern part of Bangladesh (between Chittagong and Dhaka);

(c) However, transportation of 9 ft 6 in high containers is not possible along the whole Southern Corridor but only within the Central Asian countries as well as in India and meter gauge section of Bangladesh (between Chittgong and Dhaka) in the form of ODC.

(d) Possible routes for various containers transportation can be shown as follows:

<u>8 ft and 8 ft 6 in high ISO containers</u>

Bangladesh - India - Pakistan - the Islamic Republic of Iran - Central Asia
Bangladesh - India - Pakistan - the Islamic Republic of Iran - Turkey - Europe
Sri Lanka - India - Pakistan - the Islamic Republic of Iran - Turkey - Europe

<u>9 ft high containers</u>

Central Asia - the Islamic Republic of Iran (up to Mianee)
Pakistan (from Sibi) - India - Bangladesh

9 ft 6 in high containers

Central Asia

India

Bangladesh

(e) However final recommendations should be based on a special detailed study which should also cover:

(i) the possibility of introduction/use of special low profile container wagons to accommodate non-ISO "High Cube" and "Super High Cube" containers in the TAR Southern Corridor;

(ii) the possibility of revision/enlargement of railway loading gauges in the participating countries;

(iii) the determination of bottlenecks for container transport on TAR routes and related measures to overcome the problems.

B. AXLE LOAD

1. Railways of the participating countries

Axle load is the static vertical load imposed per axle imposed on the track by a rail vehicle and its load. Depending upon the size/type and number of containers loaded on a wagon, the design axle load of parts of the TAR network could impose a constraint on container transport.

The maximum gross weight of a 20 ft ISO container is 24 tonnes, and to accommodate three 20 ft containers, the length coupler to coupler of a container wagon should be longer than 18,288 mm, but in many cases, the length of container wagons used in the Southern Corridor falls short of this requirement and consequently only two 20 ft containers are transported on a single wagon.

Taking into consideration the 18 tonnes tare weight of container wagon (the tare weight of container bogie wagon in the region to transport two TEUs is in the range of 18.0-20.5 tonnes), the combination of 2 containers and flatcar adds up to 66 tonnes, and imposes a load of 16.5 tonnes of load per axle. This load is below the axle load limit of railway systems in this region with the exception of that of the Eastern Bangladesh meter gauge system as shown below.

	Islamic Republic of Iran	Pakistan	India	Sri Lanka	Bangladesh
Permissable axle load (tonnes)	20 25 (Bafq-Bandar Abbas)	17	18.8	16.5	22.5 (broad gauge) 13 (metre gauge)

This means that two 20 ft ISO containers loaded on one freight wagon can be transported through the entire TAR Southern Corridor under consideration except the meter gauge section in Eastern Bangladesh.

If the maximum gross weight for a 20 ft container is assumed, then a container wagon carrying three 20 ft ISO containers will exceed the permissable axle load on all railway systems in the TAR Southern Corridor.[3]

However, in practice, skeletal container flat wagons of 17 tonne tare weight could be used and in planning for container transport it is usually assumed that the gross loads of containers will typically not exceed 75 per cent of the maximum gross load of 24 tonnes (i.e. 18 tonnes). According to the information provided by the Iranian Railway Administration, some container flatcars of 17 tonnes tare weight can accommodate three TEUs. If it is assumed that the gross load of containers will be 18 tonnes per unit, then the gross load of a wagon and three 20 ft containers will amount to 71 tonnes, for an axle load of 17.8 tonnes, which is considerably lower than the 20 tonne axle load currently applying on the Iranian railway system.

However, as far as the possibility of transport of 3-TEUs ISO containers on a flat wagon is concerned, it is known that such an experience does not yet exist in the participating countries and therefore it should be further studied taking into account the availability of such flat wagons, their tare weight, carrying capacity, etc.

2. Railways in Central Asia and Europe

For the main international rail routes in Europe, the European countries (including Turkey) signed an agreement in 1991 to facilitate the international transport of goods. In the agreement namely "The European Agreement on Important International Combined Transport Lines and Related Installations (AGTC)", it is stipulated that International combined transport lines should be capable of taking the most modern existing and future vehicle traffic, in particular:

[3] The maximum gross weight of a 20 ft ISO container is 24 tonnes, and the tare weight of container wagons designed to carry three 20 ft containers is around 27 tonnes (tare weight of Russian made 13-9004 wagon is 26 tonnes and that of Iranian freight cars with length of 20 m is around 24-27.5 tonnes). Taking into consideration the tare weight of a container wagon of 27 tonnes, the combination of 3 containers and the container wagon makes 99 tonnes, equal to an axle load of 24.8 tonnes. Thus, to accommodate three 20 ft ISO containers on a single wagon, an axle load limit of at least 25 tonnes would be required.

