The European Union's Tacis TRACECA programme
for Armenia, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Romania, Tajikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan

Review of Railways Rehabilitation in Central Asia

for Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan

Module B – Detailed Design and Tender Documents of the rehabilitation measures for the Kungrad – Kazakh Border railway section (Uzbekistan)

October 2005

This project is funded by the European Union

ITALFERR
A project implemented by Italferr S.p.A.

Report cover page

Project Title:	**Review of Railway Rehabilitation in Central Asia**		
Project Number:	**65290 – EuropeAid/116151/C/SV/Multi**		
Countries:	**Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan**		

	Local operators		EC Consultant
Name:	Republican State Enterprise "KAZAKHSTAN TEMIR ZHOLY" Mr. Talaspekov K.S.	State Company KYRGYZ TEMIR ZHOLU Mr. Isaev K. Sh	ITALFERR S.p.A.
Address:	98, Pobeda av., 473000, Astana, Kazakhstan	83, L. Tolstoy str., 720009, Bishkek, Kyrgyz Republic	via Marsala, 53/67 – 00185 Rome – Italy Akhunbabaeva ul, 15 – 700047 Tashkent – Uzbekistan
Tel:	(3172)935002	(998312) 657068	+39.06.49752721 +998.71.1321237
Fax:	(3172) 935836	(996312) 651441	+39.06.49752209 +998.71.1321286
Name:	Tajik Railways Mr. Khukumov A.	State Joint Stock Railway Company "UZBEKISTON TEMIR YULLARI" Mr. Ramatov A. J.	E-mail: a.veralli@italferr.it
Address:	35, Nazarshoev str., 734012 Dushanbe, Tajikistan	7, T.Shevchenko str., 700060 Tashkent, Uzbekistan	
Tel:	(992372) 216059	(99871) 1388414	
Fax:	(992372) 218334	(99871) 1320552	

Contact Person:	Project Director Alessandro Veralli
Signature:	

Date of report: 31 October 2005

Authors of report: Project Team

EC M & E team	[name]	[signature]	[date]
NCU Uzbekistan	[name]	[signature]	[date]
TACIS Bureau [task manager]	[name]	[signature]	[date]

ABBREVIATIONS

ABLS	Automatic Block Line System
ADB	Asian Development Bank
ALC	Automatic Level Crossing
BC	Border crossing
CAR	Central Asian Republic
COTIF	Convention concerning the International Transport of Goods by Rail
CIS	Commonwealth of Independent States
CTC	Central Traffic Control
CWR	Continuous Welded Rail
EAEC	Euro Asian Economic Community
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECE	UN Economic Commission for Europe
ECO	Economic Cooperation Organisation
ECMT	European Council of Ministers of Transport
EDD	Unified Transit Tariff
EIRR	Economic Internal Rate of Return
ERII	Electric Relay Interlocking Installation
EU	European Union
FSU	Former Soviet Union
GDP	Gross Domestic Product
IGC	Intergovermental Commission TRACECA
IMF	International Monetary Fund
IRU	International Road Transport Union
IsDB	Islamic Development Bank
JBIC	Japanese Bank for International Cooperation
KAZ	Kazakhstan
KGZ	Kyrgyz Republic
KTZ	Kazakhstan Temir Zholy (Kazakhstan national railways)
MLA	Multilateral Agreement on International Transport for Development of TRACECA
KZT	Kazakhstan Tenge
LC	Level Crossing
MKDII	Mechanic Key dependent Interlocking Installation
MOTC	Ministry of Transport and Communications
MTT	International Railway Tariff
OECD	Organisation of Economic Co-operation and Development
OSJD	Organisation for the Cooperation in Railways (based in Varshaw)
PRC	People's Republic of China
PW	Permanent Way (rails, sleepers, fastenings, ballast)
SIS	Static Interlocking System
SMGS	Agreement on International Railway Freight Transport
SPECA	Special Programme for the Economies in Central Asia
TA	Technical Assistance
TACIS	Technical Assistance for the Commonwealth of Independent States
TAJ	Tajikistan
TAR	Trans-Asian Railway
TEU	Twenty Foot Equivalent Unit
TIR	Transport International Routier
TOR	Terms of Reference
TRACECA	Transport Corridor Europe Caucasus Asia

UIC	Union International des Chemins of Fer (based in Paris)
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
USAID	United States Agency for International Development
USD	United States Dollar
UTY	Uzbek Temir Yullari (Uzbekistan national railways)
UZB	Uzbekistan
WTO	World Trade Organisation

TABLE OF CONTENTS

ANNEXES

Executive summary

After the development of the Feasibility Study (March 2005), project activities have been carried out, aiming at producing tender documents suitable for international tender for rehabilitation measures for the Kungrad-Kazakh border railway line. The present document is to report the conclusions of such activities of Detailed Design and Tender Documents issuing.

Historically the section under study belongs to the Kungrad - Beyneu railway line (407 km) as it is shown in the following Figure.

The Kungrad – Beyneu railway line

After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national border between Uzbekistan and Kazakhstan: the Kungrad – Border (327 km) and the Beyneu – Border (80 km).

The administrative change could not modify so much the situation since the two sections are still working in conjunction. This is why the report is making reference to the whole line.

Besides this fact, improvements along the main line have to be financed and managed by two different Railway Administrations.

Consequently the issue of the competence has required to consider two different Feasibility Studies and two different Tender Documents for rehabilitation measures concerning sections of the same line.

The activities for the Detailed Design and Tender Documents preparation have been performed by the Consultant developing the proposed "Option 1" of the Feasibility Study delivered in March 2005

The categories in which the whole rehabilitation works can be divided are:

1. Infrastructure:
    a. Civil works concerning earthworks;
    b. Permanent way replacing works (just for the line, stations excluded)
    c. Existing permanent way rail welding and tension regulation;
    d. Re-alignment, leveling and ballast cleaning on the existing sections;
    e. Civil works concerning structures (replacement of bridge beams);
    f. Civil works concerning re-pavement of some level crossings (L.C.). In terms of level crossings no elimination has been envisaged for the low traffic both on the railway line and on the interfered roads (mainly unpaved roads).
2. Power supply systems: new double three-phase overhead 10kV line for supporting electrical needs of signaling and ancillary services of stations and line.
3. Telecommunications.

Costs for the rehabilitation works have been estimated to be of 79,4 millions of US$ and the Consultant strongly recommends the adoption of international standards documents to assure an International Competitive Bidding (ICB).

The works to be performed have been split into 3 lots according to their nature:

- Lot 1.1 – Permanent Way and Civil Works;
- Lot 1.2 – Power Supply
- Lot 1.3 – Telecommunications

Because of the nature of the works to be performed, the tenders should be international tenders for "Design-Build" and for "Procurements of Goods". Consequently tenders documents which have been prepared can be used for launching a tender for Design-Build for the renewing of the Permanent Way and Civil Works (Lot 1.1) and two tenders for Procurement of Goods for the renewing of the Power Supply and Telecommunications issues (Lots 1.2 and 1.3).

According to this rationale the Consultant has developed the tender documents using international standards (ADB guidelines) and including:

- prequalification of bidders
- tender for Design-Build Contracts with Single Stage procedure
- tender for Procurements of Goods Contracts with Single Stage procedure

Such approach of using international standards leaves open the possibility of adopting guidelines of procurement of bodies other than ADB. Thus the approach doesn't prevent the Beneficiary to implement the project using other guidelines (i.e. World Bank, EBRD, national, etc.) simply taking the core part of the tender document, namely the technical drawings and specifications, and embedding them into a different set of standards documents.

The Consultant has presented such documents in separate Annexes (Annex A, Annex B and Annex C) which can be straight used for the tender just including some basic additional information from the Beneficiary (i.e. employer's name and address, representative of the employer, deadline for presentation, etc).

0. Project synopsis

Project Title:	Review of Railway Rehabilitation in Central Asia
Project Number:	65290 – EuropeAid/116151/C/SV/Multi
Country:	Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan

Wider project objectives: The development of viable, secure, safe and competitive transport routes linking the countries of Central Asia with Europe and other neighboring countries. Strengthened border management capacity facilitating economic development, the movement of people and goods and the prevention of organized crime.

The object of the project is to carry out:

Module A / Analysis of the relevant national railway transport plans and any regional railway transport planning provisions.

Module B / Preparation of Technical and Economic Justifications to support and to attract the investments for the rehabilitation of railway lines in the Kyrgyz Republic, Kazakhstan and Uzbekistan for the purpose of increasing transportation capacities of these areas. Preparation of Feasibility study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Specific project objectives:

The project will carry out:

Module A /

- Overview of relevant traffic flows and forecasts, with special attention on freight transport from Central Asia towards Europe especially through TRACECA corridor;
- Identification of weaknesses and bottlenecks;
- Investigation on the cross-border elements, including co-operation in exchange of data and in customs (also with Afghanistan);
- Evaluation of multi-modal dimensions and possibilities for inter-operability;
- Harmonization of standards and of operating procedures, with particular attention to compatibility with EU standards, in particular with regard to safety and security standards for the transportation of dangerous goods and oil products.

Module B /

Technical and Economic Feasibility Studies for the rehabilitation and construction of new railways lines. Pursuant to the Technical and Economic Justification data there will be prepared the loan applications to the lending banks for the allocation of investments to implement the projects.

Feasibility Study of measures for the maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways.

Planned outputs:

Module A /

- Recommendations concerning multimodal transport
- Recommendations on harmonisation of standards and operating procedures and interoperability.
- Recommendations on improvements of border-crossing procedures.
- Traffic forecasts.
- Tentative prioritisation of recommended actions.

Module B /

- Technical and economic feasibility study of the railway line sections previously identified in Kazakhstan, Kyrgyzstan and Uzbekistan.
- Draft tender document for the same sections.
- Definition of a policy for the maintenance, rehabilitation and renewal of wagons in Tajikistan.
- Feasibility study and preparation of tender documents for rehabilitation and renewal of the existing workshops and maintenance plants in Tajikistan.

Project activities:

Module A /

A.1 – Collection and review of transport and economic studies. Data collection

A.2 – Overview of traffic flows

A.3 – Identification and review of physical, geopolitical, social and environmental issues

A.4 – Analysis of national railway transport plans and regional railway transport planning provisions.

A.5 – Traffic forecasts – Identification of capacity bottlenecks

A.6 – Investigation of border-crossing issues – Recommendations for improvement at borders

A.7 –Review of multimodal transport – Identification of development bottlenecks – Recommendations for improved services

A.8 – Harmonisation of standards and of operating procedures – Recommendations on standards adaptation and improved inter-operability

A.9 – Selection of railway section to be submitted to feasibility study under Module B

A.10 – Discussion with the Project Partners representatives

A.11 – Refining output of Module A

	Module B /
	Activities to be developed in Kazakhstan, Kyrgyzstan and Uzbekistan:
	B.1 - Traffic Analysis
	B.2 - Technical Feasibility
	B.3 - Environmental Impact
	B.4 - Economic Viability
	B.5 - Detailed Design
	B.6 - Rehabilitation/construction implementation schedule
	B.7 - Draft tender documents preparation
	Activities to be carried out in Tajikistan:
	B.8 - Feasibility Study of measures for maintenance, rehabilitation and renewal of the freight wagon fleet of the Tajik Railways
Project starting date:	1 March 2004
Project duration:	20 months

1. Introduction

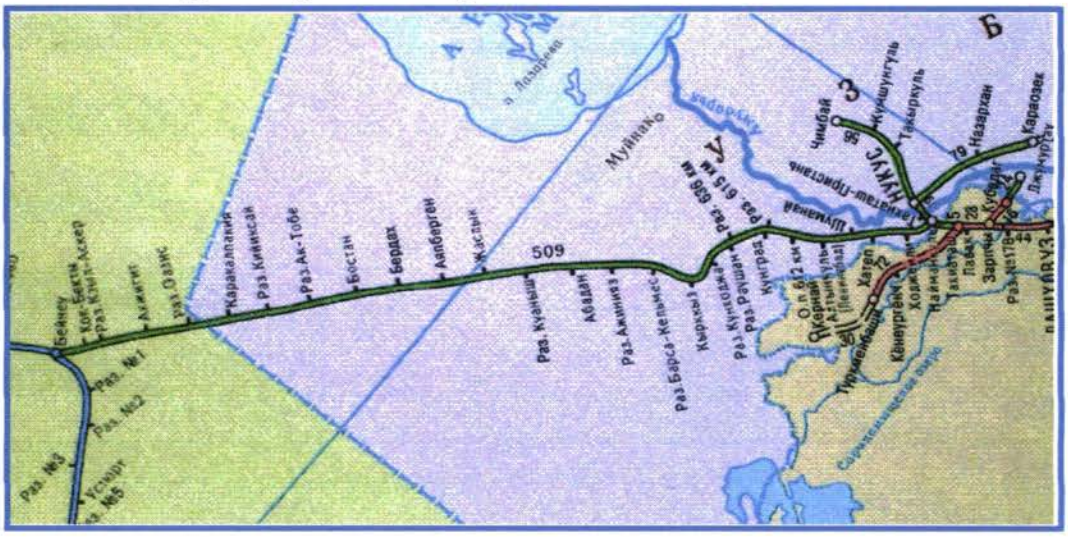
The present document is to report the conclusions of the activities of Detailed Design and Tender Documents developed following the feasibility study of the rehabilitation measures for the Kungrad - Kazakh border railway section in Uzbekistan delivered in March 2005.

Historically the section under study belongs to the Kungrad - Beyneu railway line (407 km) as it is shown in the following Fig. 1-1.

Fig 1-1 The Kungrad – Beyneu railway line

Details of the line are shown in the next Fig. 1-2

Fig 1-2 Details of Kungrad-Beyneu railway line



After the collapse of the former Soviet Union, the line has been split into two sections because of the introduction of the national border between Uzbekistan and Kazakhstan: the Kungrad – Border (327 km) and the Beyneu – Border (80 km).

The administrative change could not modify so much the situation since the two sections are still working in conjunction. This is why the report is making reference to the whole line.

Besides this fact, improvements along the main line have to be financed and managed by two different Railway Administrations. Consequently the study has to consider two addressee for the two different Feasibility Studies for rehabilitation measures concerning sections of the same line.

The importance of this line for Uzbekistan is without questions: the line is to be contributing significantly to the national economy giving access to important trade markets other than neighboring countries.

As a matter of facts Uzbekistan is a double-land locked country and the infrastructural heritage from the former Soviet Union economy was inward oriented with relation with Russia more then with other countries. Actually this is reflected in the organization of Uzbek railway network which has no connection with east and south and that can reach the most important trade markets only from three borders: Alat (mainly for reaching Europe and Middle East), Keles (most probably for China and Russia) and of course Karakalpakia (for Europe and Russia), the last-one passing through the Kungrad – Kazakh Border railway line.

The activities for the Detailed Design and Tender Documents preparation have been performed by the Consultant developing the proposed "Option 1" of the Feasibility Study delivered in March 2005. After that date, several meetings have been held with high representatives of the Uzbek railways to discuss details of the option proposed in the Feasibility Study without relevant comments or request to introduce important changes.

The Consultant has consequently undertaken the Detailed Design and the Tender Documents preparation for the best option selected during the Feasibility Study.

In particular the categories in which the whole rehabilitation works can be divided are:

1. Infrastructure:
    a. Civil works concerning earthworks;
    b. Permanent way replacing works (just for the line, stations excluded)
    c. Existing permanent way rail welding and tension regulation;
    d. Re-alignment, leveling and ballast cleaning on the existing sections;
    e. Civil works concerning structures (replacement of bridge beams);
    f. Civil works concerning re-pavement of some level crossings (L.C.). In terms of level crossings no elimination has been envisaged for the low traffic both on the railway line and on the interfered roads (mainly unpaved roads).
2. Power supply systems: new double three-phase overhead 10kV line for supporting electrical needs of signaling and ancillary services of stations and line.
3. Telecommunications.

The works to be performed have been, consequently, split into 3 lots according to their nature:

- Lot 1.1 – Permanent Way and Civil Works;
- Lot 1.2 – Power Supply

- Lot 1.3 – Telecommunications

In all cases the tender should be an international tender: for Lot 1.1 a Design-build (Single Stage) tender has been adopted while for Lot 1.2 and Lot 1.3 a Procurement of Goods Tender should be adopted.

For both tenders typologies the Consultant has developed tender documents packages using international standards (ADB standards). In the case of the Design-build tender the following steps have been included:

A prequalifaction of bidders, and

B design-build tender (single stage)

In the case of "procurement of goods" the following steps have been considered:

A prequalifaction of bidders, and

B tender for procurement of goods (single stage)

Such approach of using international standards, leaves open the possibility of adopting guidelines of procurement of bodies other than ADB. Thus the approach doesn't prevent the Beneficiary to implement the project using other guidelines (i.e. World Bank, EBRD, national, etc.) simply taking the core part of the tender document, namely the technical drawings and specifications, and embedding them into a different set of standards documents.

The Consultant has presented such documents in separate Annexes (Annex A, B and C) which can be straight used for the tender just including some basic additional information from the Beneficiary (i.e. employer's name and address, representative of the employer, deadline for presentation, etc).

2. Detailed Design of Permanent Way and Civil works (Lot 1.1)

The envisaged works consist in the rehabilitation of 327km single track railway line including permanent way replacement works which were considered necessary as a consequence of the Feasibility Study delivered on March 2005 (about 177km including sub-ballast, ballast, sleepers, fastenings, rails, weldings for creating the continuous welded rail and joints) and tamping, levelling, re-aligning and ballast addition over 277km. Stations are excluded (rail yards, buildings and passenger facilities). Replacement works over 44 small bridges and other minor works are also envisaged.

Therefore description of the present situation and detailed design have been limited to those aspects included in the Lot 1.1.

The Consultant was provided with the only existing profile of the line on paper support in very bad condition, hardly readable. The plan-profile at scale 1:10000 has been completely redone on digital support. A new row has been inserted to give the depth of the excavation from the rail level along the stretches on which the sub-ballast layer has to be implemented, supposing to be reliable, at the time being, the original design of the slopes **(see drawing L1.1-2, 111 sheets)**.

It is worth mentioning that the adopted tender documents for "design and build" gives to the construction contractor the full responsibility of developing the executive design following the so called "employer's requirements".

The detailed design performed by the Consultant is due just for formulating the employer's requirement and not for other elaborations.

On the contrary the construction contractor is the sole responsible of the executive design and of the works implementation. In such circumstances, the detailed design made by the consultant has to be seen a base/advise which doesn't prevent the construction contractor to propose other works methodology and formulate their financial proposal accordingly.

2.1 Description of the present situation

2.1.1 Permanent Way and earthworks

The description of the existing Kungrad - Kazak border section has to be referred to Kungrad – Beyneu line and has to be done in the frame of the definitions established for lines by the order 70"H" dated 09.11.95, concerning types and elements of permanent way, track works, maintenance and periodicity of their execution.

From the following tables 2.1.1 - 1 and 2.1.1 - 2 the line classification in **categories**, by their technical characteristics, and in **groups,** by density of freight traffic, is possible.

Table 2.1.1 - 1 Track classification (decree 70"H" of 09.11.95)

Track group	Density of freight traffic, mln. tkm gross weight km/per year	Track category						
		1	**2**	**3**	**4**	**5**	**6**	**7**
		Speed: passenger trains is numerator; freight trains is denominator, km/h						**Station, branch and other tracks**
		121-140	**101-120**	**81-100**	**61-80**	**41-60**	**40 and less**	
		> 80	**> 70**	**> 60**	**> 50**	**> 40**	**main reception/departure tracks**	
		Main tracks						
A	> 80	1	1	1	2	2	3	
B	50-80	1	1	2	2	3	3	
C	25-50	1	2	2	3	3	4	5 class
D	10-25	1	2	3	3	4	4	
E	10 and less	2	2	3	3	4	4	

Considering that the section under study had in the last years a freight traffic of 1,5÷2,0*10^6 gross tons/year, and that, on almost all the section, the speed is for the time being 50-60 km/h and that old wooden sleepers and worn out P50 rails are installed on the major part of the section, it is possible to conclude that this line is currently classified as an **E5 line**.

Table 2.1.1 - 2 Technical terms and conditions for track laying and maintenance according to its class (decree 70"H" of 09.11.1995)

Track class				
1	**2**	**3**	**4**	**5**
1. Superstructure constructions **Continuous welded rail (CWR) tracks on reinforced concrete sleepers or link track on timber sleepers**				
2. Types and characteristics of superstructure				
New temperature –resistant R65 rails, 1 group, 1 class; new fastenings; new sleepers (impregnated timber, 1 group). Sleepers profile: on direct lines and curves R>1200 m - 1840 pcs/km; on curves with R<1200 m and less - 2000 pcs/km. Ballast: gravel or asbestos with the layer depth of 35 cm under timber sleepers; 40 cm – under reinforced concrete sleepers.	New R65 rails or used ones in accordance with the Table 2.3. New or repaired used fastenings and sleepers – in accordance with Technical Conditions for the usage of used superstructure materials. Profile and the group of rails are the same as on the 1st and 2nd class tracks. Gravel or asbestos ballast, with layer depth of 25 cm under timber rails and 30 cm under reinforced concrete sleepers.	Used R65 rails – in accordance with the Technical Conditions for the usage of used superstructure rails. Used fastenings and sleepers, as a rule repaired ones. Sleeper profile is the same as on the 1 - 3 class rails. The laying of new sleepers of 2nd group is allowed. Ballast: gravel, asbestos, gravel and sand with layer depth of 20 cm under timber sleepers and 25 cm under reinforced concrete ones.	Rails, fastenings and sleepers are all used ones of all types, including the ones unusable in track laying of the 3rd and 4th class but not lighter than R 43. Interlacing of used reinforced concrete sleepers with timber ones is allowed. Sleepers profile: 1440 pcs/km on direct lines; 1600 pcs/km on curves with R< 650 m. Ballast depth underneath the sleeper not less than 15 cm.

Alignment

The section length is 327 km, mostly on straight, being the total curves length only 20,5 km. Every circular curve is provided with parabolic transition curves at the beginning and at the end.

The maximum allowed load is 23 t/axle.

Line formation

Along the Kungrad – Kazak border section the track formation is represented mainly by embankments 1÷2 m high with the exception of the line stretch from the Amu-Darya floodplain to

Ustyurt plateau (chainages from km 745 to km 747), where the embankment height reaches up to 7.0 m.

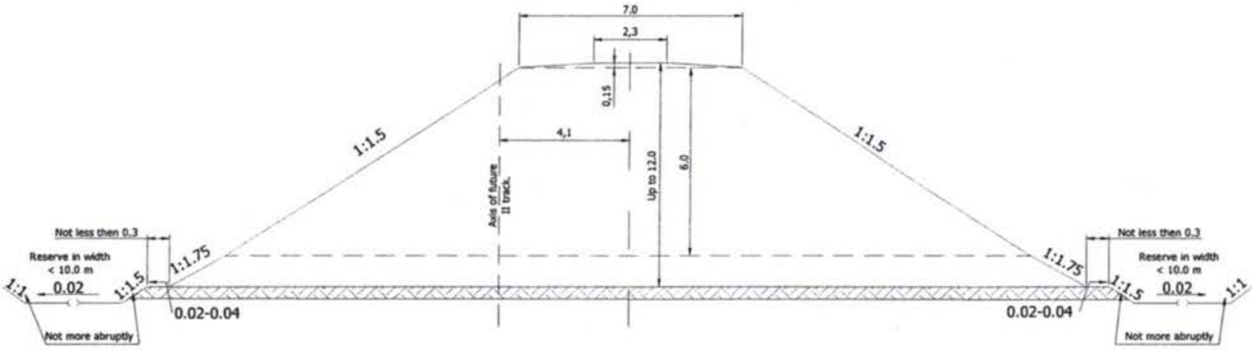
The top surface of the embankment width varies from 6,0 m to 7,1 m.

The embankment is built with local soil represented by clayey and sandy materials.

On this track section no problem related to geology, instability of soil, seismology has been detected.

The typical cross section of embankments is shown in Fig. 2.1.1 – 1; it can be observed the slope of about 6% towards both sides, starting from a central strip 2,3 m wide.

Fig. 2.1.1 – 1 Standard cross section of formation



Typical cross structure of embankment in height up to 12 m from clay soils, fine and powdery sand and it is easy weathered rock.
The note: At erection of embankments from dry sand with a corner of a natural slope less than 340 their slopes are arranged more gentle slope .

Superstructure

The typical superstructure cross-sections on straight track and on curve are shown in Fig.2.1.1 – 2. On the top surface of the embankment is laid down a sandy gravel layer 0,2÷0,3 m thick, and a ballast layer 0,20÷0,35 m thick under sleepers.

Along the main line of the track section the study is taking into consideration,

- the sandy gravel layer and the ballast layer are, respectively, 0,2 and 0,3 m thick,
- both wooden and concrete sleepers are installed (see Fig. 2.1.1 – 3 and 2.1.1 – 4); they are laid down at a distance of 0,55 m / 0,50 m between their axels on straight / on curves of radius less than 1200 m (1840 / 2000 sleepers per km),
- P50 and P65 type of rails are laid down (see Fig. 2.1.1 – 5),
- fastenings rail-wooden sleepers and rail-reinforced concrete sleepers are shown in Fig. 2.1.1 – 6.

