CHAPTER 9 MAINTENANCE AND INVESTMENT PLAN

9.1 CURRENT STATUS OF FACILITIES AND ROLLING STOCK

9.1.1 Rolling stock

(1) An overview of the fleet

Table 9.1.1-1 shows the number of locomotives and their ages. It features 44 units of most powerful 5,100 kW- EL as main hauling engine with design speed of 130 km/h followed by 274 units of more than 3,000 kW- powerful engines with design speed of 110-130km/h.
Most of the engines including DL are comparatively obsolete. Approximately 30% of units exceeds 25 years old. DLs consist of diesel hydraulic and diesel electric units, of which the latter are used mainly for main line haulage.
BDZ holds 83 units of EMU (Electric Multiple Units) with a single composition of 2M2T employed mainly for urban use. Their ages are below 25 years old, but the units of 20 to 25 years old account for 66% of total EMUs.

Table 9.1.1-2 shows the number of passenger cars and freight wagons and their ages.
Approximately 20% of passenger cars are over 25 years of use. It must be added that more than 35% of car stocks were out of service during 1995/96, and all the available stocks were included in the timetable with no reserves left.
The comfort and convenience in service of the passenger cars are lowered in level due to insufficient washing of car body and toilet facilities, etc. While, the resourcefulness of BDZ should be valued in that they imported used sleeping cars and recycled them into service as decent second class cars with compartments each for 8 persons.

The freight wagons are 29,178 in number at the end of 1995. BDZ classifies them by types of use. Among them, the most of the covered wagons with 2 axles, tank wagons, and refrigerator cars are aged over 20 years.
According to the BDZ' documents, 14,870 wagons, about 50% of the fleet, need repair, but only 810 were replaced during 1990-1995.

The technical level of BDZ' rolling stock staff is regarded as high and regulations are well observed. The development and research activities have been undertaken so far despite the difficulties. **Their development-oriented mind should be kept in view of the prospective introduction of energy-saving and software-oriented engines and machines, especially for future high speed attempts.**

Table 9.1.1 -1 Locomotives and multiple units

Number of locomotives and their ages (Jan.1,1996)

Locomotive		Inventory	Age (Years)					Max speed (km/h)	Builders (Country)
			10	15	20	25	Over 25		
EL	2,880kW	1					1	110	Czech
	3,020 to 3,040kW	274		59	73	66	76	110 to 130	Czech
	5,100kW	44	44					130	Romania
	Total	**319**	44	59	73	66	77		
DL (Main lines)	1,540 to 2,200kW	193		1	15	115	62	100 to 120	
(Narrow gauge)	280 to 810kW	35	10	2	13		10	30 to 70	
	Total	**228**	10	3	28	115	72		
Total		**547**	**54**	**62**	**101**	**181**	**149**		
EL (Shunting)	800kW	23	20				3		Czech
	Total	**23**	20				3		
DL (Shunting)	440 to 920kW	302			70	120	112		
	Total	**302**			70	120	112		
Total		**325**	20	0	70	120	115		
Locomotive Total		**872**	**74**	**62**	**171**	**301**	**264**		

Number of multiple units and their ages (Jan.1,1996)

MU		Inventory	Age (Years)					Max speed (km/h)	Builders
			10	15	20	25	Over 25		
EMU(Units)	1,320kW	77			22	55		130	Lithania
	1,360kW	6	6					120	Lithania
	Total	**83**	6		22	55			
DMU(Units)	535kW	6					6	100	Hungary
	Total	6					6		
MU Total		**89**	6	0	22	55	6		
Grand Total		**961**	**80**	**62**	**193**	**356**	**270**		

(Source:BDZ)

Table 9.1.1 -2 Passenger cars and freight wagons

Number of passenger cars and their ages (Jan.1,1996)

Car		Inventory	Age (Years)				
			10	15	20	25	Over 25
Passenger Fleet	1st Class	129	3	45	2	46	33
	2nd Class	1,274	316	19	354	331	254
	1st & 2nd Class	8				8	
	Couchette	121	37		19		65
	Sleeping Car	75		56		19	
	Buffet	43			36	7	
	Restaurant	17		17			
	Baggage	101			48	53	
	Total	**1,768**	**356**	**137**	**459**	**464**	**352**

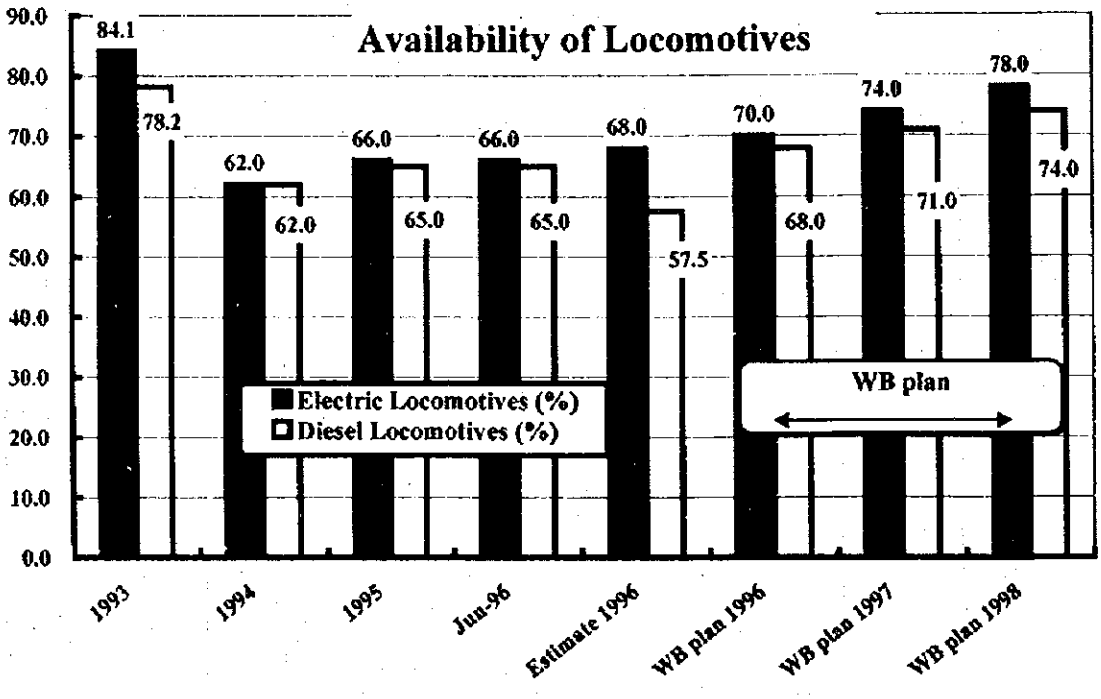
Number of freight wagons and their ages (Jan.1,1996)

Wagon		Inventory	Age (Years)				
			10	15	20	25	Over 25
Feight Wagon	Covered, 2 axles	2,772			865	1,178	729
	Covered, 4 axles	2,145	605	1,534	6		0
	Flat	5,636	200	3,886	1,305	184	61
	Open	8,400	2,996	2,485	2,395	255	269
	Grain carrier	1,505	543	767	195		
	Ore carrier	672	672				
	Saddle Shaped	1,878	1,588	290			
	Hopper	451	38	243	57	69	44
	Tank	4,337	530	515	753	1,474	1,065
	Refrigerator	121		50			71
	Cement carrier	1,261	374	346	375	166	
	Total	**29,178**	**7,546**	**10,116**	**5,951**	**3,326**	**2,239**

(Source:BDZ)

(2) Operational performance of rolling stock

Availability of locomotives is now low due to a large amount of inventory compared to reduced train traffic. EL comes to about two times as much as DL in terms of hauled-km/day of locomotives.



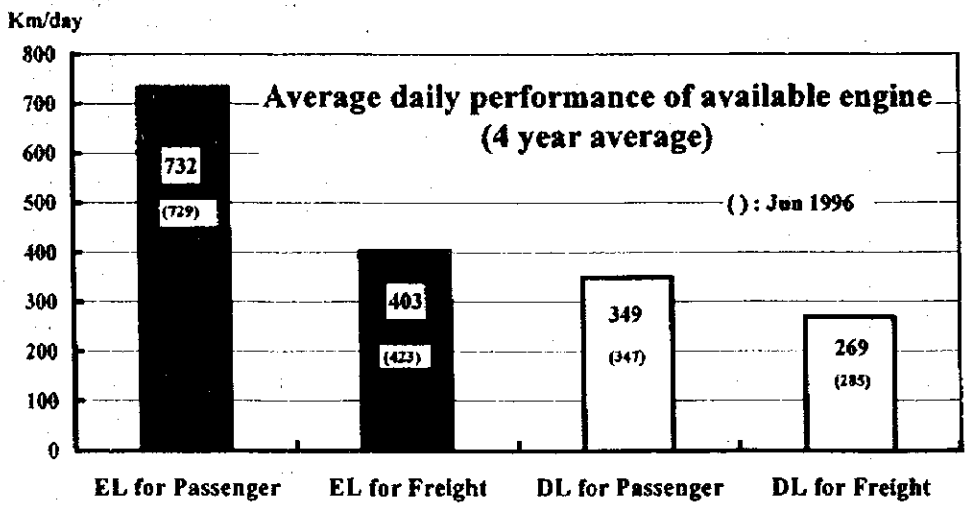


Fig 9.1.1-1 Operational performance of rolling stock (Source : BDZ)

(3) Downsizing of rolling stock

About 10 years ago, BDZ carried twofold freight and 1.6-fold passenger traffic compared to the current volume. Corresponding motive powers, carriages and wagons were needed there. However, an environment surrounding BDZ has drastically changed and BDZ has to downsize the scale of business and modernise itself.
The size and performance of the BDZ fleet have to be consistent with train operation plan.

The progress of the Railway Restructuring Plan (RRP) that was worked out with a support of international organs has been monitored by World Bank.
RRP includes the downsizing of rolling stock as well as the rehabilitation projects until 1998.
The most recent data in terms of downsizing plan of rolling stock are given in the following table;

Table 9.1.1-3 Projected inventory of rolling stock by RRP

	Current Inventory (1996)						⑦ Projected Inventory 1999 (RRP Plan)	⑧ Numbers to be scrapped until 1999 ①-⑦
	① Inventory 1996.1.1	② Over 25 Years	③ 20~25 years	④ 15~20 years	⑤ 10~15 years	⑥ less than 10 years		
EL	319	77	66	73	59	44	252	67
DL	228	72	115	28	3	10	145	83
Shunter	325	115	120	70	0	20	203	122
EMU	83	0	55	22	0	6	83	0
DMU	6	6	0	0	0	0	6	0
PC	1,768	352	464	459	137	356	1449	319
FC	29,178	2,239	3,326	5,951	10,116	7,546	21,500	7678
Total	31,907	2,861	4,146	6,603	10,315	7,982	23,638	8,269

(Source: BDZ)

9.1.2 Permanent way and structures

(1) Outline of railway facility and construction gauge

- BDZ has a railway network with a total length of 4,031 km (Fig.5.1.-1).
- As for the railway facilities equipment, the three lines (lines No 1+8, 2, 3), connecting the capital Sofia with the Black Sea coast from west to east are in relatively good conditions (electrification 100%, double tracks 56%).
- The four lines going from south to north (lines No 4, 5, 6, 7) cross the Balkan mountains and the Rodopi mountains and this is one of the reasons why the condition of their facilities are worse than those of the east-west lines (electrification 65%, double tracks 5%).
- BDZ has worked out a future development plan till 2005. It includes increasing of trains' speed and improvement of the facilities designed for over 200 km/h.
- The above future development plan aims at the integration of the Bulgarian railway network into the European railway network.
- The existing railway facilities as well as an outline of the construction standards are given in **Table 9.1.2. (1).**
- **Figure 9.1.2 (1)** shows BDZ's roadway diagraph, while **Figure 9.1.2 (1) -1** illustrates the standard cross section of the track.

Table 9.1.2.(1) Outline of railway facilities and standards

Length	railway route length 4,031 km double track length 960 km (24%) length of electrified lines 2,748 km (62%)
Gauges	ordinary sections standard gauge 1,435 mm some sections only narrow gauge 760 mm (245 km)
Tracks	ballast tracks (ballast thickness 330 mm) concrete sleepers (approx. 30%) 49 kg/m rails
Minimum curve radius	300 m (at some places 150 m ··· Line No 4)
Steepest gradient	28‰
Maximum project speed	130 km/h
Project axle load	22.5 tons
Railway facilities	Bridges 982 Tunnels 183 Crossings of road 916

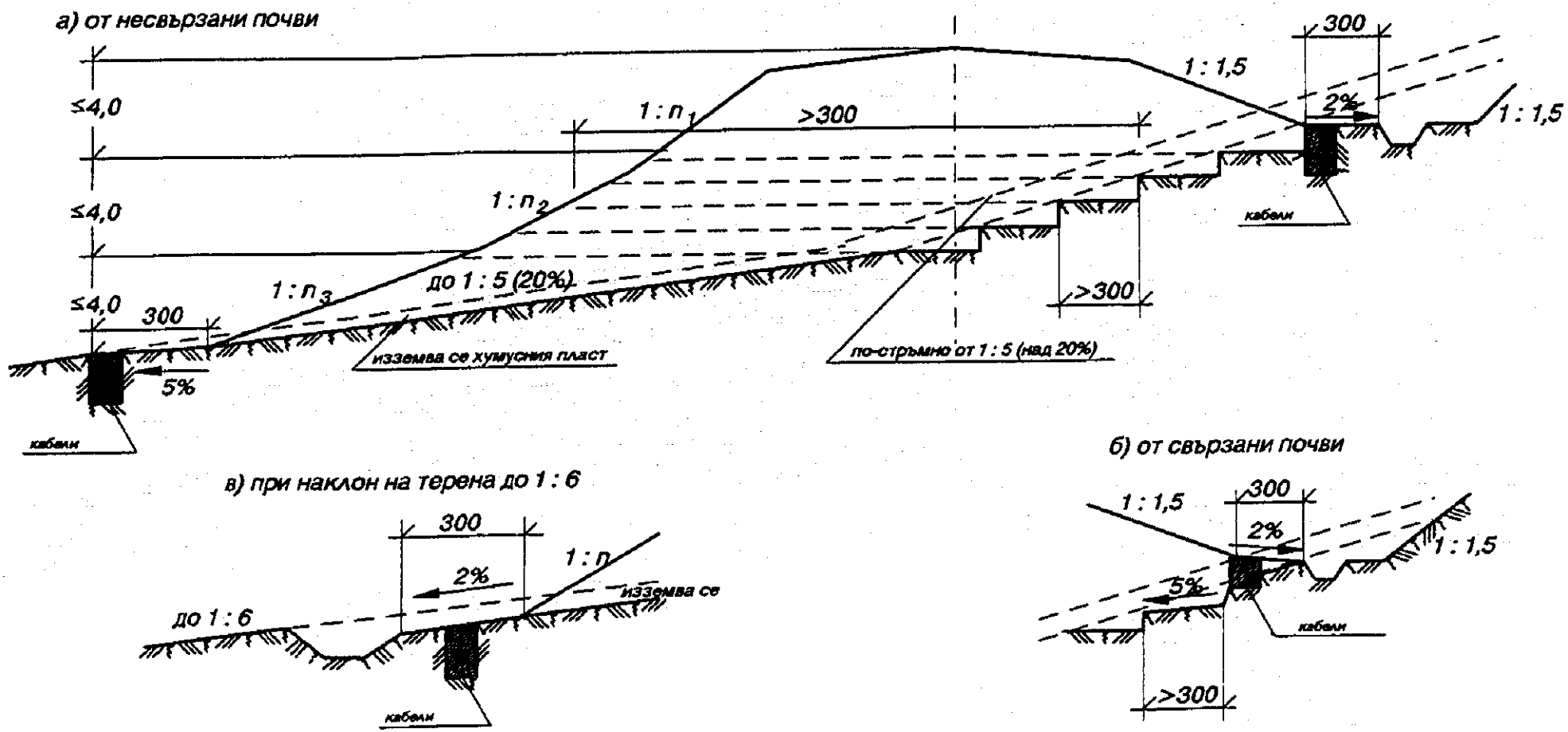


Fig.9.1.2 (1) Roadway diagraph (Enbankment)

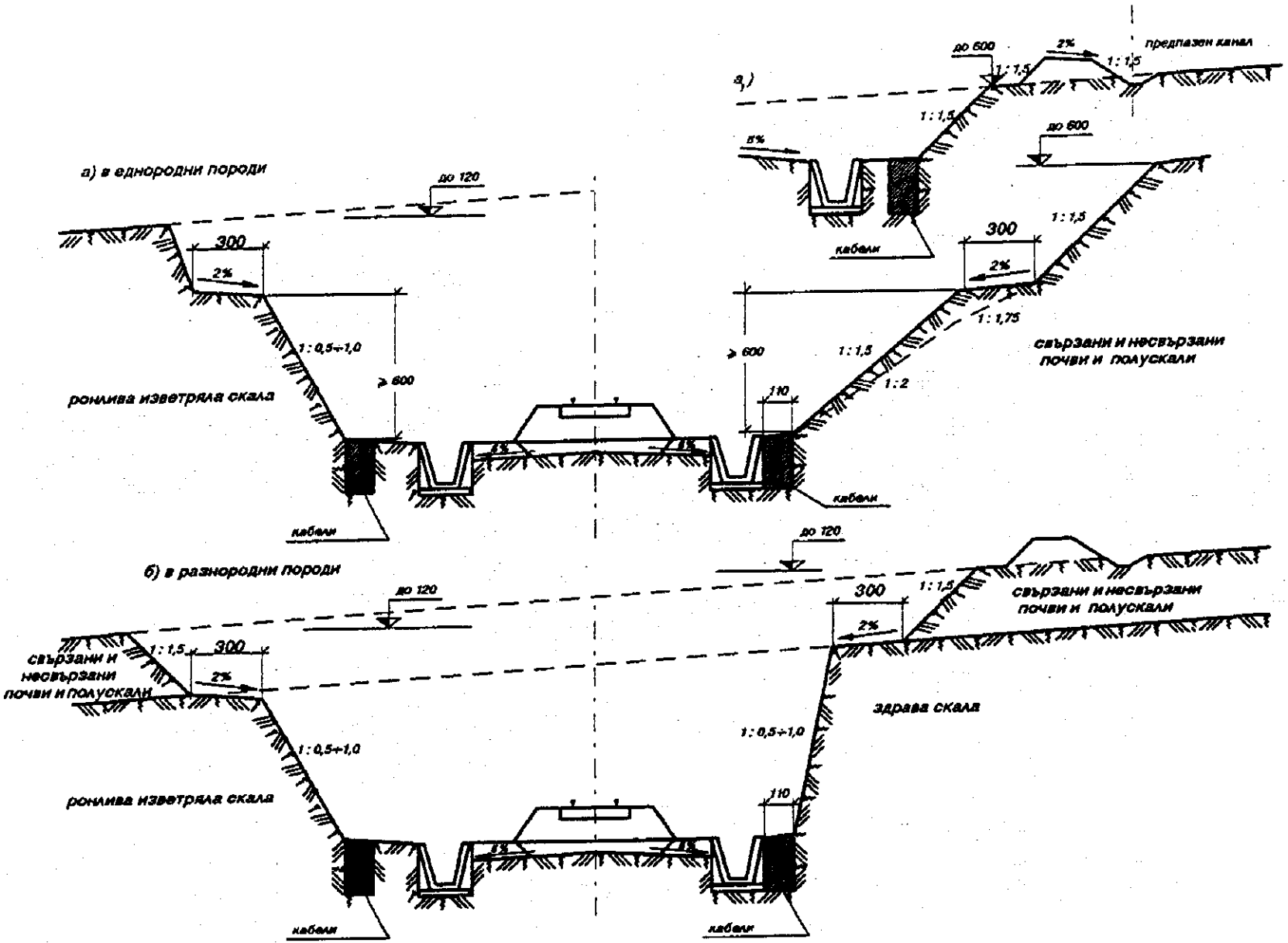


Fig.9.1.2 (1) Roadway diagraph (Cutting)