" Wagons with a mass per axle of 20 tonnes, which corresponds to UIC class C; a wagon mass per axle of 22.5 tonnes up to 100 km/hour has been adopted, in conformity with recent UIC decisions. The mass per axle limits of 20 tonnes for a speed of 120 km/hour are set by the UIC regulation."

According to above stipulation, major railway lines in Europe and Turkey can apparently carry two 20 ft ISO containers in one wagon safely. Considering the fact that flatcars run in Europe are lighter than that of Russian made and containers are seldom stuffed to the maximum gross weight limit, it seems that three 20 ft ISO containers can be transported on a single flat wagon throughout Europe.

For Central Asia, whose the railway systems were built to railway standards, of the former USSR, the axle load limit is 23 tonnes.

In the case of Railways of Turkey, as the axle load limit is 21 tonnes, it seems that they also can carry three TEU of containers on a single container wagon, if those wagons are of sufficient length.

3. Conclusion

It appears that there is no problem to transport two 20 ft ISO containers on a single container wagon throughout the whole TAR Southern Corridor under consideration.

However a possibility of transport of three 20 ft containers on a single container wagon should in future be the subject of a special study which takes into account recent technological developments in container wagon design.

IV. TRANSIT TIME AND SPEED - TAR SOUTHERN CORRIDOR

As already indicated in the previous chapters, the primary purpose of establishing TAR Southern Corridor is to facilitate the transport of containers between Asia and Europe by rail. However, as sea transport is the major transport mode at present for container transport between Asia and Europe, in order to attract container traffic, the TAR should be able to offer a package of transit times and tariffs which is competitive with the existing shipping services.

In this context, there are two major determinants of competitiveness - the quality of service and its cost. In other words, consignees want their containers to be delivered quickly and on time in order to be able to minimize their inventory costs and they want to minimize their overall transport costs. Thus it is essential to compare the possible transit times and tariffs that the TAR could offer to customers with those already provided by sea transport.

However, as the TAR Southern Route container service has yet to come into existence (and rail transit tariffs therefore are non-existent at present), it is very difficult to compare tariffs. Nevertheless, transit times of container transport between South Asia and Europe/Central Asia via shipping services may be examined and compared with the probable transit times that the TAR Southern Corridor could offer for the same service.

A. DEFINITIONS

Transit Times - for Sea and Rail. Whether the journey is by ship or by train, transit time is the elapsed time between departure from an origin (ie. where the consignor delivers his container for line haul movement) and arrival at an ultimate destination (ie. where the container is available for collection by the consignee).

In the case of ship movement, transit time includes voyage time between ports, time in ports en route, dwell time in the destination port (due unloading and customs clearance), and time for delivery to ultimate destination by land transport or short sea shipping services.

In the case of rail movement, transit time includes running time and stopping time en route for the purposes of traffic handling, safe working, customs inspection at borders, train servicing/maintenance and transhipment or inter-gauge transfer.

Average Transit Speeds - for Rail. Average Transit speeds are calculated as the total distance between origin and ultimate destination divided by transit time (as defined above). In a railway context, these are sometimes known as "schedule speeds".

A minimum value for the Average Transit Speed of rail services will be defined by the transit time reduction required to realize a competitive advantage over sea transport.

Average Running Speeds - for Rail. Average Running speeds are calculated as the total distance (as defined above), divided by the transit time **net** of the total time trains are (for whatever reason) stationary en route between origin and ultimate destination.

A minimum value for Average Running Speed of rail services will also be defined, but only partly, by the transit time reduction required to realize a competitive advantage over sea transport. However, it should be noted that actions taken to increase running speeds may not be successful in reducing transit time, unless complementary actions are taken to reduce en route stationary (or delay) time. In fact, it could well prove more expensive to facilitate faster running speeds than to take action to reduce en route delays, which may be influenced more by institutional factors (eg. customs procedures) than by deficient infrastructure.

B. TRANSIT TIME AND SPEED BETWEEN SOUTH ASIA AND EUROPE

Since the ability of railways to offer an attractive alternative to sea transport in the movement of containers in the Southern Corridor depends largely on the achievement of competitive transit times by rail, the setting of realistic transit time targets for rail, based on existing transit times for shipping services seems to be a logical starting point. After establishing the transit time typically offered by shipping services, this is compared with the potential transit time of the TAR Southern Corridor between South Asia (SA) and Europe. The routes used as a basis for the comparison are reflected in Table 4.1.