***Fig. 2.1.1 – 2* Typical superstructure cross sections on straight track and on curve**

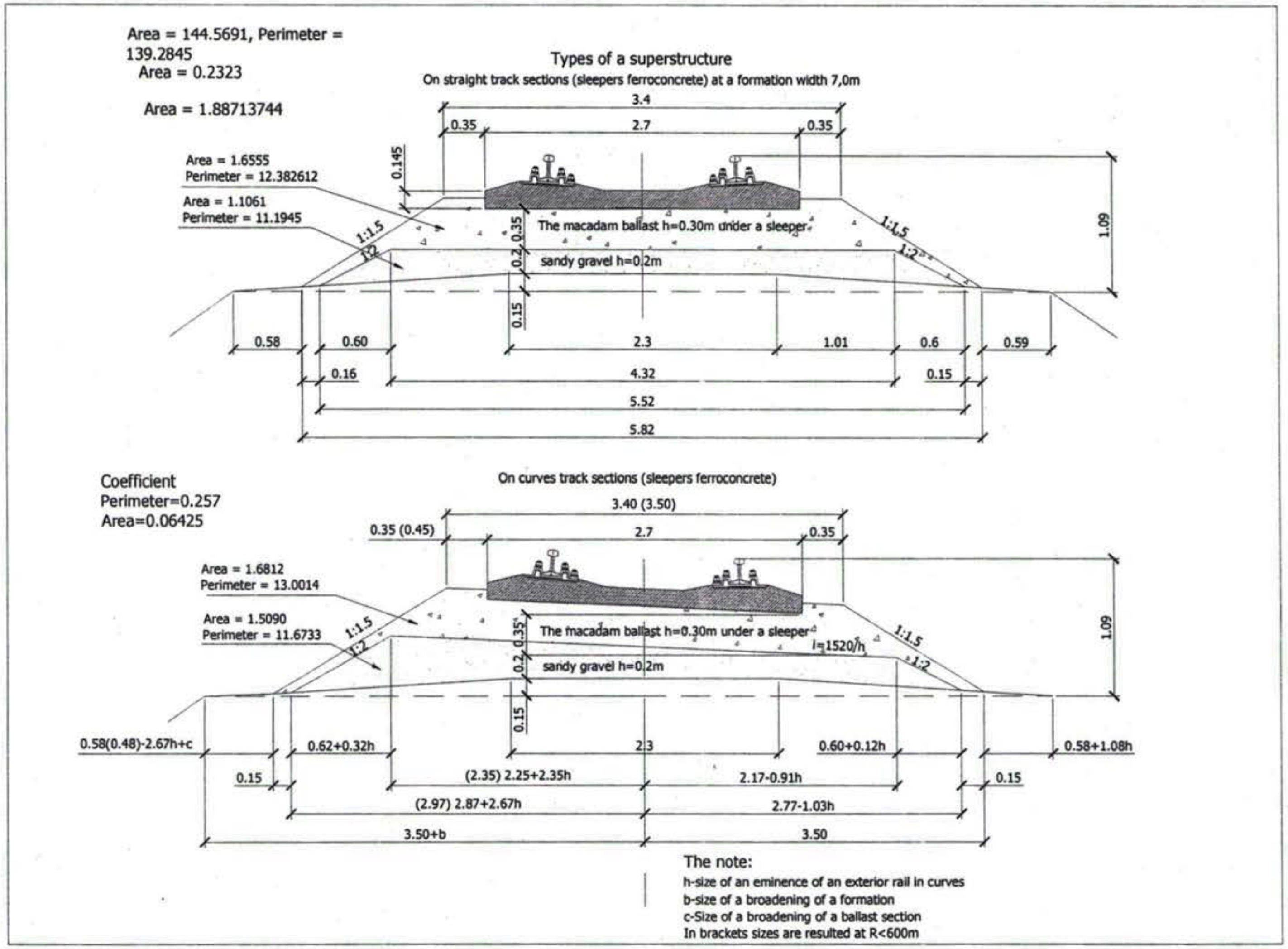
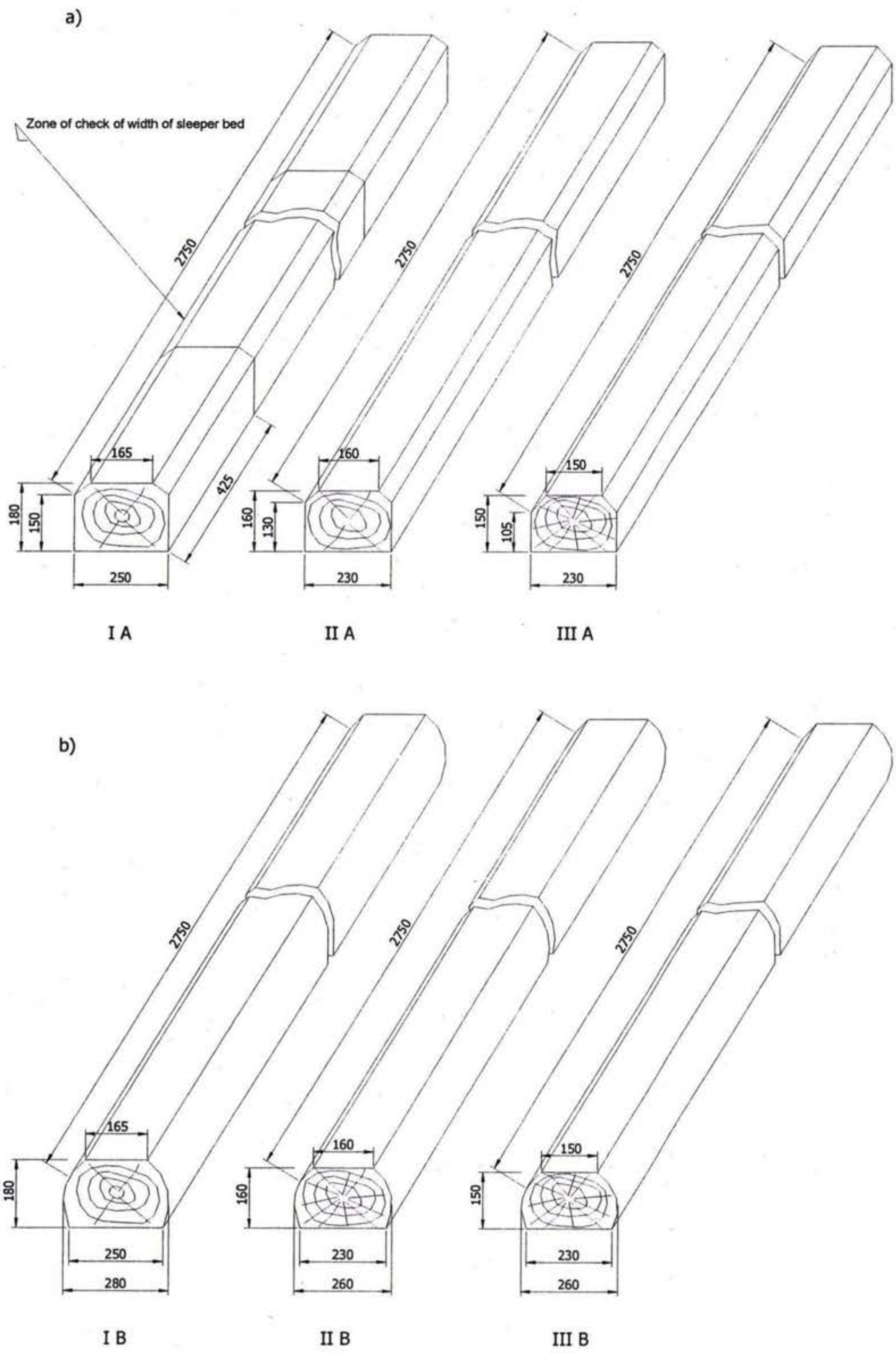


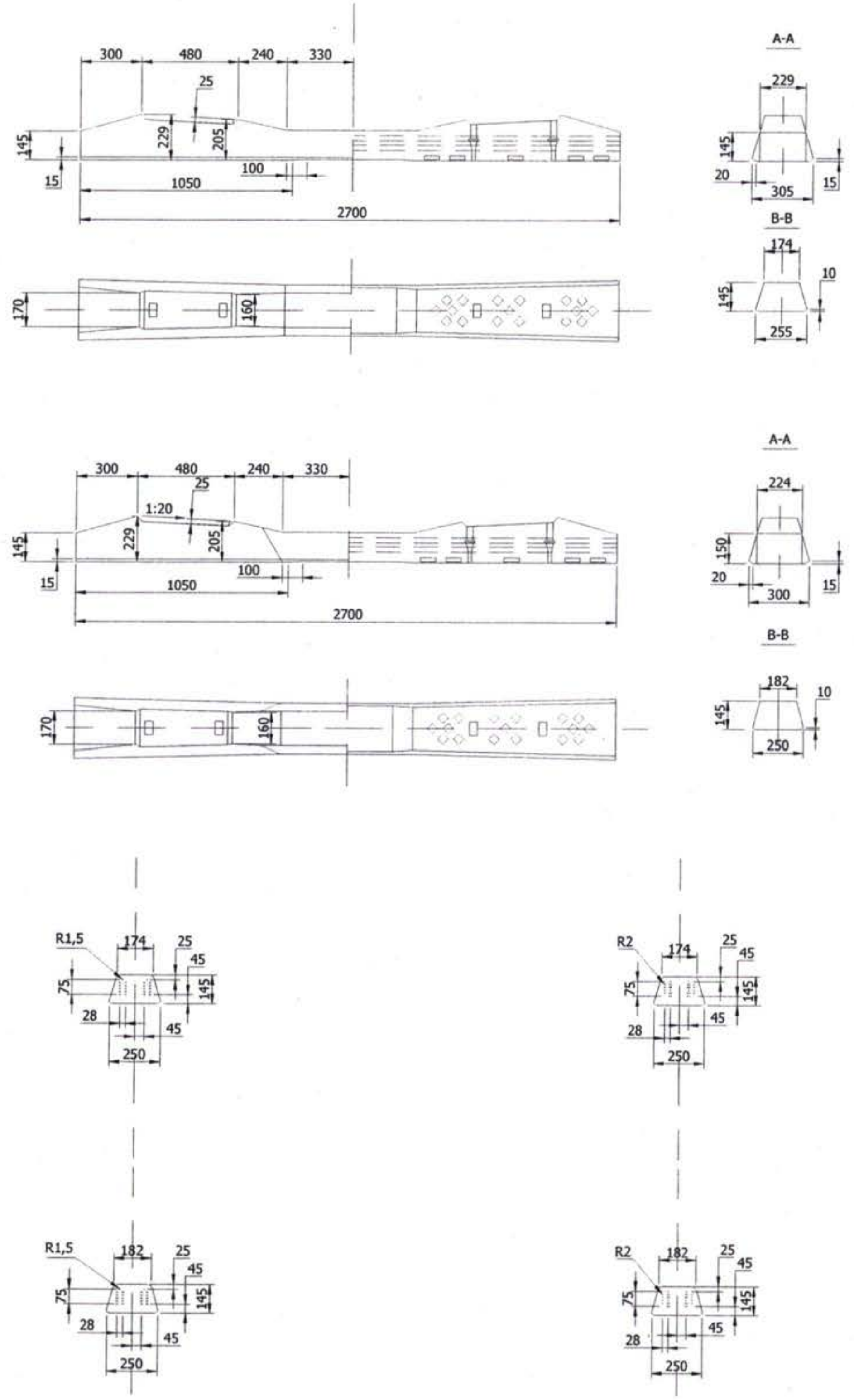
Fig. 2.1.1 – 3 Wooden sleepers

(mm)



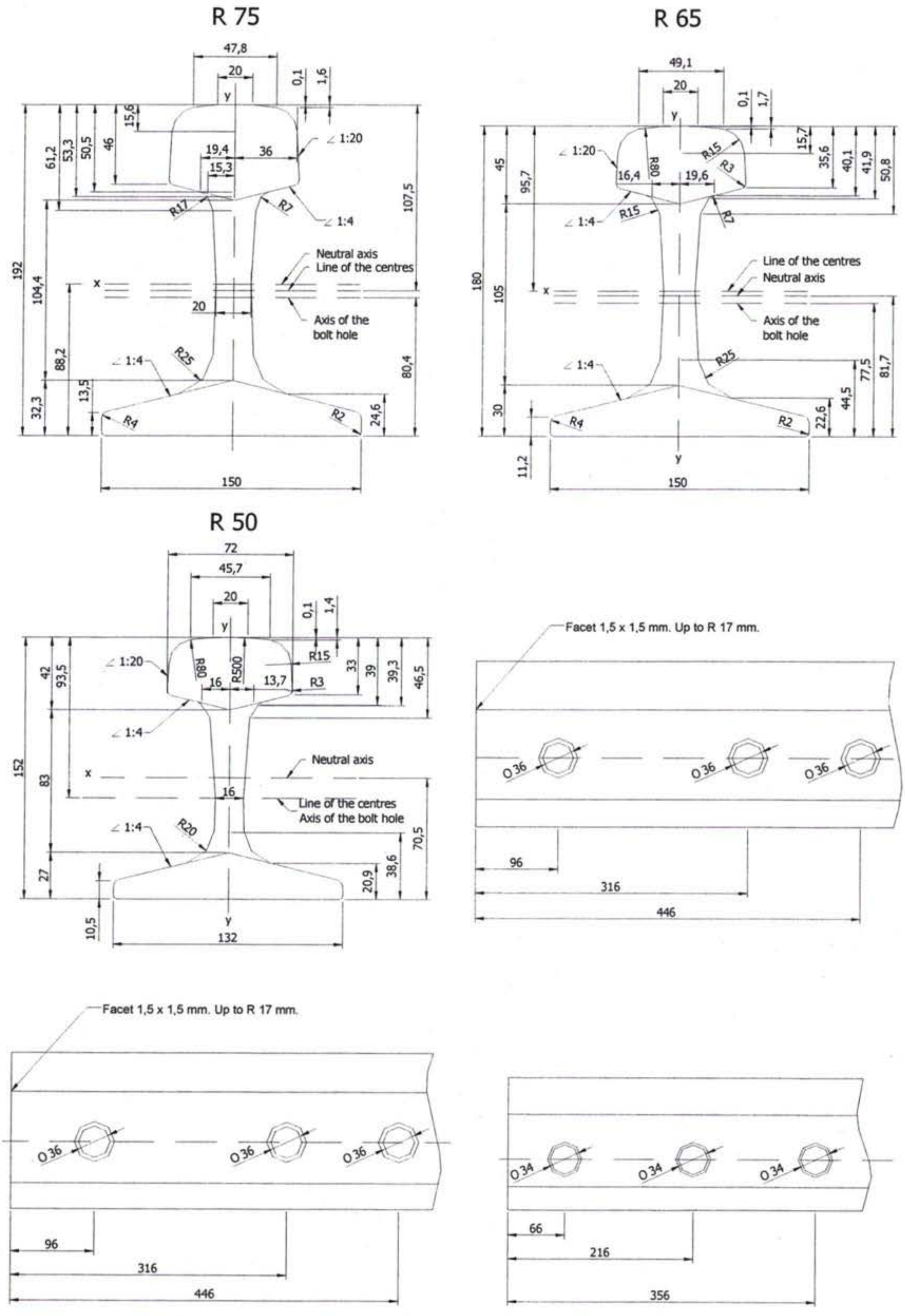
Types of timber sleepers:
A) edging; B) not edging.

Fig. 2.1.1 – 4 Design of ferroconcrete sleepers
(mm)



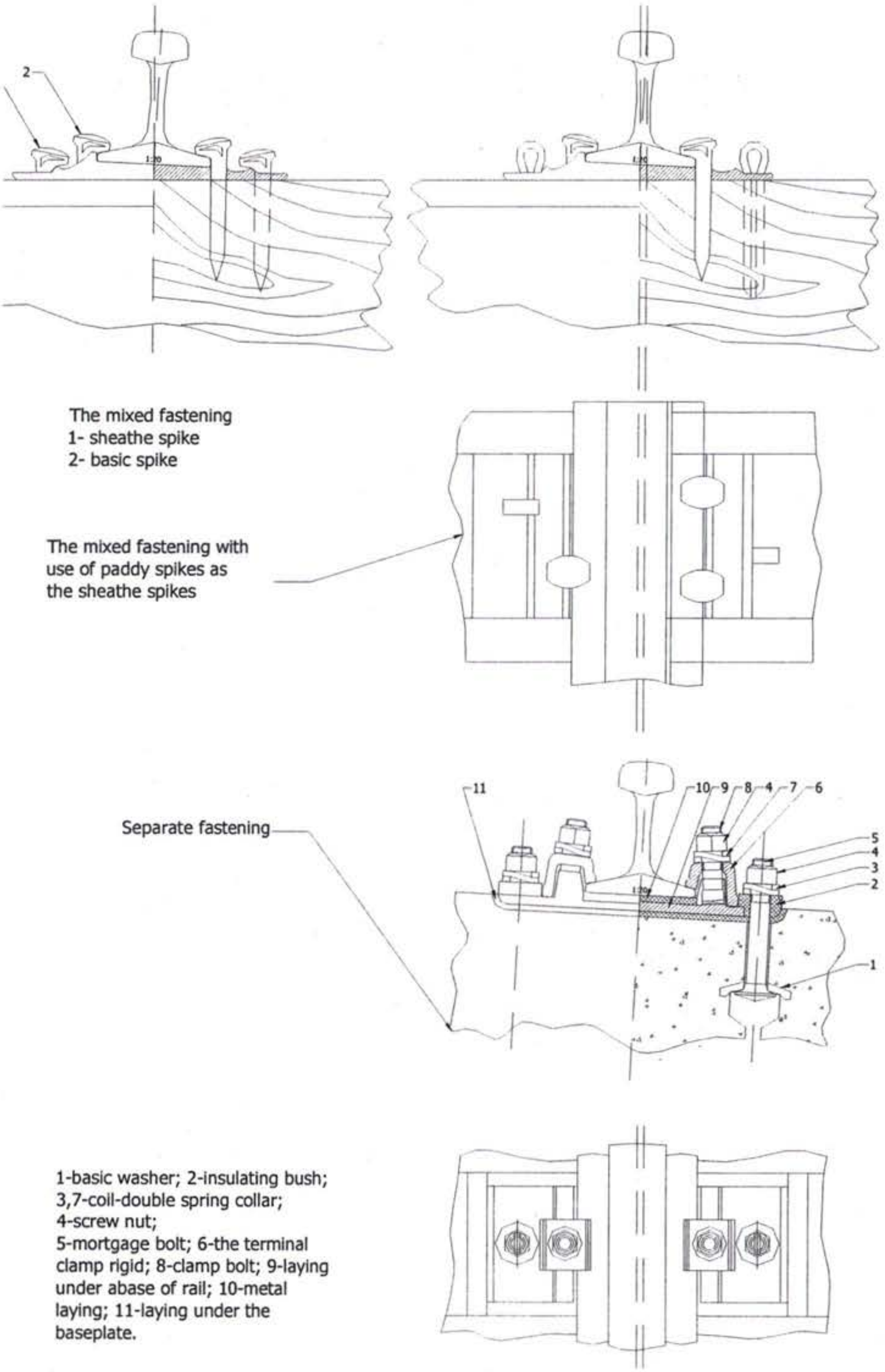
Design of ferroconcrete sleepers
a - such as C-73-1; b - such as C-73-2; c - cross sections and reinforcing of sleepers C-73-1; d - cross sections and reinforcing of sleepers such as C-73-2.

Fig. 2.1.1 – 5 Cross profiles of standard rails (R 75, R 65, R 50)



Cross profiles of standard rails (R75 R65 R50)

Fig. 2.1.1 – 6 Types of fastenings



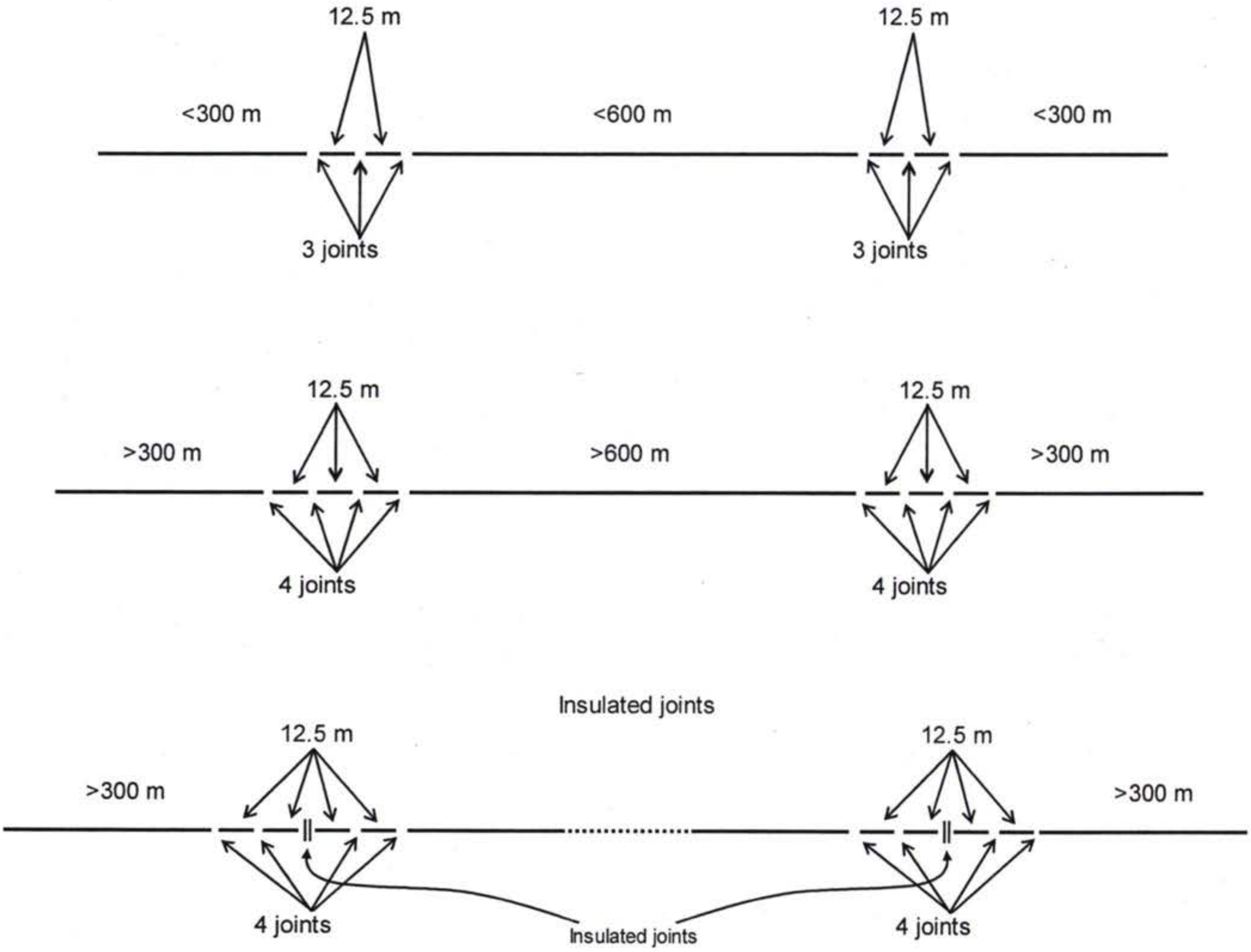
Normally the rails are provided in 25 m bars; so, when they are laid down, a joint has to be done every 25 m. To reduce the hammering at the passage of trains, the joints on one rail are displaced 3 cm from the relevant ones on the other rail along the track

On lines equipped with concrete sleepers, a great reduction of hammering effect can be obtained by welding rails in long bars (continuous welded rails, cwr).

The great advantages of this technique, which will be described in the next paragraphs, are the increase in comfort for passengers and considerable reductions in noise, in wearing out of rails and rolling stocks, in costs of maintenance.

According to Russian standards the maximum length of welded rail bars in Central Asia countries is 900÷1000 m. At the beginning and at the end of the long welded bars a sequence of joints and short bars 12,5 m long has to be laid down to allow a limited "expansion" of the long bar at the highest levels of temperature. The schemes to be implemented are reported on Fig. 2.1.1 – 7:

Fig. 2.1.1. - 7
(measures in m)



The situation of the existing permanent way on line and into stations on the studied section, can be summarized as it follows (see table 2.1.1 – 3)

Table 2.1.1 – 3 Existing permanent way on line and stations

Rehabilitation of the Kungrad-Beyneu railway line - Permanent way type on the Kungrad - Border section												
Station		**Chainage**		**Type of rails**		**Type of sleepers**		**Traffic**	**Stations**			
	Name							**by 01.05**	**Siding 1**	**Turnouts**		
		start km	**end km**	**P-65**	**P-50**	**Wood**	**Concr.**	**(mln gross tn)**	**PW Type 1**	**Tot**	**P50**	**P65**
		Between turnouts		*km*	*km*	*km*	*km*					
1	*Kungrad*	*626.000*	*628.269*		*1.868*	*1.868*			*W+P50*	*12*	12	0
		628.269	645.254		16.985	16.985						
2	*Raushan*	*645.254*	*647.583*	*2.229*			*2.229*		*C+P65*	3	3	0
		647.583	657.200	*9.617*			*9.617*					
		657.200	659.200		*2.000*	*2.000*						
		659.200	670.249	*11.049*			*11.049*					
3	*Kunkhodja*	*670.249*	*672.660*	*1.057*	*1.254*	*1.254*	*1.057*		*C+P65*	3	3	0
		672.660	*686.615*	*10.000*	*4.000*	*4.100*	*9.900*	*325.800*				
4	*Kyrk-Kyz*	*686.615*	*688.715*		*1.966*	*1.966*			*W+P50*	*4*	4	0
		688.715	711.182	*6.000*	*16.500*	*22.500*	-	800.200				
5	*B.-Kelmes*	*711.182*	*713.540*		*2.258*	*2.258*			*C+P65*	*3*	3	0
		713.540	732.799	*2.400*	*19.600*	*19.600*	*2.400*	800.200				
6	*Ajiniyaz*	*732.799*	*735.140*		*2.241*	*2.241*			*W+P50*	3	3	0
		735.140	756.506	-	*21.400*	*21.400*	-	800.200				
7	*Abadan*	*756.506*	*757.845*		*1.205*	*1.205*			*W+P50*	*4*	4	0
		757.845	777.348		*19.503*	*19.503*		800.200				
8	*Kuanysh*	*777.348*	*779.701*		*2.253*	*2.253*			*C+P65*	*3*	3	0
		779.701	796.146		*16.445*	*16.445*		800.200				
9	*Jaslyk*	*796.146*	*797.890*		*1.577*	*1.577*			*W+P50*	5	5	0
		797.890	820.770		*22.880*	*22.880*		789.300				
10	*Ayapb.*	*820.770*	*823.136*		*2.266*	*2.266*			*C+P65*	*3*	3	0
		823.136	*845.185*	22.049			*22.049*	*359.000*				
11	*Berdakh*	*845.185*	*847.532*		*2.247*	*2.247*		*789.300*	*W+P50*	*3*	3	0

			847.532	870.220	22.688			22.688					
	12	*Bostan*	*870.220*	*871.579*	*1.192*			*1.192*		*W+P50*	*5*	1	4
			871.579	*891.477*	*19.898*			*19.898*	*188.700*				
	13	*Ak-Tobe*	*891.477*	*893.800*		*2.223*	*2.223*			*W+P50*	*3*	3	0
			893.800	*912.309*		*18.509*	*18.509*		*789.300*				
	14	*Kiyiksay*	*912.309*	*914.651*		*2.242*	*2.242*			*C+P65*	*3*	3	0
			914.651	927.900		*13.249*	*13.249*		789.300				
			927.900	932.741	*4.841*			*4.841*	441.500				
	15	*Karak.*	*932.741*	*934.186*		*1.245*	*1.245*			*W+P50*	*6*	5	1
			934.186	953.000	*18.814*			*18.814*	230.600				
		BORDER	953.000								**63**	**58**	**5**

In Table 2.1.1-3, also the age of the permanent way is indicated for the most part of the considered section. The age is indicated in terms of million gross tonnes passed on the railway after the last Capital Maintenance.