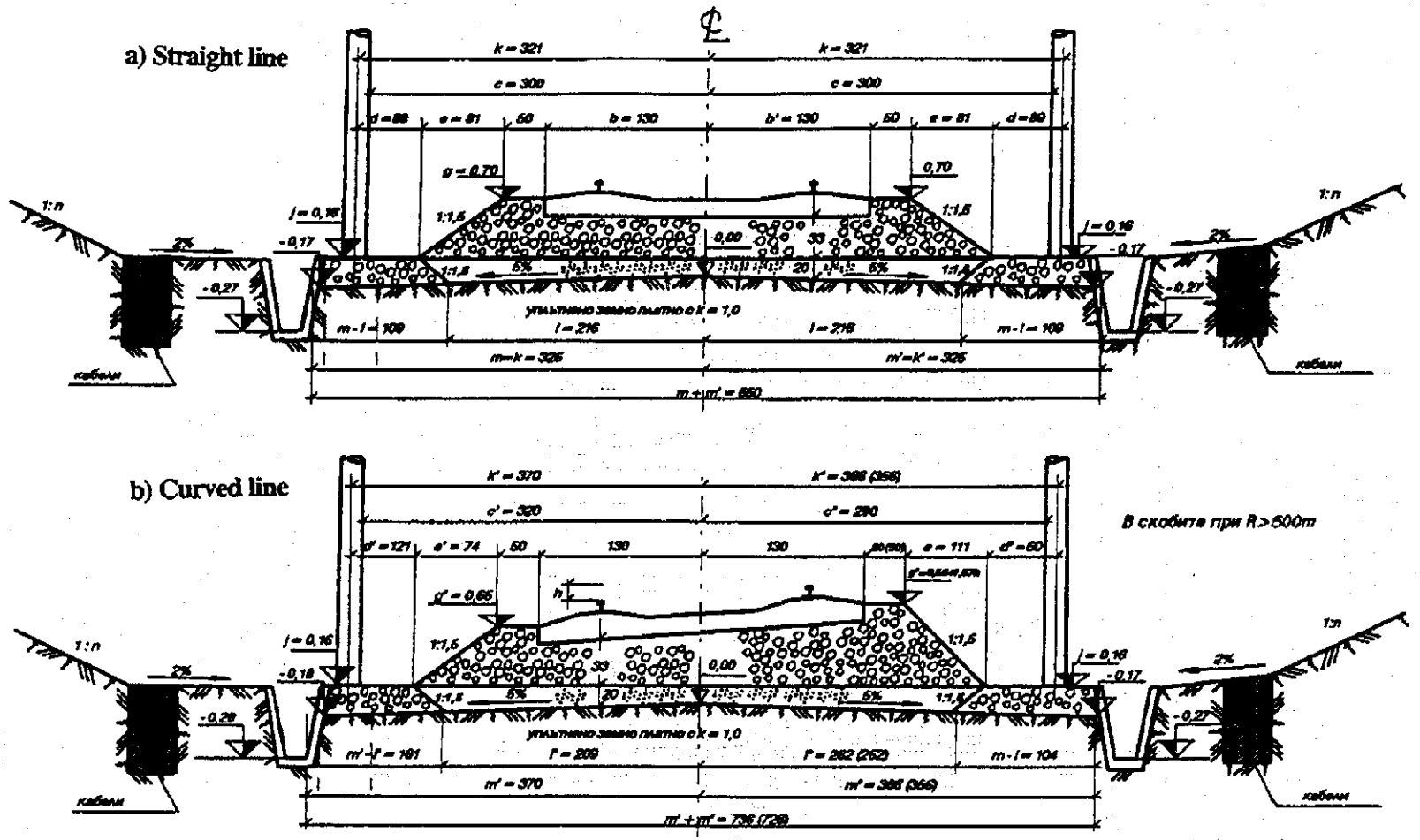


Fig.9.1.2.(1)-1 Standard section of track
(for Cutting and 120～140 Km/h)

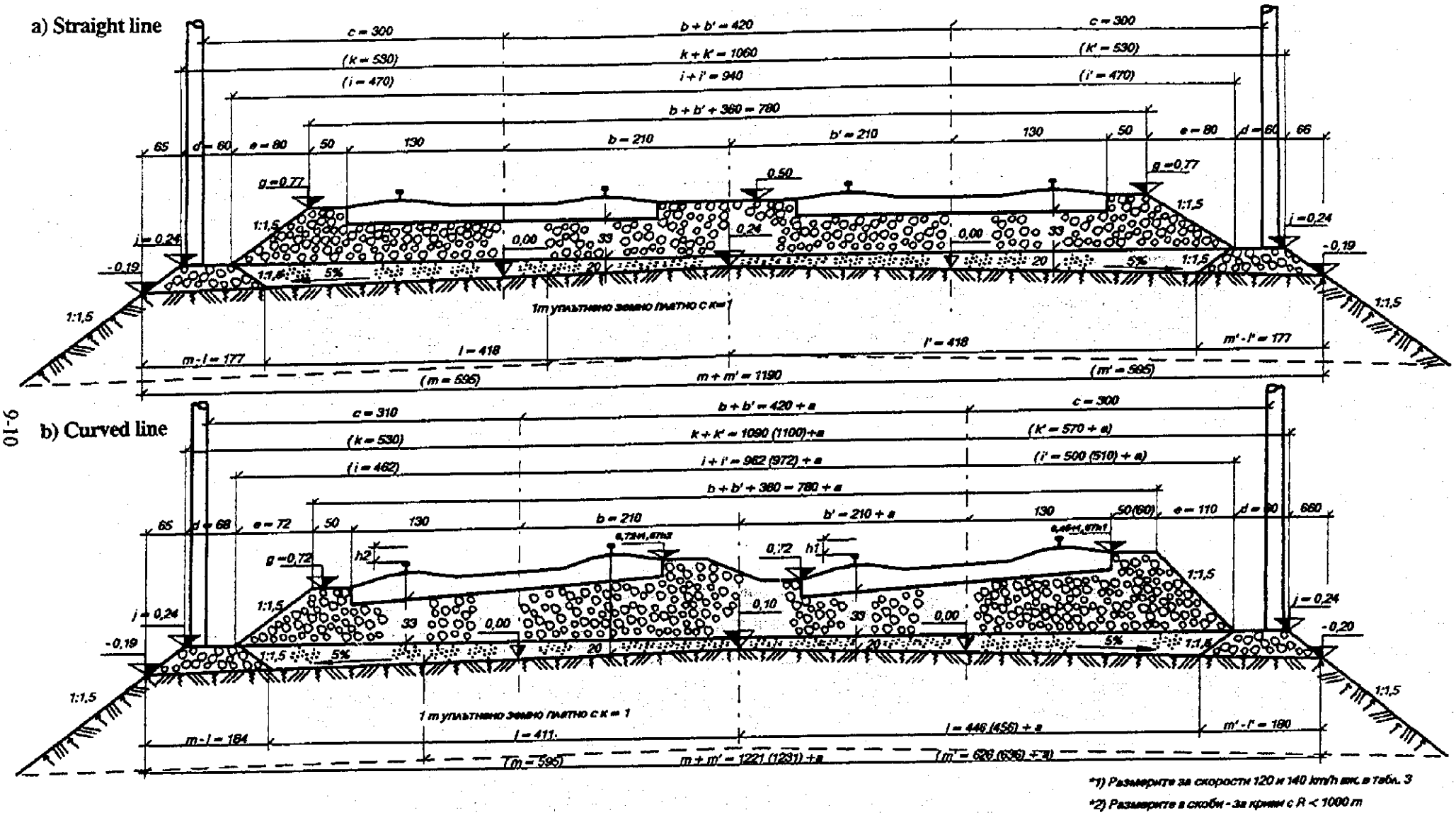


Fig.9.1.2.(1)-1 Standard section of track
(for Embankment and 160～200 Km/h)

(2) Organization of Permanent way and Stations Maintenance

- In BDZ, the maintenance of the whole railway network with a length of 4031 km is under the control of the Infrastructure Deputy General Manager
- The length of the 9 main lines of the 3 railway regions is shown in **Table 9.1.2 (2)**
- The personnel involved in the Railway Maintenance sector is 9218 persons, i.e. 2.3 persons per km of the railway length.

Table 9.1.2. (2) Length of the 9 main lines of the 3 railway regions

Line	Sofia (km)	Plovdiv (km)	Gorna Oryahovisa (km)
1	145	217	
2	186		346
3	148	317	39
4		193	225
5	194		
6	151		
7	179		
8		234	
9			142
Total	1003	961	752

(3) Permanent way and Stations

① Track-bed

- The outline of the routes in the plains is good.
- The construction of the track-bed was made about 130~40 years ago (from 1860 to 1960). That is why it is firm and in a good condition.
- While,the problems lie in the drainage crossing the railroad.
- There are drainage facilities at 2818 places and their total length is 8900m.
- Subsidence of the track-bed, typical of areas with low moisture, is observed in all routes.

② Bridges

- BDZ maintains and manages 982 bridges with a total length of about 16 km.
- BDZ considers as a serious problem the maintenance and exploitation of steel bridges, Superannuated, they are lowered in loading capacity than the concrete ones.

- The reconstruction of the bridges of the main trunk lines (No 1, 2, 3, 5, 8) will be completed with the end of the works on the section under construction at the moment

(Line No 2 Sofia - Mezdra).

- The Railway Restructuring Project includes the early reconstruction of 6 bridges, but there are no data about the reconstruction expenses.
- Because of the increasing of the impact load due to the higher speed of the trains, it will be necessary to reconstruct the bearing parts of both steel and concrete bridges.

③ Tunnels

- BDZ maintains and manages 183 tunnels with a total length of about 47,2 km.
- Tunnels are also old and there are a lot of block brick arches. This is the main reason for the water leakage.
- BDZ has set out the following tasks concerning the reconstruction of the tunnels:
  improvement of clearance limits (Line No 4 - 9 tunnels)
  water leakage prevention activities (Line No 3 - 5 tunnels)
  unification of the height of drainage facilities (removing hindrances on the way of the track maintenance machines)
- The financing of the tunnel reconstruction is not included in the Railway Restructuring Project.

④ Tracks

- There has been no rubbish found on the tracks which is a proof that the regular maintenance staff are completing their duties properly.
- Anyway, the existing track structure can hardly meet the requirements for increasing the train speed in the future.
- BDZ has set out a Renewal Plan up to 2005 for securing train operation safety, maintenance labour saving and increasing of the train speed. The tasks concerning the improvement of the railway tracks according to this Plan are as follows:
  -renewal of turnouts
  -usage of heavy rails and long rails
  -usage of elastic fastenings
  -securing high quality ballast etc.
- The expenses for securing a high quality ballast are not included in the Railway Restructuring Project.

⑤ Stations

- The total number of stations, excluding the halts, is 491.
- The platforms are low and the platform length of the main stations is at least 400 m.
- The space of the main stations are large enough, since they are designed mostly for goods handling.

- The station buildings of main stations show the characteristics of the region. The broad inside space gives opportunities for a more effective usage in the future.
- BDZ has set out as an important task the renewal of the turnouts in stations in the high speed sections.
- The improvement of station facilities is not included in the Railway Restructuring Project. (The renewal of turnouts is a part of the track renewal).

⑥ Progress of the Railway Restructuring Plan

- According to the R.R.P., the reconstruction works concerning the maintenance, including the supply of materials and machines, are in the implemented agreed plan which was to start in June 1995.
  The contracted materials and machines are shown in **Table 9.1.2 (3) ⑥**.

Table 9.1.2 (3) ⑥ Contracted materials and machines

Project Element	Quantity ; Volume	Contract Signing
Rails type S - 49	25,600 tons	08-22-96
Rails type UIC-60	24,000 tons	10-18-96
Elastic fastenings	715,000 sets	08-06-96
Track maintenance machines	4 tamping machines &4 ballast regulators	06-15-96
	2 turnout tamping machines	08-22-96
	4 track stabilizing machines	01-15-97
	1 heavy machine for grinding of rails	01-15-97

- Because the P/C sleepers are not yet installed, the track improvement works are likely to be more or less delayed.
- The line connecting Sofia and the Black Sea coast is being equipped and maintained with a priority. This is an important line, linking East and West Bulgaria and the realization plan is evaluated as appropriate.

⑦ Problems identified

- **Priority setting**
  The priority setting of all railway lines is a basis for developing management improvement policies, but it has not been done.

  The elements to be considered in the above-mentioned priority setting will be referrd to in Chpter 9 **9.2.2.**
- **Topographical/geological analysis**

The improvement cost of the infrastructure depends highly on the topographical/geological conditions of the relevant lines/segments.

The JICA Team lacks data in this concern. It is up to the Permanent way and Station specialists of BDZ to examine the Team's proposal based on the second analysis of the routes.

- **Relationship with the higher speed operation of trains**

1)BDZ's 2005 Plan stresses the improvement of trains operating speed, to which the Team quite agrees. The cost required for such imprrovement is caliculated under step-by-step method and covers 9 major lines of BDZ.

Preliminary discussions between the Permanent way and Station specialists and the Marketing people are expected on targeted the timing of improvement and the required speed.

- **Ensuring high quality ballast supply**

Ballast is supplied from ballast plants owned by BDZ. The ballast is cracked because of poor strength if trains with high tonnage run over rails. This makes it very difficult to maintain rail tracks as the number of trains that run at high speed increaases.

Two methods can be applied to procure high-quality ballast. One method is to select a new ballast plant that satisfies the UIC standard. The new ballast plant should be owned by BDZ. The other method is to purchase ballast from private companies.

Ballast is general-purpose material used generally for constructing buildings and roads. It would be reasonable to purchase ballast produced by private companies that satisfies the UIC standard.

The study team, therefore, recommends that ballast be purchased from private companies.

9.1.3 Electrification, signalling and telecommunications

(1) Electrification

Electrified railway network of BDZ currently extends over **2,478 km,** accounting for about **62%** of the BDZ network. **(Fig. 9.1.3 -1)**
This presents a significant share in route length, taking into account the worldwide average ratio of 18.8% (1992) and the ratio of JR in Japan of 58.5%. **The electric traction-km also dominates BDZ' train hauls , amounting to the share of about 85%.**

1) Electrification system

Electrification system of BDZ consists of the **direct feeding** for traction power supply and the overhead contact grid for current collection of rolling stock.
Overview of feeding circuit are as follows;

Overview of feeding circuit

* Power receiving: 110 kV, 50 Hz of the republican power system **(without exception)**
* Feeding: Direct feeding, AC 50 Hz, 27.5 kV (rail for return circuit)
* Contact system with rolling stock: Generally, catenary on AC 50Hz, 25 kV
* Permissible voltage regulation: 19 kV～29 kV
* Fault level at power receiving: 2,300～3,800 MVA
* Equivalent feeding line constants: $Z=0.114\cos\theta+0.305\sin\theta\ (\Omega)$

  ($\cos\theta$: power factor of rolling stock, average 0.74)
* Measures for the induced disturbance to telecommunication circuits

  : the shield cables that are buried underground along the track

2) Substations

Now, 47 traction power substations are incorporated in the network, presenting that a single substation is assigned to a average feeding of approximate 53 km. Between the two substations is a sectioning post for the purpose of avoidance of phase coupling and extension of feeding.
Load of substations of BDZ currently appears to be as low as 60% due to reduced train frequency.