Table 4-1. Sea and Rail Routes Between Europe and South Asia

Options	Origin	Cities en route	Destination	Remark
Sea route	Dhaka[1] Calcutta New Delhi[2] Colombo Lahore[3] Tehran[4]	(sea)	Europe	Services now available
TAR Southern Corridor[5]	Dhaka	New Delhi - Lahore - Kerman - Tehran - Istanbul	Europe	Services not available until missing section (of 545 km) between Kerman and Zahedan is constructed

1 Through Chittagong port;

2 Through Bombay port;

3 Through Karachi port;

4 Through Bandar Abbas port;

5 Between Dhaka and Jamuna River section conveyance of only 8 ft ISO containers are feasible

1. Sea Transit Times

Voyage times were estimated from a sample of shipping schedules of mid-1995, provided by various shipping companies. To these voyage times was added an allowance for dwell time in the port of destination (due to the time taken for ship unloading, customs clearance, and transfer to road or rail vehicles) and for delivery by land transport vehicle to the final destination, in order to arrive at overall estimates of sea transit time. As shown in Table 4-2, transit times from Colombo to Europe are around 22 days and from other cities in South Asia to Europe around 31-35 days. Disparity in transit time between Colombo and other ports is due to feeder services because the other South Asian ports are not located on the mainline container shipping routes.

Table 4-2. Transit time from South Asia to Frankfurt (sea route to Rotterdam)

(Unit : days)

Origin	Sailing time; (feeder) + (line haul)	Dwell time at transhipment port	Delivery to final destination by rail	Total time
Chittagong	6 + (18-20)	7 (Colombo) 1 (Rotterdam)	1	33-35
Bombay	5 + (18-20)	7 (Colombo) 1 (Rotterdam)	1	32-34
Calcutta	5 + (18-20)	7 (Colombo) 1 (Rotterdam)	1	32-34
Colombo	18-20	1 (Rotterdam)	1	20-22
Karachi	(7-12) + (18-20)	7 (Colombo) 1 (Rotterdam)	1	34-41
Bandar Abbas	10 + (11-15)	7 (Jeddah) 1 (Rotterdam)	1	31-34

Source:

1) Transit Time between Colombo and Rotterdam; Shipping Schedules of Choyang, YangMing, Shipping Company in mid-1995;

2) Transit Time between Jeddah and Rotterdam; Shipping Schedule of OSK, Hapag-Lloyd Company in mid-1995;

3) Feeder Services: Bombay-Colombo;-Shipping Schedule of NYK, Karachi-Colombo; Shipping Schedule of NYK in mid-1995

4) Dwell time of containers in the South Asian ports was assumed one week considering the fact that most favourable port dwell time in South Asian region is around one week.

2. Transit Time - TAR Southern Corridor

The route length from Chittagong to Frankfurt is around 11,900 km. The route length of the TAR in each country is reflected in Table 4-3.

Table 4-3. TAR Route Length in Each Country

Country	Section	Length (km)	Major cities en route
Bangladesh	Chittagong - Darsana	690	Dhaka (Dhaka-Darsana : 420 km)
India	Gede - Attari	1,980	Calcutta, New Delhi
Pakistan	Waga - Koh-i-Taftan	1,730	Lahore, Rohri
Islamic Republic of Iran	Mirjaveh -Razi	2,670	Tehran, Bafq
Turkey	Kapykoy -Kapykule	2,390	Ankara
Europe	Svilengrad - Frankfurt (Bulgaria)	2,400	Sofia, Beograd, Budapest Wien, Munchen
Total		11,860	

Source: - Route length in Bangladesh, India, Pakistan, the Islamic Republic of Iran; Information from country papers.

- Route length in Turkey; Information from ECE document (TRANS/SC2/GE1/R.7.24. 1988).

The route lengths from cities in South Asia and the Islamic Republic of Iran to Frankfurt are shown in Table 4-4. In calculating the distance from Dhaka to Frankfurt, it should be noted that there are still two missing sections, and it was assumed that these sections will be filled in near future.

According to the information from the Bangladesh railway administration, construction of a 4 lane combined road and rail (metre gauge) bridge over the Jamuna River commenced in 1994 and is expected to be completed by mid 1998. In the case of the 545 km gap between Kerman and Zahedan, the Iranian railway administration is reportedly considering the possibility of construction of this link. However, considering enormous financial implication of the project, the view of Iranian Railway Administration is that early construction of the line as well as the line between Fairman-Bafq, could only be realized through financial support by interested multilateral as well as bilateral investors and private sector.

Table 4-4. TAR Route Length between Major Cities in the Southern Corridor and Frankfurt

(km)

From	Distance	Number of border crossings within the region	Number of break of gauge point
Dhaka	11,590	4	2
Calcutta	11,170	3	1
New Delhi	9,650	3	1
Lahore	9,170	2	1
Tehran	5,750	1	0

Notes: (i) It is assumed that there are no border crossing delays in Europe;

(ii) It is assumed that there will be a break of gauge point at Shirajgang Ghat in Bangladesh when Jamuna River bridge is completed.

According to the information provided by the participating countries, transit time between Dhaka and Razi would be around 636 hours (Table 4-5), including 3 days of border crossing time on average at each border. However it should be noted that border crossing time provided by the country paper of the Islamic Republic of Iran was 5 days.