Moreover, the same table also describes the situation of the PW in the first siding of each station and the situation of the turnouts (number and PW per each station).

Some sections of the line are also equipped with continuous welded rails (CWR), as described by the following table.

Table 2.1.1 – 4 Sections equipped with CWR

Rehabilitation of the Kungrad-Beyneu railway line – PW with CWR on the Kungrad – Border section			
Chainages	**Rail type**	**Type of sleeper**	**Notes**
km 647 – km 658	P65	reinforced concrete	Continuous welded rails
km 658 – km 660	P65	wooden	Continuous welded rails
km 660 – km 677	P65	r. concrete	Continuous welded rails

The following tables resume the PW characteristics along the Kungrad-Border line.

Table 2.1.1 – 5 PW characteristics along the Kungrad-Border line

PW type Uzbekistan (327 km) (turnouts excluded)		
	Km of line	**Km in stations main tracks**
W+P50	177.071	22.976
C+P65	121.356	4.478

Turnouts on main line into stations have been excluded from the distances shown in the table 2.1.1-5 (each turnout type 1:11 has a total length of about 33.5m).

Visit of the line

The line was visited by Italferr experts from 9th to 14th of November 2004. Experts of each technical field were allowed to investigate in detail each technical matter and to take pictures on almost all the line. Photographic report of the visit is annexed to the Feasibility Study.

PW defects of the line

According to the data collected on filed and to the meetings held with UTY Representatives in Tashkent and on the line, the following defects can be summarised:

- PW is old and worn out in many sections, rails type P50 and wooden sleepers are at their life limit, and their use leads to current heavy speed restrictions and to the sensitive risk of derailment for heavy trains (where the dynamic factor on the permanent way is higher);
- fastening devices, in particular those equipped on wooden sleepers, are old, and their fastening force is almost absent. Bolts and their parts are often worn out. A part of them is not properly working because of the conditions of the sleepers; old wooden sleepers are damaged and their retaining force on bolts and screw is low;
- rail junctions (every 25m for the sections not interested by the C.W.R.) are old and worn out, many bolts are missing for vibration and hammering;
- in correspondence with rail junction, hammering on the rails leaded to a rail consumption over the limits, in particular for those junction where the opening is larger than the maximum admitted;
- general conditions of the alignment geometry have been lost and their preservation is very difficult because of the deformation of the track panels and the bearing capacity of the formation level;
- in parts of the line the lateral paths of 0,59 cm on both sides of the top embankment surface disappeared for the action of raining waters and blowing wind; moreover, further ballast tampings and line re-levellings by using big quantities of ballast, lead to an oversized shape of ballast in the current cross section, consequently quantities of ballast fell down and were wasted;
- in many cases the shoulders of ballast on the sides of sleepers, that in normal conditions are 0,35÷0,45 m wide, are non-existent and sleepers are not lateral contained by the ballast prism, this leading to a risk of alignment loosing, in particular in curve sections, where the centrifuge force is high;
- most of the ballast is extremely polluted with clayey soil and sand;
- big quantities of wooden sleepers are cracked, deformed and therefore to be replaced;
- drainage ditches are generally not existing or highly polluted, the same can be observed for drainage devices (culverts, hydraulic bridges, etc.);
- service roads on the side of formation need interventions to be safely used by railway maintenance cars.

PW maintenance

Constant operability of tracks, long service of its elements, uninterrupted and safe train transportation with established speeds are ensured by the system of planned-preventive maintenance which includes supervision over permanent way, track formation, its drainage and strengthening devices, structures, their maintenance and different types of repairs.

Technical specifications and norms for constructions, types and elements of permanent way, track-works, periodicities of their execution according to the order 70 "H" dated 09.11.95 are reflected in the following table 2.1.1-6.

It has to be pointed out that the line in current status is in category E5 of track, corresponding to the track class 4, while after renewal of permanent way it will be in category E2 of track, corresponding to the track class 3.

Table 2.1.1 – 6 Norms of intervals in renovation and major repair works of the track for establishing the necessity of track works in perspective planning
(in brackets – for junction points)
(decree 70"H" of 09.11.1995)

Track class	**Combination of group and category of the track**	**Intervals in track renovation and major repair works, ml tkm/km per year**		**Diagram of track works in the period between renovations (major repair works) of the track**	
		continuous welded rail track with reinforced concrete sleepers	**Linked train with timber rails**	**continuous welded rail track with reinforced concrete sleepers**	**Linked train with timber rails**
1	2	3	4	5	6
1 and 2	A1; A2; A3	1400	1200	OBПB (PC)BПBO {OBPB(PC)BPBO}	OBПB (PC)BПBO {OBPB(PC)BPBO}
	A4	1500	1300	same	same
	A5	1600	1400	same	same
	B1; B2; B3	1400	600	OBCB (PC)BCBO {OBPB(PC)BPBO}	OBCO {OB(PC)PBO}
	B4	1500	650	same	same
	B5	1600[1])	700	same	same
	C1; C2; C3	1400[1])	600[2])	OBCB (PC)BCBO {OBPB(PC)BPBO}	OBBCBBO {OB(PC)PBO}
	D1; D2; E1	Once in 25 years	Once in 15 years	OBBCBBO {OBB(PC)PBBO}	OBCBO same
3	A6	1200	1000	KBLB (PC)BLBK	KBLB (PC)BLBK
	B5; B6	1200	500	{OBPB(PC)BPBO}	{OBPB(PC)BPBO}
	C4; C5	700[3])	500[2])	KBB (PC)BLK {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
	D3; D4; **E2**; E4	**Once in 25 years**	Once in 15 years	**KBBCBLK** {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
4 including reception and departure	C6	1200[3])	Once in 15 years	KBLB (PC)BLBK {OBPB(PC)BPBO}	KBCLK {OB(PC)BO}
	D5; D6; **E5**; E6	Once in 25 years	**Once in 15 years**	**KBBCBLK** {KBB(PC)BLK}	KBCLK {KBCLK}
5	A7; B7; C7; D7;E7	Once in 30 years		KBBCBLK {KLPLK}	KLCLK {KLPLK}

Note:

O – superstructure renovation; (PC) – complete rail replacement (metal elements of junction points): in the period between track renovations – with new ones; in the period between major repair works – with used ones), accompanied by medium track repairs (on sections with asbestos ballast instead of medium may be carried out a lifting repair work or systematic warning track level adjustment); K – major track repair works; C – medium track repair; L – lifting track repair; B - systematic warning track level adjustment using the set of *machines; medium repair in accordance with the project documentation may be replaced with the reconstruction of ballast prism, which is, as well as medium repair, can be carried out as a separate work.*

It is therefore possible to define normative necessity by class of tracks, types and volume of track-works, the amount of new and used materials of permanent way, machines, labour and other resources.

Operations on technical maintenance of track and switches are subdivided into the following maintenance cycles:

1. renewal of a track ("*Capital Maintenance*");
2. thorough repair of a track;
3. reconstruction of a ballast section;
4. mid-life repair of a track ("*Medium Maintenance*");
5. complete replacement of rails and metal parts of switches for new of used ones;
6. lifting track maintenance ("*Lifting Maintenance*");
7. grinding of rails;
8. planned- preventive track alignment with the use of a complex of machines.

Renewal of a track. It is intended for periodic full renewal of rail-sleeper panels.

Renewal of a track and switches should be accompanied by rehabilitation of a ballast section or its purification according to Technical specifications for indicated works, or accompanied by substitution of low-purity ballast of other types.

At the renewal of a track conducted with rehabilitation of a ballast section, it is necessary to carry out packing of railbed slope with liquidation or hardening of ballast stub lines and providing of a steepness of slopes 1:1.5 in conformity with standard typical cross profiles of a track formation.

At renewal of a track the following works are performed: substitution of rail-sleeper grid, repair of drainages, liquidation of heaving places in track formation and increase of bearing capacity of its main platform in places of deformation, adjustment and wadding of track with its placement on a design reference mark in the profile, adjustment of curves in the layout with restoring of design radiuses, standardization of the length of spiral curves and direct insertion curves between curves in conformity with the top speeds of movement established in the section, planning of ballast section, reduction (ct) of edge of track formation planning and purification of ditches, repair of level crossings, cleaning of river-beds and planning of cones of small structures and other works stipulated by the project.

Thorough repair of tracks. It is intended for substitution of permanent way on tracks of class 3-5 (switches –class 4, 5) for more powerful or less worn out ones which is mounted form either completely old materials or from combination of old with new materials including laying of old rails on tracks of class 3 at speeds of t passenger trains traffic up to 100 km/h.

Thorough repair of a track is executed in a complex - with full substitution of a track skeleton, and in a separate way - with substitution of rails and fastenings, metal parts of switches, sleepers, skids with clearing or reconstruction of a ballast section.

At thorough repair of a track the same operations are to be performed as at renewal of a track.

Reconstruction of a ballast section. The reconstruction is carried out on the sections where the ballast section exceeded admissible sizes due to over-track raising of a track, and does not ensure availability of roadsides (edges) of width not less than 40 sm, or if further track raising is restricted by limited dimensional distances to structures as well as if change of ballast is necessary due to its insufficient carrying capacity or a heightening of stability of the main basic platform of track formation.

At reconstruction of ballast section clearing of detritus is made into such depth that will enable to mark the profile of the track to the designed one and restore normal sized of a section (prism). The broken stone ballast of weak rock is substituted to the ballast of hard rock. Works can be conducted together with restoration of sand cushion and laying of special coatings on the main platform of track formation. Flattening of slopes of embankment to steepness of 1:1.5, liquidation or hardening of ballast stub lines on them are carried out as well.

Other ancillary works executed under reconstruction of ballast section include: substitution of unsuitable sleepers, bars and fastenings, removal of heavy cards (at timber sleepers), alignment of circular and transition curves in the profile and payout according to the design, repair of level crossings, drainage and supporting structures, clearing of river-bed and medium structures and other ancillary works. If necessary, grinding and welding of rails, entire substitution of metal parts of switches can be carried out.

Medium repair of a track. Improvement of a ballast section by means of entire clearing broken stone ballast on the depth specified or by renewal of a low-purity ballast of other type on sections where it is not required to downgrade the mark of a track.

At medium repair of a track the same ancillary work are carried out as at reconstruction of ballast section.

Lifting track maintenance. It intended to decrease the extent of unbalance of permanent way and non-equal elasticity of under-sleeper basis by substituting worn out elements of permanent way, and partial restoration of draining properties of ballast, entire alignment and wadding of a track.

At lifting track maintenance the following works are carried out: substitution of a low-purity ballast, regulation of clearances in junctions, removal of heavy cards or adjusting shims, substitution of unsuitable sleepers, transferable bars, fastenings, anticreepers, entire lubrication and fixing of bolts, clearing of drainage structures and other works the necessity in which imply from the actual condition of a track.

Grinding of rails. Two types of grinding of rails are carried out: profile at which the head of a rail is grinded along all perimeter; and grinding intended for elimination of a undulating wear and short irregularities of other types on the surface of rails rolling with the purpose of decrease of vibration effects of a rolling stock on a track.

The abrasion is executed by rail grinding trains.

The primary grinding is carried out after laying of new and used rails. The grinding of rails is executed according to technical specifications authorized by the State Joint Stock Company UTY.

Besides the listed works, other works on track repair, structures as well as repair of industrial plants related with track operation are performed at the expense of repair fund of the railways.

The following works are referred to such operations: complete substitution of bars on switching points; fixing of switches on broken stone ballast or asbestos ballast; welding of rails, scissors crossings, other elements of switches; repair of rails, fastenings, sleepers, transferable and bridge bars; the device of a protection of track and switches, repair of fixed fences erected along the track for the warning of cattle; thorough repair of level crossings and the equipping them with automation; thorough repair of track formation and its drainage and strengthening devices; structures, structure of industrial bases which carry out mechanization and preparatory works for renewal and thorough repair of a track; erection of temporary structures related to repair of track,

track formation and structures; operations on winter warehousing of detritus and other materials; redeployment of tracks machine stations, re-equipment of coaches for inhabited and cultural-welfare during their thorough repair; the device of soil roads along the track formation transfer of equipment from one to other place of operations.

Inspections for determining the present condition of a track. Includes inspection over the condition of a track and it is carried out continuously during the year including the sections where repair works are being conducted.

Operations are divided into urgent and primary, related with the elimination of dangerous inaccuracies of the track in places of their detection, and planned-preventive works, carried out with application of a complex of machines and mechanisms with the purpose of prevention of the emersion of faultinesses in a track.

According to the collected information, the following table 2.1.1-7 resumes the average quantities of replaced p.w. materials per each maintenance cycle.

Table 2.1.1 – 7 Maintenance cycles materials

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section)			
	Type of Maintenance		
	Lifting	Medium	Capital
Ballast	30%	60%	100%
Sleepers and fastenings	20%	40%	100%
Rails	10%	30%	100%
Per km of line			
Ballast (m3)	**540**	**1,080**	**1,800**
Sleepers and fastenings (n)	368	736	1,840
Rails (t)	13	39	130

Table 2.1.1-8 resumes the average cost for 1 km maintenance of the railway line infrastructure including permanent way, turnouts, civil works, earth-works, drainages, structures, tamping, aligning, levelling. These costs have been calculated taking into account local railway manpower, materials and machines.

Table 2.1.1 – 8 Average cost for 1 km maintenance of the railway line

Rehabilitation works for Kungrad - Beyneu Line (Kungrad-Border section)			
	Cost per km of type of maintenance		
	Lifting	Medium	Capital
$/km	58,989.87	153,181.58	364,883.83

2.1.2 Stations

General

The present Lot 1.1 doesn't consider interventions within stations. Notwithstanding that, a description is here below given.

The line Kungrad-Border is provided with 15 stations with an average distance of 20 km. Their main functions are:

- operation (train crossings and overcomings);
- train parking;
- rolling stock (for service, for shunting or for maintenance) parking;
- passenger service;
- link for branches.

The following table 2.1.2-1 resumes the stations position and distances on the Kungrad-Beyneu line.

Table 2.1.2 – 1 Stations position and distances on the Kungrad-Beyneu line

Stations of the Kungrad-Beyneu line					
Station name	Chainage km	Distance km	Station name	Chainage km	Distance km
Kungrad	626.917		Berdakh	846.503	
		19.651			24.497
Raushan	646.568		Bostan	871.000	
		25.034			21.788
Kunkhodja	671.602		Ak-Tobe	892.788	
		16.582			20.797
Kyrk-Kyz	688.184		Kiyiksay	913.585	
		24.298			19.583
Barsa-Kelmes	712.482		Karakalpakia	933.168	
		21.610			20.332
Ajiniyaz	734.092		BORDER	953.500	
		23.050			1.470
Abadan	757.142		Oasis	954.970	
		21.540			21.551
Kuanysh	778.682		Akjigit	976.521	
		18.698			27.117
Jaslyk	797.380		Kzyl-Asker	1003.638	
		24.700			19.523
Ayapbergen	822.080		Kok-Bekty	1023.161	
		24.423			10.418
			Beyneu	1033.579	

The following table resumes the station typologies and their number on the entire line.

Table 2.1.2 – 2 Station typologies and their number on the entire line

Stations type	Uzbekistan	Kazakhstan	Tot
Terminal	1	1	2
Small crossing stations	9	3	12
Medium crossing stations	3	1	4
Large stations	2	0	2
TOTAL	***15***	***5***	***20***

2.1.3 Level Crossings

Along the Kungrad-Oasis railway section a total of 15 level crossings is present.

All the level crossings are situated in proximity of the stations, in a range of 100 – 1000 m of distance from the limit of the stations, with the only exception of the level crossing that is located at chainage Km 634+105. The other 14 level crossings of the line are near the following stations:

- Kungrad;
- Kunkhodja;
- Kyrk-Kyz;
- Barsa-Kelmes;
- Ajiniyaz;
- Abadan;
- Kuanysh;
- Jaslyk;
- Ayapbergen;
- Berdakh;
- Bostan;
- Ak-Tobe;
- Kiyiksay;
- Karakalpakia.

The level crossing protection system is only assured by crossing warning signals (traffic lights and Saint Andrew crosses) without barriers.

The warning signalling system is automatic: track circuits detect trains and activate warning indications at level crossings.

Usually in correspondence of the level crossings there are unpaved tracks and not proper roads. The pavement of the level crossing area is typically made of concrete blocks or rarely of wooden beams.

From general experience, the level of safety afforded by these devices on their own is insufficient. In the specific case of the Kungrad - Kazakh Border railway line this protection system could be justified by the low intensity of rail traffic and by the trifling volume of road traffic.

2.1.4 Structures and Drainages

The line object of this study is mainly running in a flat territory, mostly dry and without particular interferences with human settlements or natural constraints.

The area is mainly dry for most part of the year and this influences the nature of the river courses, almost absent. The few water courses are generally not permanent and therefore dry for the most part of the year. But this doesn't mean that the drainage system of the railway strip is not necessary; there are in fact some periods of the year in which the rainfalls are consistent and the natural depressions becomes rivers with a valuable water flow.

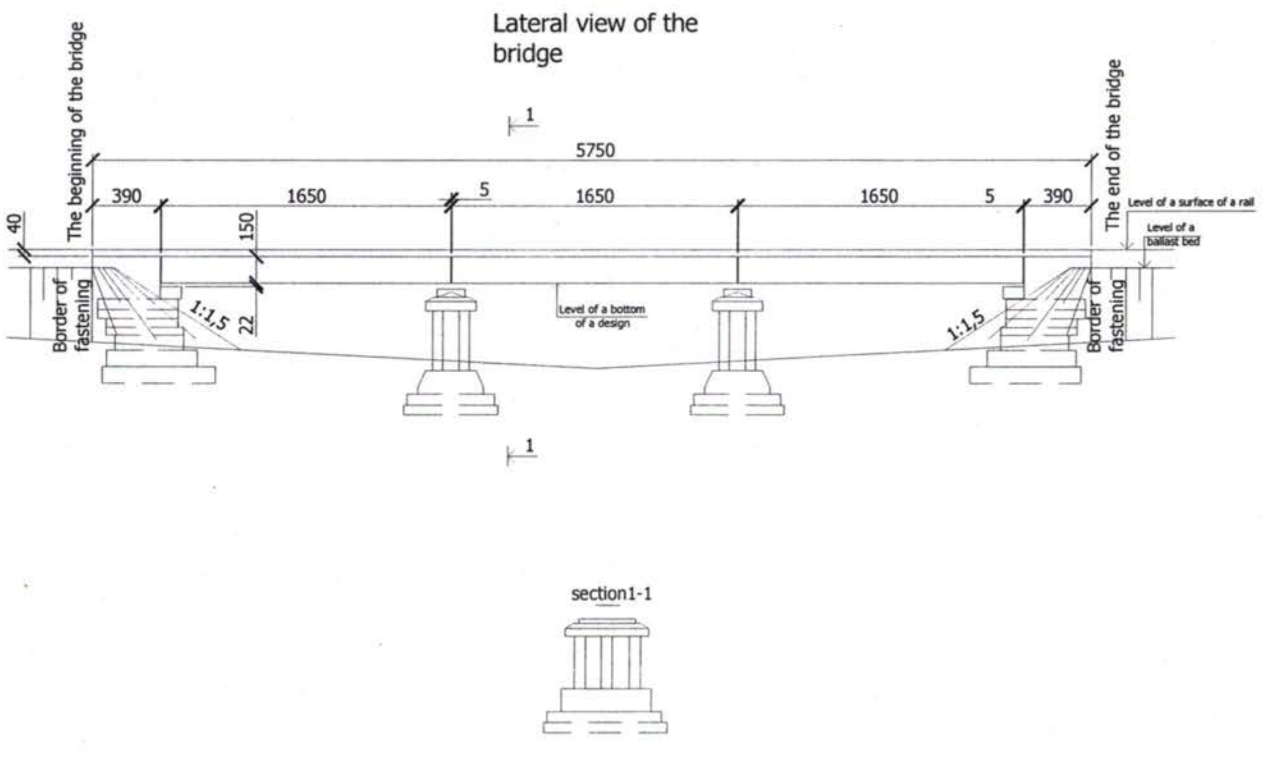
With the aim of collecting and taking away these sudden waters, the line has been designed with many pipe culverts and small bridges, mainly composed by single or double span 6m long simply leaned structures.

Drainage main structures

Along the section Kungrad – Kazak border 46 bridges were built to overtake depressions, channels and little rivers. Their length does not exceed 25 m, with the exception of one bridge 115,3 m long at chainage km 605+205. Most of the time they are waterless, but during a short period of the year a considerable quantity of rain water is canalised towards depressions and dried river beds. The bridges avoid water static pressure against the formation (dam effect), water overflowing tracks severely damaging layers of ballast and sub-ballast, erosion of the base of the slope.

They are formed by door pillars and piers supporting reinforced concrete beams, generally of standard length. On fig. 2.1.4 – 1 is shown a typical view of a railway bridge.

Fig. 2.1.4 – 1 Typical view of a railway bridge



The list of the existing bridges is reported in the Table 2.1.4 – 1.

Table 2.1.4 – 1 Kungrad – border (km 953+500) section

Name of station to station block	№	Piquet value (ПК+)	Type of structure	Scheme of structure	Total length of bridge, m	Number of bars to span, unit	Condition of span		Condition of piers (bearings)	
							Satisfactory	Nonsatisf.	Satisfactory	Nonsatisf.
1	2	3	4	5	6	7	8	9	10	11
Kungrad st. – Raushan siding 1.	1	6286+88	Concrete	3x6,0	21,94	6		Renewal of span, cracks		Repair of piles
	2	6288+18	Concrete	3x5,5	22,07	6		Renewal of span		Nonsatisf.
	3	6292+69, 6	Concrete	3x6,0	21,94	6		Capital repair	Satisf.	
	4	6292+30	Concrete	3x6,0	22,07	6		Capital repair	-//-	
	5	6298+18	Concrete	3x6,0	22,07	6		Capital repair	-//-	
	6	6304+47	Concrete	2x6,0	16,02	4		Renewal of span		-//-
	7	6311+98	Concrete	2x6,0	15,9	4		Renewal of span		-//-
	8	6318+88	Concrete	2x6,0	15,88	4		Renewal of span		-//-
	9	6330+71	Concrete	2x6,0	15,9	4		Renewal of span		-//-
	10	6337+91	Concrete	2x6,0	15,98	4		Renewal of span		-//-
	11	6369+43	Concrete	3x6,0	21,95	6		Renewal of span		-//-
	12	6400+87	Concrete	1x6,0	9,9	2		Renewal of span	Satisf.	
	13	6415+06	Concrete	1x6,0	9,9	2		Renewal of span	-//-	
	14	6438+45	Concrete	1x6,0	9,98	2		Renewal of span	-//-	
	15	6452+05	Concrete	6+6x16,5+ 6	11530	16	Satisf.			Repair of bearing (post)
Raushan siding – Kunkhoja station 2	16	6541+41	Concrete	3x6,0	21,95	6		Renewal of span		Nonsatisf.
	17	6580+43	Concrete	2x6,0	15,98	4		Renewal of span		-//-
	18	6609+42	Concrete	2x6,0	15,91	4		Renewal of span		-//-
	19	6651+97	Concrete	3x6,0	21,91	6		Renewal of span		-//-
Kunkhoja station- Kyrk-Kyz station 3	20	6801+55	Concrete	2x6,0	15,86	4		Renewal of span		-//-
	21	6801+55	Concrete	2x6,0	15,86	4		Renewal of span		-//-

	22	6831+86	Concrete	1x6,0	9,87	2		Renewal of span	Satisf.	
	23	6849+83	Concrete	3x6,0	22,04	6		Renewal of span	Satisf.	-//-
Kyrk-Kyz station –Barsa Kelmes siding 4	24	6896+83, 5	Concrete	1x6,0	9,88	2		Renewal of span	Satisf.	
	25	7014+85	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	26	7037+83	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	27	7053+87	Concrete	2x6,0	15,94	4		Renewal of span	Satisf.	Nonsatisf.
Barsa-Kelmes siding– Ajiniyaz siding 5	28	7192+39	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	29	7209+86	Concrete	1x6,0	9,90	2		Renewal of span	Satisf.	
	30	7238+85	Concrete	1x6,0	9,94	2		Renewal of span	Satisf.	
	31	7326+12	Concrete	1x6,0	9,93	2		Renewal of span	Satisf.	
Ajiniyaz siding – Abadan station 6	32	7356+88	Concrete	1x6,0	9,89	2		Renewal of span	Satisf.	
	33	7390+87	Concrete	2x6,0	15,94	4		Renewal of span		Nonsatisf.
	34	7429+80	Concrete	3x6,0	22,04	6		Renewal of span		-//-
Kuanysh siding –Jaslyk station 8	35	7836+56	Concrete	2x6,0	16,00	4		Renewal of span		Nonsatisf.
Lyapbergen siding –Berdakh siding 10	36	8235+10	Concrete	2x6,0	15,96	4		Renewal of span		Nonsatisf.
	37	8296+31	Concrete	1x6,0	9,83	2		Renewal of span	Satisf.	
	38	8406+09	Concrete	2x6,0	15,91	4		Renewal of span		Nonsatisf.
	39	8455+07	Concrete	2x6,0	15,93	4		Renewal of span		Nonsatisf.
Berdakh siding-Bostan station 11	40	8525+00	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	41	8563+05	Concrete	2x6,0	15,92	4		Renewal of span		Nonsatisf.
	42	8598+70	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	43	8641+05	Concrete	2x6,0	15,97	4		Renewal of span		Nonsatisf.
	44	8655+07	Concrete	3x6,0	22,00	6		Renewal of span		Nonsatisf.
	45	8670+00	Concrete	2x6,0	16,00	4		Renewal of span		Nonsatisf.
	46	8707+51	Concrete	2x6,0	15,90	4		Renewal of span		Nonsatisf.