3) Catenary and equipment

The BDZ is presently provided with three types of catenary system according to both the train speed and the required power loads with aggregate length of 6,776 km.
The catenary systems of BDZ feature "the compensated chain catenary" which has been developed on their own and adopted with a view to competing with heavy load and train speed of more than 100km/h. **(BDZ says the capability is up to 160 km/h).**

4) Points to be issued

BDZ has suffered the **frequent failures of both the insulator** of hinged cantilever and the connecting fixtures and elements in terms of catenary system. Those failures account for about 60% of all the catenary failures including those caused by outsider.**(Fig. 9.1.3-2)**

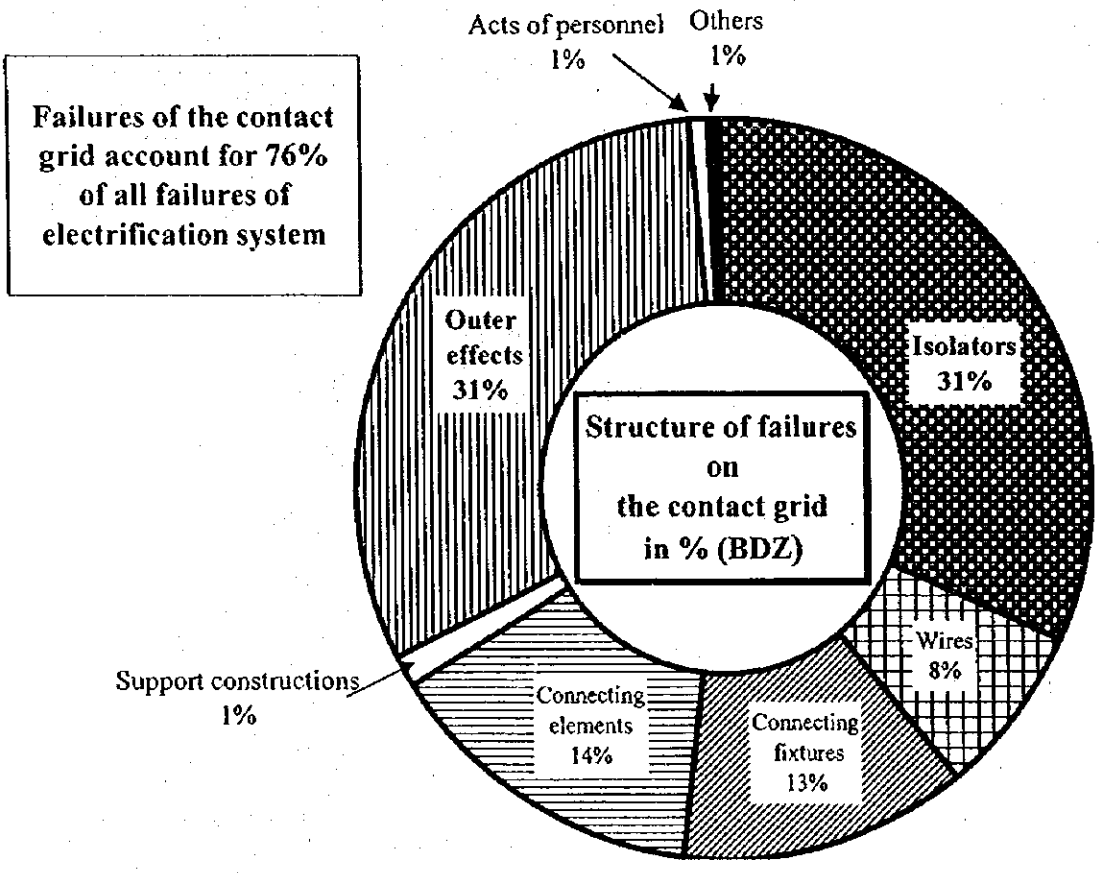


Fig. 9.1.3- 2 Structure of the failures of power supply

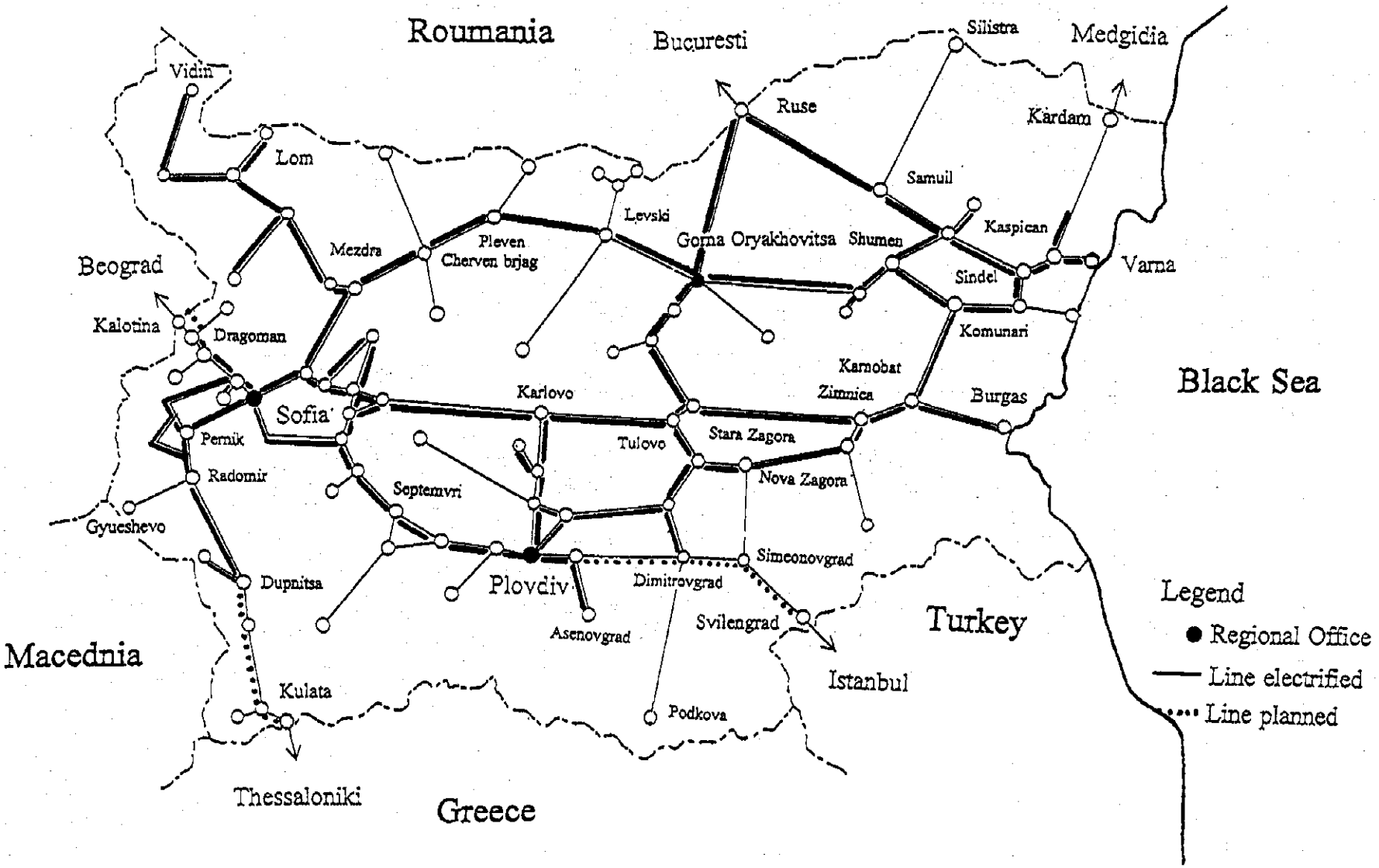


Fig. 9.1.3-1 Railway electrification network of BDZ

(2) Signalling

1) Train blocking and signalling system

(a) Automatic blocking

The automatic blocking system is designed to automatically control the signal aspects by train that travels on a continuous track circuit, so that the system is seen as one of the most reliable blocking system.
This system is currently employed only in the sections of Sofia to Karlovo on the Line 3, and Sofia to Plovdiv on the Line 1, and other short sections, with aggregate length of **347 km (approximate share of 8.6 %).**

Sofia-Karlovo :165 km (Producer USSR, 1972)
Sofia-Plovdiv :164 km (Producer BDZ[ZAT] 1985)
*ZAT: Automation & Tele-mechanics Plant in BDZ

(b) Semi-automatic blocking

The semi-automatic blocking system is currently applied to the most of the sections of BDZ with a total length of **3,190 km (approximate share of 79 %).**
This system is designed for the station to station blocking without track circuits in between and only with the signals interlocked between stations. So, this system is considered as a tokenless blocking system. Since the track circuits in short length are installed both at the vicinity of starting and home signal and at the same time interlocked with signals, point switches, and blocking instruments, the safety of train operation can be secured.
However, this system inherently limits the train frequency due to both the station to station blocking (fundamentally allowed a single train in a single blocking area) and also due to the handling block instrument.
Since this system **has not any continuous track circuit** between stations, **an addition of axle counters at the stations will be effective for the safety, provided that the train traffic is not so large .**

(c) Telephone blocking

The particular sections other than the above are not equipped with any interlocked blocking but telephone, accounting for approx. **12% of all lines (494 km).**
Since it allows a single train to travel between two stations only upon the confirmation

through telephone contact between two stations, **human attentiveness is required for train operation.**

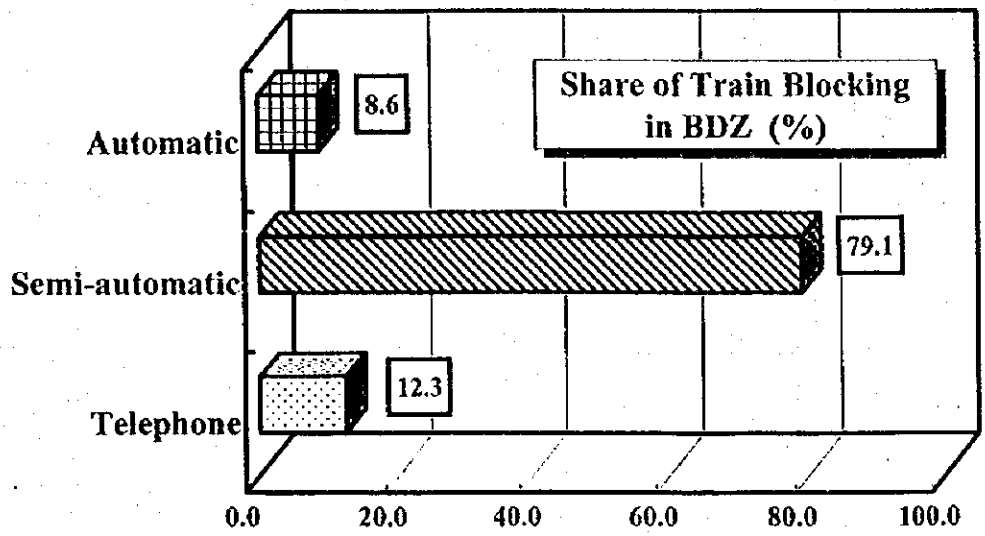


Fig. 9.1.3-3 Structure of train blocking system of BDZ

2) Interlocking devices

The interlocking system currently applied in BDZ are classified as in Fig. 9.1.3-4.

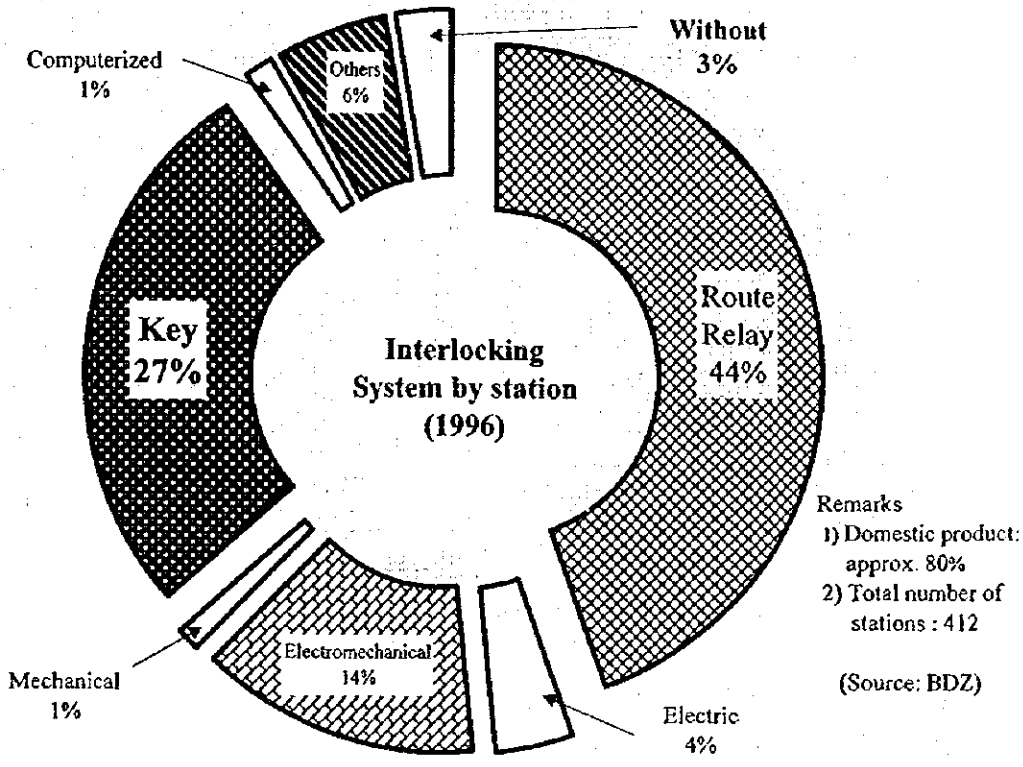


Fig. 9.1.3-4 Interlocking system of BDZ

The interlocking devices classified as above are sub-divided into a wide variety of types (**more than 15**) in accordance with both producers and produced periods, that entails the difficulties in the process of maintenance and repair (technical training, procurement of spare parts, and reconstructing).

The service life of interlocking devices are considerably long. They are evaluated as obsolete. See below:

Category of Interlocking Devices	Service Life
70% of route relay & electric interlocking devices	more than 20 years
Electro-mechanical interlocking devices	since 1930-1959's
Mechanical interlocking devices	since 1940's
Key interlocking devices	1940-1960's

Key interlocking devices are operated by the mechanical interlocking of signals with points, but with points **having to be manually handled at sites**. Now BDZ does not allow to build new key interlocking devices. One of the problem is that these machines are still employed even in some parts of main lines like Line 5.

Moreover, another problem for the safety of train operation is that 11 stations are unequipped with any interlocking systems.

3) Train protection and speed control

BDZ has **not yet installed the absolute train stop** except for the ATP (Automatic Train Protection)-installed section. Absolute train stop herein referred to, means a system like ATS (Automatic Train Stop) which stops forcibly the train if the driver should overlook the stop signal.

ATP is employed over the section between Sofia and Provdiv (164km) on the Line 1 intended for the train speed control and safety. This system was introduced in 1989 based on Swedish technology, and consists of a kind of transponders intermittently scattered along the track and a cab signal onboard (currently 103 locomotives), to control the train speed according to signal aspects.

4) Traffic control

Traffic control in BDZ is generally carried out through the telephone-dispatching commands to stations and drivers from dispatchers assigned to traffic control center.

All the dispatching commands and voice- exchanges are recorded in the center.

CTC (Centralized Traffic Control) is introduced to the single tracked line, Sofia-Karlovo (165km of Line 3), and additionally to the double tracked line, Sofia-Provdiv (164 km of Line 1). The former system that builds in relay and semiconductor was supplied by USSR in 1972, and the latter system that is computerized was supplied by Slovenia in 1987.

(3) Telecommunications

1) Transmission circuits and system

The BDZ transmission lines consist of some 3,550 km Quad **composite cables** mainly for trunk lines which are installed underground of about 80cm depth alongside the railway track. The cable features a steel-coated and aluminum-sheathed protection in its outer crust, taking into account the induced disturbance of AC traction circuits and theft as well.
Not a few cables are superannuated, especially on the sections of Tcherven Briag - Gorna Oryahovitsa (Line 2), Sofia - Karlovo (Line 3), and Ruse - Gorna Oryahovitsa (Line 4) respectively.
Some segments of the cable system currently have margins of spare capacity, while others are fully utilized. **The situation is most critical in this respect on the Mezdra/Gorna Oryahovitsa, where the available 48 channels are fully assigned.** The **Sofia/Karlovo** section presents a similar situation.
The overhead exposed steel wires are employed mainly on some branch lines (750km), much of this wires being old and deteriorated.
BDZ main transmission systems employ **analog Frequency Division Multiplexing** (FDM) technology, with much of the equipment being around 20 years old or more.
With a growing demand of transmission traffic, the FDM systems will be preferably replaced to TDM (Time Division Multiplex) systems with PCM (Pulse Code Modulation), **while transmission circuits will also be replaced to coaxial cables or optic fiber cables.**

2) Telephone exchange facilities

The telephone exchange infrastructure of BDZ currently consists of a three-tier system with total lines of 25,700 in number.
The primary, or tier 1, exchanges(PABXs) are located in Sofia, G. Oryahovitsa, Varna, Stara Zagora and Plovdiv. All together they account for around 10,500 lines. These were old Siemens step by step exchange dating back to the 1930s. However, rapid replacement into digital version is now in progress.

3) Train radio

Currently, the train radio system covers much of the main lines **(1,595 km)**. Additionally the system of the section of Ruse to Gorna Oryahovitsa on the Line 4 has been completed by 80%, while the system to the Greece border on the Line 5 is planned.
400 main line locomotives and EMUs have been fitted with the necessary mobile equipment. 450 shunting locomotives, representing about 75% of the shunting locomotive fleet are fitted with radio for local operation in station areas.
The current problem with the train radio system of BDZ appears to be the presence of low audibility area like inside of tunnels or in the shade of mountains.

4) Data networking infrastructure

The wide-area data networking infrastructure of BDZ consists of two principal systems, namely Telex system and X.25-based system
Telex is still actively employed by BDZ. Much of the internal telex traffic is in the nature of confirmation messages such as train composition, wagon contents, etc.
The main advantage of the telex network lies not in its performance but in its geographical coverage, it currently extends to many locations which are not served by the X.25 network.
Additionally, the telex network appears to play a useful role in BDZ as a back up data network and/or a means of emergency communication.
A data networking technology called **X.25 ("packet switching")** was originally introduced to BDZ by Syscom (Liechtenstein) in 1984. It serves partially as a means of **Information System of BDZ.**
The core of the X.25 network consists of X.25 packet switches located at four main nodes (Sofia, Provdiv, Gorna Oryahovitsa, Varna). Secondary sites (in particular, those at border crossing) are linked to the core nodes via packet assemblers/disassemblers (PADs).
The core is also linked to the Main Computing and Information Center and BDZ Headquarters in Sofia. The node equipment is interconnected in a mesh configuration using dedicated analog channels on BDZ's FDM transmission infrastructure. The modems on these core channels currently operate at 19.2 kb/s, but it is unlikely that further significant increase in transmission speed will be possible. The modems linking the PADs to the core typically operate at 9.6 kb/s.
As for the current system, **a notable deficiency is the lack of network management tools,** what with not having the capability to monitor basic performance parameters and to track patters of usage. Therefore, to cope with the data-intensive environment that will be created by MIS applications, this system is due to be upgraded soon.