Table 4-5. Transit time between Dhaka and Razi

(Unit : hour)

Country	Section	Distance	Transit time (Hour)	Average transit speed (km/h)	Border crossing/ Transhipment time (Hour)[1]	Total
Bangladesh	Dhaka - Border	420	28	15.0	72 (border crossing) 24 (break of gauge point)[2]	124
India	Gede - Attari	1,980	63	31.4	72	135
Pakistan	Waga - Koh-i-Taftan	1,730	89	19.4	72	161
Islamic Republic of Iran	Mirjaveh - Razi	2,670	144	18.5	72	216
Total	Dhaka-Razi	6,800	324	21.0	312	636 (26.5 days)

1 Border crossing time at the western border;

2 Break of gauge point at Jamuna River;

Source of transit time:
- India, Pakistan, Islamic Republic of Iran : Information provided by railway administrations;
- Bangladesh : Estimated assuming average speed of container train being 15 km/h.

According to the above table, it would take around 26.5 days for the containers to be transported from Dhaka up to the border of the Islamic Republic of Iran and Turkey including border crossing time between the Islamic Republic of Iran and Turkey.

Transit times in Turkey and Europe were estimated from the average speeds of freight trains based on the information that maximum operating speed of container train in Germany is around 100 km/h[4]. With this information taken into consideration, the average speed of container train in Europe was assumed to be 50 km/h, and that of Turkey - 25 km/h considering the long single track section from Ankara to the east and the need for ferry movement of container wagons across Lake Van.

It should be also noted that no border crossing procedure is supposed to take place between Turkey and Europe and within Europe because Turkey and the European countries are members of "European Agreement on Important International Combined Transport Lines and Related Installations" (1991 in Geneva) initiated by UN Economic Commission for Europe. The agreement stipulates that:

> "Trains of combined transport shall run as far as possible all the way across borders to a station where the exchange of wagon groups is necessary in any case or to their final point of destination, without having to stop en route. There shall be, if possible, no stops at the border or, if unavoidable, only very short stops (of no more than 30 minutes). This shall be achieved: (i) by not carrying out work normally effected at the frontier or, if this is not possible, by shifting this work to inland places where the trains have to stop in any case for technical and /or administrative reasons; (ii) by stopping only once, if at all, at joint border stations".

Transit times between cities in South Asia/the Islamic Republic of Iran and Frankfurt were calculated on the basis of this information and are reflected in Tables 4-6 and 4-7.

4/ Source: 'Feasibility study on connecting rail networks of China, Mongolia, Kazakhstan, the Russian federation and the Korean Peninsula (ESCAP 1994-5)

Table 4-6. Transit Time from the Border of Turkey/the Islamic Republic of Iran to Frankfurt

Section	Length	Average speed	Transit time (hours)
Turkey (Kapykoy-Kapykule)	2,390 km	25 km/h	96 (4 days)
Europe (Svilengrad-Frankfurt)	2,400 km	50 km/h	48 (2 days)
Total	4,790 km		144 (6 days)

Table 4-7. Transit Times between Cities in South Asia and Frankfurt

(Unit : hours)

Origin - Destination	Transit time (hours)	Number of border crossings)[1]	Numbers of break of gauge points[2]
Dhaka - Frankfurt	780 (33 days)	4	2
Calcutta - Frankfurt	656 (27 days)	3	1
New Delhi - Frankfurt	604 (25 days)	3	1
Lahore - Frankfurt	520 (21 days)	2	1
Tehran - Frankfurt	260 (11 days)	1	0

1 It is assumed that there are no border crossing procedures between Turkey and Europe and within Europe;

2 There are two break of gauge points: one at the Jamuna River and the other within the Islamic Republic of Iran.

3. Comparison of TAR Transit Time with Sea Transit Time

The comparison of TAR and shipping transit times is summarised in Table 4.8. It should be noted that allowances have been made in shipping transit times for the overland movement of containers between feeder ports and inland origins/destination, and these allowances are shown as footnotes to the table.

Table 4-8. Comparison of Transit Time between TAR and Sea Route (days) (from cities in South Asia/the Islamic Republic of Iran to Frankfurt)

City	Transit time		Margin of TAR route (A - B)
	Sea route (A)	TAR (B)	
Dhaka	41-43[1]	33	8-10
Calcutta	32-34	27	5-7
New Delhi	41-43[2]	25	16-18
Lahore	44-51[3]	21	23-30
Tehran	41-45[4]	11	30-34

[1] Transit time 21 h (322 km / 15 km/h) to Chittagong, Transhipment 7 days

[2] Transit time 49 h (1,538 km/ 31.4 km/h) to Bombay, Transhipment 7 days

[3] Transit time 63 h (1,219 km/ 19.4 km/h) to Karachi, Transhipment 7 days

[4] Transit time 86 h (1,600 km/ 18.5 km/h) to Bandar Abbas, Transhipment 7 days

[1 3 4] includes transit time to the port and transhipment at port.