Maintenance status

The main defects presented by reinforced concrete structures are:

- cracks in concrete;
- corrosion of armature;
- lixiviation of concrete;
- protective layer breaking off;
- waterproofing collars damages.

Their maintenance is classified by Uzbekistan railways as it follows:

operating maintenance

- clearing the structure from dust, dirt, traces of lixiviation, peeling of concrete,
- rehabilitation of original layers,
- embedding of cracks of up to 0.15 mm in width,
- injection of cracks of more than 0.15 in width with epoxide resin.

thorough repair

- as before,
- removing detachments and defected concrete parts, cleaning the armature from corrosion and protecting it with antirust paint, replacing with mortar the removed material.

reinforcement

- as before,
- implementing constructive solutions to increase the carrying capacity.

Nevertheless, when these structures have been in operation for a long time, they generally present corrosion of the armature and lixiviation of concrete. In case of capital maintenance of the line their replacement is the more rational solution.

Maintenance interventions for piers are similar. Furthermore foundations and back walls and protections have to be inspected and repaired mainly with masonry works, rebuilding or lengthening walls, installing gabions.

Drainage small structures

Besides the above mentioned bridges, the Kungrad – Kazak border section is provided with concrete/metal pipe culverts and prefabricated concrete elements (box) culverts.

A typical section is shown in fig. 2.1.4 -2.

Maintenance

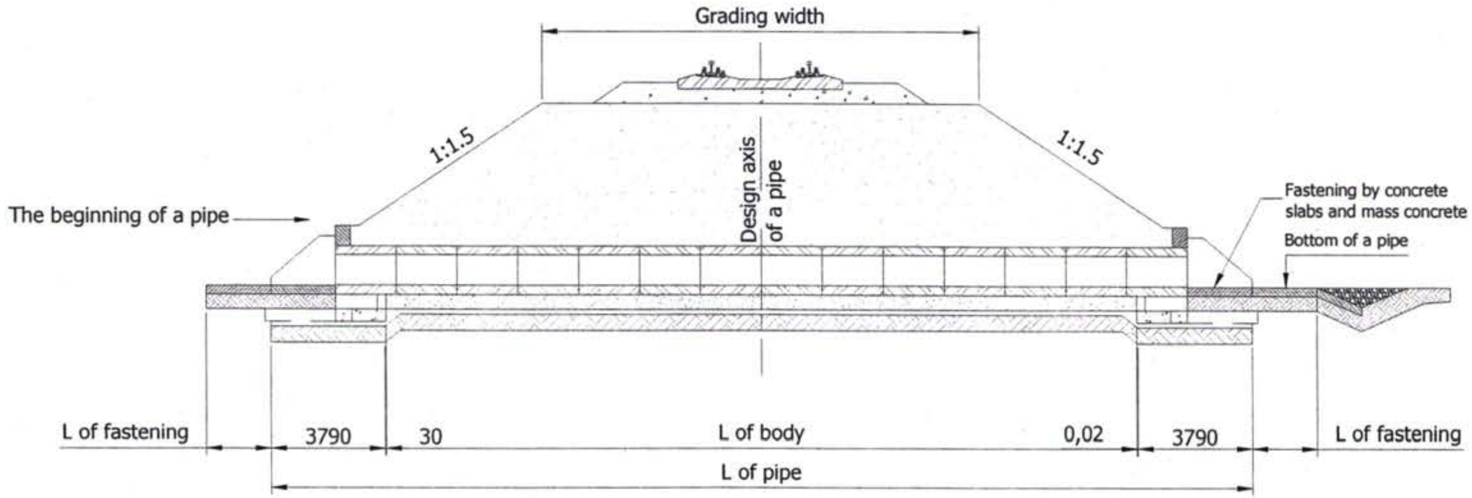
According to the condition of the structure, the activities to be implemented are

- cleaning the bottom of pipes from dust to restore the original section,
- fixing the eroded joints,
- repairing with metal grid and mortar the broken surfaces,
- charging mortar into fundaments when holes are detected,
- repairing the inlet and outlet wind walls,
- replacing the pipes and rebuilding the culvert if necessary.

The Table 2.1.4 - 2 shows the different types of culverts existing along the section and the Table 2.1.4 – 3 their location and their condition.

Fig. 2.1.4 - 2

The scheme of a laying of concrete pipes 1x1.5 and 1,5x1.5



Facade of a culvert head

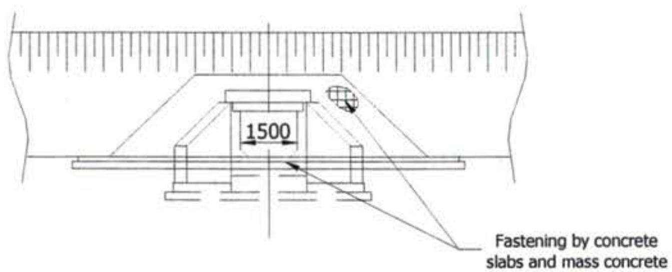


Table 2.1.4 – 2 Small drainage structure types and number (pipes and box culvert)

N°	***Type of structure***	***Kungrad – km (953+500)***
1	Metal pipe Φ 1.0 m	1
2	Reinforced concrete pipes Φ 1.0 m	15
3	Reinforced concrete pipes 2 x Φ 1.0 m	3
6	Reinforced concrete pipes Φ 1.25 m	13
7	Reinforced concrete pipes 2 x Φ 1.25 m	6
8	Reinforced concrete pipes Φ 1.5 m	8
9	Reinforced concrete pipes 2 x Φ 1.5 m	9
10	Reinforced concrete pipes Φ 2.0 m	3
11	Reinforced concrete pipes 2 x Φ 2.0 m	3
12	Prefabricated concrete elements: section 1,0 m X 1,5 m	2
13	Prefabricated concrete elements: section 1.5 m X 2.0 m	2
14	Prefabricated concrete elements: section 2.0 m X 2.0 m	2
Total		***67***

Tab. 2.1.4 – 3 List of small drainage structures existing on Kungrad-Kazakh border section. (pipe or box culverts)

Name of station to station	№	Chainage	Condition of bed stream	Type of structure	Pipe Φ or section dimension (m)	Length of pipe, (m)	Distance from the embankment top surface to the pipe top	Conditions	
								Non satisf.	Satisf.
block	2	3	4	5	6	7	8	9	10
Kungrad - km 953+500 section									
Kungrad station – Raushan siding	1	6381+95,6	dry	Met. pipe	1,00				
Rausha siding-Kunkhoja station	2	6664+45	dry	Reinforced concrete pipe	1,25	17,58	1,68	-	satisf.
	3	6673+34	dry	Box culvert	1,5x2,0	21,43	1,25	-	satisf.
	4	6685+00	dry	r.c.p.	1,5+1,25	18,27	1,84\2,09	-	satisf.
	5	6697+20	dry	r.c.p.	1,25	20,25	1,25	-	satisf.
	6	6711+02	dry	r.c.p.	1,5	30,4	3,18	-	satisf.
Kunkhodja station-Kyrk-Kyz station	7	6720+20	dry	Box culvert	1,5x2,0	25,20	1,13	-	satisf.
	8	6726+28	dry	r.c.p.	1,5	17,0	0,58	-	satisf.
	9	6740+26	dry	r.c.p.	1,5	19,5	3,83	-	satisf.
	10	6746+17	dry	r.c.p.	1,0	20,8	3,04	-	satisf.
	11	6750+87	dry	r.c.p.	1,25	18,65	1,91	-	satisf.
	12	6762+34	dry	r.c.p.	2,0	9,6	1,95	-	satisf.
	13	6769+45	dry	r.c.p.	1,0	18,0	2,64	-	satisf.
	14	6779+66	dry	r.c.p.	2,0	9,9	1,34	-	satisf.
	15	6783+96	dry	Box culvert	1,0x1,5	11,95	0,18	-	satisf.
	16	6792+53	dry	Box culvert	1,0x1,5	17,7	0,84	-	satisf.
	17	6837+85	dry	r.c.p.	2x1,0	16,42	1,74	-	satisf.
	18	6843+85	dry	r.c.p.	1,0	13,83	1,31	-	satisf.
Kyrk-Kyz station-Barsa Kelmes siding	19	7095+13	dry	r.c.p.	1,25	17,24	2,68	-	satisf.
	20	7102+08	dry	r.c.p.	2x1,5	16,3	1,51	-	satisf.
Barsa Kelmes siding-Ajiniyaz station	21	7135+86	dry	r.c.p.	2x1,25	12,87	1,24	-	satisf.
	22	7154+46	dry	r.c.p.	1,5	15,5	1,85	-	satisf.
	23	7172+22	dry	Box culvert	2,0x2,0	16,72	1,92	-	satisf.
	24	7295+76	dry	Box culvert	2,0x2,0	17,24	1,72	-	satisf.
Ajiniyaz siding-Abadan station	25	7408+09	dry	r.c.p.	1,25	20,4	4,81	-	satisf.
	26	7411+89	dry	r.c.p.	1,25	23,5	5,81	-	satisf.
	27	7457+85	dry	r.c.p.	2x2,0	16,3	1,72	-	satisf.
	28	7474+82	dry	r.c.p.	2x2,0	31,75	5,5	-	satisf.
	29	7537+18	dry	r.c.p.	2,0	15,46	1,55	-	satisf.
	30	7600+52	dry	r.c.p.	2x1,25	13,51	1,21	-	satisf.

Abadan station-Kuanysh siding	30	7600+52	dry	r.c.p.	2x1,25	13,51	1,21	-	satisf.
	31	7670+89	dry	r.c.p.	2x2,0	17,33	1,66	-	satisf.
	32	7683+60	dry	r.c.p.	2x1,5	14,19	1,43	-	satisf.
	33	7728+87	dry	r.c.p.	1,5	15,12	1,6	-	satisf.
	34	7746+97	dry	r.c.p.	1,25	17,33	2,41	-	satisf.
	35	7770+23	dry	r.c.p.	1,25	13,27	1,55	-	satisf.
Kuanysh siding-Jaslyk station	36	7809+10	dry	r.c.p.	1,5	15,83	1,78	-	satisf.
	37	7895+78	dry	r.c.p.	1,5	12,16	1,27	-	satisf.
	38	7936+78	dry	r.c.p.	1,0	14,22	1,66	-	satisf.
	39	7885+78	dry	r.c.p.	1,0	12,16	1,27	-	satisf.
	40	7926+78	dry	r.c.p.	1,0	14,22	1,66	-	satisf.
Jaslyk station-Ayapberg en siding	41	7985+77	dry	r.c.p.	1,0	12,08	1,79	-	satisf.
	42	8009+00	dry	r.c.p.	1,25	13,60	2,05	-	satisf.
	43	8038+78	dry	r.c.p.	1,0	13,21	1,78	-	satisf.
	44	8078+00	dry	r.c.p.	1,25	13,75	1,75	-	satisf.
	45	8151+90	dry	r.c.p.	2x1,5	15,87	1,47	-	satisf.
	46	8198+65	dry	r.c.p.	1,0	12,00	1,38	-	satisf.
Ayapberge n siding-Berdakh siding	47	8346+05	dry	r.c.p.	2x1,0	12,80	1,43	-	satisf.
Berdakh siding-Bostan station	48	8605+05	dry	r.c.p.	1,0	12,22	1,32	-	satisf.
Bostan station - Aktobe siding	49	8720+00	dry	r.c.p.	2x1,25	12,82	1,19	-	satisf.
	50	8748+98	dry	r.c.p.	1,25	13,02	1,45	-	satisf.
	51	8760+00	dry	r.c.p.	2x1,5	14,02	1,61	-	satisf.
	52	8792+88	dry	r.c.p.	2x1,5	14,01	2,28	-	satisf.
	53	8815+98	dry	r.c.p.	2x1,5	13,78	1,61	-	satisf.
	54	8853+97	dry	r.c.p.	2x1,5	20,30	1,67	-	satisf.
Aktobe siding-Kiyiksay siding	55	8907+92	dry	r.c.p.	1,25	12,99	1,34	-	satisf.
	56	9019+91	dry	r.c.p.	2x1,25	13,01	1,02	-	satisf.
	57	9037+92	dry	r.c.p.	2x1,0	12,55	1,45	-	satisf.
	58	9050+00	dry	r.c.p.	2x1,25	8,00	1,23	-	satisf.
Karakal-pakiya station-Oasis siding	59	9394+71	dry	r.c.p.	2x1,5	15,41	1,42	-	satisf.
	60	9404+71	dry	r.c.p.	1,25	12,93	1,09	-	satisf.
	61	9427+50	dry	r.c.p.	1,0	12,88	1,18	-	satisf.
	62	9455+25	dry	r.c.p.	1,0	14,61	1,92	-	satisf.
	63	9472+20	dry	r.c.p.	1,0	13,00	1,51	-	satisf.
	64	9485+20	dry	r.c.p.	1,0	14,17	1,65	-	satisf.
	65	9498+00	dry	r.c.p.	1,0	13,09	1,27	-	satisf.
	66	9527+25	dry	r.c.p.	2x1,5	13,87	1,20	-	satisf.

Thus no works are envisaged for minor drainages.

Ditches

According to the theoretical section of the embankment (see Fig. 2.1.1 – 1), ditches have to collect raining waters all along the line. From the site visit it has been clarified that they are present only in some places. Anyway the rare atmospheric precipitation on the Karakalpakian desert justifies plainly the poor attention to this aspect of maintenance.

In the stations, on the contrary, ditches are totally missing and the damages due to the raining water stagnation and the "pumping effect" at the passage of trains that lifts fine materials from underneath, was evident in Kungrad, Kunkhodja, Kyrk-Kyz stations.

2.1.5 Bridges

Existing bridges

The list of existing bridges along the line with specification of the scheme, scope of works and the length is shown in the Table 2.1.5-1

Along the Kungrad–Kazak Border (km 953+500) section there are 46 bridges. 45 bridges are built with an only type of beam 6.0 meters long and they differ only for the bridge schemes: 1x6 m – 13 bridges; 2x6 m – 19 bridges; 3x6 – 13 bridges. All bridges are pile bridges. Pile piers consist of the following elements:

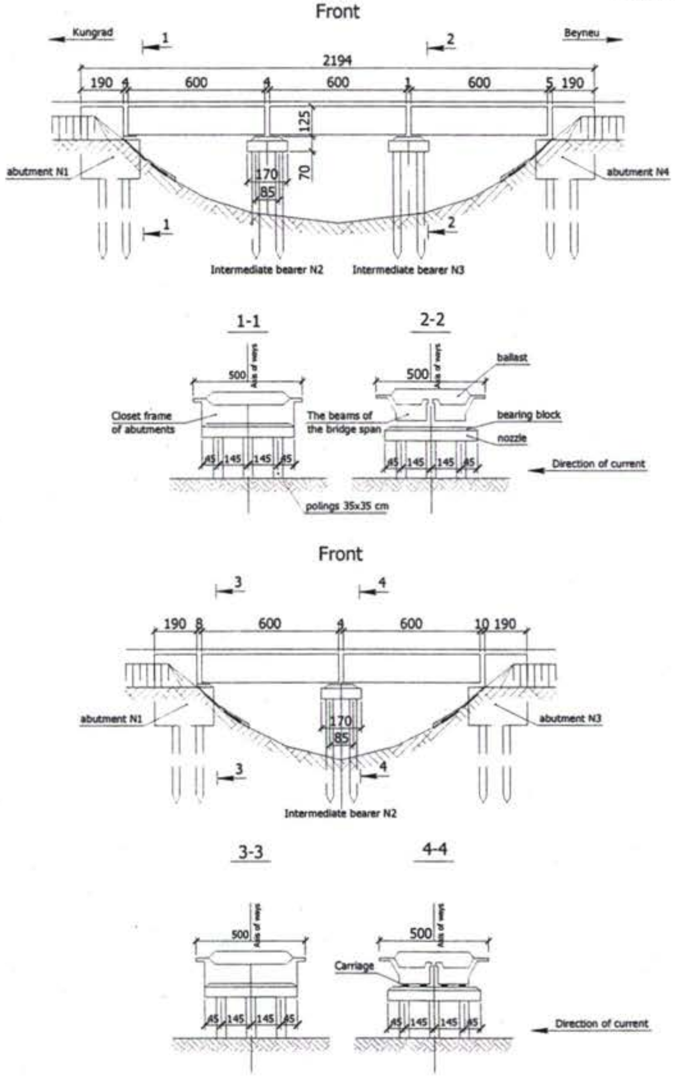
- Piles with section of 35x35 centimeters;
- Reinforced concrete nozzles for abutments and intermediate supports;
- Reinforced concrete cabinet type blocks, paving slabs, soft entrance plates for abutments;
- Metal consoles for paving slabs;
- Bearing blocks for intermediate supports.

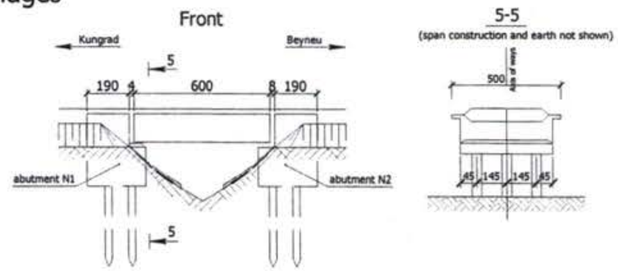
The existing bridges have been built in 1972.

Reinforcement of the bridges cones and bed of the carriages is done by stone paving with D=16 centimeters. General view of the bridges and basic details about bridge superstructures are given in the Figure 2.1.5-1.

Figure 2.1.5-1

Existent bridges





The data on bridge span

N N	The list of the data	1 span
1	Material	f/c
2	Size of a bridge span, m	6.0
3	Size of a effective span, m	5.5
4	Cubic capacity, m^3	8.2
5	Year of design norms	1962
6	Calculated load	S-14
7	Year of erection	1972
8	Year of installation	1972
9	Typee of the span	beam

The data on bridge footing

N N	The list of the data	N N of abutments & piers								
		1 x 6		2 x 6			3 x 6			
		1	2	1	2	3	1	2	3	4
1	Material	1972	II	II	II	II	II	II	II	II
2	Size of a bridge span, m	f/c	II	II	II	II	II	II	II	II
3	Size of a effective span, m	f/c	II	II	II	II	II	II	II	II
4	Solution	cement								
5	Foundation	pile								
6	Depth of foundation	8.32	8.32	8.32	8.40	8.32	8.32	8.40	8.40	8.32
7	Cubic capacity of footings with foundation, m^3	13.05	13.05	13.05	10.6	13.05	13.05	10.6	10.6	13.05

Only three bridges by the scheme 3x6 m located at chainages km 6292+69, km 6296+30, km 6298+18, are in satisfactory condition. The project envisages overhaul works of bridge superstructures on these bridges. The other bridges require replacement of bridge superstructures and repair of bearings.

Along the section there is one beam type railway overpass at the picket 6452+05 by the scheme 6+6+16.5+6 m.

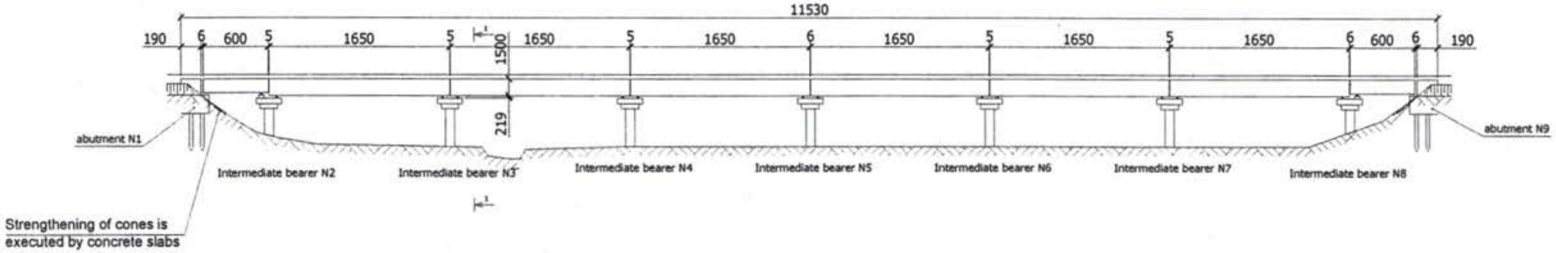
Intermediate piers and abutments are made from pre-cast reinforced concrete. Abutments are made from two concrete frame blocks longitudinally placed along the axis of the line, and intermediate piers from one transversally frame concrete block. Foundations are on piles with section of 35x35 centimeters.

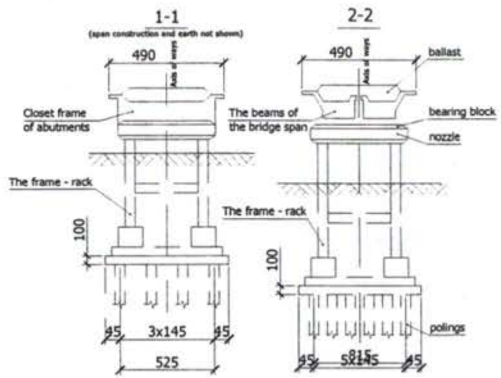
General view of the bridge and basic details about bridge superstructures and piers are given in the Figure 2.1.5-2. General view on the conditions of the bridges and of their components is given in Table 2.1.5-1. In this table the suggested maintenance works on the bridges are identified

Figure 2.1.5-2

Existent bridge on the PK 6452+05

Front





The data on bridge span

N N	The list of the data	NN Of the span	
		1-8	2-7
1	Material	f/c	f/c
2	Size of a effective span, m	5.5	15.8
3	Cubic capacity, m^3	8.2	38
4	Year of design norms	1972	1972
5	Calculated load	SN200-62 S-14	SN200-62 S-14
6	Year of erection	1972	1972
7	Year of installation	1972	1972
8	Typee of the span	beam	beam

The data on bridge footing

N N	The list of the data	N N of abutments & piers								
		1	2	3	4	5	6	7	8	9
1	Year of erection	1972	II	II	II	II	II	II	II	II
2	Material of a laying	f/c	II	II	II	II	II	II	II	II
3	Material of a bearing block	f/c	II	II	II	II	II	II	II	II
4	Solution	cement								
5	Foundation	pile								
6	Depth of foundation	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40
7	Cubic capacity of footings with foundation, m^3	22.5	25.3	136.6	136.6	136.6	136.6	136.6	25.3	22.5

List of existing bridges at Kungrad-Kazakhstan border section

Table 2.1.5-1

	No	Card No	Picket (PK+)	Type of facility	Scheme of facility	Total bridge length, m	Number of beams of BS	Volume of concrete work of carriages, m³	Volume of concrete work of BS, m³	Metal BS, tn	Condition of BS		Condition of piers		Scope of overhaul works									
																		Replacement of BS			Overhaul of BS			Cost of works ('000 sums)
											Satisfactory	Poor	Satisfactory	Poor	Strength.of ф-ра, m³	Surface of carriages, m³	Replacement of bearings tonns	Length, m	Q-ty, pieces	Volume, m³	Cracks, m	Cut-off of def. layer, m³	Smoothing of surface, m²	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Kungrad-Raushan sub-section 1	1	88	6286+88	R/concrete bridge	3x6.0	21.94	6	47.3	24.6	-		Replace., cracks		Repair of piles	108.5	-	1.128	6.0	3	30.3				79507.335
	2	Pr of.	6288+18	R/concrete bridge	3x5.5	22.07	6			-		Replace.			-	71.0	1.128	5.3	3	24.46				58323.310
	3	3	6292+69.60	R/concrete bridge	3x.06	21.94	6	47.3	24.6	-		overhaul			-	-	-	-	-	-	54	2.2	53.8	5095.399
	4	4	6292+30	R/concrete bridge	3x.06	22.07	6	50.1	24.6	-		overhaul			-	-	-	-	-	-	54	2.2	53.8	5095.399
	5	89	6298+18	R/concrete bridge	3x.06	22.07	6	50.1	24.6	-		overhaul			-	-	-	-	-	-	54	2.2	53.8	5095.399
	6	90	6304+47	R/concrete bridge	2x6.0	16.02	4	36.6	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56

	7	91	6311+98	R/concrete bridge	2x6.0	15.9	4	34.0	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	8	92	6318+88	R/concrete bridge	2x6.0	15.88	4	52.9	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	9	93	6330+71	R/concrete bridge	2x6.0	15.9	4	42.1	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	10	94	6337+91	R/concrete bridge	2x6.0	15.98	4	42.1	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	11	95	6369+43	R/concrete bridge	3x6.0	21.95	6	83.8	24.6	-		Replace.			-	71.0	1.128	6.0	3	30.3				58323.310
	12	96	6400+87	R/concrete bridge	1x6.0	9.90	2	26.8	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	13	97	6415+06	R/concrete bridge	1x6.0	9.92	2	23.0	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	14	98	6438+45	R/concrete bridge	1x6.0	9.98	2	23.0	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	15	99	6452+05	R/concrete bridge	6+6x16, 5+6	115.3	16	778.6	105.8	-	yes			Repair of supports	-	231	-	-	-	-				2004.48
Kunkhodja sub-	16	100	6541+41	R/concrete bridge	3x6.0	21.95	6	99.536	35.204	-		Replace.			-	71.0	1.128	6.0	3	30.3				58323.31

	17	101	6580+43	R/concrete bridge	2x6	15.98	4	61.776	23.5	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	18	104	6609+42	R/concrete bridge	2x6	15.91	4	60.80	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	19	105	6651+97	R/concrete bridge	3x6	22.91	6	75.4	24.6	-		Replace.			-	71.0	1.128	6.0	3	30.3				58323.31
Kunkhodja-kyrkkyz sub-section 3	20	36	6801+55	R/concrete bridge	2x6	15.86	4	59.5	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	21	37	6815+74	R/concrete bridge	2x6	15.86	4	60.6	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	22	38	6831+86	R/concrete bridge	1x6	9.87	2	43.6	8.2	-		Replace			-	-	0.376	6.0	1	10.1				29191.117
	23	41	6849+83	R/concrete bridge	3x6	22.04	6	75.4	24.6	-		Replace.			-	71.0	1.128	6.0	3	30.3				58323.31
Kyrkkyz-Barsa-Kelmes sub-section 4	24	42	6896+83.50	R/concrete bridge	1x6	9.88	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	25	43	7014+85	R/concrete bridge	1x6	9.90	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	26	44	7037+83	R/concrete bridge	1x6	9.90	2	44.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	27	45	8053+87	R/concrete bridge	2x6	15.94	4	59.5	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56

Barsa-Kelmes-Ajiniyaz sub-section 5	28	51	7192+39	R/concrete bridge	1x6	9.90	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	29	52	7209+86	R/concrete bridge	1x6	9.90	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	30	53	7238+85	R/concrete bridge	1x6	9.94	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	31	55	7326+12	R/concrete bridge	1x6	9.93	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
Ajiniyaz-Abadan sub-section 6	32	56	7356+88	R/concrete bridge	1x6	9.89	2	43.6	8.2	-		Replace.			-	-	0.376	6.0	1	10.1				29191.117
	33	57	7390+87	R/concrete bridge	2x6	15.94	4	60.1	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	34	60	7429+80	R/concrete bridge	3x6	22.04	6	72.1	24.6	-		Replace.			-	71.0	1.128	6.0	3	30.3				58323.31
Kuanysh-Jaslyk 8	35	71	7836+56	R/concrete bridge	2x6	16.0	4	59.6	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
Lyapbergen-Berdakh sub-section 10	36	80	8235+10	R/concrete bridge	2x6	15.96	4	59.6	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	37	81	8296+31	R/concrete bridge	1x6	9.83	2	43.6	8.2	-		Replace.			-		0.376	6.0	1	10.1				29191.117

	38	83	8406+ 09	R/concrete bridge	2x6	15.91	4	34.0	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	39	84	8455+ 07	R/concrete bridge	2x6	15.93	4	34.0	16.4	-		Replace.			-	35.5	0.752	6.0	2	20.2				44139.56
	40	85	8525+ 00	R/concrete bridge	3x6	22.00	6	50.0	24.6	-		Replace			-	71.0	1.128	6.0	3	30.3				58323.31
	41	86	8563+ 05	R/concrete bridge	2x6	15.92	4	34.0	16.4	-		Replace			-	35.5	0.752	6.0	2	20.2				44139.56
	42	87	8598+ 70	R/concrete bridge	3x6	22.00	6	50.0	24.6	-		Replace			-	71.0	1.128	6.0	3	30.3				58323.31
	43	89	8641+ 05	R/concrete bridge	2x6	15.97	4	34.0	16.4	-		Replace			-	35.5	0.752	6.0	2	20.2				44139.56
	44	90	8655+ 07	R/concrete bridge	3x6	22.00	6	50.0	24.6	-		Replace			-	71.0	1.128	6.0	3	30.3				58323.31
	45	91	8670+ 00	R/concrete bridge	2x6	16.00	4	34.0	16.4	-		Replace			-	35.5	0.752	6.0	2	20.2				44139.56
	46	92	8707+ 51	R/concrete bridge	2x6	15.90	4	34.0	16.4	-		Replace			-	35.5	0.752	6.0	2	20.2				44139.56
Total for whole section																								1839843.96

2.2 Description of the designed improvements

The envisaged works for line rehabilitation are as follow:

a. Civil works concerning earthworks;
b. Permanent way replacing works (just for the line, stations excluded)
c. Existing permanent way rail welding and tension regulation;
d. Re-alignment, leveling and ballast cleaning on the existing sections;
e. Civil works concerning structures (replacement of bridge beams);
f. Civil works concerning re-pavement of some level crossings (L.C.). In terms of level crossings no elimination has been envisaged for the low traffic both on the railway line and on the interfered roads (mainly unpaved roads).