9.2 MAINTENANCE AND INVESTMENT

9.2.1 Basic concept

(1) Reinstatement of deferred maintenance

Proper maintenance of facilities and equipment is vital for the efficient management of railway industry. Otherwise, it is feared that it should invite disorder of train traffic as well as serious accidents, resulting in the loss of reliability of general public to the railway.

Through the discussion with our counterparts of BDZ as well as our investigation at sites, the Team comes to know that the investment for upkeep of facilities and rolling stock has been insufficient for the last decade, lagging behind the adequate timing of their renewal or replacement. See paragraph 9.2.3 as to the detail.

Reduced maintenance costs for the last decade are most likely to affect the regular train operation in future, which have been proved in other developing countries.

In the past, BDZ had offered comparatively good quality of train operation in terms of safety and on-time performance, and the good heritage should be maintained for future.

Therefore, the Study Team recommends that **the priority should be given to the reinstatement of deferred maintenance including strengthening or renewal of facilities in consideration of prospective lines' nature.**

This policy should be stressed also in view of the necessity to prepare for the efficient integration of the BDZ system into European railway system and for enhancement of technological levels required for it.
The extent and the level of the said reinstatement is recommended in subsequent paragraph 9.2.3.

(2) New projects

BDZ has the traffic capacity which roughly corresponds with the traffic volume of a decade ago. But the actual traffic is 55% in freight ton-kms and 65% in passenger-kms, compared with those in 1990. The BDZ has apparently superfluous traffic capacity.

The traffic demand forecast predicts that, as a whole, the traffic will stay stagnant well

beyond 2010.

Pre-emptive investments for qualitative improvement of service will do stimulate the demand sometimes and improve the morale of the employees. But the current economic environment of Bulgaria does not encourage a risky investment. The financial prospective of BDZ is also inhibitive of large scaled investments.

As a whole, the Study Team considers that the investment policy of BDZ should be, as a principle, conservative.

While conservative, however, the policy should be sensitive as regards:

--- The Pan-European trends, oriented to the development of international CT. (See CHAPTER 4)

--- The chance to increase the operational revenue through provision of speedy and frequent passenger services.

--- The chance to reduce the operational cost through improvement of efficiency, energy saving, etc.

Accordingly, the new projects will be rather restrictive as shown below;

a. Modernisation of freight transport system

Seamless combined freight transport scheme should be taken up for consideration with the top priority, considering the integration to European railway transport system and revenue increase. See 9.2.4 as to the detail.

b. Increasing traffic capacity

For the revenue line/sections where the train frequency is considerably high and constraints are actually felt in formulating train diagram, some measures are to be taken to extend the track capacity on priority basis. The measures include doubled tracking, introduction of automatic block signal, etc.

c) Increasing train speed

For the revenue line/sections where traffic increase is expected, "the shortening of end-to-end journey time" will be effective, and the realisation of higher train speed will strategically contribute to the customers' better image of railway service, and to, hopefully, better revenue.

d) Others

Considered are the projects for saving energy, enhancement of safety, and increased efficiency, etc. (Example : electrification, CTC, CSC)

The new projects are outlined with cost estimates in Table 9.2.4 and 9.2.5.

9.2.2 Selection of lines

The planning, therefore, starts with the selection of lines with better market perspectives.

For the selection, major points to be considered are as follows;

- Current traffic or number of trains operated (which will tell the features of the operation)
- Connection of the line with other key transport routes (especially for international routes)
- Profitability records of the line (cost recovery ratio, among others)
- Future demand level in general
- Current dimensions of the traffic capacity and system of the line
- Social impact perspective
- **General consistency and concurrence with BDZ' management requirements**

The Team took the liberty of picking up the following lines/sections for concentrating the investment for maintenance and new projects.

Line 1, Line 2, Line3, Line 4, Line 5,
Line 6(excluding the section of Radomir to Gyushevo), Line 7, Line 8, Line9,
Line 82 (section of Plovdiv to Karlovo), and Line 83

The aggregated total of the route lengths of the above mentioned lines/sections account for approximately 68% of BDZ network and their average cost recovery ratio is 95.8%.
For more detailed dimensions, refer to " **5.1 RAILWAY NETWORK (CHAPTER 5)**".

9.2.3 Reinstatement of deferred maintenance

(1) Rolling stock

Currently, BDZ is strenuously pushing ahead with the downsizing plan of the fleet as well as the rehabilitation plan of rolling stock based on RRP. At the accomplishment of RRP, numbers of rolling stock and their ages will be as shown in Table 9.2.3-1 below;

Table 9.2.3-1 Projected inventory at 2000 by RRP

	Projected Inventory at 2000 (RRP)	Inventory by age at 2000				
		Over 30 years	25~30 years	20~25 years	15~20 years	less than 15 years
EL	252	10	66	73	59	44
DL	145		104	28	3	10
Shunter	203		113	70		20
EMU	83		55	22		6
DMU	6	6				
PC	1,449	33	464	459	137	356
FC	21,500			3,838	10,116	7,546
Total	23,638	49	802	4,490	10,315	7,982

Replacement or renewal of rolling stock is planned in Table 9.2.3-2.
As mentioned in the previous paragraph (9.2.1), an adequate maintenance (especially for the rolling stock) is indispensable for preparation of the integration to European railway system. Therefore, renewal overhaul of the fleet must include upgrading of body and mechanism.

The points to be issued;

- Currently, rolling stock are often subject to "cannibalising" repair, due to insufficient budget. This practice should be abolished as much as possible.

- Necessary chemical materials for washing of car bodies should be provided sufficiently to ensure the comfort of customers.

- The VAT and custom duty have been a grave financial burden on purchase of imported vehicles and their parts. The tax charge should be reduced as much as possible through negotiation with the authorities concerned.

Table 9.2.3-2 Renewal plan of rolling stock

	Projected Inventory at 2000 (RRP)	Plan of Renewal or Replacement (for every 5 years)				
		2000~2004	2005~2009	2010~2014	2015~2019	2020~
EL	**252**	43	70	66	52	21
DL	**145**	52	66	16	7	4
Shunter	**203**	56	92	35	10	10
EMU	**83**	30	36	11	3	3
DMU	**6**	6				
PC	**1,449**	265	462	298	247	177
FC	**21,500**		1,919	6,977	8,831	3,773
Total	**23,638**	**452**	**2,645**	**7,403**	**9,150**	**3,988**

Note: 1) Figures of Table 9.2.3-2 include the purchase of rolling stock for the upgraded replacement, but not including the purchase of cars for the strategic projects.

2) Figures of Table 9.2.3-2 depict the average numbers of rolling stock which are classified by age, not by prospective running-km.

(2) Permanent way and structure

BDZ is implementing, its Railway Restructure Plan into execution to bring the slow work of railway maintenance to a normal pace. However, this plan covers only what is imminent and vital in railway maintenance.

A long-term railway maintenance and management plan is required to realize growth and development of the Bulgarian economy and improve management of BDZ.

For this purpose, we have formulated the following maintenance and management project based on a local survey.

Maintenance and management project

1) Facilities for maintenance and management

This project includes two items: facilities requiring maintenance on a regular basis (regular maintenance) and facilities requiring age-based replacement (replacement and reinforcing).

(a) Regular maintenance

Regular maintenance which is practiced throughout the year includes the following:

1) Maintenance of drainage system of base course, 2) Improvement of the tracks (including resetting of super elevation and replenishment of ballast, 3) Coating of bridges, 4) Prevention of water leaks in tunnels, 5) Repair of buildings, etc.

(b) Replacement and reinforcing

Replacement and reinforcing of facilities required by aging are as follows:

1) Improvement for long rails

To prevent the tracks from deteriorating and to increase travel comfort, replacement of short rails with long rails is required for railway segments whose speed limit is 100 km/h or more.

2) Improvement for heavy rails

Heavy rails are required according to passing tonnage.

3) Turnout replacement

Most turnouts are reaching the time for age renewal and need to be replaced by turnouts that can handle 130 km/h.

4) Construction and repair of bridge superstructures

5) Widening of tunnel cross sections

2) Standards for improvement of facilities (draft)

When the facilities are improved on this plan, we propose that the (draft) standards conforming to the railway system which will continue to become faster in the future be applied to the maximum extent possible by BDZ.

Standards for improvement of facilities (draft)

Sectors these standards apply	Line-1,2,3,4,5,6,7,8,9, 82, 83
Single-tracked or double-tracked	Laid according to the operating plan
Power	Electrification with alternating current 25kv
Gauge of track	1,435m/m
Design highest speed	130 km/h and more (new line: 200 km/h and more)
Minimum radius of a curve	2,500m (standards: 4,000m)
Steepest gradient	Passenger line: 35% Freight line: 12%
Construction gauge	UIC standards (Ro-La system)
Rail weight	49 kg/m or 60 kg/m
Thickness of track-bed ballast	33 m/m and more
Width of construction base	According to track-bed diagraph of BDZ
Load capacity of bridges	23 tons (UIC standards)

3) Schedule of maintenance and management project

			Year 2009	
			Year 2000	Year 2019
(1)	Regular maintenance			
	1)	Drainage		
	2)	Resetting of super elevation		
	2)	Ballast replacement		
	3)	Repainting of bridges	←	→
	4)	Prevention of water leaks in tunnels		
	5)	Maintenance of buildings		
(2)	Replacement and reinforcing			
	1)	Improvement for long rail	←	→
	2)	Improvement for heavy rail	←	→
	3)	Turnout replacement	←	→
	4)	Construction and repair of bridge superstructures		← →
	5)	Widening of tunnel cross sections		← →

(3) Electrification, signalling and telecommunications

Major investment plans for maintenance of electrical engineering are as follows;

1) Replacement of contact grids

Progress of wear of contact wire is normally proportional to the number of pantograph passages.
Under normal execution of maintenance, replacement of contact grids is to be implemented taking into account the pantograph passage, record of failures, loads, train speed, age in service and the level of importance of the railway line, etc.
At the time of the accomplishment of RRP, the ages of contact grids in service are classified in terms of extension of wire as follows;

- more than 35 years 10%, - more than 25 years 8%, -more than 20 years 24%-

Especially, BDZ' catenary system has suffered the frequent failures of associated fixtures and elements as mentioned in previous paragraph.
Therefore, the replacement should be done on priority bases.

(Example: Line 3, Line 2, Line 1,,,,,)

2) Improvement of circuit breakers, disconnecting switches in traction substations

Circuit breaker of traction substation is decisive for prevention of grave accident of lines.
Superannuated machines with oil filled type are to be renewed into new type ones as of vacuum tube on step by step approach.

3) Conversion of " key interlocking system" into perfect interlocking system

Interlocking system designed for interlocking the signals with turnout points should be operated on the safe side at any moment. Additionally operational requirements for this mechanism are to operate as fast as possible conflicting with increased train frequency.
Key interlocking devices are operated by the mechanical interlocking of signals with turnout points, however, the points have to be manually handled at sites.
Key interlocking system still accounts for 27% of all BDZ' stations and the problem is of their scattered existence even in Main Lines.
Replacement should be made on priority bases, but hurriedly.

(Example: Line 2, Line 5, Line 9, Line 7, Line 83,,,,,,,)

4) Replacement of CTC system

Centralised Traffic Control(CTC) introduced for supervision and concentrated-route setting between Sofia and Karlovo in1972 suffers the shortage of necessary parts due to the termination of producing in former USSR, and this system has not built in modernised electronic devices and is almost superannuated.
Line 3 is one of the most profitable line of BDZ, therefore a renewal is required on phased plan basis.

5) Improvement and reinforcement of transmission cable lines

Margin of spare capacity in transmission cable has been reduced over the route of Sofia to G. Oryahovitsa as well as Sofia to Karlovo. Additionally, they have been engaged in long service, and almost superannuated.
Management Information System (MIS) will be commissioned at the end of RRP schedule.
Hence, renewal with reinforcement of transmission cable should be made by converting the existing copper cable into modernised optic-fibre cable.

Table 9.2.3- 3 Maintenance cost plan

(Unit: Thousand US$)

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rolling Stock	Regular	8,000.0	8,000.0	8,000.0	8,000.0	8,000.0	7,800.0	7,800.0	7,800.0	7,800.0	7,800.0
	Renewal & Replacement	22,209.0	22,209.0	22,209.0	22,209.0	22,209.0	36,948.0	36,948.0	36,948.0	36,948.0	36,948.0
	Total	**30,209.0**	**30,209.0**	**30,209.0**	**30,209.0**	**30,209.0**	**44,748.0**	**44,748.0**	**44,748.0**	**44,748.0**	**44,748.0**
Civil Enginnerintg	Regular	10,000.0	10,000.0	10,000.0	10,000.0	10,000.0	7,000.0	7,000.0	7,000.0	7,000.0	7,000.0
	Renewal & Replacement	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0	19,900.0
	Total	**29,900.0**	**29,900.0**	**29,900.0**	**29,900.0**	**29,900.0**	**26,900.0**	**26,900.0**	**26,900.0**	**26,900.0**	**26,900.0**
Electric Engineering	Regular	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0
	Renewal & Replacement	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7
	Total	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**
Grand total		**64,074.7**	**64,074.7**	**64,074.7**	**64,074.7**	**64,074.7**	**75,613.7**	**75,613.7**	**75,613.7**	**75,613.7**	**75,613.7**

Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rolling Stock	Regular	7,700.0	7,700.0	7,700.0	7,700.0	7,700.0	7,600.0	7,600.0	7,600.0	7,600.0	7,600.0
	Renewal & Replacement	32,164.0	32,164.0	32,164.0	32,164.0	32,164.0	29,809.0	29,809.0	29,809.0	29,809.0	29,809.0
	Total	**39,864.0**	**39,864.0**	**39,864.0**	**39,864.0**	**39,864.0**	**37,409.0**	**37,409.0**	**37,409.0**	**37,409.0**	**37,409.0**
Civil Enginnerintg	Regular	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0	20,100.0
	Renewal & Replacement	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0	2,000.0
	Total	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**	**22,100.0**
Electric Engineering	Regular	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0
	Renewal & Replacement	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7	3,365.7
	Total	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**	**3,965.7**
Grand total		**65,929.7**	**65,929.7**	**65,929.7**	**65,929.7**	**65,929.7**	**63,474.7**	**63,474.7**	**63,474.7**	**63,474.7**	**63,474.7**

9.2.4 Project

1) Seamless Combined Transport

A basic plan (draft) for setting up modern container freight yards for promoting international freight combined transport. The flat cars and containers required for the plan are considered to be leased and no investment is considered for the time being.

(a) To construct a freight terminal for container complex through-transport, it is desirable to construct terminals at Varna, Russe, Plovdiv, etc., if the budget permits.

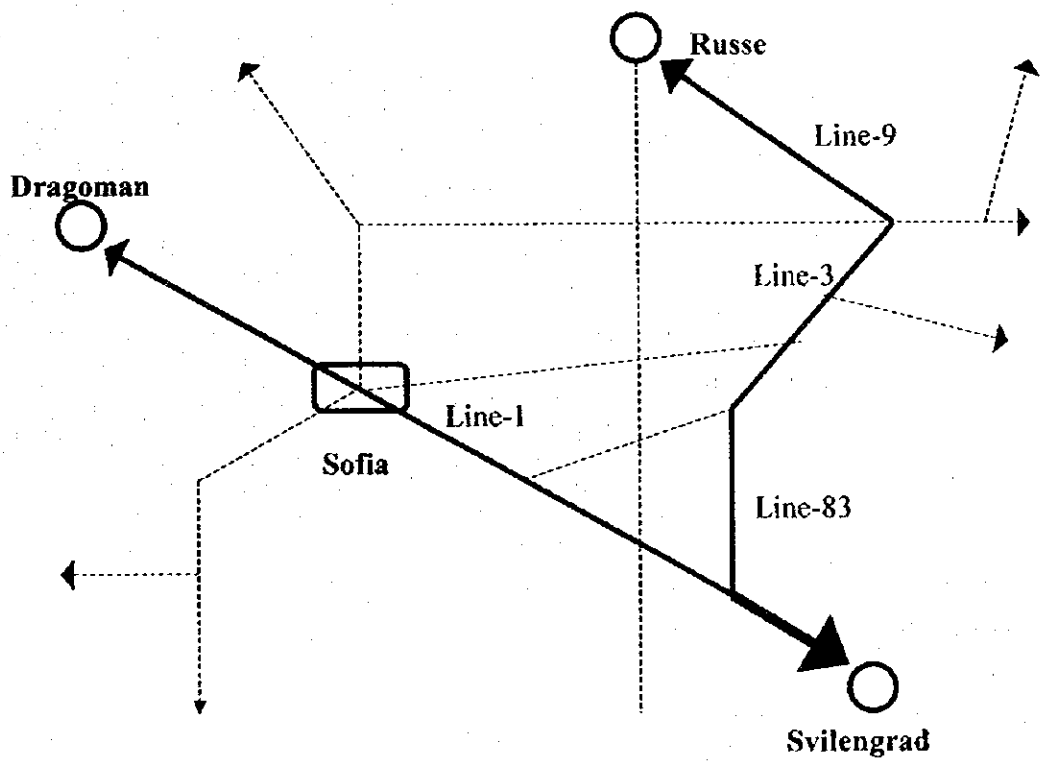
(b) To adopt international freight transport system (Ro-La System) in which freight trains can carry trailers.

One of the purposes of adopting this system is preservation of environment (prevention of air pollution).

In order to carry out this system, we propose that BDZ construct 3 additional freight yards that employ the Ro-La System at Dragoman Station near the Yugoslavian border, Svilengrad Station on the Turkish border and Russe Station near the Roumanian border.

The figure below shows the freight trains routes in this system.

Figure showing train routes in RO-LA system.



(2) Other projects

1) Project to make Line 8 double-tracked

It will become necessary to improve some single-tracked sections on Line 8 to double-tracked (149 km in total):
Skutare – Mihaylovo (77 km), Kalitinovo - Bezmer 57 km, Yambol - Zimnitsa15 km
The method to widen the existing line to make it double-tracked (construction of a new line parallel to the existing line) is proposed.