While the table indicates a substantial margin of transit time advantage for the TAR over shipping services, two particularly important qualifications need to be borne in mind:

(a) The Threat from Mainline Shipping Services

In most cases, the sea transport of containers from South Asia to Europe involves feedering through the Port of Colombo, with substantial time penalties in terms of feeder vessel transit time as well as of port dwell time.

There is an assumption implicit in the above transit time comparison that feedering through Colombo will continue, when in fact it is highly possible that container volumes at some of the South Asian ports (notably those of India) could rise to levels which might in future justify direct calls of mainline vessels. If this happened, then the sea transit times from some South Asian points of origin would reduce by at least 12 days, thereby eliminating any significant transit time advantage for the TAR.

(b) The Necessity for a Competitive Through Tariff

The transit time advantage for the TAR needs to be complemented by a *competitive through railway tariff,* since a shorter transit time may not of itself be sufficient to attract container business to rail.

Numerous railway administrations would share in the transportation of containers between South Asia and Europe. Some would need to commit substantial investments to closing gaps in the TAR network and/or to upgrading their infrastructure for container services, and might require high tariff levels in order to recover these investments. Such a requirement might work against the need for rail to be able to offer a tariff which is competitive with the shipping rate.

Co-operation in tariff setting will be a new experience for most of the railway administrations participating in the TAR, yet the establishment of a competitive through rail tariff will be an essential pre-requisite for container movement in the corridor once a through TAR route is in place.

4. Other Factors Affecting the Comparison of Transit Times

The comparison of TAR with shipping transit times will also be sensitive to the assumptions used for border crossing time in the case of the total TAR transit time and for feeder-mainline transfer, or transhipment, time in the case of the total shipping transit time.

(a) Effect of Border Crossing Time

For the above comparison, TAR transit times reflect an assumption of 3 days of delay at each border crossing between Dhaka (Bangladesh) and Razi (Islamic Republic of Iran). However, since there has thus far been no international container traffic in the corridor, there has been no experience upon which an estimate of border crossing time could be based, and therefore there is no guarantee that the allowance of three days would be adequate.

Thus, the effect of alternative assumptions with respect to border crossing times was tested and the results are shown in Table 4-9.

Table 4-9. Effect of Increased Border Crossing Time on Overall Transit Time Comparison (Rail Versus Shipping, to Frankfurt)

(Unit : days)

Origin	Transit time of sea route (transhipment time 7 days) (A)	Transit time on TAR Southern Corridor with alternative assumptions about delay at each border crossing (B)			Margin in transit times (A) - (B)
		[1] 3 days	[2] 4 days	[3] 5 days	
Dhaka	41-43	33	37	41	[1] 8-10 [2] 4-6 [3] 0-3
Calcutta	32-34	27	30	33	[1] 8-10 [2] 2-4 [3] (-1)-1
New Delhi	41-43	25	28	31	[1] 16-18 [2] 13-15 [3] 10-12
Lahore	44-51	21	23	25	[1] 23-30 [2] 21-28 [3] 19-26
Tehran	41-45	11	12	13	[1] 30-34 [2] 29-33 [3] 28-32

In order for the TAR to have a competitive advantage over shipping, it is likely that it would have to deliver transit times which are at least 7 days shorter than those of the shipping services (allowing some compensation for the possibility of higher tariffs for rail).

In relation to this target, Table 4-9 shows that transit time competitiveness for rail is lost in the case of traffic starting from Dhaka or Calcutta if the delay at each border crossing point averages 4-5 days instead of the 3 days assumed in the initial transit time comparison between rail and sea. It may thus be concluded that delay at each border crossing time point should be less than 4 days if the rail transportation of containers from cities located at the eastern end of the TAR Southern Corridor to Europe is to be competitive with shipping services, *on the assumption that transhipment time through the Port of Colombo will be about 7 days.*

(b) Effect of Port Transhipment Time

There appears to be a wide variation between South Asian and European ports in terms of the overall dwell time for a container being transferred from mainline to feeder vessel and vice versa. However, no definitive information on actual transhipment times is available either for ports in Europe or for ports in South Asia.

For the purposes of this analysis, dwell time at the Port of Colombo (the principal South Asian port of transhipment for containers bound for, or arriving from, Europe) has thus far been assumed to be 7 days, while that of the Port of Rotterdam has been assumed to be 1 day. It is possible that the actual dwell time at Colombo is something less than 7 days. (Indeed, the average dwell time for Chittagong Port as quoted in the Bangladesh country paper is 5 days).

There is also a strong possibility that the container handling performance of several South Asian ports will improve significantly through improved management practices and equipment modernization, with a commensurate improvement in the turnround of transhipped containers.

The effect on the comparison of overall rail and shipping transit times of alternative assumptions with respect to container transhipment time in ports was tested and the results are shown in Table 4-10.