Location of the envisaged works along the line is given in Drawing L1.1-3 while the following Table 2.2-1 gives a short description of the different works.

Table 2.2-1 – Infrastructures works for line rehabilitation

Code	Works	Description
1A	Topographic survey of the line and corrections of the existing alignment and profile.	Topographic survey to be carried out along the line, for a strip of 50+50m around the existing railway axis, production of the current status cartography, and detailed correction of the alignment and profile of the line. New plan profile in scale 1:1,000 and current cross sections of the line in scale 1:200-1:100 step 50 m will be produced, indicating the existing and future geometrical parameters of the line.
2A	Demolition of line.	It consists in dismantling the existing worn out permanent way (rails, junctions, sleepers and fastenings), transportation of the materials to the deposit sites, dividing them into old and re-usable materials (residual value). This operation will be presumably carried out according to the methodology developed in this area: after having manually eliminated the fish-plated junctions of the rails, the dismantling train will pass over the free track panels, and its tail equipped with a dismantling crane will dismantle the track panels and automatically transport them into the front platform wagons.
3A	Excavation.	After having dismantled the permanent way, excavation of about 50-60 cm of topping material of the embankment by means of machine (bulldozer with front shovel). Generally, during this process, old polluted ballast and old polluted sub-ballast (sandy gravel) are discharged on embankment side for their future re-use. In case this work takes place into stations, the removed top material will be transported to dump. This item also include the further compaction of the top layer of the embankment for increasing its bearing capacity and for re-shaping the embankment roof.

4A	Partial lateral rebuilding embankment section, placing and compacting the removed top material for widening the top surface of about 1,0 m on both sides.	This item will be applied only on those sections where the existing embankment is found to be eroded and not compliant with the typical cross section. In many cases in fact, ballast is falling on the embankment side for the embankment is reduced in transversal dimensions due to the water and wind erosion of its slopes, not protected by means of grassing. For this item, material will be taken from the side material demolished in Item 3A for those sections where 3A took place, while for the other sections material will be transported or taken from the surrounding environment after tests. In order to widen the embankment side, the existing eroded side will be shaped in steps, and the additional earth will be added in layers of max 20-30cm in order to compact it by means of manual vibro-compacting machine.
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast).	After the item 4A, on the compacted top layer of the embankment the new layer of sandy gravel (sub-ballast) will be laid and compacted in the correct shape, according to typical cross section.
6A	Construction of line.	After the item 5A, the new track will be built (sleepers, fastenings and rails), by laying it on the sub-ballast layer. This procedure will be presumably carried out with the system used in this area, described in detail in the Figure on the next page. This system is based on the use of construction train, similar to the dismantling train, with opposed operations. Tail locomotive of this train will push the front laying crane against the section to be built, and the crane will lay track panels, casted outside of the field, on the sub-ballast layer. Provisional junctions will be installed and the construction train will run on the just installed panels. Construction of the line can also be carried out with other methods, as for example that envisaging the use of long welded rail to be laid on the two sides of the existing permanent way and the transportation of the sleepers only on the construction train. This second method allows to avoid the big number of weldings to be done on field and allows to transport on field sleepers and long rails separately. The first train transporting long rails would also run during line operation, laying the new rails on the two sides, the second train would dismantle the existing permanent way, cleaning and re-laying the sub-ballast, laying the sleepers (transported by its wagons) at the correct distance and it would finally install the lateral new rails on the sleepers, with fastenings. In the next pages the two envisaged construction methodologies will be described with schematic drawings. The item 6A also includes first layers ballast spreading, tamping and lifting of rails up to 3 cm to final level.
7A	Flash-butt or thermic weld of P65 rail.	Welding of the panels by means of flash-butt or thermic system. Welding of the rails will have to be done according to strict technical specifications, that will be detailed in the next phase of the study.
8A	Regulation of mechanical tension of long welded rails (l.w.r.).	After the rail welding, mechanical tensions will be regulated, according to strict technical specifications, that will be detailed in the next phase of the study.
9A	Final tamping and levelling of new line.	The permanent way, so welded and regulated, will be in this phase taken to its final level and alignment by means of final tamping and levelling.
10A	Ballast cleaning on the other existing sections.	On some of the sections where existing permanent way is preserved, ballast cleaning will be carried out. Ballast cleaning concerns the existing section ballast cleaning and re-shaping, with some addition of new ballast where necessary. It can be carried out by means of automatic machines or by handwork.

11A	Tamping, levelling and aligning the other existing sections with l.w.r.	All over the sections where existing permanent way is preserved, tamping, levelling and aligning will be carried out for reaching the final alignment.
13A	Excavation of ditches.	Hydraulic drainages must be cleaned and embankment side ditches must be excavated when absent, in order to protect the embankment side from water infiltration and foot erosion. In general, no concrete cover is requested for the ditches. Trapezoid ditch 0.5-0.5-0.5 has a volume of 0,5m3/m.
14A	Pavement of level crossings.	This item concerns the reconstruction of the pavement of the level crossings for the area of railway crossing only. It has been estimated that each level crossing envisages an area of about 50m by 10m.
22A	Renewal of bridges beams	Replacement of beams (double span bridges) and base plates
23A	Maintenance of piers and abutments	Rehabilitation of reinforced concrete structures, and of masonry and stone pitching works on the abutments.

Several works are standard works which don't need to be detailed more then what has been described in the Technical Specifications included in the Tender Documents for the present Lot 1.1 (Annex A).

The Consultant has deemed important to detail more some specific methodologies for the implementation possibly introducing European methodology or comparing European methodology with the CIS methodology.

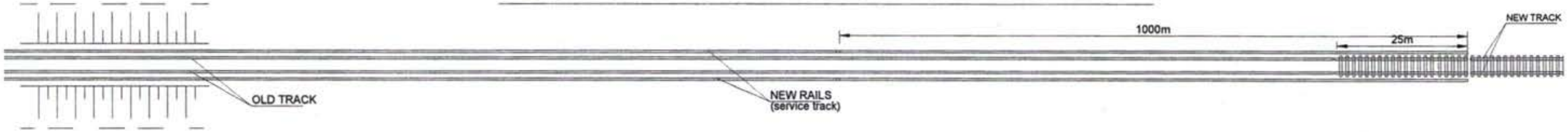
2.3 Methodology for the line construction (Permanent Way)

2.3.1 Methodology 1

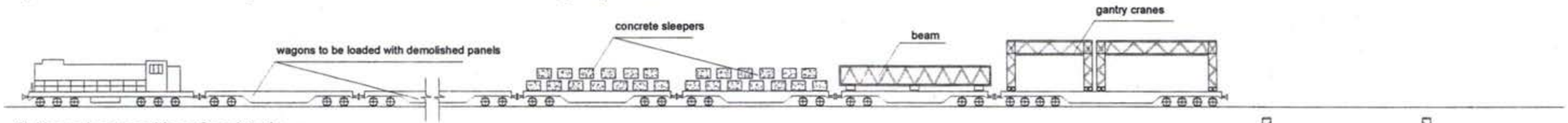
Hereafter the procedure commonly used in Europe to implement these works with heavy machines is described (see also Figure 2.3.1-1 here attached):

Figure 2.3.1-1

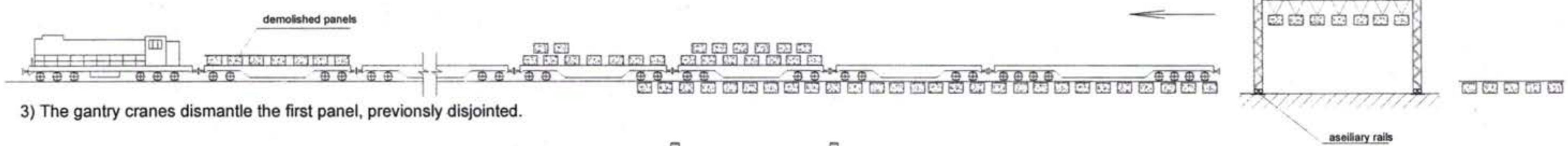
METHODOLOGY 1 FOR TRACK REPLACEMENT



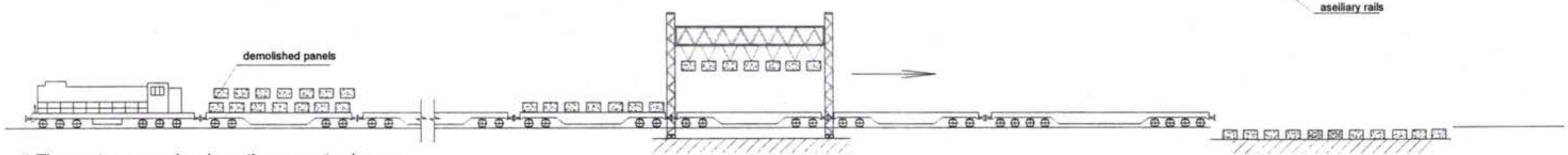
1)New rails are laid down along track to be first used as service track for gantry cranes.



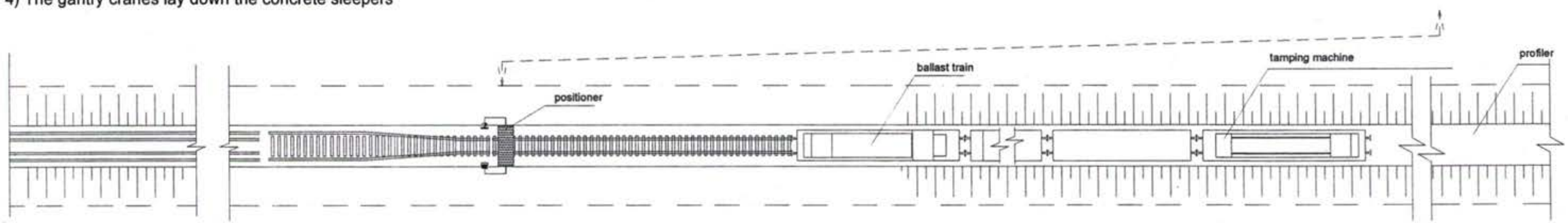
2) Normal composition of work train.



3) The gantry cranes dismantle the first panel, previonsly disjointed.



4) The gantry cranes lay down the concrete sleepers



5) The positioner put the auxiliary rails on the concrete sleepers to form the new track.

Previous activities

I. the P65 rail bars 25 m long are welded in bars of 100÷125 m and staked,

II. the long P65 rail bars are loaded on platforms, transported and laid down along the line on both sides of the existing track, positioned and jointed to be initially used as service track for portal cranes,

Activities to be done in the same day

III. a work train arrive at the beginning of the stretch scheduled to be dismantled and rebuilt with P65 rails on concrete sleepers (in this case the average length of this stretch is 600 m per day). The work train is formed by:
   - platforms loaded with 2 self moving portal cranes and an ancillary beam;
   - platforms to be loaded by dismantled 25 m track frames;
   - platforms loaded with concrete sleepers to be installed.

IV. the portal cranes and ancillary beam, unloaded from the platforms, displace themselves on the service track, stop in correspondence of the first 25 m panel, previously disjointed from the adjacent ones, lift it and, coming back along the train, unload it on a flat wagon; this operations are repeated up to complete the dismantling of the scheduled length of track (see also item 2A);

V. the excavation of the existing materials start and go on until the design depth is reached (see also item 3A);

VI. the sandy-gravel material is spread on the surface between the service rails and compacted (see also item 5A);

VII. the portal cranes by means of the ancillary beam lift the concrete sleepers from wagons, run along the service track and lay down in two phases the concrete sleepers on the sandy gravel layer (distance between sleeper axles = 0,54 cm, that is 1840 sleepers per km are to be laid down) up to cover the full length of the dismantled stretch; at this stage the Contractor shall make use of reference stakes for locating the track CL and avoid abnormal adjustments in a further stage;

VIII. the portal cranes and beam are re-loaded on their wagons,

   After placing the polyethylene pads on the rail seats of the sleepers, using a little machine called "positioner" the P65 rails, forming the service track till the present phase, are put in their definitive position on the concrete sleepers and fastened; at this stage 50% of fastenings will be inserted, the joints shall be assured with additional bolts

   The new track shall be, manually and/or using the tamping machine, leveled, aligned and put in order to allow the passage of trains at a temporary speed limit of 10 km/h,

Activities to be done in the following period

IX. The long bars are welded up to a length of 400 m (temporary section); the Contractor may weld the joints by "thermic" or flash-butt process,

X. the finishing of the excavation and of the sandy gravel layer on both external sides is implemented,

XI. about 1 m^3 of ballast is laid down and the track lift of about 0,20 cm using the tamping machine and jacks,

XII. additional quantities of ballast are laid down and the track is lift up to reach a level of 0÷20 mm to the design level,

XIII. during the lay down of additional ballast, the lifting and tamping operation, the ballast section profile shall be adjusted by a "profiler" machine, equipped with a brush for clearing the track,

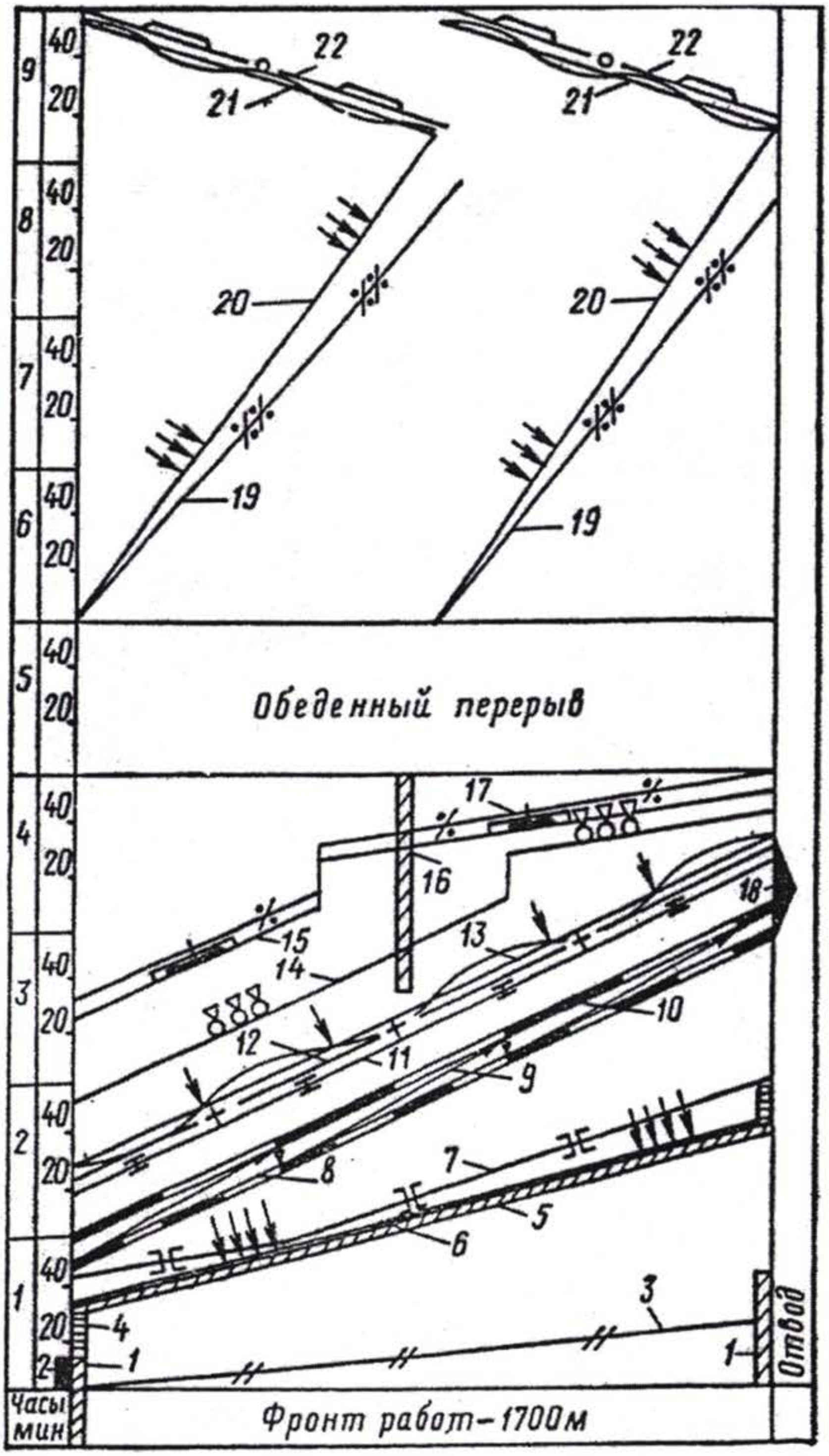
XIV. before final lifting, straightening and leveling of the track, the Contractor shall carry out the regulation of the mechanical stresses of the rails, the formation of the continuous welded rails (CWR), adjust the expansion joints and fix the 100% of the fastenings.

XV. a final tamping of the complete track has to be carried out, making use of an heavy tamping machine, at least 60 days after all the works described in the above paragraphs have been successfully completed. The final line profiling has also to be implemented at this stage.

2.3.2 Methodology 2

Hereafter the procedure commonly used in CIS countries to implement these works with heavy machines is described (Figure 2.3.2-1, Figure 2.3.2-2, Table 2.3.2-1):

Fig 2.3.2 – 1 Main work schedule in the major repair works on track



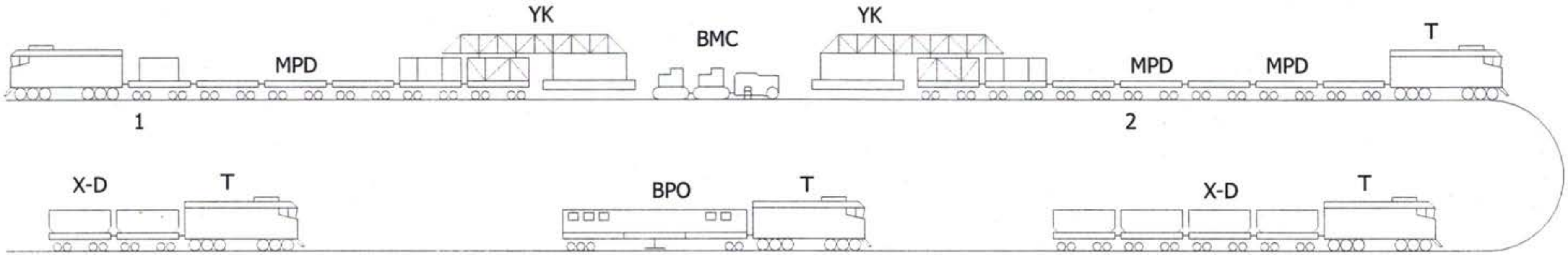
1 – preparing for charging and discharging of gravel-cleaning machine; 2 – securing the closure of the route section; 3 – preparing for dismantling; 4 - preparing for charging and discharging of gravel-cleaning machine; 5 – gravel cleaning; 6 – track rectification; 7 – unbolting the rail joints; 8 - dismantling of the track; 9 – gravel ploughing; 10 – track laying; 11 - bolting the rail joints; 12 – installing inventory stop brakes; 13 – setting the track on axle; 14 – gravel unloading; 15 – track rectification with VPO-3000 machine; 16 – equipping electrically-failed joints; 17 and 19 – exit of stop brakes; 18 – exhaust unit; 20 - track rectification; 21 - lining of the track; 22 – prism alignment.

The following table contains detailed timing of each phase of the works.

Table 2.3.2 – 1 Operational main work schedule in "possession"

N.	Operation name	Planned time	
		Duration (min)	End of operation, Hours and minutes
	The passing of the last scheduled train on station		10.40
	The work of the dismantling train		
1	Arrival to the place of work	15	10.50
2	Positioning in running order	8	10.58
3	Dismantling of first packet (gravel-cleaning machine's work start)	12	11.10
4	Dismantling of second packet	12	11.22
5	Same, third etc	12	11.34
22	Dismantling of twentieth packet	12	14.58
23	Positioning in transport order	12	15.10
24	Departure of dismantling train	5	15.15
	Gravel-cleaning machine's work		
1	Arrival on track	5	11.15
2	Gravel cleaning on the first section extending over 50 m (beginning of track laying)	5	11.20
3	Finishing gravel cleaning	225	15.00
4	Derailment	5	15.05
	Laying train work starts		
1	Following to the place of work	20	11.10
2	Positioning in running order (start of laying)	10	11.20
3	First packet laying	12	11.32
4	Same, second etc	12	11.44
22	Twentieth packet laying	12	15.20
23	Exhaust unit positioning of crane in transport order	10	15.30
24	Departure for station	3	15.33
	Hoppers-dozers work		
1	Following to the place of work of welded structure from 40 hoppers-dozers (start unloading)	15	13.00
2	Ballast unloading during track laying		15.20
3	Unloading after track laying		15.35
4	Departure of welded structure from 40 hoppers-dozers for station		15.40
	The work of VPO-3000 machine		
1	Following to the place of work	15	13.35
2	Charging	5	13.40
3	Machine's work during gravel unloading		15.40
4	The finishing of the measured shovel-packing		15.55
5	Machine discharging and leaving for station	5	16.00
	Hoppers-dozers work		
1	Following to the place of work	15	14.00
2	Ballast unloading		16.15
3	Departure of welded structure from 40 hoppers-dozers for station		16.20
4	Time route section is closed	from 10. 40 until 16.40	

Fig. 2.3.2 – 2 Current Permanent Way replacement cycle



1 - dismantling (distributor) train; 2 - packing (laying) train; T - disel locomotive; MPD - motor platform; YK - laying crane; BMC - balast dearer; XD - hopper-batcher; BPO - liner-tamper supfaser.