2) Test for higher speed operation of trains (Sofia and Plovdiv)

BDZ's next target for higher speed operation will be 160 km/h on Sofia - Plovdiv, after the current target (130 km/h) is attained.
As the test section 24 km between Sofia and Elin Pelin will be selected.
Improvement of facilities for the test includes separation of road and railway at principal crossings, purchase of a pendulum car, replacement of the existing turnout with turnouts for higher speed operation and improvement of electrical facilities as of signal, electrification.

3) Change of a level-crossing to an elevated crossing

The separation of road and railway at crossings on Lines 1, 2, 3 and 8 will greatly contribute to the improvement of trains' speed and safety.

4) Electrification plan

The electrification of 143 km between Krumovo - Svilengrad section on Line 1 will be necessary to increase the transport efficiency as well as international traffic capacity.

5) Tunneling project

If Sofia and Plovdiv are connected within one hour, balanced development of the two cities will be promoted and it will contribute much to the BDZ passenger sales.
Construction of 2 tunnels will be necessary to improve parts of a sharp curve and a steep gradient in the mountainous region.
But considering the enormity of the investment it should not be planned within the Project life

(After 2020).

Pobit Kamak – Hubkovo (Tunnel length = about 20 km) :

Rodrovo – Kastanets (Tunnel length = about 11 km)

Table 9.2.4 - 1 Project plan

(Unit : Million US$)

Project	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total	2020~	Remarks
1. Modernisation of freight transport																							Combined seamless transport
(1) Sofia freight yard	1.0	4.0	5.0																				
(2) Ro-La system yard		8.0	19.6																				
Total	**1.0**	**12.0**	**24.6**																		**37.6**		
2. Increased traffic capacity																							Line 8 (Plovdiv to Zimnitsa)
(1) Doubled track						42.6	42.6	42.6	42.6	42.6	42.6	42.6											
Total						**42.6**	**42.6**	**42.6**	**42.6**	**42.6**	**42.6**	**42.6**									**298.2**		
3. Incresed train speed																							Max. speed 160km/h Pendulum car
3.1 Sofia - Plovdiv											←→												
(1) Elevated crossing												1.8	1.8	1.8							5.4		
(2) Rolling stock														10.0	15.0	25.0	25.0				75.0		
(3) Other facilities													1.0	1.0	1.0	1.0	1.0				5.0		
Total												**1.8**	**2.8**	**12.8**	**16.0**	**26.0**	**26.0**				**85.4**		←→ Testing
3.2 Other																						500.0	Line 1 (Sofia to Plovdiv)
(1) Tunneling																							
(2) Elevated crossing											4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.8	45.3		
Total											**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**	**4.8**	**45.3**		
4. Electrification																							Line 1 (Krumovo to Svilengrad)
(1) Electrification													5.0	6.0	8.3	8.3	8.3						
Total													**5.0**	**6.0**	**8.3**	**8.3**	**8.3**				**35.9**		
Grand total	**1.0**	**12.0**	**24.6**	**0.0**	**0.0**	**42.6**	**42.6**	**42.6**	**42.6**	**42.6**	**47.1**	**48.9**	**12.3**	**23.3**	**28.8**	**38.8**	**38.8**	**4.5**	**4.5**	**4.8**	**502.4**		

9.2.5 Maintenance and projects plan year by year

Table 9.2.5-1 Maintenance and Project plan

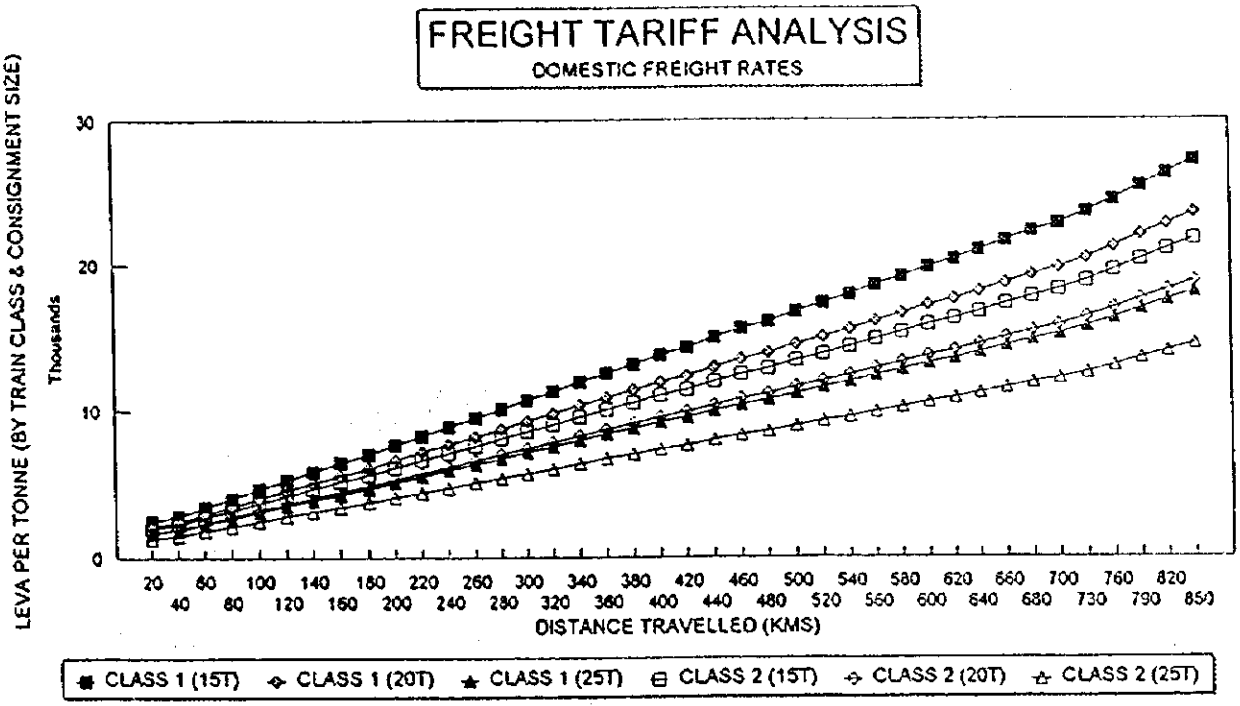
(Unit : Million US$)

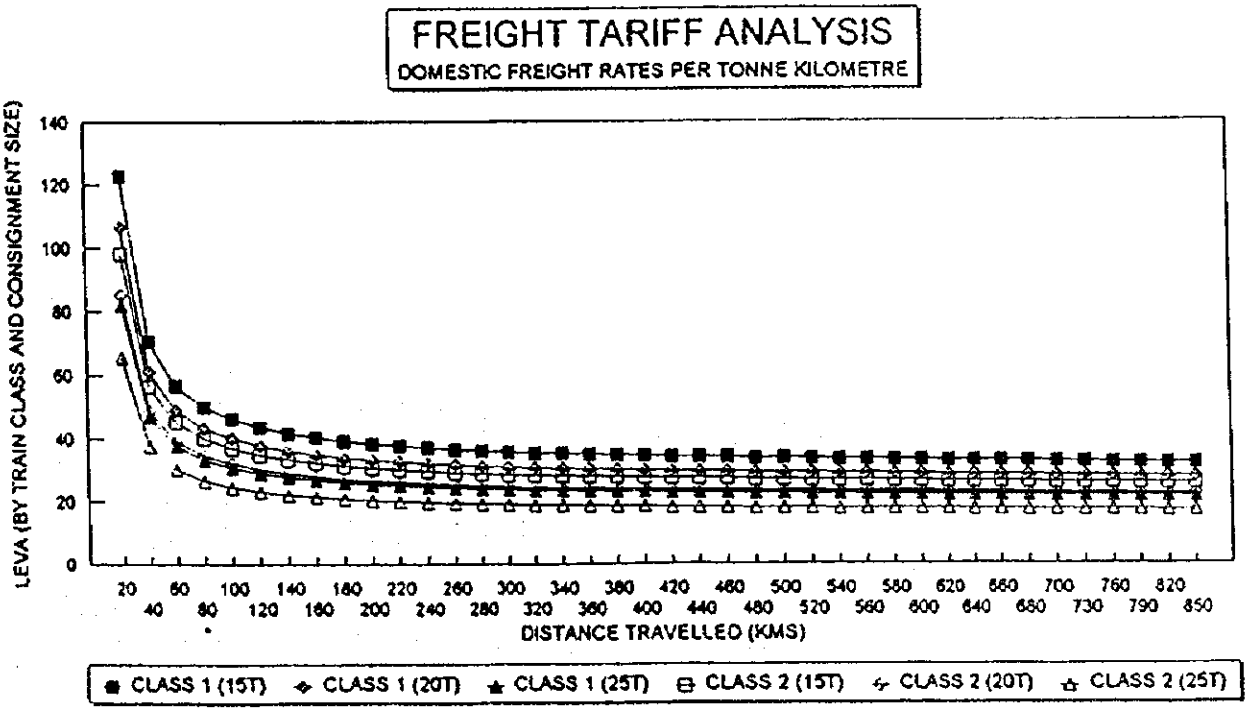
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Mainte-nannce	Rolling stock		30.2	30.2	30.2	30.2	30.2	30.2	44.7	44.7	44.7	44.7	44.7	39.9	39.9	39.9	39.9	39.9	37.4	37.4	37.4	37.4	753.8
	Civil engineering		29.9	29.9	29.9	29.9	29.9	26.9	26.9	26.9	26.9	26.9	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	505.0
	Electrical engineering		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	80.0
	Total		64.1	64.1	64.1	64.1	64.1	61.1	75.6	75.6	75.6	75.6	70.8	66.0	66.0	66.0	66.0	66.0	63.5	63.5	63.5	63.5	1,338.8
Project	Modanisation of freight transport		1.0	12.0	24.6																		37.6
	Increased traffic capacity							42.6	42.6	42.6	42.6	42.6	42.6	42.6									298.2
	Increased train speed	Sofia - Plovdiv												1.8	2.8	12.8	16.0	26.0	26.0				85.4
		Others											4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.8	45.3
	Electrification														5.0	6.0	8.3	8.3	8.3				35.9
	Total		1.0	12.0	24.6	0.0	0.0	42.6	42.6	42.6	42.6	42.6	47.1	48.9	12.3	23.3	28.8	38.8	38.8	4.5	4.5	4.8	502.4
Grand total			65.1	76.1	88.7	64.1	64.1	103.7	118.2	118.2	118.2	118.2	117.9	114.9	78.3	89.3	94.8	104.8	102.3	68.0	68.0	68.3	1,841.2

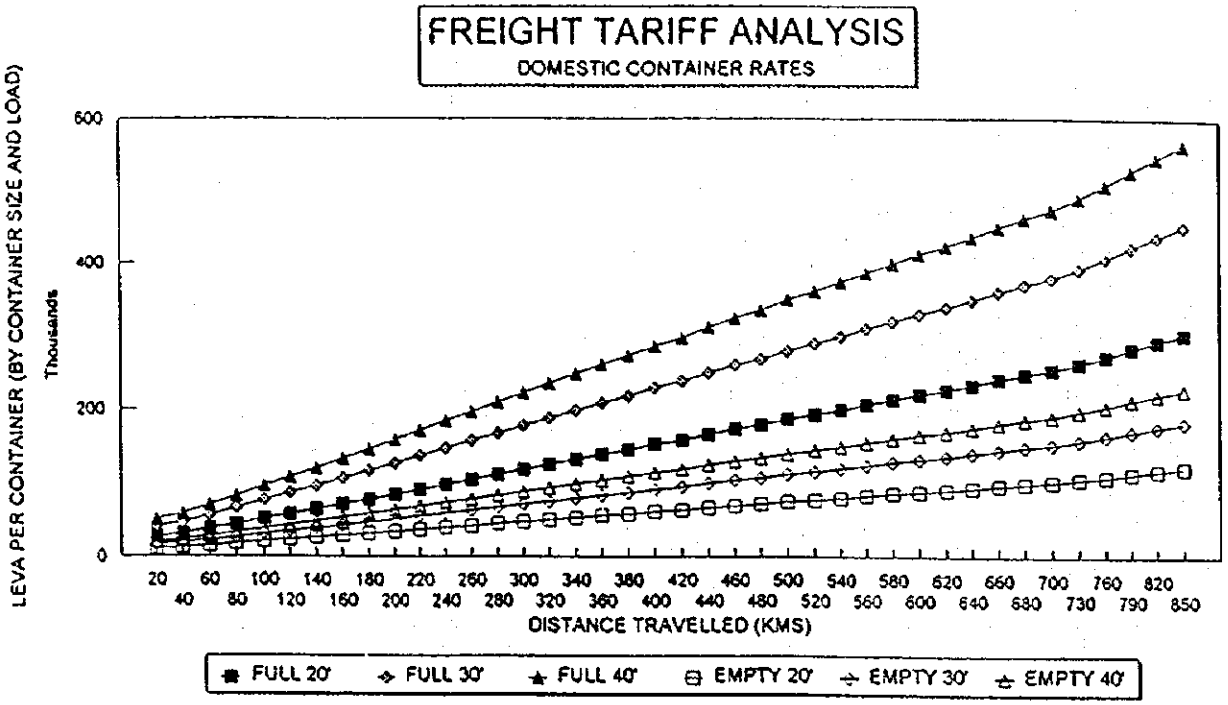
APPENDIX

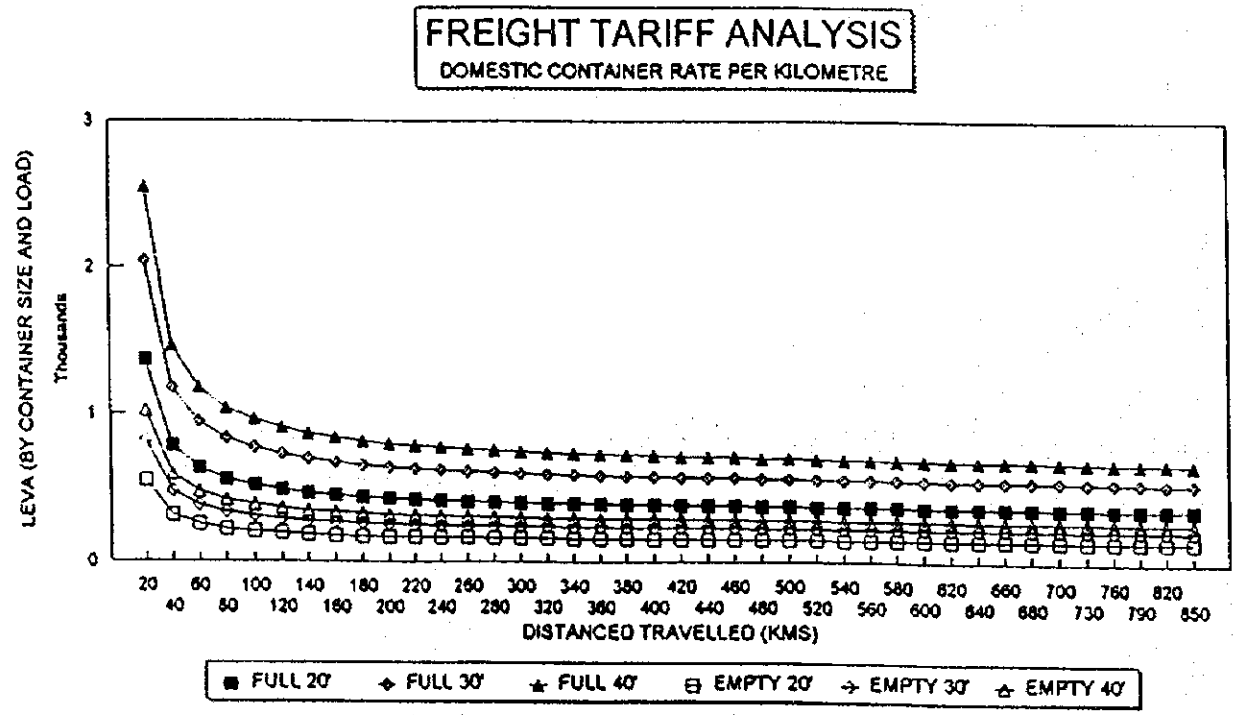
1. APPENDIX FOR TARIFF POLICY OF CHAPTER 7.2