Table 4-10. Effect of Reduced Port Transhipment Time on Overall Transit Time Comparison (Rail Versus Shipping, to Frankfurt)

(Unit : Days)

Origin	Transit time of shipping services, with various alternative assumptions about transhipment time at ports (A)			Transit time of TAR (border crossing time 5 days) (B)	Margin of transit times (A) - (B)
	[1] 3 days	[2] 4 days	[3] 5 days		
Dhaka	33-35	35-37	37-39	41	[1] - (8-6) [2] - (6-4) [3] - (4-2)
Calcutta	28-30	29-31	30-32	33	[1] - (5-3) [2] - (4-2) [3] - (3-1)
New Delhi	33-35	35-37	37-39	31	[1] 2-4 [2] 4-6 [3] 6-8
Lahore	36-43	38-45	40-47	25	[1] 11-18 [2] 13-20 [3] 15-22
Tehran	33-37	35-39	37-41	13	[1] 20-24 [2] 22-26 [3] 24-28

This table shows that, if the transhipment times of containers at ports are shortened while border crossing time by rail remains at 5 days, there is little possibility that rail can capture container traffic between Europe and some cities in South Asia, notably Dhaka, Calcutta and New Delhi. This would tend to indicate that border crossing delay could be an influential factor in determining whether or not container traffic will ultimately move in the TAR Southern Corridor.

C. TRANSIT TIME AND SPEED BETWEEN SOUTH ASIA AND CENTRAL ASIA

To facilitate trade between Central Asia and South Asia, efforts are being made to connect these two subregions by rail. For this purpose the Government of the Islamic Republic of Iran on March 1995 commissioned a rail link between the port of Bandar Abbas and the existing rail system. This new 700 km line connects Bandar Abbas with the central city of Bafq enabling the railway system to take traffic to/from Central Asia via Tehran. The only gap remaining between Bandar Abbas and Central Asia is the Meshad-Tedjen section the construction of which has been given high priority by both Governments.

When the rail link between the Islamic Republic of Iran and Turkmenistan is completed in 1996, traffic from Central Asia will be able to reach South Asia through the Iranian railway system and the port of Bandar Abbas. Probable routes from Central Asia to South Asia can be assumed as follows:

<u>All rail route</u>

(a) *Almaty-Tashkent-Serakhs-Tehran-Bafq-Kerman-Zahedan-Lahore-New Delhi-Calcutta-Dhaka*

(b) *Ashgabad-Tashkent-Serakhs-Tehran-Bafq-Kerman-Zahedan-Lahore-New Delhi-Calcutta-Dhaka*

<u>Rail-cum-sea route</u>

(a) ***[Rail]:****Almaty-Tashkent-Serakhs-Tehran-Bafq-Bandar Abbas-* ***[Ship]****-Karachi-****[Rail]****-Lahore*

(b) ***[Rail]:****Almaty-Tashkent-Serakhs-Tehran-Bafq-Bandar Abbas-* ***[Ship]****-Bombay****[Rail]****-New Delhi*

(c) ***[Rail]:****Almaty-Tashkent-Serakhs-Tehran-Bafq-Bandar Abbas-* ***[Ship]****-Calcutta*

(d) ***[Rail]:****-Almaty-Tashkent-Serakhs-Tehran-Bafq-Bandar Abbas-* ***[Ship]****-Chittagong-Dhaka*

At present, the all-rail route is not yet available due to two missing sections. The missing section between the Islamic Republic of Iran and Turkmenistan will be filled in the near future, but it is likely that completion of the link between Kerman and Zahedan will be realized only in the distant future.

1. Transit time - rail-cum-sea route

Transport of containers by rail from Central Asia to South Asia will be possible up to the Bandar Abbas port and then by sea assuming that missing section between Tedjen and Meshad will be completed by 1996 as planned. The route lengths of railway lines from Central Asian cities to Bandar Abbas are shown in Tables 4-11 and 4-12.

Table 4-11. Rail Route Length between Almaty and Bandar Abbas (km)

Origin	Cities en route				Destination
Almaty	Tashkent	Serakhs	Tehran	Bafq	Bandar Abbas
Distance from origin - via Tehran	523	2,093	3,145	3,985	4,601

Table 4-12. Rail Route Length between Ashgabad-Bandar Abbas (km)

Origin	Cities en route			Destination
Ashgabad	Serakhs	Tehran	Bafq	Bandar Abbas
Distance from origin - via Tehran	350	1,402	2,242	2,858

It was also estimated that the probable transit times for rail from Almaty to Bandar Abbas and from Ashgabad to Bandar Abbas via Tehran would be around 11 days and 9 days respectively, assuming an average transit speed of 35 km/h in Central Asia and 18.5 km/h in the Islamic Republic of Iran.