Previous activities

I. panels 25 meters long of concrete sleepers fastened to P65 rails are prepared in a station near the work site and loaded on the laying train,
II. a dismantling train and a laying train (loaded with the new panels to be installed), coming from one of the adjacent stations, are placed astride the first panel to be dismantled; every train has a crane on the queue of the composition, able to work on the site of this panel,
III. the crane of the dismantling train lifts the first panel, whose joints have been previously unbolted, and, with a backward movement, lays it on a mobile device under crane on the platform wagon; this operation is repeated according to the possibilities given by the height of the crane, after a train displacing in successive positions correspondent to the other panels to be dismantled,
IV. the mobile device, pulled by the rope of a winch, transfer on rollers the panels stacked on it to wagons in a rear position to allow the dismantling and stacking of more panels,
V. on the dismantled stretch, excavation works start, using ballast cleaner machine, soil moving machines, motor grader, pneumatic-tired roller, leveler, to prepare the new sandy-gravel layer, if it is foreseen by the design, and /or a leveled ballast surface,
VI. the crane of laying train, lays down the 25 m long new panels assembled P65 rails fastened on concrete sleepers, and provisional joints of panels are performed,

Activities to be done in the following period:

VII. new ballast is spread along the line and the tamping machine start to compact ballast and to lift the rails up to 2÷3 cm from the design level,
VIII. rails are welded in 800 m bars and provisional joints recovered,
IX. during the lay down of additional ballast, the lifting and tamping operation, the ballast section profile shall be adjusted by a "profiler" machine, equipped with a brush for clearing the track,
X. before final lifting, straightening and leveling of the track, the Contractor shall carry out the regulation of the mechanical stresses of the rails, the formation of the continuous welded rails (CWR), adjust the expansion joints and fix the 100% of the fastenings.
XI. a final tamping of the complete track has to be carried out, making use of an heavy tamping machine, at least 60 days after all the works described in the above paragraphs have been successfully completed. The final line profiling has also to be implemented at this stage.

2.4 Methodology for rail welding

According to the information collected, the habit in CIS countries is not to weld rails on site but in the workshops. The length of the section to be considered is therefore limited by transport constraints (up to 800 m of long welded bars).

The European experience proves that rail welding can be performed on site by either of two methods:

- Thermic process
- Electric process

2.4.1 Thermic welding

<u>Type</u> - The thermic welds shall be of the "rapid" type with prefabricated moulds and oxygen activated preheating.

<u>Material and Equipment</u> – The moulds shall be of the prefabricated type and suitable for P65 rails; they shall be stored in the cardboard boxes in which supplied.

The welding portions shall be of the type suitable for welding, with normal welding gaps, P65 rails in workshop or on site.

They shall be packed in sealed bags bearing in print the characteristic data: type of weld ("rapid"), type of rails and of steel. It is not allowed to use welding portions whose packaging has been tampered with and nothing shall be empirically added to or removed with welding portions. Should it be found necessary, in particular cases recognized as inevitable by the Engineer, to weld with wider gaps than specified, use shall be made of the appropriate welding portions.

Pre-heating shall be done by means of a suitable oxy-propane burner.

Particular care shall be taken in the storage of materials; the welding portions and the moulds shall be stored in a dry room away from inflammable materials; the oxygen cylinders and propane bottles shall be stored in isolated rooms and apart from each other. The welding equipment may be stored in the room were the welding portions and moulds are stored.

Operating procedures – The gap between the rail ends to be welded shall be between 15 and 16 mm or as specified by the manufacturer of the welding portions.

The rail ends shall be perfectly aligned in both the horizontal and vertical plane. To compensate for lowering due to thermal contraction, the two rail end sections shall be raised by 1 mm. The alignment shall be maintained during welding by inserting steel wedges. The rail ends shall be cleaned with a wire brush and any moisture dried by using the burner.

The welding casting shall not be poured directly into the mould but through a casting pocket. The slag shall be collected in an appropriate box.

The burner shall be accurately centered on the welding gap and placed with the orifice 40 mm above the running surface of the rail.

During the pre-heating, the oxygen and propane pressures shall be respectively 5 kg/cm^2 and 0.5 kg/cm^2. the pre-heating shall last not less than 6 minutes.

The above data are indicative and compliance therewith shall not relieve the Contractor from responsibility for the correct execution of the welds.

The procedures for the subsequent operations, from the ignition of the portion through removal from the moulds, are left to the worker's experience and skill.

The feed head may be removed by hammer and chisel or by a hydraulic press fitted with a suitably shaped chisel. The chiseling operation shall not result in the removal of material from the essential part of the welds.

The side surfaces and the running surface of the rail head shall be ground down by means of a suitable grinder to the normal rail profile.

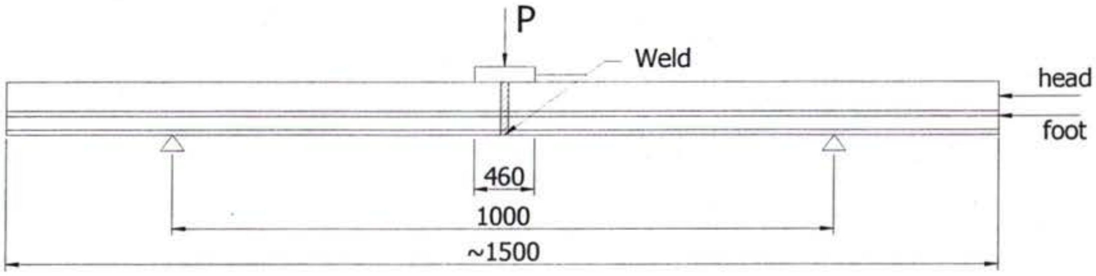
On the remaining parts of the rail section the presence of the weld bead remaining from the chiseling operation shall be tolerated, after removal of the feed head and of the other superfluous parts of the weld casting, the welded joint shall be cleaned with a wire brush and protected by rust-proofing paint over a length of 20 cm.

Sample Testing and Checking

I. Moulds: visual inspection for integrity shall be performed on a 4% sample of each stock of welding moulds.

II. Portions: two portions chosen by the Engineer shall be taken from each stock and two welds shall be executed on two pairs of rail sections, each 0,75 m long, so as to obtain two samples with a welded joint.

III. Bending test: samples shall be subjected to the bending test in accordance with the following sketch:



Load P shall be increased slowly from 0 to 40 tons, continuously recording the deflection of the mid portion. Under the maximum load neither cracks nor fractures shall appear. After removing the load, the residual permanent deformation shall be measured one hour after the test.

IV. Internal sections: the specimen shall be cut through the center of the weld along a plane perpendicular to the longitudinal axis and then along the plane of symmetry of the rail sections. The sulphur print of the cross section shall be taken. Inspection of the sections shall show no cavities, internal damage or porosity. At the Engineer's absolute discretion, a light degree of porosity internally to the web and head may be tolerated.

V. Brinell hardness: on the longitudinal section, 5 mm under the surface the hardness shall be measured aver a 300 mm length. The Brinell hardness shall be comprised in the range of 20 units less to 40 units more than that measured on the steel of the original rail. The hardness test shall be performed with a steel ball 10 mm in diameter pressed against the steel with a load rising from 0 to 3000 dN in 30 second. The impression shall be spaced to 10 mm intervals.

VI. Other tests: any other test required by the Engineer with a view to determine the quality of the material used for thermic welding may be carried out. In the event of failure the weld shall be rejected

Manufacture Cheks and Tests

Each stock of welding portion supplied shall be accompanied by a certificate issued by an official testing Institute of the manufacturer's country, showing the results of the following tests performed on rail section welded with one of the portions from the stock, following the same procedures above outlined:

- bending test (see the preceding III. Paragraph)
- Brinell hardness (see the preceding IV. Paragraph)
- Sulfur prints of the weld cross section, and
- Chemical analysis which shall show that S and P contents not exceed each 0.05% and combined 0.09%.

Systematic Weld Checks

The following checks shall be performed on the welds executed in workshop or on the line:

- Visual check - A perfectly straight ruler 1,0 m long, accurate to within 1/10 of 1mm, has to be used for lining and leveling the welded joint; the check shall be done over a length of 1 m centered on the weld and defects shall not exceed those shown in the drawing L1.1-17,

- Visual check for the integrity of the weld,
- Ultrasound check by means of a special apparatus operating above the 3 MHz frequency

2.4.2 Electric Flash-butt Welding

Rail welding machine

The welds are executed by a welding machine that may operate either on track along the line or in the station yard.

The welding head shall be suitable for welding P65 rails and perform the following functions:

- grabbing the rail ends over a sufficient length to ensure good alignment and hold them tightened with great force for the entire duration of the process,
- heating the rail ends and bringing them to the upsetting state,
- upset-welding the rail ends with the necessary force,
- allowing the mechanical removal of the welding bead,
- leaving the rail with the joint in good alignment and condition.

All the welding process shall take place automatically without the intervention of the operators whose only jobs shall be to prepare the rails, remove the welding beads and finish the rail head surface.

After the mechanical removal of the bead produced by upsetting the head surfaces shall be finish-ground with a grinding machine, as required for the thermic welds.

For the acceptance of the welds the welding machine shall be equipped with a special apparatus recording the following data for any weld:

- current absorption,
- shortening of rails due to metal fusion,
- the batting force of the welding head.

Should the recording apparatus be out of order, no welding work will be allowed.

Sample Checking and Testing

Before beginning work, The Contractor shall prepare two sample welded joints produced with the welding machine which he plans to use. The samples shall have the same characteristics as those prepared by thermic welding and shall be subjected to the following checks and tests:

- visual check with 1 m metal ruler of the same characteristics as that used to check thermic welds,
- bending test as that used to check thermic welds
- internal sections as that used to check thermic welds
- Brinell hardness check as that used to check thermic welds

The machine shall be accepted if the result of the tests and checks prove satisfactory and and conform with the specifications. Otherwise the Contractor shall adjust the machine and repeat the tests until satisfactory results are obtained. Should the Contractor fail to obtain results conforming with the specifications, the machine shall be rejected.

Systematic Weld Checks and Tests

Every flash-butt weld is subjected to:

a. visual checks as that described for thermic welds
b. integrity check

2.4.3 Formation of Continuous Welded Rails (CWR)

The purpose of forming CWR is to eliminate all rail joints and creating in the rails an even condition of thermal stresses in order to prevent thermal expansion (stress settling). The temperature at which the CWR is formed is called ***neutral temperature*** (zero stress at all points of the rail), hereinafter abbreviate as NT.

No CWR shall be formed on curves with a radius lower than 350 m and in stations where they will be formed according to Engineer's instructions.

On the lines equipped with Automatic Block, the CWR is to be interrupted in correspondence of the signals and an insulated joint has to be installed to allow the correct work of the track circuits; towards and backwards two stretches 12,5 m long have to be formed using by means of two additional normal joints.

The CWR shall be formed at the NT. The conditions required to get the NT may be obtained either naturally or artificially, i.e. by natural heating or with the use of tensors.

The temperature of the rail shall be monitored for at least one year and the NT lies in the range of + 7 °C -3 °C of the average temperature. The NT shall be fixed by the Engineer at the beginning of work.

The Contractor shall be required to have available special rail thermometers suitable for measuring rail temperatures to within 1 °C.

The forming of the CWR shall be done on days when the rail reaches the NT by natural Heating and the NT is likely to remain constant within ± 3 °C through the entire duration of the forming operation. If these conditions are not obtained, the operations shall be suspended.

In a temporary section (see paragraph IX. of the item 6A Construction of line), the 36 m long central zones are defined as ***central stretches*** (CS).

The CWR is formed by welding two contiguous temporary semi-sections, through the following operations:

I. disassembling the fastenings on all sleepers, except in the CS zones of the contiguous temporary semi-sections
II. disassembling the temporary joint between the two temporary semi-sections,
III. lifting the rail by means of stakes, starting from the joint towards the CS and inserting every 9 m expansion rollers into the rail seats, after removing the polyethylene pads; the expansion rollers, at least 20 mm in diameter, shall be positioned with their axles perpendicularly to the rail,
IV. jarring the rail with wooden mallet blows to facilitate its expansion and the removal of any hindrances to thermal expansion,
V. cutting thin slices off the rail ends to allow the free expansion of the temporary semi-section; this is necessary when the forming of the latter was done at temperatures below the NT. In the event of the temporary semi-sections having been formed at temperatures higher than the NT, a makeup rail shall be inserted to fill the gap due to thermal contraction. The length of the makeup rail shall be not less than 3 m. The makeup rail shall be welded to either of the temporary sections ends,

VI. having reached the NT within ± 3 °C, forming the welded gaps, forming the weld gaps, quickly removing the expansion roller (starting from the CS), reinstalling the previously removed polyethylene pads,
VII. assembling the fastenings, starting to the joint towards the CS, of the first 40 sleepers and next of one sleeper every three,
VIII. welding the joint,
IX. during the welding, completing the assembling of the fastenings,
X. immediately on completion of the casting of the thermic weld, disassembling the fastenings of 46 sleepers astraddle the joint in order to allow the thermal contraction of the weld on a rail length of at least 12 m on each side,
XI. after one hour, assembling the fastenings disassembled in step X.

Rail pulling

When it proves impossible to form the CWR by natural heating, the use of rail tensor may be required.

The tensors shall be designed to permit the execution of thermic welds and be able of producing a 60 t pull without damaging the rails.

Stress settling and CWR forming shall not be allowed to be done at temperatures under + 10 °C.

When rail pulling is used, the following operations shall be carried out, after applying the rail thermometers to the rails:

1. same as per point I.
2. same as per point II.
3. same as per point III.
4. same as per point IV.
5. affixing a reference mark on the rail foot on the ends of the two temporary semi-sections, recording the rail temperature, calculating the elongation to be produced in the two temporary semi-sections, multiplying 0,000012 by the length of the two temporary semi-sections and by the difference between the NT and the temperature recorded on the rail,
6. applying the turnbuckles and pulling the rails till the calculated elongation is achieved, as checked by reference marks, jarring the rails by wood mallet blows to facilitate elongation and remove any interferences therewith,
7. cutting thin slices off the rails ends to allow elongation,
8. when the calculated elongation is reached, quickly removing the expansion rollers starting from the CS and reassembling the rubber pads,
9. assembling the fastenings, starting from the joint towards the CS,
10. welding the joint, continuing to pull the rail till 3 minutes after the casting of the thermic weld to compensate for the tension stress of weld contraction during weld solidification,
11. loosening and removing the turnbuckles 10 minutes after the casting of the weld,
12. disassembling and immediately reassembling the fastenings of 46 sleepers astraddle the weld

2.5 Methodology for beam substitution and improvements of bridges

Beam substitution

Methodology for beam substitution should be that one used in CIS here below shortly described.

Figure 2.5-2 describes the methodology for substitution of beams of a three spans bridge.

In such case the operation considers two stages:

- I stage – replacement of the first two spans
- II stage – replacement of the third span

For bridges of two spans (which is the most common case along the line), the operation should be limited to the first stage.

Works to be carried out requires a special standard train made of: two diesel loco at the ends, a platform wagon for beams, a crane (EDK-1000) including a platform wagon for the boom on rest/transport, a gondola wagon for ballast.

Stage I

Works to be carried out requires a windows of 8 hour and 20 minutes:

1. Closure of the line and work train leaving the station full loaded;
2. The train reaches the bridge;
3. The crane boom is freed and the train is divided into two parts positioned each one on the two different approaches to the bridge;
4. Ballast, sleepers and rails are removed from the two spans to be substituted near to the crane;
5. The crane removes the old beams from the nearest span, put them on the temporary site aside, replace the old beams with the new-ones;
6. The crane performs the same operation for the central span;
7. Ballast, sleepers and rails are replaced;
8. Old frames are collected and loaded on the train;
9. Loco N° 2 push platform for crane boom and gondola to form again an unique train;
10. Crane boom is fixed in the rest/transport position;
11. The train reaches a station;
12. Line is open to the traffic.

Stage II

Works to be carried out requires a windows of 5 hour and 30 minutes, operations are basically the same but only beams of one span are substituted. This stage is evidently not necessary for bridges of two spans or less.

The substitution of the beams should be operated before the long bar welding.

Improvement of bridges

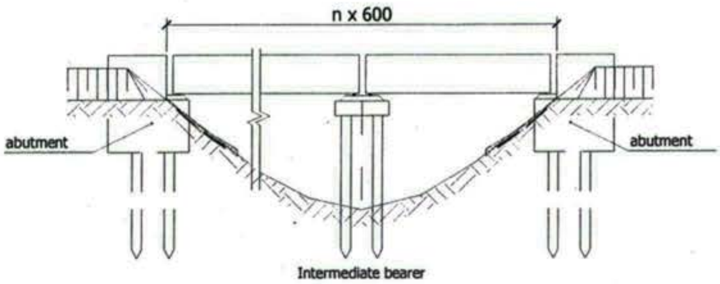
According to the conditions of bridge superstructures and piers, mentioned in the list of existing bridges (table 1.1.5-1) the following works are envisaged under the Project:

- Replacement of bridge superstructures according to the scheme nx6 m;
- Waterproofing of mallet plates
- Replacement of bearings
- Repair of bridge superstructures
- Repair of piers

General features of the bridges are given in the Figure 2.5-1

Figure 2.5-1

Front



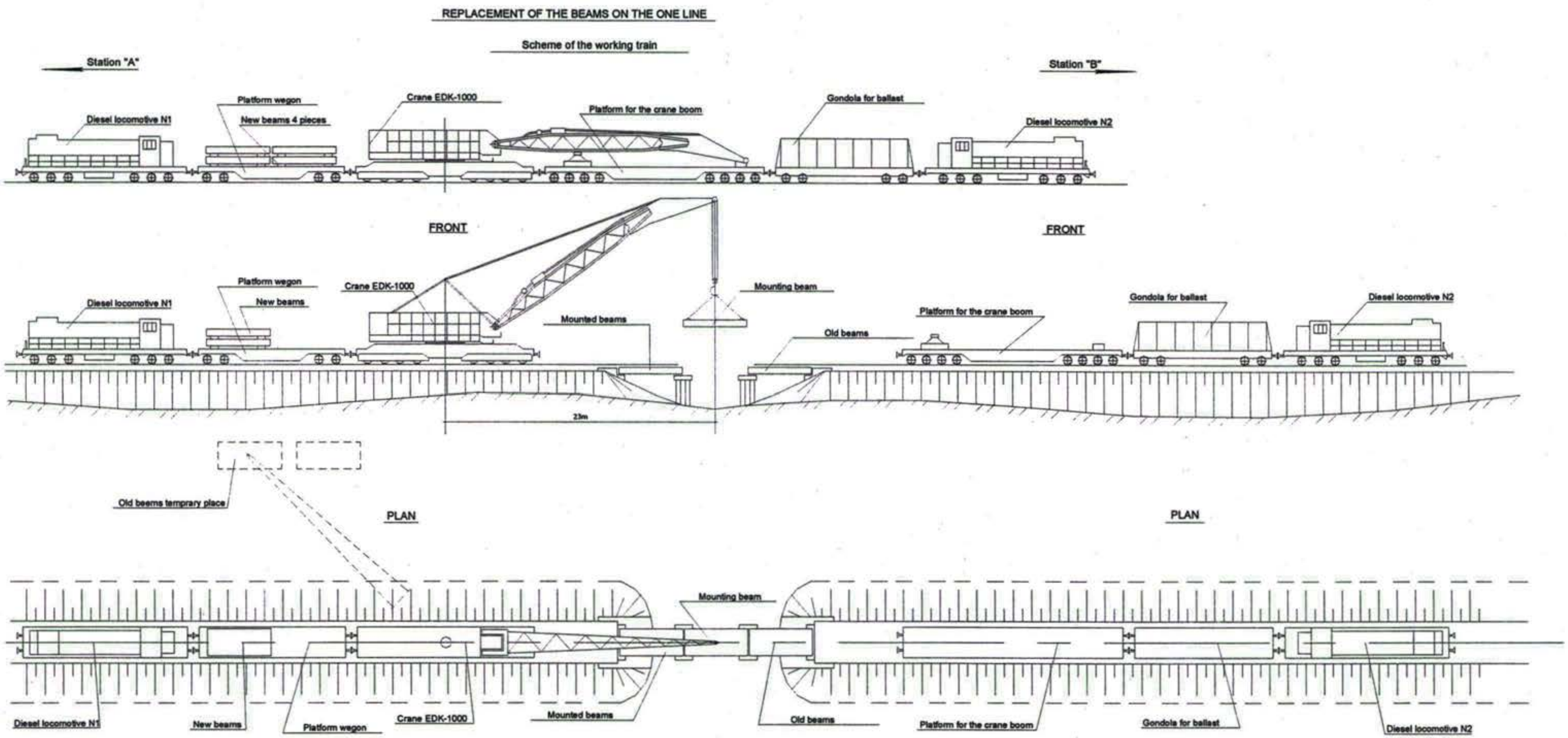
	The name of activites	Unit	Quantity		
			The scheme of the bridge		
			1 x 6	2 x 6	3 x 6
1	Disassembly of a way from rails R 65	r.m.	50	50	50
2	Removing of the ballast on existing bridges	m^3	14	25	36
3	Assembly of the sleeper platform	items	60	100	100
4	Levelling of place under sleeper platform	m^2	11	22	33
5	Stone bed h=10cm under the sleeper platform	m^3	1.1	2.2	3.3
6	Dismantling of an existing bridge span l=6m	span	1	2	3
7	Disassembly of existing bearings	ton	0.376	0.752	1.128
8	Precast and monolithic reinforced-concrete span l=6m	m^3	9.7	19.4	29.1
9	Metal of bearings	ton	1.124	2.248	3.372
10	Precast concrete of walkway slabs	m^3	0.7	1.4	2.02
11	Metal of railings and consoles with bracing	ton	1.764	2.86	3.956
12	Removing of the defective layer on pad stone	m^3	0.5	0.6	0.8
13	Repair of broken parts of the pad stone by concrete	m^3	0.4	1.35	1.6
14	Disassembly of an existing steel concrete laying cordon stones on foundations	m^3	4	4	4
15	Precast concrete and concrete bearing block, closet and cordon blocks	m^3	4.78	5.88	6.48
16	Restoration of a blanket by a cement mortar	m^2	-	15	26
17	Rubbing the cement mortar of surfaces of support	m^2	-	20.5	45
18	Closing up of cracks by a cement mortar	m	-	3	4
19	Ballasting on the bridge by stone ballast	m	12	23	32
20	Assembling of the tracks	l.m.	50	50	50

Replacement of bridge superstructures

Taking into account poor physical condition of bridge superstructures with the length of 6 m and their insufficient capacity, the Project envisages a replacement of bridge superstructures. Replacement of old bridge superstructures and installation of new ones is implemented into "window" by railway crane EDK-1000 with removal of old cordon stones and installation of new bearing blocks PB-1 and PB-2.

Scope of works on replacement of bridge superstructures and making up a work train scheme is given in the Figure 2.5-1 and 2.5-2.

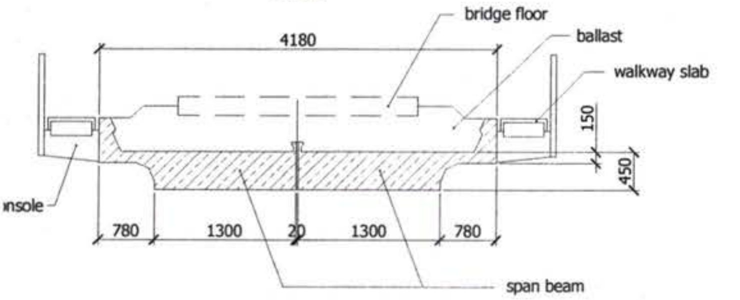
Figure 2.5-2


REPLACEMENT OF THE BEAMS ON THE ONE LINE
Scheme of the working train
Station "A"
Station "B"
Diesel locomotive N1
Platform wegon
New beams 4 pieces
Crane EDK-1000
Platform for the crane boom
Gondola for ballast
Diesel locomotive N2
FRONT
FRONT
New beams
Mounted beams
Mounting beam
Old beams
23m
Old beams temprary place
PLAN
PLAN

New bridge superstructures with the length of 6 m, reinforced concrete paving slabs installing on the metal consoles are adopted on the basis of the standard design of Lengiprotransmost No 557, 1969 Figure 2.5-3.

Figure 2.5-3

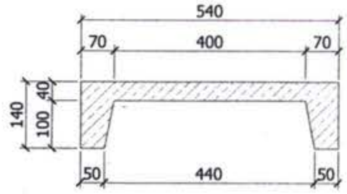
Span



The basic parameters on one span

overall length	effective span Lp, m	Building height from a sole of a rail up to pad stone m	Mark of concrete	Volume of concrete, m³			Weight of armature, ton			Weight of one block with isolation, ton
				of the beams	Of the walkway slab	Total	A I	A II	Total	
6.0	5.4	1.02	V-25	9.7	0.4	10.3	0.57	1.59	2.16	14.1

walkway slab



The basic parameters on one walkway slab

Mark of element	The basic sizes of elements, cm	Concrete		Weight ton	Armature steel	
		Mark of concrete	Volume of concrete, m³		Class of the armature A I, kg	Class of the armature A II, kg
P-2	173 x 54 x 15	V-25	0.058	0.145	8.5	3.0
P-5	208 x 54 x 15	V-25	0.07	0.175	10	3.7

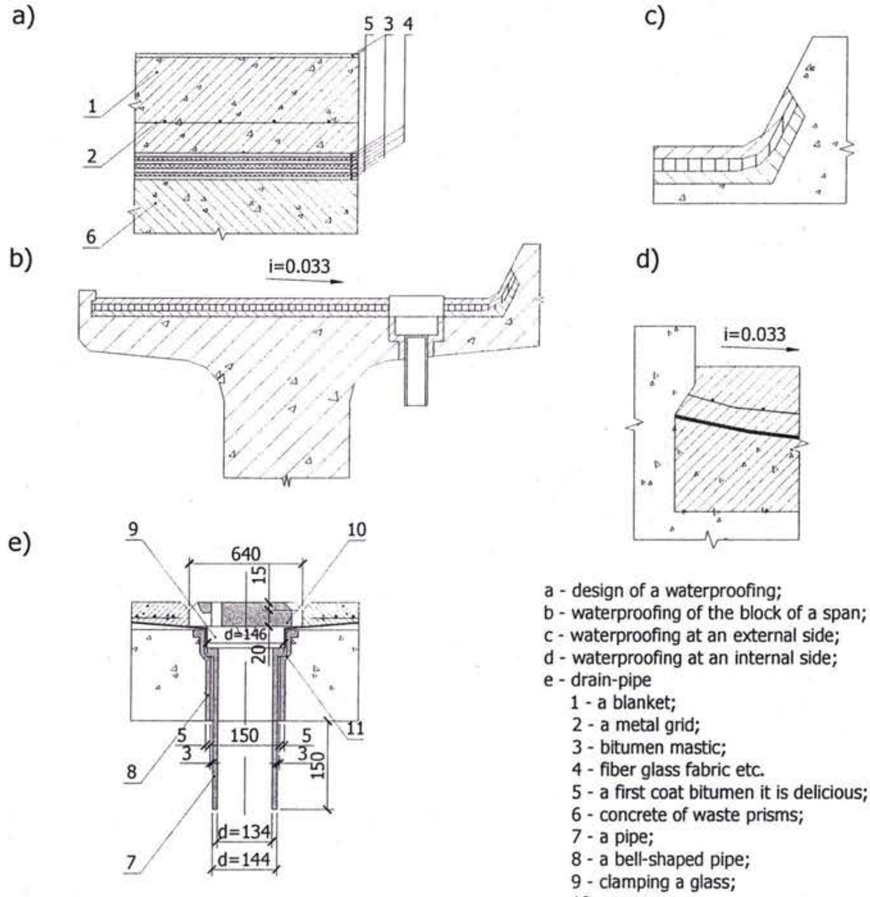
Waterproofing of ballast plates

Life time of reinforced concrete bridge superstructures in a great extent depends on waterproofing condition and fast water diversion from ballast plate and other surfaces of bridge superstructures.