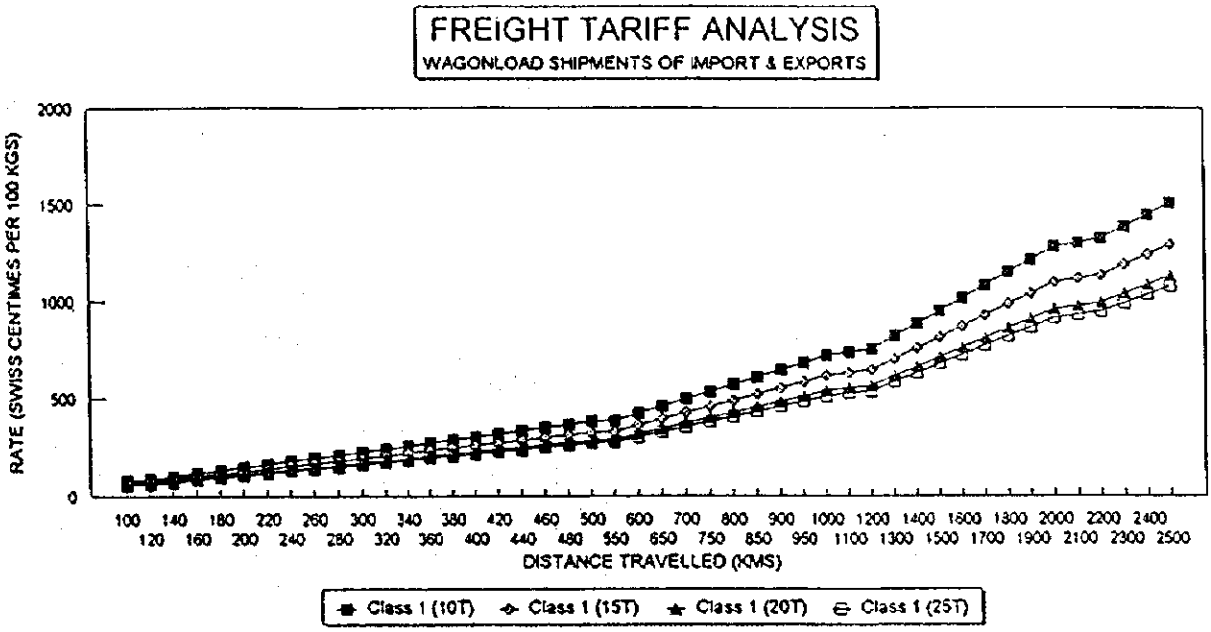
1.1 GRAPHICAL ANALYSIS OF TARIFFS

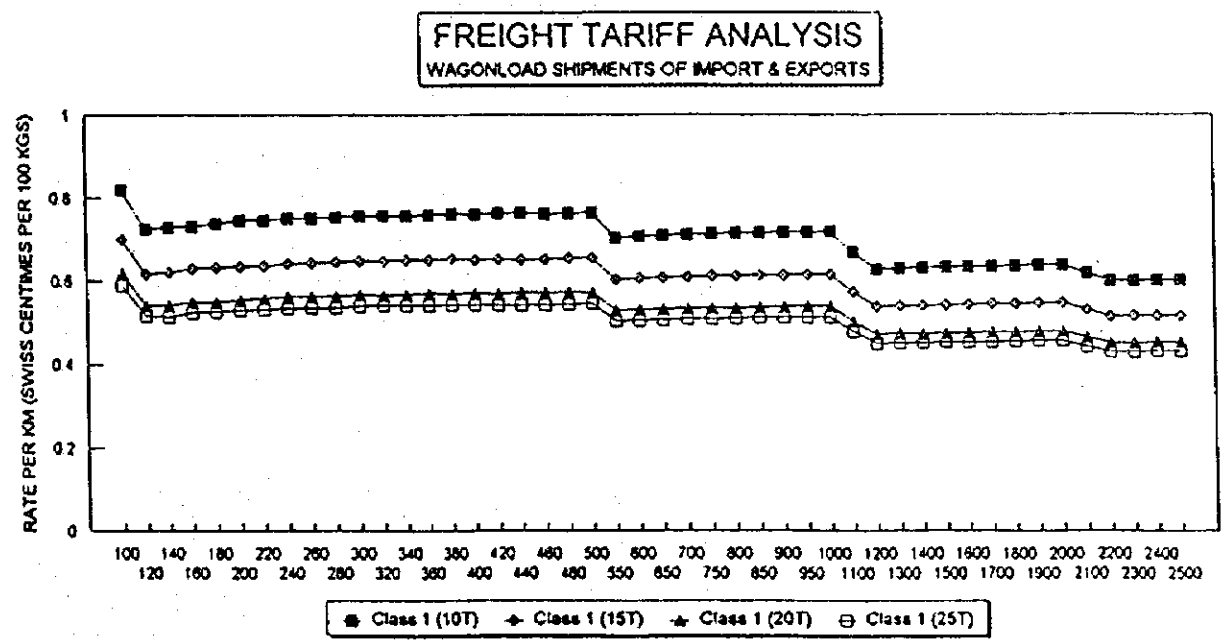


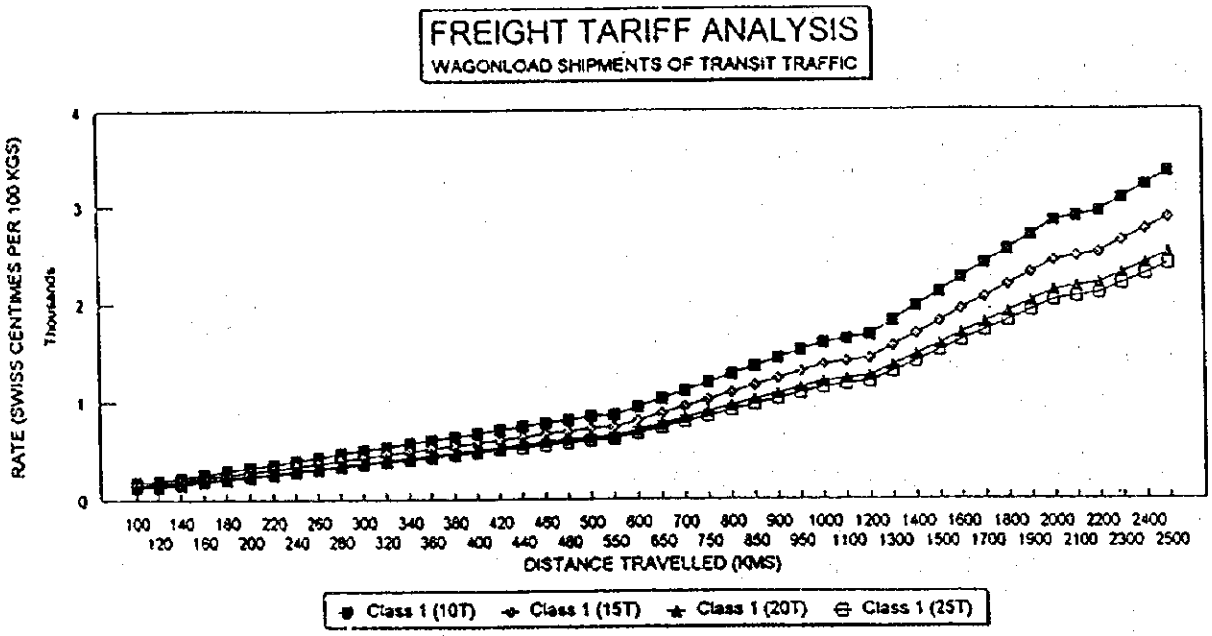


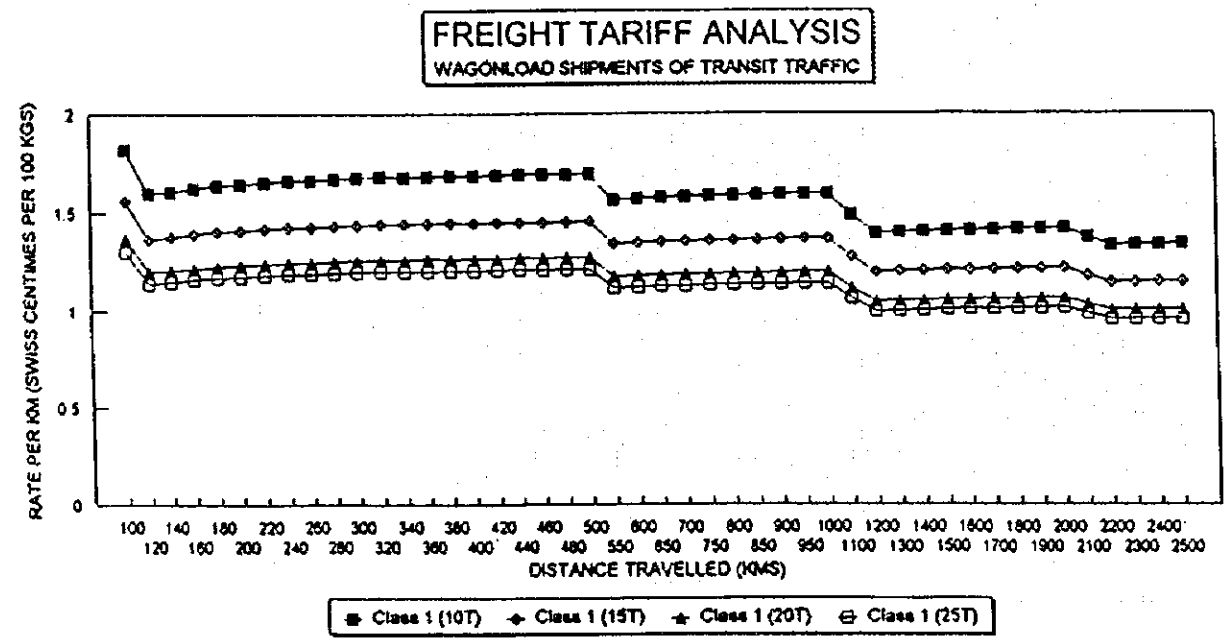

FREIGHT TARIFF ANALYSIS
DOMESTIC CONTAINER RATES
LEVA PER CONTAINER (BY CONTAINER SIZE AND LOAD)
Thousands
600
400
200
0
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 730 760 790 820 850
DISTANCE TRAVELLED (KMS)
FULL 20'
FULL 30'
FULL 40'
EMPTY 20'
EMPTY 30'
EMPTY 40'

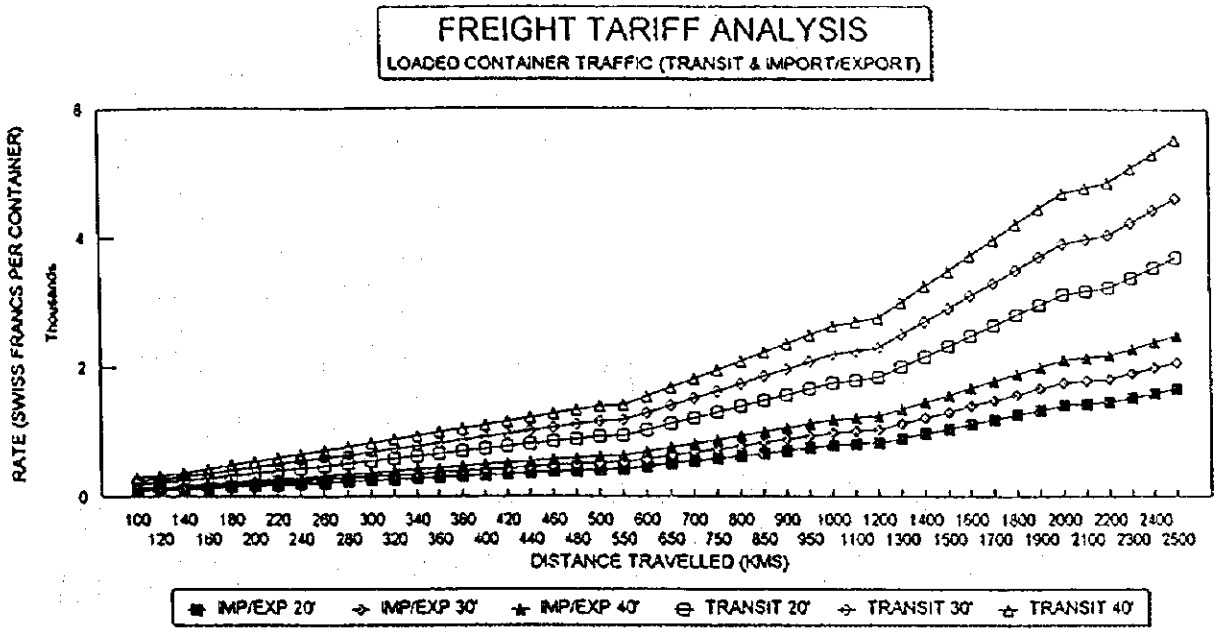

FREIGHT TARIFF ANALYSIS
DOMESTIC CONTAINER RATE PER KILOMETRE
LEVA (BY CONTAINER SIZE AND LOAD)
Thousands
3
2
1
0
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700 730 760 790 820 850
DISTANCED TRAVELLED (KMS)
FULL 20'
FULL 30'
FULL 40'
EMPTY 20'
EMPTY 30'
EMPTY 40'

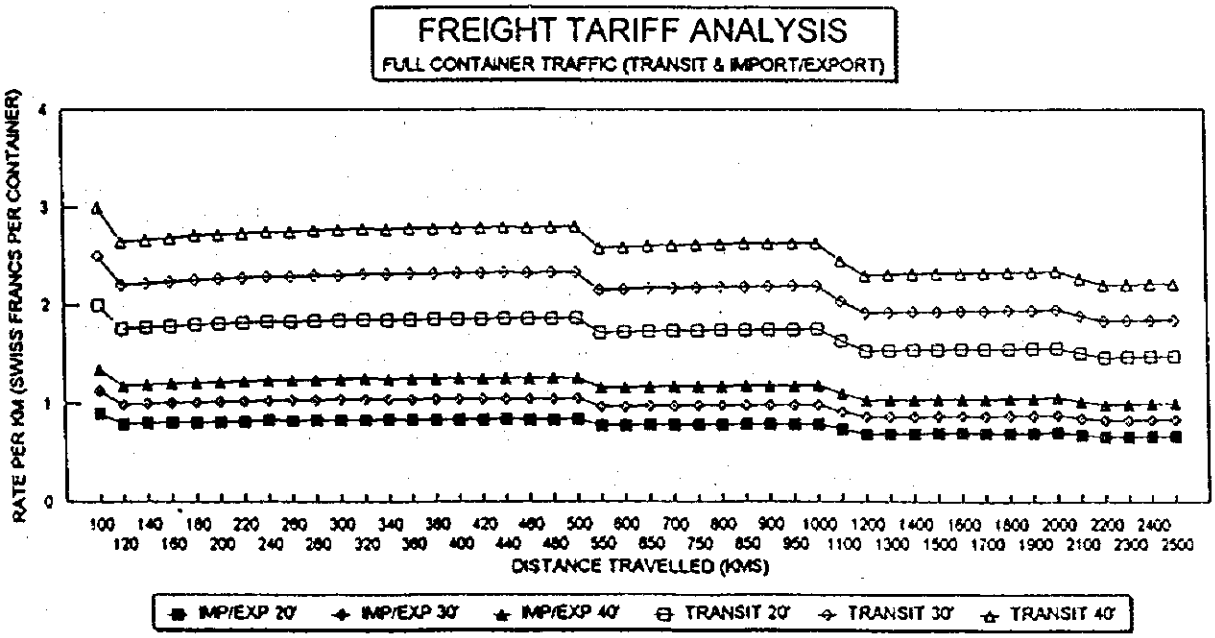

FREIGHT TARIFF ANALYSIS
WAGONLOAD SHIPMENTS OF IMPORT & EXPORTS
RATE (SWISS CENTIMES PER 100 KGS)
2000
1500
1000
500
0
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
Class 1 (10T)
Class 1 (15T)
Class 1 (20T)
Class 1 (25T)

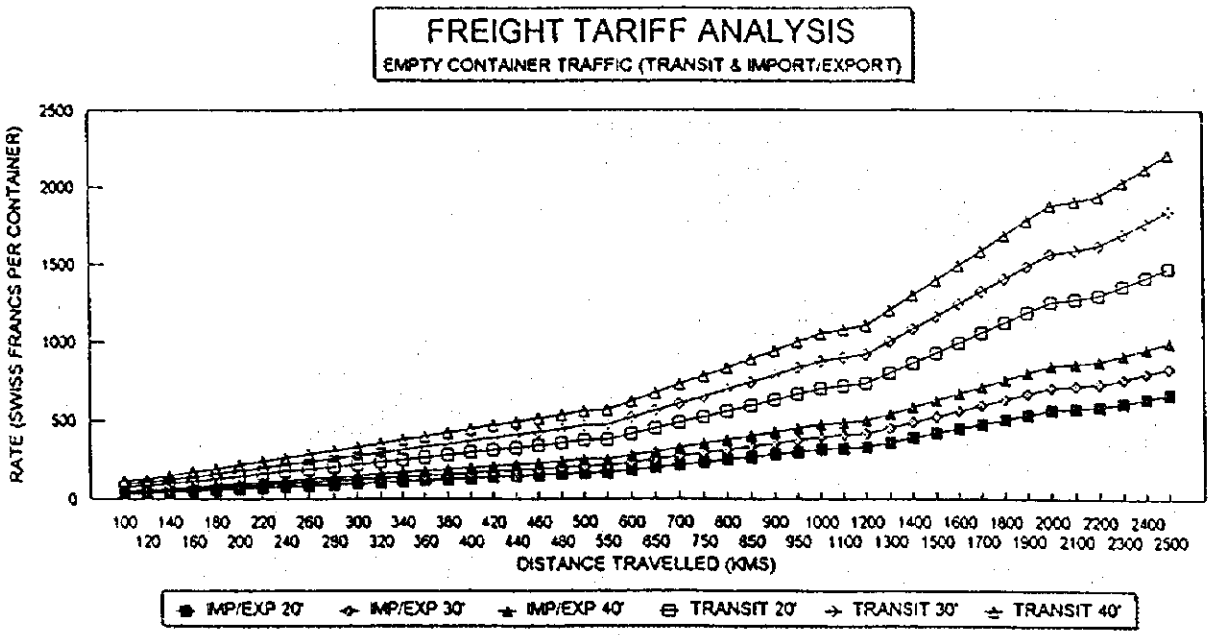

FREIGHT TARIFF ANALYSIS
WAGONLOAD SHIPMENTS OF IMPORT & EXPORTS
RATE PER KM (SWISS CENTIMES PER 100 KGS)
1
0.8
0.6
0.4
0.2
0
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
Class 1 (10T)
Class 1 (15T)
Class 1 (20T)
Class 1 (25T)