Table 4-13. Transit Times between the Capital Cities of Central Asia and Bandar Abbas

Origin	Transit time	Border crossing/ Transhipment	Total transit time
Almaty	Almaty-Serakhs 2,093 km/35 km/h = 59.8 h (2.5 days) Serakhs-Tehran 1,052 km/18.5 km/h = 56.9 h (2.4 days) Tehran-Bandar Abbas 78.7 h (3.3 days)	3 days	11.2 days
Tashkent	Tashkent-Serakhs 1,570 km/35 km/h = 44.9 h (1.9 days) Serakhs-Bandar Abbas 135.6 h (5.7 days)	3 days	10.6 days
Ashgabad	Ashgabad-Serakhs 350 km/35 km/h = 10 h (0.4 day) Serakhs-Bandar Abbas 135.6 h (5.7 days)	3 days	9.1 days

Notes:

(1) Transit time from Tehran to Bandar Abbas was reported in the country paper as 102 hours.

(2) No allowance was made for border delay within the Central Asian countries. Up until now border crossing traffic within the subregion has to been required to stop for border inspection, although it is understood that regulations may change in future.

As to the transit times from Bandar Abbas to various destinations in South Asia, no exact information was available for this study. There appears to be no regular shipping service between Bandar Abbas and South Asian ports.

For the purpose of this study, therefore, it was assumed that containers would be conveyed between Bandar Abbas and South Asian ports by conventional ships, with an average speed of 12 nautical miles per hours. Application of these assumptions would result in the transit times from Bandar Abbas to South Asian destinations as shown in Table 4.15.

Table 4-14. Transit time from Bandar Abbas to various cities in South Asia

Destination	Transhipment at Bandar Abbas (hour)	Sea transit time (hour)	Transhipment at South Asia ports (hour)	Rail transit time (hour)	Total transit time (hour/day)
Lahore	168 (7 days)	54	168 (Karachi)	63	453/18.9
New Delhi	168	90	168 (Bombay)	49	475/19.8
Colombo	168	153	168 (Colombo)	-	489/20.4
Calcutta	168	255	168 (Calcutta)	-	591/24.6
Dhaka	168	259	168 (Chittagong)	21	616/25.7

Note: Distance from Bandar Abbas to ports in South Asia (km):
Karachi (1,190); Bombay (1,987); Colombo (3,400); Calcutta (5,660); Chittagong (5,750).

Table 4.15 sums the transit times from the above two tables (i.e. Tables 4-13 and 4-14), to reflect total transit times from cities in Central Asia to cities in South Asia. This table shows that transit times between Central Asian cities and port cities in South Asia would be around **25-36 days**, and that transit times between Central Asian cities and inland cities in South Asia would be around **28-37 days.**

Table 4-15. Total transit time from Central Asia to South Asia (days)

	Almaty	Tashkent	Ashgabad
Karachi	27.5	26.9	25.4
Lahore	30.1	29.5	28
Bombay	29	28.4	26.9
New Delhi	31	30.4	28.9
Colombo	31.6	31	29.5
Calcutta	35.6	35.2	33.7
Chittagong	36	35.4	33.9
Dhaka	36.9	36.3	34.8

Note: Distance from Bandar Abbas to ports in South Asia (km):
Karachi (1,190); Bombay (1,987); Colombo (3,400); Calcutta (5,660); Chittagong (5,750).

2. Transit time by all rail method

Despite the current lack of a through rail connection from the countries of Central Asia to the countries of South Asia, rail transit times were calculated as if such a connection were in place.

Table 4.16 shows the route lengths from Almaty to various cities in South Asia. The overall rail distance between Almaty and Dhaka is about 9,000 km.

Table 4-16. Rail route length in each country (km)

Country	Section	Length (km)	Major cities en route
Kazakhstan	Almaty - Tashkent	523	Chu, Chimkent
Uzbekistan, Turkmenistan	Tashkent - Serakhs	1,570	Samarkand, Tedjen
Islamic Republic of Iran	Serakhs - Bafq- Mirjaveh	2,770	Meshad, Tehran, Kerman
Pakistan	Koh-i-Taftan - Waga	1,730	Rohri, Lahore
India	Attari - Gede	1,960	New Delhi, Agra
Bangladesh	Darsana - Dhaka	420	Ishurdi, Sirajgang Ghat
Total		8,973	

From these route lengths, transit times between Central Asian cities and South Asian cities were estimated (see Table 4.17). Rail transit times from Almaty to cities in South Asia range from 18 to 30 days.