Structure of surface waterproofing consists of preparatory isolating and protective layers Figure 2.5-4 and Table 2.5-1.

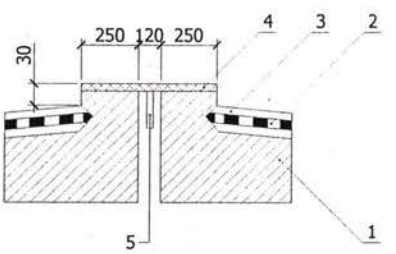
Figure 2.5-4

Details of a waterproofing
(the sizes in mm)



a - design of a waterproofing;
b - waterproofing of the block of a span;
c - waterproofing at an external side;
d - waterproofing at an internal side;
e - drain-pipe
1 - a blanket;
2 - a metal grid;
3 - bitumen mastic;
4 - fiber glass fabric etc.
5 - a first coat bitumen it is delicious;
6 - concrete of waste prisms;
7 - a pipe;
8 - a bell-shaped pipe;
9 - clamping a glass;
10 - a cover;
11 - the bell, is filled bitumen (or on epoxy) mastic.

Overlapping of deformation seams



1 - preparatory layer
2 - waterproofing;
3 - blanket;
4 - steel sheet - =4 - 6 mm;
5 - the rod d=12mm, l=150 mm.

Table 2.5-1 Contents of waterproofing layers:

Waterproofing layer	Thickness of layer	Materials
Preparatory layer (and drainage surface)	According to site	Concrete M 200 (with crushed stones not more than 15 mm) or cement and sand mixture
Grounding with asphalt paint of the preparatory layer	-	Asphalt paint (to be prepared on the work site)
"reinforcing" cloth (material)	Depends on material thickness	One of the following: glass fabric (layer up to 1 mm), waterproofing, antiseptic fabric
Bitumen mastic	2-3 mm of each layer	Content of bitumen mastic depending on climatic zones
Protective layer with metal gauze	Not less than 30 mm	Concrete M 200 (with crushed stones not more than 15 mm) or cement and sand mixture M 200; metal gauze from the wire, d=1-2 mm with cells from 50x50 mm to 75x75 mm

Transverse and longitudinal welds between the bridge superstructures and carriages and widening welds should be blocked in such way to provide continuity of waterproofing. Welds should be placed on "watersheds" with the slope towards water diversion devices Figure 2.5-4.

Dimensions of drainpipe parts depend on thickness h_p of the mallet plate of bridge superstructures (Table 2.5-2).

Table 2.5-2

Name of part	Material	Weight, kg (numerator) and length, cm (denominator) with h_p			Surface layer
Pipe	Cast Iron	4.8 / 26	5.5 / 31	6.5 / 36.5	Internal surface is grounded with asphalt paint
Slip-joint pipe	-//-	4.8 / 16.3	6.4 / 21.5	8.1 / 27	The same
Liner clamp	Steel 0	1.3 / 6.5	1.3 / 6.5	1.3 / 6.5	To be zinc coated
Cover	Cast Iron	8.0 / 3.5	8.0 / 3.5	8.0 / 3.5	To be coated with asphalt paint

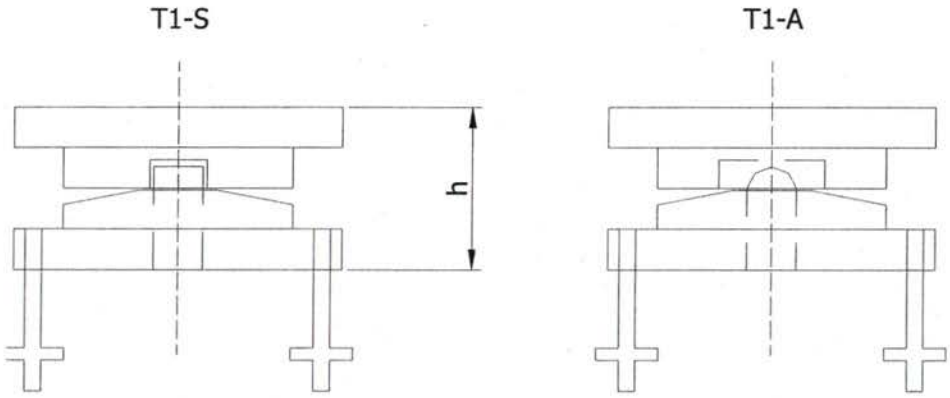
Bearings

During replacement of the bridge superstructures the Project envisages a replacement of defective bearings.

It is allowed to install the reinforced concrete bridge superstructures with the length of 6 m on welded tangential bearings with the height of 20 cm Figure 2.5-5.

Figure 2.5-5

Welded tangential carriages for slab span



The basic parameters on one span

Height of the carriage mm	End reaction to the one carriage ton	Design move-ment mm	Sizes of the bottom bearing sheet		Distance between anchors along an axis of the bridge	Weight of one bearing sheet kg		Quantity of bearings on the span Lump of bearings on the span
			Along an axis of the bridge	Across an axis of the bridge		actuated bearing	stationary bearing	
200	109	25	430	310	300	164	8	1316

Repair of bridge superstructures (BS)

According to survey data reinforced concrete bridge superstructures have the following damages: cracks in the concrete, corrosion of armoring, leaching of concrete, separation of protective layer, damages of waterproofing.

The following works are envisaged under the Project implemented from outside scaffoldings “under the train traffic conditions”:

- Current repair: facilities cleaning from dust, dirt, leaching of concrete with rehabilitation of protective layer, trimming of cracks up to 0.15 mm with “polymer compound”, injection of cracks more than 0.15 mm with epoxy resin, improvement of waterproofing and water diversion defects on bridge superstructures is carried out from overhead rail package with the length of 5 m.

Repair of abutment

Overhaul works of piers are carried out from outside scaffoldings.

Works implemented into “window” include:

- Cutting out of defective layer with the thickness of 4 cm on bearing blocks;
- Sealing up of chips with the monolithic concrete B 25;
- Dismantling of reinforced concrete laying, destroyed cordon stones;
- Installation of new reinforced concrete bearing blocks PB-1, PB-2 (Figure 2.5-6/7);
- Installation of new cordon blocks CB-1 and cabinet type blocks (Figure 2.5-8).

The works implemented “under the train traffic conditions”:

- Sealing up of chips with the thickness of 2 cm in reinforced concrete bearing blocks;
- Cement floating of abutment surface;
- Protective layer rehabilitation with cement;
- Sealing up the cracks.

Labor protection and safety engineering

The works for rehabilitation and repair of the bridges are carried out on railway line operated sites, where regular traffic is available.

Civil works under line operation conditions should be carried out with provision of train traffic safety and full safety of employees working along the line, as well as without traffic delay.

When working along the line with traffic continuity work site should be protected with the signals according to instructions for safety of train traffic as well as safety engineering rules.

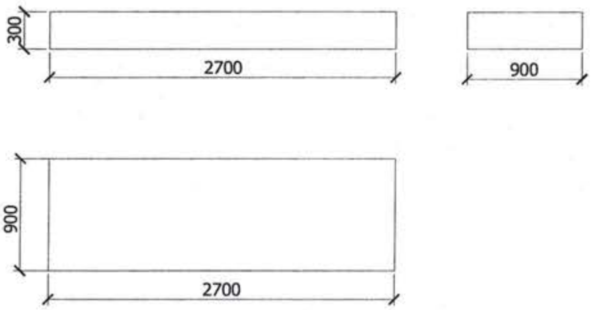
When working into “window” on operated lines with traffic interruption closing of span is carried out after permission of line master. If such closing will not cause the change of traffic volume and arrival and departure time to neighboring stations it may be permitted by the line master.

The project took into account the requirements for safety engineering stipulated by the normative documents:

- ShNK 3.01.03-03 – "Civil works arrangement"
- KMK 3.01.02-00 – "Safety engineering during civil works"
- KMK 3.06.07-98 – "Bridges and pipes. Survey and test rules".

Figure 2.5-6

Bearing block PB-1

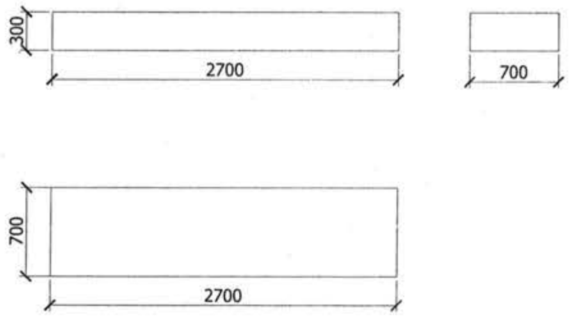


The basic parameters of the block

Mark of elements	The basic sizes of elements	Concrete		Weight ton	Reinforcement metal		ZD kg
		Mark of beton	Volume of beton m^3		Class A I kg	Class A II kg	
PB-1	270x90x30	V-25	0.73	1.83	21	35	86.5

Figure 2.5-7

Bearing block PB-2

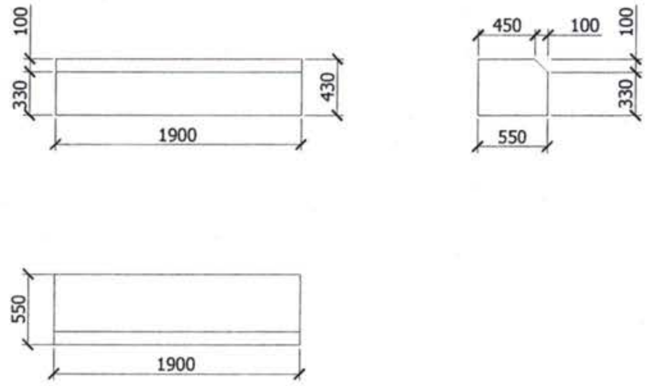


The basic parameters of the block

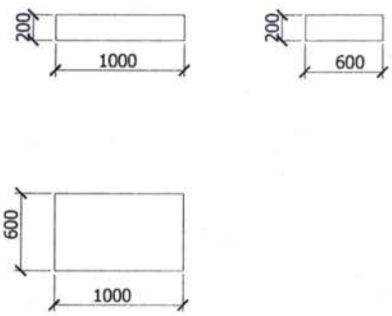
Mark of elements	The basic sizes of elements	Concrete		Weight ton	Reinforcement metal		ZD kg
		Mark of beton	Volume of beton m^3		Class A I kg	Class A II kg	
PB-2	270x70x30	V-25	0.57	1.42	16	27	86.5

Figure 2.5-8

Cordon block KB-1



Closet block ShB-1



The basic parameters of the block

Mark of elements	The basic sizes of elements	Concrete		Weight ton
		Mark of beton	Volume of beton m^3	
KB-2	190x55x43	V-25	0.45	1.08
ShB-2	100x60x20	V-25	0.577	1.38

2.6 Bill of quantities

Consideration derived by the adoption of the above technologies together with more standards consideration brings to the assessment of the following bill of quantities which considers both works and materials.

Table 2.6-1 – Bill of quantities for the permanent way and civil works

Code	Description	Unit	Quantity	Notes
			A. WORKS	
1A	Topographic survey of the line and corrections of the existing alignment and profile	km	327,00	327km in Uzbekistan
2A	Demolition of line	km	177,07	All the sections with P50 and wooden sleepers, excluding main tracks into stations
3A	Excavation	m^3	521.577	It includes the removal of about 0.6 m tick layer of top embankment material (ballast and sub-ballast), laying it on both sides of the embankment, profiling and compacting the top section of the embankment.
4A	Partial lateral rebuilding embankment section for 100 km, placing and compacting the removed top material for widening the top surface of about 1,0 m	m^3	543.000	It includes control and correction of 3.A material granulometry, if necessary, placing and compacting the removed top material for widening the top surface of about 1,0 m on both sides. In case the embankment is 1,0m high, it consists in removing 0,15m3/m and adding 1m3/m, in case the embankment is 2,0m high, it consists of removing 0,30m3/m and adding 2m3/m.
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast)	m^3	218.009	It includes spreading, compacting and profiling section of materials
6A	Construction of line	m	177.070	It includes installation of concrete sleepers, P65 rails, fastenings, spread of ballast, tamping and lift of rails up to 3 cm to final level
7A	Flash-butt or thermic weld of P65 rail	unit	16.524	
8A	Regulation of mechanical tension of long welded rails (l.w.r.)	km	486,00	
9A	Final tamping and leveling of new line	km	277,00	
10A	Ballast cleaning on the other existing sections	km	66,00	
11A	Tamping, leveling and aligning the other existing sections with l.w.r.	km	66,00	

13A	Excavation of ditches	m of line	100.000	100 km of line-2 ditches. Trapezoid ditch 0.5-0.5-0.5 has a volume of 0,5m3/m
14A	Pavement of level crossings	unit	15,00	
22A	Renewal of 176 bridges beams (44 bridges)	each	176,00	Each span bridge is composed by 2 beams.
23A	Maintenance of piers and abutments	each	110,00	
B. MATERIALS				
1B	P65 rails	t	22.239	177km of old rails will be replaced. Out of them, 6 km are existing on the section from 688 to 711.
2B	Concrete sleepers	unit	325.808	177km of old sleepers will be replaced.
3B	Fastenings for concrete sleepers	pairs	325.808	
4B	Ballast for renovated sections	m^3	316.955	1,77 m^3/m on straight; 1,9034 m^3/m on curve (cantilever: 75 mm).
5B	Additional ballast for existing sections (99 km)	m^3	58.410	50% additional ballast on ballast cleaning operation
6B	Sandy gravel on track sections (new sub-ballast layer)	m^3	204.622	1,08 m^3/m on straight; 1,2 m^3/m on curve.
7B	Blocks for level crossings	unit	360,00	0,24 m3 each block. 24 blocks per L.C.
13B	Rail Joints	each	2.673,00	243 km of line
14B	Insulated rail joints	each	243,00	243 km of line
19B	176 bridges beams (44 bridges)	each	176,00	Each span bridge is composed by 2 beams.

2.7 Costs estimates

2.7.1 Unit costs

For the rehabilitation of the Kungrad – Border line, a detailed cost analysis has been carried out by this Consultant, with the valuable support of the local Sub-Consultant.

The analysis was aimed at detailing all the cost items, including foreign and national expenditures for materials, foreign and national cost for man-power, cost of the machines and expenditures for taxes, duties and Contractor and Client general expenditures.

For the Infrastructure and Power supply, the construction cost is subdivided into the following types of work and expenditures in accordance with the structure of capital investments and the planned schedule of activities of constructing-and-mounting companies (Contractors):

- Materials;
- Construction works;
- Works on mounting of equipment (mounting works);
- Expenditures on equipment, furniture and inventory;
- Miscellaneous expenditures of a contractor;
- Miscellaneous expenditures of a customer.

A Contractor includes in the above cost both direct and concomitant expenditures (factor costs, miscellaneous expenditures, profit, and also funds for payment of taxes, duties and other obligatory payments).

Direct expenditures (including miscellaneous ones) are the expenditures of a contractor to construct a requested object that is labour and material resources, etc.

When calculating a construction cost, the following types of work and expenditures are considered:

1. Materials cost – cost of the necessary building materials, divided in national and foreign costs, according to the production Country;
2. Manpower Construction works – works on construction of buildings, different types of structures, finishing works, installation of external and internal engineering networks, installation of foundation and supporting structures for equipment, preparation a site for construction , etc.;
3. Manpower Mounting works - assembly and installation of devices at the place of their permanent operation (including inspection and individual testing of all kinds of equipment, electric installations, devices, computer engineering, connection of the equipment to engineering networks and other works);
4. Cost of equipment, furniture, inventory – the cost of manufacturing, purchasing and delivery to the warehouse of all sets of equipment, controlling equipment, instruments, punches, spare parts included in the basic funds of production capacity, cost of materials necessary for mounting of equipment, cost of equipment mounting, etc.;
5. Miscellaneous expenditures are the rest of expenditures not included in the factor costs for construction-and-mounting works, including:
    - Other industrial expenditures defined for a construction project (a contractor's expenditures);
    - For organization of construction works (overhead expenses);
    - For construction of temporary buildings;
    - For performing works in winter time;
    - For long service bonus;
    - For additional leave of workers;
    - Traveling expenses;
    - For transportation of workers up to the building object;
    - For relocation of construction-and-mounting organizations;
    - For a mobile method of work performance;
    - Insurance of construction risks;
    - Obligatory payments (taxes), duties in conformity with the legislation of the Republic of Uzbekistan;
    - Unforeseen costs and other expenditures for construction of objects.

Besides, the construction cost includes other expenditures of a customer during the construction:

- Allotment of a piece of land for construction of an object and external engineering structures;
- Fixing of points and signs;
- Demolition of structures;
- Bonus for timely and prescheduled commissioning of objects;
- Insurance of building risks;
- For banking services;
- Loan interests;
- Maintenance of a customer's facilities;
- Training of operational staff;
- Design and survey works;
- Survey works;
- Expertise of the design documentation;
- Profit necessary to cover the expenditures of a customer;
- Unforeseen costs.

The cost of the above mentioned expenditures is defined through calculations or through actual expenses of a customer and a contractor.

In the conditions of the market economy being developed in the Republic of Uzbekistan, the prioritized importance is attached to the method of calculating a construction cost based on the cost of resources. This method of defining a construction cost is a method of calculating expenditures in current prices or forecast prices and tariffs to be incurred during a project implementation.

A construction cost in current prices is defined on the basis of resource estimates developed through the above mentioned resource method with the use of information on actual prices for resources.

The factor cost is determined based on the allocated resources in current prices by types of expenditures:

a) wages including charges on social insurance;
b) maintenance cost of machines and mechanisms;
c) cost of building materials, items and structures including their transportation.

When calculating a construction cost, the level of current prices is taken on the basis of:

- wages – average statistical wage of construction workers as per the data of the State Committee on Forecast and Statistics;
- maintenance of machines and mechanisms – as per similar objects or special calculations;
- materials, items, structures, equipment - proceeding from the price level at the local and foreign markets, on the basis of wholesale prices of manufacturing factories, prices at stock exchanges and fairs of building materials, the catalogue of current prices for building materials published by the State Architecture and Construction Committee of the Republic of Uzbekistan (Gosarhitektstroy), data of the regional price formation centres of the State Architecture and Construction Committee of the Republic of Uzbekistan.

2.7.2 Unit costs for materials

The following table resumes the main unit costs for materials, according to detailed investigation carried out over the Uzbek market, split into "foreign" or "national production.

Table 2.7.2 – 1 Main unit costs for materials

Rehabilitation works for Kungrad - Beyneu Line "Main unit costs for materials"				
Material	Unit	Rate ($)	Variation	
Rails	tonne	580.00	+/-20 $	Foreign
Concrete sleepers	each	25.00	+/-4 $	National
Indirect fastenings	couple	25.00	+/-3 $	Foreign
Ballast	m3	5.50	+/-1 $	National
Sub-ballast	m3	2.00	+/-1 $	National
Bridge beams in reinforced concrete (6m span)	each	7,750.00	+/-10 %	National
Rail joint	each	25.00	+/-4 $	Foreign
Insulated joint	each	34.00	+/-4 $	Foreign

Sources: UTY, Boshtransloyiha, Italferr

2.7.3 Unit costs for machines

The following table resumes the main unit costs for machines averagely used for similar rehabilitation works for railways.

Table 2.7.3 – 1 Main unit costs for machines

Rehabilitation works for Kungrad - Beyneu Line "Main unit costs for machines"			
	Machine	*Unit*	*$*
1.	MOTORGRADERSE (MAINTAINERS) OF MEAN (AVERAGE) TYPE 99 [135] KWT [Л.С]	MACH/HOUR	8.27
2.	BULLDOZER AT WORK ON OTHER TYPES OF CONSTRUCTION: 79 [108] KWT [Л.С]	MACH/HOUR	11.63
3.	BULLDOZER AT WORK ON OTHER TYPES OF CONSTRUCTION: 96 [130] KWT [Л.С]	MACH/HOUR	11.63
4.	TROLLEY OF WIDE GAUGE WITH CRANE 3,5 T	MACH/HOUR	17.69
5.	GANTRIES OVERHANGING FOR WORKS ON ASSEMBLAGE BASES, 10 T	MACH/HOUR	2.02
6.	CRANES ON RAILWAY MOTION 16 T	MACH/HOUR	8.27
7.	STACKING (LAYING) CRANES FOR RAIL UNITS 25 M ON WOODEN SLEEPERS	MACH/HOUR	67.71
8.	STACKING CRANES FOR RAIL UNITS 25 M ON CONCRETE SLEEPERS	MACH/HOUR	67.71
9.	MACHINES FOR BALLASTING OF RAILWAY TRAIL ON CONCRETE SLEEPERS	MACH/HOUR	37.24
10.	MACHINES FOR TAMPING WITH PNEUMATIC TAMPING PICK (CUTTING)	MACH/HOUR	12.16
11.	LINERS	MACH/HOUR	3.11

12.	MOTOR PLATFORMS FOR TRACKLAYER	MACH/HOUR	37.58
13.	PLATFORM OF WIDE GAUGE WITH ROLLER CONVEYER	MACH/HOUR	2.41
14.	PLATFORMS OF WIDE GAUGE 71 T	MACH/HOUR	2.41
15.	SELF-PROPELLED TRACK LIFT	MACH/HOUR	6.11
16.	DIESEL LOCOMOTIVES OF WIDE GAUGE SHUNTING 883 [1200] Kwt [Л.С]	MACH/HOUR	59.47
17.	DIESEL LOCOMOTIVES OF WIDE GAUGE 294 [400] KWT [Л.С]	MACH/HOUR	59.47
18.	SINGLE BUCKET DIESEL EXCAVATOR ON CATERPILLAR AT WORK ON OTHER TYPES OF CONSTRUCTION: 0,4 M3	MACH/HOUR	14.06

These figures are referred to Railway Administration (R.A.) owned machines. It is therefore assumed that the Contactor will make use of these machines, by renting them from the R.A. or will use its own machines at similar current costs.

Anyway, for the work typology considered in the frame of the line rehabilitation, this Consultant estimates that the cost of machines is between 6% and 10% of the materials cost.

2.7.4 Unit costs for local manpower

It is assumed by this Consultant that the works to be carried out for the line rehabilitation will be carried out by local manpower with the exception of field engineers and works coordinators, whose costs will be considered apart.

It is estimated therefore that the Contractor will make use of local workers and the average salaries and wages have been derived from those of railway employees in the country to which the line belongs (Uzbekistan).

The following table 2.7.4-2 resumes the main unit costs for local manpower, per work item, according to the bill of quantities adopted for Options evaluation and based on average worker cost data, shown in table 2.7.4-1.

Table 2.7.4 – 1 Average worker cost data

Rehabilitation works for Kungrad - Beyneu Line *"General data for project cost estimation"*			
Average annual salary of builders in the region counting on 1 month, defined from statistical data for previous 12 months, soum/moths		48.228	$/ month
Average monthly fund of working time in hours as of data of the Ministry of Labor and Social Protection of population of the Republic of Uzbekistan		168	hour
Coefficient of account of the amount of deduction for social insurance (Kcc)		1.372	coeff.
Net local manpower cost per hour		0.2870714	$/hour
Total local manpower cost per hour		0.393862	$/hour

Table 2.7.4-2 Main unit cost for local manpower

Rehabilitation works for Kungrad - Beyneu Line "Main unit costs for local manpower"			
	Work Items	Unit	US$
2A	Demolition of line	km	243.90
3A	Excavation	m^3	0.09
4A	Partial lateral rebuilding embankment section placing and compacting the removed top material for widening the top surface of about 1,0 m	m^3	0.12
5A	Implementation of a layer of sandy gravel material, 0,2 m thick under sleepers (sub-ballast)	m^3	0.02
6A	Construction of line	m	0.54
7A	Flash-butt or thermic weld of P65 rail	each	1.00
8A	Regulation of mechanical tension of long welded rails (l.w.r.)	km	75.00
9A	Final tamping and levelling of line	km	79.10
10A	Ballast cleaning on the other existing sections	km	29.16
11A	Tamping, levelling and aligning the existing sections with c.w.r.	km	79.10
13A	Excavation of ditches	m	0.50
14A	Pavement of level crossings	each	100.00

2.7.5 Cost calculation flow

The following Table 2.7.5-1 resumes the main factors for calculation of the total cost amounts.

Table 2.7.5 – 1 Main factors for calculation of total cost amounts

Rehabilitation works for Kungrad - Beyneu Line "General data for project cost estimation"		
Expenses for operation of machines and mechanisms (Сэм)	5-10%	of materials cost
Transport expenditures for materials	6	%
Transport expenditures for constructions	6	%
Risk coefficient	1.15	coeff.
Other expenses and cost of contractor	20	%
Expenses for insurance of construction objects	0.4	%

Other expenses and costs of the contractor include:

- profit;

- administrative costs of the company;
- fix costs for the company;
- other general expenses.

The value of 20% has been recovered among average values of similar works in Uzbekistan.

The following table resumes the cost calculation flow.