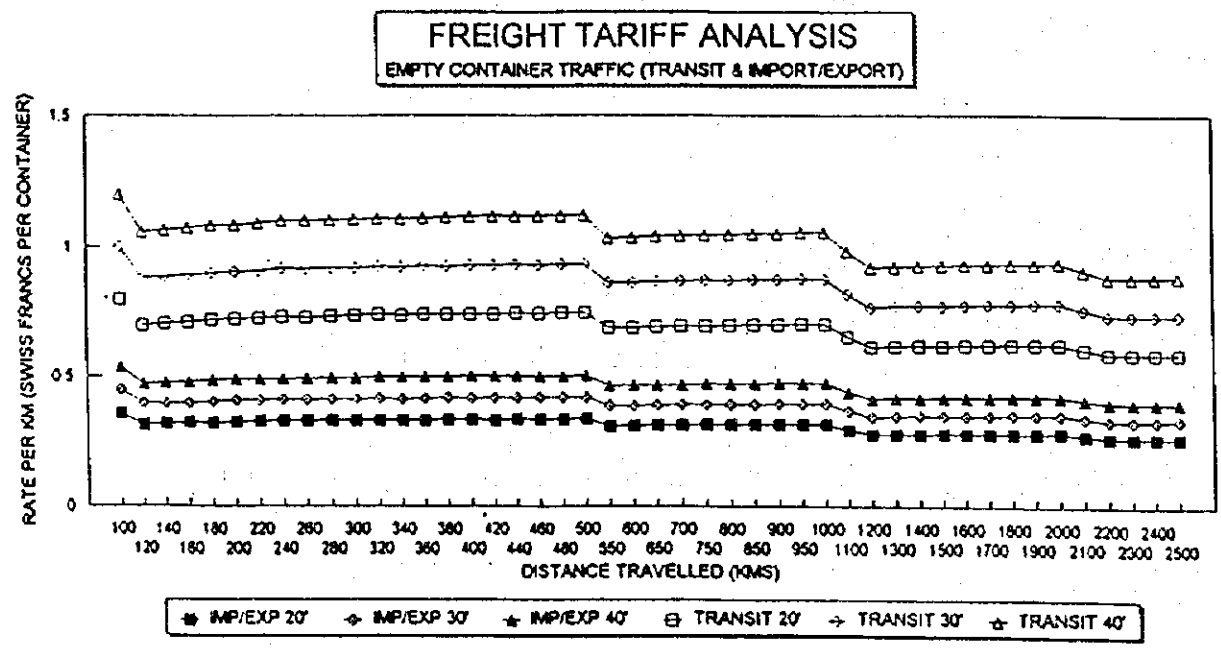

FREIGHT TARIFF ANALYSIS
WAGONLOAD SHIPMENTS OF TRANSIT TRAFFIC
RATE (SWISS CENTIMES PER 100 KGS)
Thousands
0
1
2
3
4
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
Class 1 (10T)
Class 1 (15T)
Class 1 (20T)
Class 1 (25T)


FREIGHT TARIFF ANALYSIS
WAGONLOAD SHIPMENTS OF TRANSIT TRAFFIC
RATE PER KM (SWISS CENTIMES PER 100 KGS)
0
0.5
1
1.5
2
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
Class 1 (10T)
Class 1 (15T)
Class 1 (20T)
Class 1 (25T)


FREIGHT TARIFF ANALYSIS
LOADED CONTAINER TRAFFIC (TRANSIT & IMPORT/EXPORT)
RATE (SWISS FRANCS PER CONTAINER)
Thousands
0
2
4
6
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
IMP/EXP 20'
IMP/EXP 30'
IMP/EXP 40'
TRANSIT 20'
TRANSIT 30'
TRANSIT 40'


FREIGHT TARIFF ANALYSIS
FULL CONTAINER TRAFFIC (TRANSIT & IMPORT/EXPORT)
RATE PER KM (SWISS FRANCS PER CONTAINER)
0
1
2
3
4
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
IMP/EXP 20'
IMP/EXP 30'
IMP/EXP 40'
TRANSIT 20'
TRANSIT 30'
TRANSIT 40'


FREIGHT TARIFF ANALYSIS
EMPTY CONTAINER TRAFFIC (TRANSIT & IMPORT/EXPORT)
RATE (SWISS FRANCS PER CONTAINER)
2500
2000
1500
1000
500
0
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
IMP/EXP 20'
IMP/EXP 30'
IMP/EXP 40'
TRANSIT 20'
TRANSIT 30'
TRANSIT 40'


FREIGHT TARIFF ANALYSIS
EMPTY CONTAINER TRAFFIC (TRANSIT & IMPORT/EXPORT)
RATE PER KM (SWISS FRANCS PER CONTAINER)
1.5
1
0.5
0
100 140 180 220 260 300 340 380 420 460 500 600 700 800 900 1000 1200 1400 1600 1800 2000 2200 2400
120 160 200 240 280 320 360 400 440 480 550 650 750 850 950 1100 1300 1500 1700 1900 2100 2300 2500
DISTANCE TRAVELLED (KMS)
IMP/EXP 20'
IMP/EXP 30'
IMP/EXP 40'
TRANSIT 20'
TRANSIT 30'
TRANSIT 40'

1.2 BDZ ON TRAIN SURVEY SEPTEMBER 1997

Introduction

An on train survey was organised at the end of September 1997 to research specific aspects of the passenger market, in particular the responsiveness of passengers to changes in price and journey time. It was decided to concentrate mainly of BDZ's fast train services on the principal east-west routes that are the main source of passenger revenue. Separate questions relating to the impact of price changes had also been included as part of the environmental survey of households in rural areas.

The chosen trains were :-

Route One	Sofia - Gorno Oriahovitsa & Return : Train 411 & Train 210
Route Two	Sofia - Tulovo & Return : Train 321 & Train 310
Route Three	Sofia - Plovdiv & Return : Train 120, Train 121, & Train 812

Surveys took place on Tuesday, Wednesday, and Thursday (23-25th September), avoiding any differences that would affect the results due to the calender (weekend) fares that apply on various trains on Mondays and Fridays.

Questionnaires were distributed at random amongst passengers twice during each journey. The first was close to Sofia and the second at some distance away to include passengers who joined the train on route. The procedure was mirrored on the return journey into Sofia.

The questionnaire was developed in liaison with BDZ's Passenger Department and translated in Bulgarian. Copies can be found at the end of this Appendix. A sample size of about 500-600 was sought. The response rate, however, was much better than expected. Of the 964 questionnaires distributed 954 (99%) were returned. 661 were coded for analysis split roughly by the three routes (Route One : 212, Route Two : 215, & Route Three : 234). This gave a representative sample of BDZ's passengers using fast train services. The results of the analysis is described below, with the tables of results at the end of this Appendix.

BDZ ON TRAIN SURVEY

Dear Customer
Bulgarian State Railways (BDZ) is conducting a study of their passenger train services. I would be grateful if you would assist us be spending a few minutes to complete the following questionnaire.

Yours sincerely

For Director General BDZ

Q1. **At which BDZ station did you board this train?** Station Name .....

Q2. **How did you get to the BDZ station?** (Tick One Box)
1. Walked all the way [ ] 2. Bus/Coach [ ] 3. Taxi [ ]
4. Motorcycle/Bicycle [ ] 5. Passenger in car [ ] 6. Drove car [ ]
7. Other (Please explain) .....

Q3. **At which BDZ station will you finish this journey?** Station Name .....

Q4. **How will you get to your final destination on leaving this train?** (Tick One Box)
1. Walked all the way [ ] 2. Bus/Coach [ ] 3. Taxi [ ]
4. Motorcycle/Bicycle [ ] 5. Passenger in car [ ] 6. Drove car [ ]
7. Other (Please explain) .....

Q5. **What is the main purpose of your journey** (Tick One Box)
1. To or from work place [ ] 2. On employers business [ ]
3. Visiting friends or relatives [ ] 4. Shopping [ ]
5. On Holiday [ ] 6. To or from school/college [ ]
7. Other (Please specify) .....

Q6. **How often do you make the rail journey you are now on?** (Tick One Box)
1. Several times a week [ ] 2. Once a week [ ] 3. 2-3 times a month [ ]
4. Once a month [ ] 5. Less frequent (number of times a year) .....

Q7. **Is this the outward or return part of your journey?** (Tick One Box)
1. Outward [ ] 2. Return [ ]

Q8. **What type of train are you travelling on?** (Tick One Box)
1. Express [ ] 2. Fast [ ] 3. Normal [ ]

Q9. **Are you travelling first or second class?** (Tick One Box)
1. First [ ] 2. Second [ ]

Q10. **What was the main reason for choosing to travel by train rather than by other modes of transport?** (Tick One Box)
1. Shorter journey time by train [ ] 2. Safer by rail [ ]
3. No alternative transport available [ ] 4. Cheapest mode of transport [ ]
5. More comfortable [ ] 6. More frequent or convenient service [ ]
7. Other (Please state) .....

Q11. **What type of ticket do you have?** (Tick One Box)
1. Single fare [ ] 2. Return fare [ ] 3. Student single [ ]
4. Pensioner single [ ] 5. Forces single [ ] 6. One Month Season [ ]
7. Three Month Season [ ] 8. Free Ticket [ ] 9. BDZ Staff Pass [ ]
10. Other (Please state) .....

Q12. How did you pay for your ticket? (Tick One Box)

1. Paid for by employer [ ] 2. Paid by educational organisation [ ]
3. Paid by family member [ ] 4. Paid by own money [ ]
5. Other (Please state) .....

Q13. What is the price of your ticket? .....Leva

Q14. What level of fares increase would make you stop using BDZ's train service <u>for your current journey</u> (ONLY Tick One Box)

50 - 100 Leva	[ ]	101 - 200 Leva	[ ]	201 - 300 Leva	[ ]
301 - 400 Leva	[ ]	401 - 600 Leva	[ ]	601 - 800 Leva	[ ]
801 - 1000 Leva	[ ]	1001 - 1200 Leva	[ ]	1201 - 1400 Leva	[ ]
1401 - 1600 Leva	[ ]	1601 - 1800 Leva	[ ]	1801 - 2000 Leva	[ ]
2001 - 2500 Leva	[ ]	2501 - 3000 Leva	[ ]	3001 - 4000 Leva	[ ]

More that 4000 Leva [ ] If so, how many Leva .....

Q15. If the fare was more than you were prepared to pay what would you do instead? (Tick One Box)

1. Travel to same destination by bus [ ] 2. Travel to same destination by car [ ]
3. Travel to same destination by air [ ] 4. Travel to an alternative destination [ ]
5. Not travel at all [ ] 6. Other (Please state) .....

Q16. How long is your current train journey from start to finish?

..... Hours & ..... Minutes

Q17. Which of the following time savings would cause you to make <u>the same journey</u> by rail more often? (ONLY Tick One Box)

10 -20 Minutes	[ ]	20 - 30 Minutes	[ ]	31 - 40 Minutes	[ ]
41 - 50 Minutes	[ ]	51 - 60 Minutes	[ ]	1 - 1¼ Hours	[ ]
1¼ - 1½ Hours	[ ]	1½ - 1¾ Hours	[ ]	1¾ - 2 Hours	[ ]
2 - 2½ Hours	[ ]	2½ - 3 Hours	[ ]	3 - 3½ Hours	[ ]
3 - 4 Hours	[ ]	More than 4 Hours	[ ]	If so, how many Hours	

Q18. How many additional return journeys per year would you then make?

..... journeys

Q19. Which age group do you belong? (Tick One Box)

1. Under 15 years	[ ]	2. 15-19 years	[ ]	3. 20-24 years	[ ]
4. 25-29 years	[ ]	5. 30-39 years	[ ]	6. 40-49 years	[ ]
7. 50-59 years	[ ]	8. 60-69 years	[ ]	9. 70 years or more	[ ]

Q20. Which gender are you? (Tick One Box)

1. Male [ ] Female [ ]

Q21. What is your occupation? (Tick One Box)

1. Employed	[ ]	4. Self Employed	[ ]	7. Student/scholar	[ ]
2. House person	[ ]	5. Retired	[ ]	8. Armed forces	[ ]
3. Farmer	[ ]	6. Unemployed/not working	[ ]		

9. Other (Please describe) .....

Q22. If employed or self employed, what is your approximate monthly income? (Optional question)

..... Leva

<u>THANK YOU VERY MUCH FOR YOUR ASSISTANCE</u>

АНКЕТА ВЪВ ВЛАКОВТЕ НА БДЖ

Уважаеми пътници,

Бълг. държавни железници извършват проучване на пътническите влакови услуги. Ще Ви бъдем много благодарни, ако отделите време, за да попълните тази анкета.

С уважение:_____
Зам. генерален директор на БДЖ

В 1: На коя ж.п. гара се качихте на влака? Ж.п. гара:.....

В 2: Как се придвижихте до ж.п. гарата? (Моля отбележете само един отговор)

1. Изцяло пеша	[ ]	2. С автобус	[ ]	3. С такси	[ ]
4. С мотошиклет/велосипед	[ ]	5. Като пътник в автомобил			[ ]
6. С личен автомобил	[ ]	7. Друго (Моля посочете).....			

В 3: До коя ж.п. гара пътувате? Ж.п. гара:.....

В 4: Как ще се придвижите до крайната точка на Вашето пътуване, след като слезете от влака? (Моля отбележете само един отговор)

1. Пеша	[ ]	2. С автобус	[ ]	3. С такси	[ ]
4. Мотошиклет/велосипед	[ ]	5. Като пътник в автомобил			[ ]
6. С личен автомобил	[ ]	7. Друго (Моля посочете с какво).....			

В 5: Каква е основната цел на Вашето пътуване? (Моля отбележете само един отговор)

1. До или от работното място	[ ]	2. Командировка			[ ]
3. Посещение на близки или приятели	[ ]	4. Пазар	[ ]	5. Почивка	[ ]
6. До или от училище	[ ]	7. Други (Моля обяснете).....			

В 6: Колко често пътувате с влак по този маршрут? (Моля отбележете само един отговор)

1. Няколко пъти седмично	[ ]	2. Веднъж седмично	[ ]	3. 2-3 пъти месечно	[ ]
4. Веднъж месечно	[ ]	5. По-рядко (колко пъти годишно).....			

В 7: Това пътуване отиване или завръщане от мястото на посещение ли е? (Моля отбележете само един отговор)

1. Отиване	[ ]	2. Връщане	[ ]

В 8: С какъв вид влак пътувате? (Моля отбележете само един отговор)

1. Експресен	[ ]	2. Бърз	[ ]	3. Пътнически	[ ]

В 9: Вие пътувате в първа или втора класа? (Моля отбележете само един отговор)

1. Първа	[ ]	2. Втора	[ ]

В 10: Каква е причината да изберете да пътувате с влак вместо с друг вид транспорт? (Моля отбележете само един отговор)

1. По- късо времетраене на пътуването	[ ]	2. По-безопасно е	[ ]
3. Поради липса на друга алтернатива	[ ]	4. Най-евтино е	[ ]
5. По- удобно е	[ ]	6. Връзките са по-чести или по-удобни	[ ]

Друга (Моля обяснете).....

В 11: С какъв вид билет пътувате? (Моля отбележете само един отговор)

1. Еднопосочен	[ ]	2. Двупосочен	[ ]
3. Еднопосочен за учащи	[ ]	4. Еднопосочен за възрастни	[ ]
5. Военен еднопосочен	[ ]	6. Едномесечна абонаментна карта	[ ]
7. Тримесечна абонаментна карта	[ ]	8. Безплатен	[ ]
9. Билет на служител на БДЖ	[ ]		

10. Друг (Моля посочете).....

В 12. Кой заплати билета Ви? (Моля отбележете само един отговор)

1. Работодателят	[ ]	2. Образователната институция	[ ]
3. Член от семейството	[ ]	4. Със собствени средства	[ ]
5. Друг (Моля обяснете)	[ ]		

В 13: Каква е цената на билета Ви? .....Лева

В 14: Какво повишение на цените ще Ви принуди да се откажете да използвате влаковете на БДЖ за вашето сегашно пътуване? (Моля отбележете само един отговор)

50-100 лв	[ ]	101-200 лв	[ ]	201-300 лв	[ ]
301-400 лв	[ ]	401-600 лв	[ ]	601-800 лв	[ ]
801-1000 лв	[ ]	1001-1200 лв	[ ]	1201-1400 лв	[ ]
1401-1600 лв	[ ]	1601-1800 лв	[ ]	1801-2000 лв	[ ]
2001-2500 лв	[ ]	2501-3000 лв	[ ]	3001-4000 лв	[ ]
Над 4000 лв.	Ако е така, колко лева				

В 15: Какво бихте направили ако цената на билета е по-висока от тази, която сте се приготвили да платите? (Моля отбележете само един отговор)

1. Бих пътувал/а с автобус до същото местоназначение	[ ]	2. Бих пътувал/а с кола до същото местоназначение	[ ]
3. Бих пътувал/а със самолет	[ ]	4. Бих пътувал/а до друго възможно място	[ ]
5. Не бих пътувал/а изобщо	[ ]	6. Друго (Моля обяснете)	[ ]

В 16: Каква е продължителността на сегашното Ви пътуване от началната до крайната Ви гара?
..... Часове ..... Минути

В 17: Ще пътувате ли по-често по този маршрут с влак, ако времето за пътуване се съкрати с: (Моля отбележете само един отговор)

10-20 мин.	[ ]	20-30 мин.	[ ]	31-40 мин.	[ ]
41-50 мин.	[ ]	51-60 мин.	[ ]	1 - 1 1/4 часа	[ ]
1 1/4 - 1 1/2 часа	[ ]	1 1/2 - 1 3/4 часа	[ ]	1 3/4 - 2 часа	[ ]
2 - 2 1/2 часа	[ ]	2 1/2 - 3 часа	[ ]	3 - 3 1/2 часа	[ ]
3-4 часа	[ ]	Повече от 4 часа. Ако е така, колко часа повече.....			

В 18 : Като имате предвид горепосочения отговор, колко още двупосочни пътувания бихте направили годишно по този маршрут?

..... пътувания

В 19: В коя от следните възрастови групи попадате?

1. под 15г.	[ ]	2. 15-19г.	[ ]	3. 20-24г.	[ ]
4. 5-29г.	[ ]	5. 30-39г.	[ ]	6. 40-49г.	[ ]
7. 50-59г.	[ ]	8. 60-69г.	[ ]	9. Над 70г.	[ ]

В 20: От какъв пол сте?

1. Мъжки	[ ]	2. Женски	[ ]

В 21: С какво се занимавате?

1. Работя	[ ]	4. На свободна практика	[ ]	7. Ученик/студент	[ ]
2. Домакиня	[ ]	5. Пенсиониран	[ ]	8. Военнослужещ	[ ]
3. Земеделец	[ ]	6. Безработен/ неработещ	[ ]	9. Друг..... (Моля обяснете)	[ ]

В 22 : Ако работите или сте на свободна практика, какъв е приблизително Вашият месечен доход? (Моля отговорете само ако желаете) .....лв

Много Ви благодарим за помощта!

Results of Analysis

Q1 & Q3. Boarding & Alighting Stations

It was notable that a large number of both boarding and alighting stations were represented (39 and 61 respectively). There was only a few that were major origin and/or destination stations. Sofia was the most significant source and destination of traffic. The number of stations included indicates that the origin/destination pattern of BDZ passenger network is complex. It also indicates that the sample analysed is not dominated by a few important traffic flows.