Table 4-17. Rail transit times between Almaty and cities in South Asia

Destination	Transit time (hour/day)	Border crossing/transhipment (days)	Total transit time (days)
Tehran	Almaty - Serakhs: 2,093 km/35 km/h = 59.8 h (2.5 days) Serakhs - Tehran: 1,052 km/18.5 km/h = 56.9 h (2.4 days)	3	7.9
Karachi	Almaty - Serakhs: 2,093 km/35 km/h = 59.8 h (2.5 days) Serakhs - Tehran: 1,052 km/18.5 km/h = 56.9 h (2.4 days) Tehran - Mirjaveh: 100 h (4.2 days) Koh-i-Taftan - Karachi: 1451 km/19.4 km/h = 72.7 h (3 days)	6	18.1
Lahore	Almaty - Mirjaveh: (9.1 days) Koh-i-Taftan - Lahore: 88 h (3.7 days)	6	18.8
New Delhi	Almaty - Waga: (12.7 days) Attari - New Delhi: 11 h (0.5 days)	9	22.2
Calcutta	Almaty - Waga: (12.7 days) Attari - Calcutta: 63 h (2.6 days)	9	24.3
Dhaka	Almaty - Gede: (15.3 days) Darsana - Dhaka: 420 km/15 km/h = 28 h (1.2 days)	13	29.5

Assumptions: Border crossing time, 3 days; transhipment time break of gauge point at Jamuna River, 1 day

3. Comparison of TAR transit time with sea-cum-rail transit time

The comparison of the overall transit times for rail only as compared with rail-cum-sea transport is shown in Table 4.18.

Table 4-18. Comparison of Transit Times between TAR and Sea-cum-Rail Route

City	Transit time (days)		Margin in favour of All-rail: (A) - (B) (days)
	Sea-cum-rail (A)	All-rail (B)	
Karachi	27.5	18.1	9.4
Lahore	30.1	18.8	11.3
New Delhi	31	22.2	9.8
Calcutta	35.6	24.3	11.3
Dhaka	36.9	29.5	7.4

While this table indicates a clear advantage for the all-rail transport option over the rail-cum-sea transport option, this advantage might easily be reduced by a reduction in port dwell times resulting from productivity improvements at Bandar Abbas and the South Asian ports. In this context, it should be noted that the relatively small delay (1-1.5 days) assumed to be incurred at rail break-of-gauge points versus the relatively large delay (7 days) assumed to be incurred at ports of transhipment contributes significantly to the overall transit time advantage for the all-rail option.

4. Conclusion

The TAR Southern Corridor has good potential as a trunk route for container traffic between South Asia and Europe, and between Central and South Asia, in terms of transit time. This potential results from the shorter distance and possibly higher average transport speeds of container train. However unlike the sea route, the TAR Southern Corridor is not yet a reality, so that, at best, estimates can only be made of probable rail transit times in relation to the transit time benchmarks already established for shipping services.

The validity of these estimates, and in particular the estimates of delay time at border crossing points, needs to be tested, through a more detailed analysis than was possible in the present study. Such a detailed study should in addition address other factors which can be considered to have a major bearing on rail/shipping competition in relation to the TAR Southern Corridor, such as container transhipment time at ports and tariff setting issues.

V. MAJOR FINDINGS AND RECOMMENDATIONS

This preliminary study has shown that, under certain conditions, the Trans-Asian Railway might have the capability of providing an efficient and competitive means of transporting containers between South Asia and Europe as well as between South Asia and Central Asia.

The existing railway network in the corridor and plans for its development suggest two future development scenarios, namely:

> Scenario 1, which relates to the period after 1996 (but before 2000) when a rail link between the Islamic Republic of Iran and Turkmenistan will be in place. This scenario would involve the development of international container transport in two components of the TAR southern Corridor which will have yet to be connected by the construction of a railway line between Kerman and Zahedan in the Islamic Republic of Iran. These components are the railway networks of Central Asia and the Islamic Republic of Iran, on the one hand and of South Asia (Bangladesh, India, Nepal, Pakistan and Sri Lanka) on the other.
>
> Scenario 2, which relates to the period after 2000, when both of the above-mentioned components will have been linked together following construction of the Kerman-Zahedan line. From this time onwards, there will at least be the technical possibility of container transport by rail from South Asia to Europe as well as to Central Asia.

This study has proposed TAR routes and related technical standards (loading/structure gauge and axle loads) for the Southern Corridor, and has in addition broadly identified the standard of transit performance necessary for the TAR to have a competitive advantage over shipping services.

However, it is considered that the following actions will be necessary in order to assist the operationalization of the TAR Southern Corridor:

(i) Assess in more detail and make final recommendations on the TAR network in the participating countries as well as TAR links between South Asia and South East Asia, and between South Asia and the Yunnan Province of China;

(ii) Forecast container traffic flows on the TAR routes in the Southern Corridor (to include identification of the potential for *sub-regional*, as well as inter-regional, transport of containers by rail);

(iii) Make final recommendations on major technical (loading gauge and axle load) and commercial (average transit speed) requirements for routes in the TAR Southern Corridor; and

(iv) Identify, assess, and recommend solutions to, major problems involved in making the TAR Southern Corridor operational, notably problems associated with border crossing, tariff setting and financial settlement procedures.

It is recommended that these actions be taken as part of a special project with the aim of developing a Draft Operationalization Plan for the Southern Corridor of the Trans-Asian Railway. It is intended that this plan would provide practical guidelines for railway administrations involved in the development of railway lines of international importance in the TAR Southern Corridor.