Q2 & Q4. Access & Egress Modes of Transport

Access and egress to/from the station is clearly dominated either by walking or by bus (70-80% of the responses). Bus is by far the most dominant mode. This is not surprising in Bulgaria with a low car ownership. Tram is also an important means of access to/from Sofia Central Station. BDZ, therefore, relies on other public transport operators to get passengers to/from the stations.

Q5. Journey Purpose

A range of journey purposes were included, with no single one dominating. The most significant one (at 30% of the total) was visiting friends and relatives. The next was on employers business, indicating the importance of business traffic (first and second class) to BDZ. As the trains were principally the fast inter-city services only 10% were travelling to/from work. It is to be expected that these proportions will vary significantly on Fridays and weekends with a considerably larger volume of leisure traffic.

Q6. Journey Frequency

From the responses there would appear to be three main types of passengers - those who travel frequently (possibly everyday if they are commuters); those who travel regularly once, or a few times a month; and occasional travellers who only travel once or twice a year. This indicates three difference sections of the overall travel market.

Q7. Outward or Return Journey

This was divided almost exactly into two thirds of passengers making outbound journeys and one third making return journeys.

Q8. Train Type

As to be expected this was dominated by fast trains. A proportion of the passengers were also sampled on Train 812 that is designated as an Express Train by BDZ.

Q9. Carriage Class

This is divided roughly into 20% first class and 80% second class. Whilst the second class predominates, the first class market is clearly also important for BDZ. This result corresponds with the importance of business traffic commented on in question five.

Q10. Reasons for Choosing to Travel By Train

This is dominated by two main reasons - either passengers have no other transport available or that rail is the cheapest mode. These do not represent positive reasons for choosing to use rail. As cheapness of travel is the most important it is clear that passengers will be sensitive to the movement of train fares relative to bus fares.

Q11. Ticket Type

The vast majority of tickets sold were single fares, comprising about 66% of the total. The largest individual group sold were student single tickets. Only a small proportion were season tickets. A significant proportion however (15.6%) were passengers travelling free, either with a free tickets or using a BDZ staff pass.

Q12. Ticket Payment

Payment is predominantly made from household income, either by the person buying the ticket or by someone from their family. The other major source is from the employer paying for business travel.

Q13. Ticket Price

A large range of ticket prices were included reflecting the complex pattern of traffic movements commented on in questions one and three. The vast majority of journeys are in the price range of 500 - 3000 Leva.

Q14. Fares Elasticities (Fares Increase Causing Passenger to Cease Using BDZ)

Question 14 was used in combination with questions 6 and 13 to derived fares elasticities that reflect the way passengers respond to increases in fares. Not all passengers are willing to pay additional fares when tariffs increase and stop using the train service. The revenue that BDZ will receive relates to how sensitive passengers are to fares increases. The form of the calculation of a fares elasticity is :-

%Change in demand ÷ % change in fare

A fares elasticity greater than 1.0 (called 'elastic') shows that passengers will respond highly to fares increases and BDZ will lose money by a general price increase as passenger numbers would go down more. The closer the elasticity is to zero the less sensitive passengers are to fares increases (called 'inelastic') and BDZ will gain more revenue than the loss of passengers. The total passenger market will be made up of groups who will have different fares elasticities.

It was possible to derive elasticities for the whole of the first and second class markets. In addition it was also possible to derive separate second class elasticities for second class passengers along all three routes (Northern Route via Gorno Oriahovitsa, Central Route via Tulovo, Southern Route via Plovdiv). The response to this question was lower than for most of the others. It was not possible therefore to obtain a large enough sample size to divide the first class market by routes.

With an elasticity of -1.54 is show that first class passengers are sensitive to fares increase more than second class (-0.81). The result for the first class market, however may be influenced by the small sample size (32) and the response of a small number of commuters who make a large proportion of the total number of first class journeys.

The separate elasticities for second class passengers on the three routes indicate that they will respond differently to a fares increase. The Northern Route (-0.56) is the most inelastic whereas the Southern Route has an elasticity of exactly -1.00. This indicates that fares increases should not be uniform throughout the system but should be selective by route and by separate market segments.

Q15. Alternative Arrangements if Fares Increase Too Much

The two most important alternatives are that passengers will travel by bus or not travel at all. The second implies that passengers are dependent on rail and their socio-economic activities will be curtailed if train fares are increased too much, implying social hardship. Travel by car is an option for a proportion of passengers, most likely by taxi. The level of uncoded responses implies that a significant number of passengers do not know what response would be.

Q16. Journey Time

A very significant range of responses is included. This again supports the complex pattern of traffic movements made on BDZ. With an average journey length of 234 minutes the majority of passengers are travelling inter-city rather than making local journeys.

Q17 & Q18. Journey Time Elasticities (Additional Trips)

This is similar to question 14 above except that it seeks to quantify the responsiveness of passengers to journey time changes. It was achieved by combining the answers with questions 6 and 16. The form of the calculation of a journey time elasticity is :-

%Change in demand ÷ % change in journey time

As to be expected first class passengers have the highest elasticity and are the most sensitive to journey time changes. Whilst the elasticity, at -0.97, is less than unity it only measures those people who actually use first class. It is likely that passengers who use faster modes of transport have a higher values of time. There is very little difference in the elasticity measures for second class passengers by the different routes.

Q19 & Q20. Age Group & Gender

The range of ages shows that a broad cross section of the national population has been sampled, spilt roughly evenly between men and women. The sample therefore is reliable and free from bias.

Q21 & Q22. Occupation and Monthly Income

The responses to these questions have been aggregated in the form of a cross tabulation. The largest three individual groups were those who are employed, those who are retired, and student/scholars. Together they comprised 81% of passengers.

Due to its sensitivity the question about income was left as optional. Even though only employed and self employed people were asked to provide their monthly income a range of the other employment categories also did the same. Overall about 40% of the respondents replied to this question. Of those who are employed the proportion who responded was 63%. The average monthly income from those who responded was 127151 Leva, which is slightly less than the average national wage of 150,000 Leva (July 1997). The majority of employed/self employed were in the range of 76,000 - 200,000 Leva. The majority of retired had a lower level of income up to 100,000 Leva per month.

Whilst most students/scholars did not respond to this question as they are not yet income earners, some that did indicated a significant income level. This may, however, refer to family income rather than personal. It can be concluded, therefore, that as most of BDZ's passengers are lower income earners they are likely to suffer financial hardship from significant future tariff increases.

BDZ ON TRAIN SURVEY ANALYSIS RESULTS

Q1 & Q3 Origin And Destination Stations

Origin Stations			Destination Stations		
Sofia	293	44.33%	Sofia	245	37.07%
Burgas	60	9.08%	Plovdiv	36	5.45%
Plovdiv	55	8.32%	Pleven	35	5.30%
Kazanlak	33	4.99%	Pazardzhik	35	5.30%
Stara Zagora	24	3.63%	Kaspichan	24	3.63%
Gorno Onah.	22	3.33%	Karlovo	20	3.03%
Jambol	15	2.27%	Cherven Bryag	20	3.03%
Other Stations	142	21.48%	Kostenets	18	2.72%
Uncoded	17	2.57%	Gorno Onah.	15	2.27%
TOTAL	661	100.00%	Ihtiman	15	2.27%
			Kazanlak	14	2.12%
			Other Stations	160	24.21%
			Uncoded	24	3.63%
			TOTAL	661	100.00%
No. Stations	39		No. Stations	61	

Q2 & Q4 Access And Egress Mode To/From Station

Access Mode			Egress Mode	
1. Walked	136	20.57%	180	27.23%
2. Bus/Coach	334	50.53%	339	51.29%
3. Taxi	37	5.60%	26	3.93%
4. Motor/Bicycle	2	0.30%	3	0.45%
5. Car Passenger	31	4.69%	40	6.05%
6. Car Driver	31	4.69%	24	3.63%
7. Other	12	1.82%	16	2.42%
8. Another Train	12	1.82%	5	0.76%
9. Tram	48	7.26%	18	2.72%
Uncoded	18	2.72%	10	1.51%
TOTAL	661	100.00%	661	100.00%

Q5 Journey Purpose

1. To/From Work	67	10.12%
2. On Employers Business	141	21.30%
3. Visiting Friends/Relatives	196	29.61%
4. Shopping	34	5.14%
5. On Holiday	62	9.37%
6. To/From School/College	89	13.44%
7. Other	60	9.06%
Uncoded	12	1.81%
TOTAL	661	99.85%

Q6 Journey Frequency

1. Several Times a Week	81	12.25%
2. Once a Week	53	8.02%
3. 2-3 Times a Month	95	14.37%
4. Once A Month	163	24.66%
5. 5-6 Times a Year	26	3.93%
6. 3-4 Times a Year	67	10.14%
7. 1-2 Times a Year	155	23.45%
Uncoded	21	3.18%
TOTAL	661	100.00%

Q7 Outward/Return Trip

1. Outward	425	64.30%
2. Return	224	33.89%
Uncoded	12	1.82%
TOTAL	661	100.00%

Q8 Train Type

1. Express	36	5.45%
2. Fast	613	92.74%
3. Normal	4	0.61%
Uncoded	8	1.21%
TOTAL	661	100.00%

Q9 Carriage Class

1. First	117	17.70%
2. Second	536	81.09%
Uncoded	8	1.21%
TOTAL	661	100.00%

Q10 Choice Of Rail

1. Shorter Journey Time	22	3.33%
2. Safer by Rail	19	2.87%
3. No Alternative Transport	193	29.20%
4. Cheapest Mode	264	39.94%
5. More Comfortable	81	12.25%
6. More Frequent/Convenient	58	8.77%
7. Other	8	1.21%
Uncoded	16	2.42%
TOTAL	661	100.00%

Q11 Ticket Type

1. Single Fare	192	29.05%
2. Return Fare	84	12.71%
3. Student Single Fare	124	18.76%
4. Pensioner Single Fare	95	14.37%
5. Armed Forces Single Fare	25	3.78%
6. One Month Season	9	1.36%
7. Three Month Season	10	1.51%
8. Free Ticket	46	6.96%
9. BDZ Staff Pass	57	8.62%
10. Other	7	1.06%
Uncoded	12	1.82%
TOTAL	661	100.00%

Q12 Ticket Payment

1. By Employer	160	24.21%
2. By Education Authority	3	0.45%
3. By Family Member	103	15.58%
4. By Own Money	347	52.50%
5. Other	7	1.06%
Uncoded	41	6.20%
TOTAL	661	100.00%

Q13 Ticket Price

1. Less Than 500 Leva	6	0.91%
2. 501 - 1000 Leva	100	15.13%
3. 1001 - 2000 Leva	189	28.59%
4. 2001 - 3000 Leva	115	17.40%
5. 3001 - 4000 Leva	43	6.51%
6. 4001 - 5000 Leva	14	2.12%
7. 5001 - 6000 Leva	18	2.72%
8. 6001 - 7000 Leva	4	0.61%
9. 7001 - 8000 Leva	4	0.61%
10. 8001 - 9000 Leva	3	0.45%
11. 9001 - 10000 Leva	0	0.00%
12. More than 10000 Leva	3	0.45%
Uncoded	162	24.51%
TOTAL	661	100.00%

Q14 Fare Elasticities

	Elasticity	Sample Size
First Class - Combined	-1.54	32
Second Class - Combined	-0.81	330
Second Class - Northern Route	-0.56	109
Second Class - Central Route	-0.89	111
Second Class - Southern Route	-1.00	99

Q15 Alternative Arrangements (If Fares Increase Too Much)

1. Travel By Bus	201	30.41%
2. Travel By Car	68	10.29%
3. Travel By Air	9	1.36%
4. Travel Elsewhere	35	5.30%
5. Not Travel at All	190	28.74%
6. Other	28	4.24%
Uncoded	130	19.67%
TOTAL	661	100.00%

Q16 Journey Time

1. Up to 30 Minutes	11	1.66%
2. 31 - 60 Minutes	38	5.75%
2. 61 - 90 Minutes	54	8.17%
3. 91 - 120 Minutes	51	7.72%
4. 121 - 180 Minutes	114	17.25%
5. 181 - 240 Minutes	66	9.98%
6. 241 - 300 Minutes	80	12.10%
7. 301 - 360 Minutes	43	6.51%
8. 361 - 420 Minutes	71	10.74%
9. 421 - 480 Minutes	27	4.08%
10. 481 - 540 Minutes	7	1.06%
11. 541 - 600 Minutes	1	0.15%
12. More than 600 Minutes	8	1.21%
Uncoded	90	13.62%
TOTAL	661	100.00%
Average Journey Time (Mins) =		234

Q17 & Q18 Journey Time Elasticities

	Elasticity	Sample Size
First Class - Combined	-0.97	63
Second Class - Combined	-0.67	282
Second Class - Northern Route	-0.63	102
Second Class - Central Route	-0.71	92
Second Class - Southern Route	-0.69	88

Q19 Age Group

1. Less than 15 years	3	0.45%
2. 15 - 19 Years	32	4.84%
3. 20 - 24 Years	138	20.88%
4. 25 - 29 Years	73	11.04%
5. 30 - 39 Years	88	13.31%
6. 40 - 49 Years	107	16.19%
7. 50 - 59 Years	99	14.98%
8. 60 - 69 Years	79	11.95%
9. 70 Years or more	27	4.08%
Uncoded	15	2.27%
TOTAL	661	100.00%

Q20 Gender

1. Male	306	46.29%
2. Female	337	50.98%
Uncoded	18	2.72%
TOTAL	661	100.00%

Q21 & Q22. Occupation and Monthly Income

	Average Monthly Income (000 Leva)										
Employment Categories	Up to 50	51-75	76-100	101-150	151-200	201-250	251-300	>300	N/A	TOTAL	%
1. Employed	3	17	49	48	39	7	7	3	101	274	41.58%
2. Housewife	4	0	0	0	0	0	0	0	9	13	1.97%
3. Farmer	0	0	0	0	0	0	0	0	1	1	0.15%
4. Self Employed	1	2	2	6	4	0	0	2	16	33	5.01%
5. Retired	17	12	8	1	1	0	0	0	95	134	20.33%
6. Unemployed/Not Working	1	2	1	0	0	0	0	0	24	28	4.25%
7. Student/Scholar	3	2	6	4	2	0	0	1	108	126	19.12%
8. Armed Forces	6	0	0	2	3	1	2	0	16	30	4.55%
9. Other	1	0	0	0	0	0	0	0	4	5	0.76%
10. Uncoded	0	0	0	0	0	0	0	0	15	15	2.28%
TOTAL	36	35	66	61	49	8	9	6	389	659	100.00%
% (1)	13.33%	12.96%	24.44%	22.59%	18.15%	2.96%	3.33%	2.22%			

Average Monthly Income From All Respondents (Leva) = **127151**

Note (1) Percentage Calculated From Respondents Only

1.3 BDZ FREIGHT TRAFFIC ANALYSIS BY QUARTER YEARS

	Tonne Kms (Million)				Revenue (Million Leva)				Average Rev. (Leva Per Tonne Km)			
	Purely Domestic	Domestic Only Ports	International	Total	Purely Domestic	Domestic Only Ports	International	Total	Purely Domestic	Domestic Only Ports	International	Total
1Q 1996	897	669	231	1797	1464	948	673	3085	1.63	1.42	2.91	1.72
2Q 1996	884	809	194	1887	1321	1688	736	3745	1.49	2.09	3.79	1.98
3Q 1996	993	830	179	2002	1930	3162	1087	6179	1.94	3.81	6.07	3.09
4Q 1996	914	794	155	1863	2247	4552	1530	8329	2.46	5.73	9.87	4.47
Total 1996	3688	3102	759	7549	6962	10350	4026	21338	1.89	3.34	5.30	2.83
1Q 1997	745	917	151	1813	5478	20083	5981	31542	7.35	21.90	39.61	17.40
2Q 1997	695	976	170	1841	22115	24329	6432	52876	31.82	24.93	37.84	28.72
3Q 1997	903	800	167	1870	27434	21471	7176	56081	30.38	26.84	43.06	30.00

1.4 BDZ RECOMMENDED 'REAL' TARIFF INCREASES

Passenger

1. 1998 - 2002 : 3-5% a year with increased market related tariffs;
2. 2003 - 2005 : 10 - 15% a year with a change in the tariff structure set by individual origin/destination station pairs;
3. 2005 + : 2% per year as the new tariff structure is adjusted and fine tuned.

Freight

1. International Traffic : Fixed by international tariff agreements. Traffic growth rather than tariff increases is the principal means of revenue growth. A 5% growth in real tariffs has been assumed to occur every five years;
2. Ports Traffic : Revenue growth per tonne kilometre has lagged behind that of domestic traffic. An overall increase of 20-30% early in 1998 appears feasible either by changing the January 1993 tariff structure or by altering the selective discounts to individual customers. Small real increases, e.g. 2% a year in total should be possible thereafter until the opening of the Plovdiv - Burgas/Varna motorway in 2015 which will lead to a severe increase in road competition for all commodities. A sharp overall decrease in tariffs, e.g. 20 - 25% is envisaged after this;
3. Domestic Traffic : The substantial tariff increases early in 1997 appear to have had no appreciable affect on traffic volumes. No tariff increases have occurred since April 1997. An additional real increase of 10 - 20% early in 1998 appears feasible. Thereafter small real increases should be feasible (annually 2% to the year 2005 and 1% thereafter as road traffic growth increases). Of the domestic traffic, petroleum products (from Burgas) will be the main commodity suffering competition and depressed tariffs from the opening of the new motorway.

Costing and Cost Allocation

1. The reinstatement of OSCAR and the ability to set tariffs at marginal rates should generate new traffic, particularly from the domestic and ports markets. A 5% overall increase in these markets should be achieveable by the year 2001;
2. The implementation of the MIS system including the FMS and FOS will improve the quality of cost information and quality of service to freight customers. The former will allow a more accurate identification of costs by activities and as a result operating cost savings and increased productivity of at least 10% should be achievable. The improved service in itself will generate additional traffic, particularly with high value cargoes where service quality is important. A 5-10% in total freight traffic should be achievable, with revenue growth of at least 10%.