Table 2.7.5 – 2 Cost calculation flow

Rehabilitation works for Kungrad - Beyneu Line "Project cost calculation flow"		
Item	**Article of expenses**	**Calculation method**
A	**Cost of construction + 6% transport**	**A**
B	Other expenses and costs of the contractor	B=20%A
C	**Total cost of construction and contractor and expenses**	**C=A+B**
D	tax 25%	D=25%C
E	**Total cost of construction and contractor expenses with taxes**	**E=C+D**
F	Expenses for insurance of construction objects	F=0,4%E
G	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	G=15%(E+F)
T	**Lot cost**	**T= E+F+G**

The following table 2.7.5 - 3 resumes the result of cost analysis for the Lot 1.1 Permanent Way and Civil Works. It has been developed according to the detailed bill of quantities, the unit cost and the rationale above provided.

Table 2.7.5 - 3 Lot cost analysis

Rehabilitation works for Kungrad - Kazakh Border section "Lot 1.1 Permanent way and Civil Works"		
Item number	**Article of expenses**	**Cost ($)**
A	**Cost of construction + 6% transport**	**37.007.865,71**
B	Other expenses and costs of the contractor	7.401.573,14
C	**Total cost of construction and contractor expenses**	**44.409.438,85**
D	tax 25%	11.102.359,71
E	**Total cost of construction and contractor expenses with taxes**	**55.511.798,57**
F	Expenses for insurance of construction objects	222.047,19
G	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	8.360.076,86
T	**Lot cost**	**64.093.922,63**

3. Detailed Design of the Power Supply System (Lot 1.2)

3.1 Description of the present situation for the Power Supply System

The electric power supply system of Kungrad – Kazakh border section is basically carried out by means of three medium voltage lines:

1. two three phase overhead lines installed on the same wooden posts from Kungrad to the Kazakh border; the first one operates at 6 kV and feeds exclusively the Automatic Block boxes along the section, the second one operates at 10 kV and feeds all the station facilities and plants (safety plants, lighting, pumps etc.); presently the last is de-energized from Kungrad to Jaslyk.
2. one three phase overhead line installed on prefabricated reinforced concrete posts of circular section, from Kungrad to Karakalpakia, operating at 10 kV and at 6 kV from Bostan to Karakalpakia.

Lines 1 are old and obsolete. Typical post are drawn in Fig. 3.1 – 1.

Line 2 is new and in very good condition. Typical posts are drawn in Fig. 3.1 – 2.

Fig. 3.1 – 1 Typical posts of old line

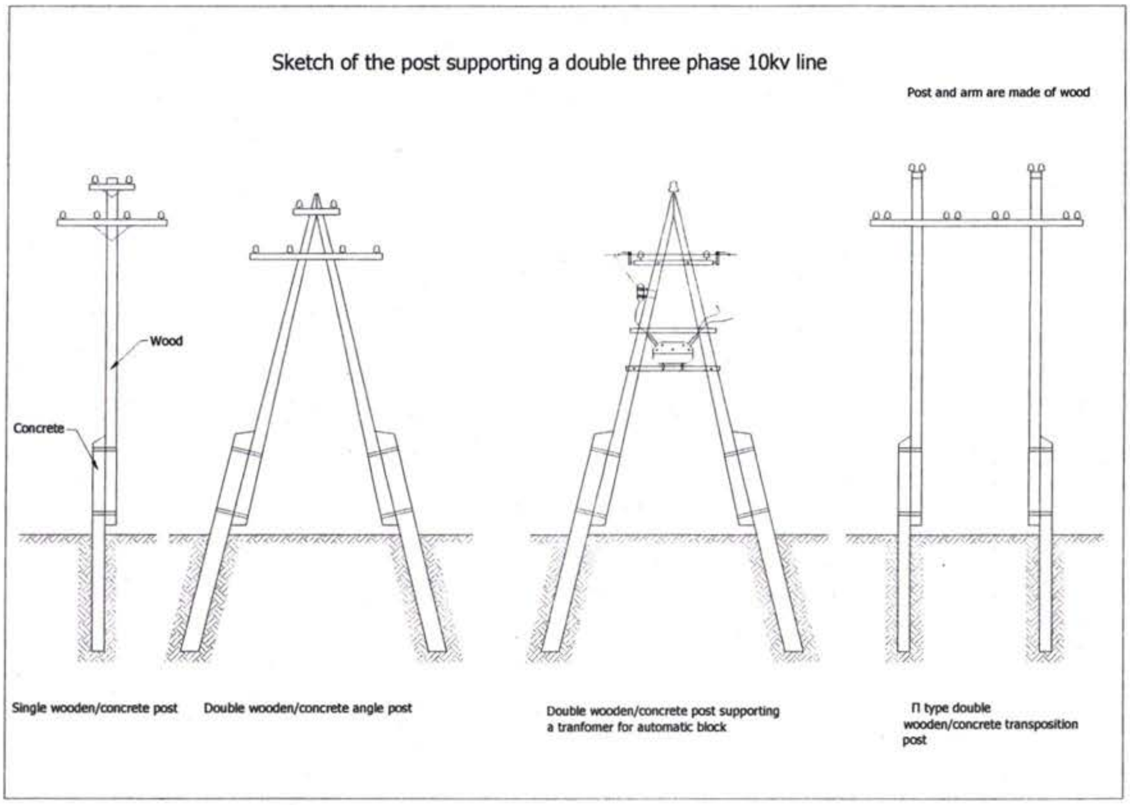
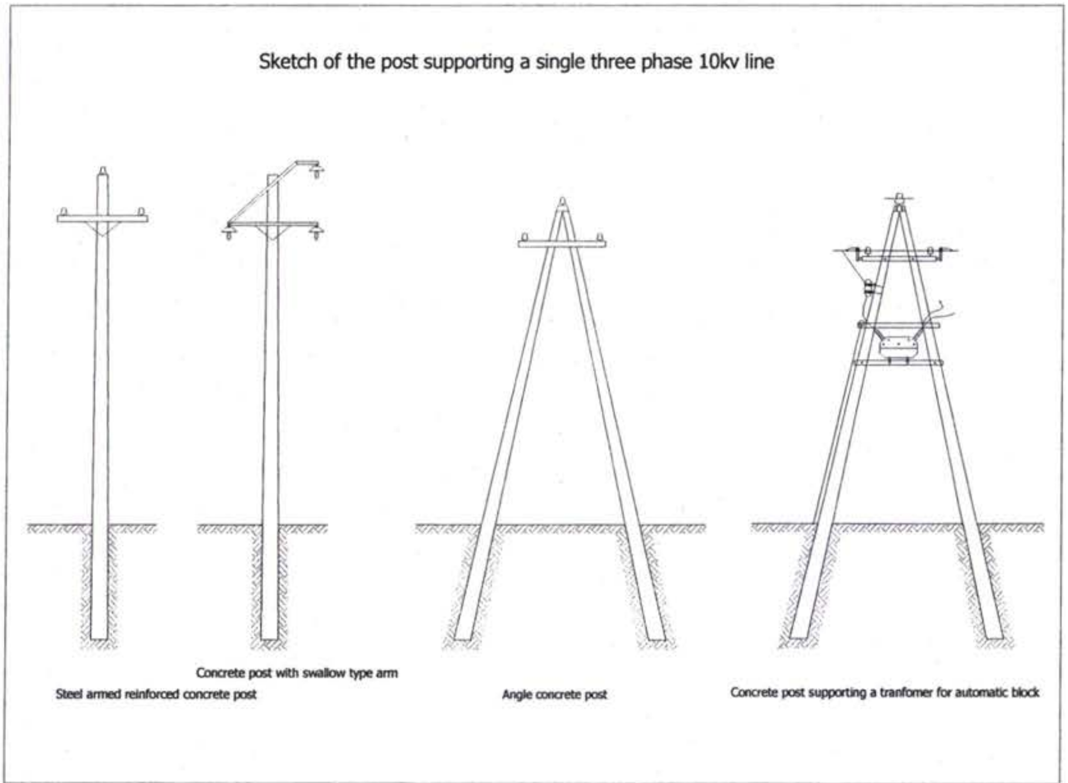


Fig. 3.1 – 2 Sketch of the post supporting a single three phase 10kv line



The described 10 kV / 6kV system is connected to the high voltage 110 kV / 35 kV national system through single three phase overhead lines at a voltage of 10 kV to the cabins of "Kungrad" and "Akchalak", at a voltage of 6 kV to the cabins of "Tuley"and "Karakalpakia". Moreover the lines are sectioned and de-energized in the Abadan and Bostan cabins. The protection is implemented with VMG 50 circuit breakers, controlled by PP 67 relays.

The scheme of connections is indicated in Fig. 3.1 – 3 and Fig. 3.1 – 4.

The total load supplied to users by the system is about 300 kW for A.B., 350 kW for the lighting of stations, 3300 kW for buildings and houses, residential areas; the total is then 3950 kW.

In Kungrad there is one diesel generator for reserving an electric power supply of 48 kW.

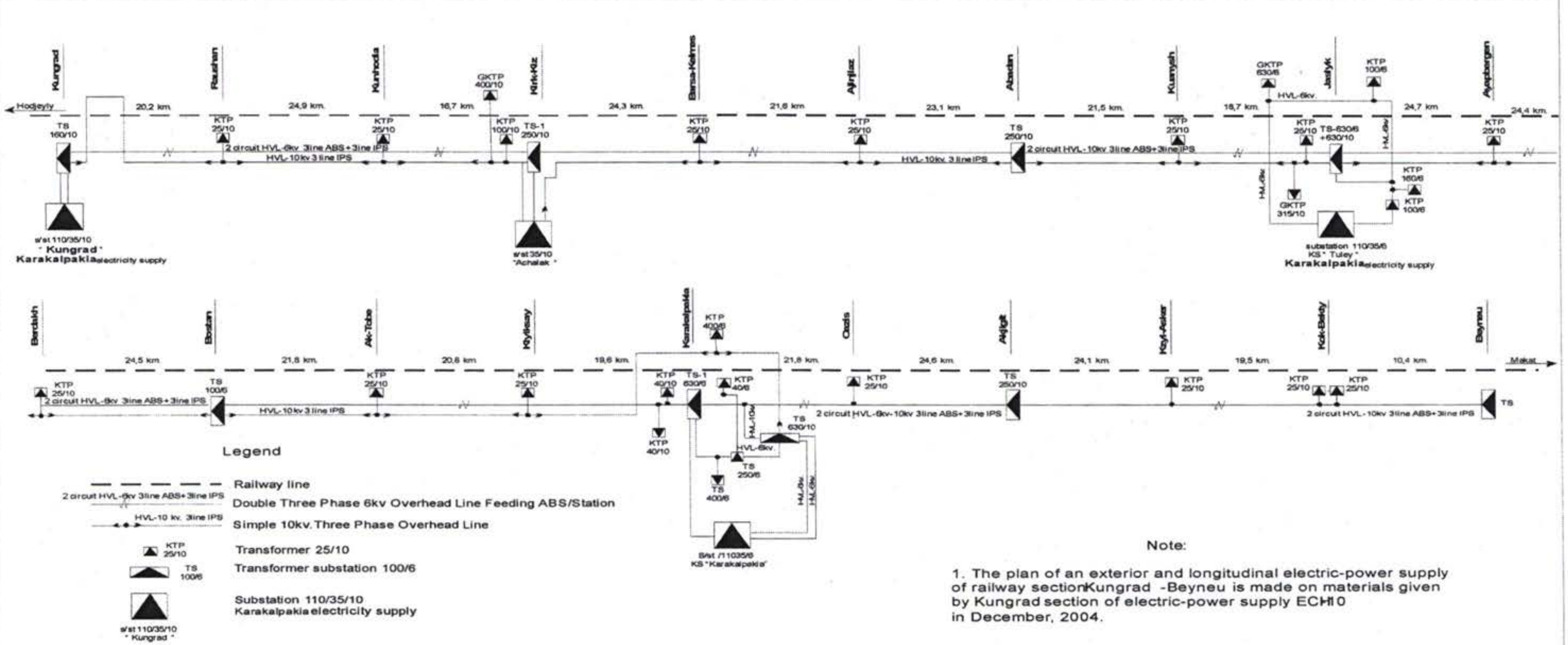
<u>Defects</u>

As above said, lines 1 are obsolete. The area is windy and the soil polluted with salt.

Both cause frequent short circuits and interruption of the power supply continuity.

The operational voltage of the three phase line feeding the A.B. was lowered to 6 kV as provisional measure to reduce the failures, but the coexistence of 10 kV and 6 kV systems does not seem to be the best solution. Presently works of partial reconstruction of the double lines 1 are going on implementing the replacement of wooden cross arms for metal ones.

Fig. 3.1 - 3 Kungrad – Karakalpakia (Uzbekistan) line. Power Supply Scheme – 10kv/6kv System



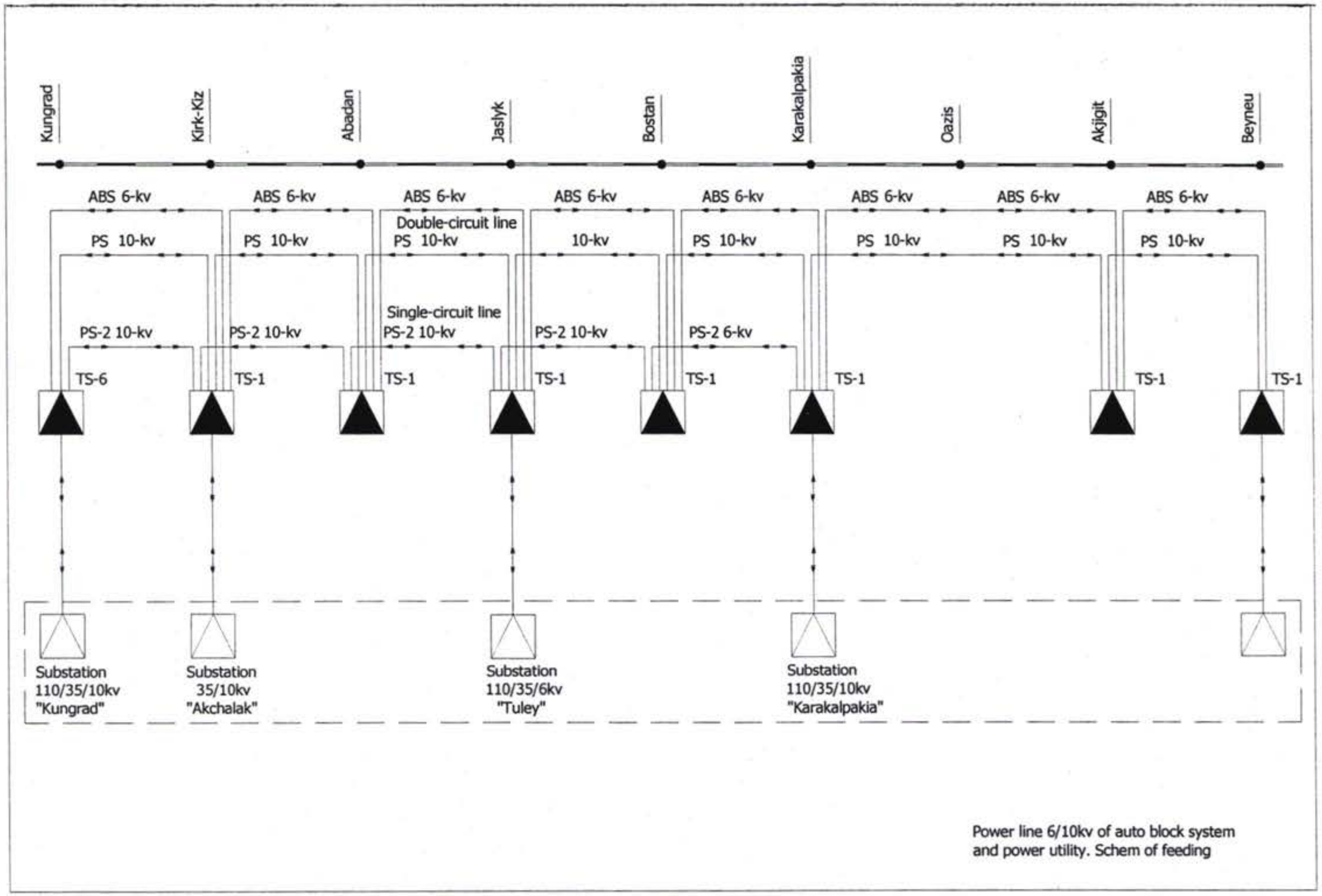
Summary of installed equipment (transformers of model OM) On the section Beyneu - border (Oazis)					
HVL-6kv.ABS	HVL-10kv.IPS	HVL-6kv.ABS	HVL-10kv.IPS	HVL-6kv.ABS	HVL-10kv.IPS
OM-0,66	OM-0,66	OM-1,25	OM-1,25	KTPO-4/6	KTPO-4/10
137	150	83	124	6	11
Section border (Oazis)-Beyneu					
41	3	11	3		5

Note:

1. The plan of an exterior and longitudinal electric-power supply of railway section Kungrad -Beyneu is made on materials given by Kungrad section of electric-power supply ECH10 in December, 2004.

Kungrad - Karakalpakia (Uzbekistan) Line
Power Supply Scheme - 10kv/6kv System

Fig. 3.1 – 4 Power line 6/10 kv of auto block system and power utility. Scheme of feeding



3.2 Description of the new configuration for the Power Supply System

Construction of a new double three-phase 10kV overhead line from Kungrad to Karakalpakia, about 326.5 km long is foreseen as well as the demolition of the existing line recovering the relevant materials.

It includes foundation works for the new reinforced concrete posts (50m distance), posts installation, posts equipments, cables laying and their tensioning. Finally it includes electrical connections to the sources and clients.

Characteristics of the new line and general specifications

The new line will be about 326.5 km long and it is made of two lines. The first line (AB) will feed the Automatic Block posts, the second line (PS-Power Supply) will feed the stations (safety and lighting plants, buildings, pumps, battery charge devices, etc.).

Both lines will be equipped with conductors steel-aluminium type.

Design of the line shall be based on the following hypothesis:

- air temperature variation between +45^{0}C and -40^{0}C,
- maximum wind speed: 29 m/sec (about 105 km/h)
- maximum ice thickness of ice sleeve around the conductor: 15 mm.

As the line passes through windy areas with soils formed by sand and clay mixed with some sodium chloride, then strong insulation is required, therefore insulators for 20kV rated voltage has to be chosen.

Soils are aggressive toward concrete therefore reinforced poles from sulphate-resistant Portland cement shall be used.

Generally poles 11 m and 13 m long, produced in the Republic of Uzbekistan shall be installed.

The double line passes through uninhabited sites; the minimum height of the lowest conductor has to be as it follows:

- from the ground level: 6 m,
- from the road level: 7 m,
- from the rail level: 7.5 m,

The normal span in plain has to be 50 m.

When the line crosses roads and railway, double anchorage on both sides has to be foreseen. No angle between road/railway and line axles less than 30^0 is allowed.

Poles are to be provided with metallic brackets and braces for supporting insulators and conductors.

Earthling of metallic parts installed on poles will be done from strip steel and L shaped steel. Resistance of poles grounded circuit should not exceed 15 ohm.

Conductors are to be transposed along the line about every 5 km.

After or during the construction of the new line, wooden poles, conductors, insulators, transformers, disconnectors, lightning arresters, cables, minor materials of the existing line, are to be recovered, distinguished in reusable and scrap, transported and staked according to the Engineer instructions, with the exception of the reusable materials and devices to be immediately reinstalled.

The new three-phase lines shall be connected to users as the existing ones; lightning arresters, disconnectors, transformers, etc. has to be recovered, revised by the Contractor, and reinstalled on the new line.

The line has to be built according to all the national rules about the correct execution of this kind of works and about the safety.

The Contractor has in any case the complete responsibility that every material used to build the line and its installation comply with the technical, structural, functional and safety requirements of the line. He is therefore authorized to propose any variation to the Engineer to implement these targets.

In Consultant's opinion, other interventions have to follow in a second phase. Circuit breakers, disconnectors, lightning arrestors, control relais are obsolete, moreover two different and separated systems at 10kV and 6kV, each provided with only two feeders along a length of three hundred kilometers are not the ideal solution for limiting the voltage drops and increasing the reliability.

Three possibilities could be studied:

- elimination of the 6kV system, involving the passage of two feeders from 6kV to 10kV (this possibility has to be verified with Uzbekenergo, the national Agency for the transport and production of electrical energy) and the change of the transformers on poles feeding the ABLS posts;
- insertion of transformers between 10kV and 6kV cabin bars,
- modification of the operation of these two systems, with the adoption of adapted control relais that allow to close all the circuit breakers obtaining substantial benefits regarding the voltage drops.

3.3 Bill of quantities

The following Table 3-3-1 gives the bill of quantity for the Lot 1.2 Power Supply.

Table 3.3-1 – Bill of Quantities

Code	Description	Unit	Quantity	NOTES
	WORKS AND PROVISION			
24-A1	Topographic survey of the line and corrections of the existing alignment and profile	km	326,5	To be done jointly with the track topographical survey
24-A2	Pole 11 m high: provision and installation	N°	7272,0	Including accessories installation
24-A3	Pole 13 m high: provision and installation	N°	68	Ditto
24-A4	Bracket Insulator: provision and installation	N°	41.328	
24-A5	Cap-and-pin insulator: provision and installation	N°	5.628	
24-A6	Conductor: rope Al-st 6x3.2+1x3.2 (50mm^2): provision and installation	T	422	including junction and anchor clamps provision and installation
24-A7	Accessories provision	kg	747.535	
24-A8	Demolition of the old line	km	327	Including transport, splitting in reusable and scrap, stacking of demolished materials

3.4 Costs estimates

3.4.1 Unit Cost

Table 3.4.1-1 shows unit costs used for the formulation of the construction costs.

Table 3.4.1-1 Unit Costs

Code	Description	Unit	Rate (US$)	NOTES
	WORKS AND PROVISION			
24-A1	Topographic survey of the line and corrections of the existing alignment and profile	km	-	To be done jointly with the track topographical survey
24-A2	Pole 11 m high: provision and installation	N°	217,92	The rate includes the accessories installation
24-A3	Pole 13 m high: provision and installation	N°	413,7	Ditto

24-A4	Bracket Insulator: provision and installation	N°	6,3	
24-A5	Cap-and-pin insulator: provision and installation	N°	3,6	
24-A6	Conductor: rope Al-st 6x3.2+1x3.2 ($50mm^2$): provision and installation	T	2.599,5	The rate includes junction and anchor clamps provision and installation
24-A7	Accessories provision	kg	1,2	
24-A8	Demolition of the old line	km	468,2	Includes transport, splitting in reusable and scrap, stacking of demolished materials

As far as costs of Item 24-A1 is concerned they have been considered under Lot 1.1 under the likely assumption that implementation of that Lot will be starting before Lot 1.2.

3.4.2 Cost calculation flow

The following Table 3.4.2-1 resumes the main factors for calculation of the total cost amounts.

Table 3.4.2-1 Main factors for calculation of total cost amounts

Rehabilitation works for Kungrad - Beyneu Line *"General data for project cost estimation"*			
Expenses for operation of machines and mechanisms (Сэм)		5-10%	of materials cost
Transport expenditures for materials		6	%
Transport expenditures for constructions		6	%
Risk coefficient		1.15	coeff.
Other expenses and cost of contractor		20	%
Expenses for insurance of construction objects		0.4	%

Other expenses and costs of the contractor include:

- profit;
- administrative costs of the company;
- fix costs for the company;
- other general expenses.

The value of 20% has been recovered among average values of similar works in Uzbekistan.

The following Table 3.4.2-2 resumes the cost calculation flow.

Table 3.4.2 – 2 Cost calculation flow

Rehabilitation works for Kungrad - Beyneu Line "Project cost calculation flow"		
Item	**Article of expenses**	**Calculation method**
A	**Cost of construction + 6% transport**	**A**
B	Other expenses and costs of the contractor	B=20%A
C	**Total cost of construction and contractor and expenses**	**C=A+B**
D	tax 25%	D=25%C
E	**Total cost of construction and contractor expenses with taxes**	**E=C+D**
F	Expenses for insurance of construction objects	F=0,4%E
G	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	G=15%(E+F)
T	**Lot cost**	**T=E+F+G**

The following table 3.4.2-3 resumes the result of cost analysis for the Lot 1.2 Power supply. It has been developed according to the detailed bill of quantities, the unit cost and the rationale above provided.

Table 3.4.2-3 Lot cost analysis

Rehabilitation works for Kungrad - Kazakh Border section "Lot 1.2 Power Supply"		
Item number	**Article of expenses**	**Cost ($)**
A	**Cost of construction + 6% transport**	**4.285.531,08**
B	Other expenses and costs of the contractor	857.106,22
C	**Total cost of construction and contractor expenses**	**5.142.637,30**
D	tax 25%	1.285.659,32
E	**Total cost of construction and contractor expenses with taxes**	**6.428.296,62**
F	Expenses for insurance of construction objects	25.713,19
G	Risk coefficient defined on basis of forecasted index of construction price growth for the following year	968.101,47
T	**Lot cost**	**7.422.111,28**

4. Detailed Design of Telecommunications System (Lot 1.3)

4.1 Description the present situation for railway telecommunications

In the following a synthetic description of the telecommunications equipment of the line Kungrad – Kazakh border is provided. A graphic description of the present telecommunication situation of the line is presented in Figure 4.1-1.

The analogue transmission system along the railway line use both buried copper cable and aerial links.

The copper cable is installed only on the section Kungrad-Jaslyk and it has the following technical specification:

3KP 1x4x1,2 1x4 - High frequency quad copper wire, diameter 1,05mm, polyethylene insulation, quad twisted 2 copper tape shield pitch filler, polyethylene sheath.

The steel/bimetal aerial link is present on the entire section Kungrad-Beyneu and it is of the following technical type: V-12-3 and V-3-3.

All the stations are equipped with manual commutator of stations and line sections telephone service, for operation and maintenance activities. The following types of commutatores are installed: KASS – 6 and KASS – DU.

Telecom switches (analogue PABX) are installed on the following stations:

- Kungrad – ESK-400E - 300 Internal lines; ESK-400E - 400 Internal lines
- Jaslyk – ESK-400E - 400 Internal lines
- Karakalpakia – ESK-400E - 400 Internal lines

The following equipment for loud speaking communication is present: TU – 50, TU – 100, TU – 600, RUS.

The equipment for train to station radio communication presently installed is IZ RTS, 71 RTS.

Most of the equipment is very old, aged about 30 years, since it dates from the first years of 70s when the line was built.

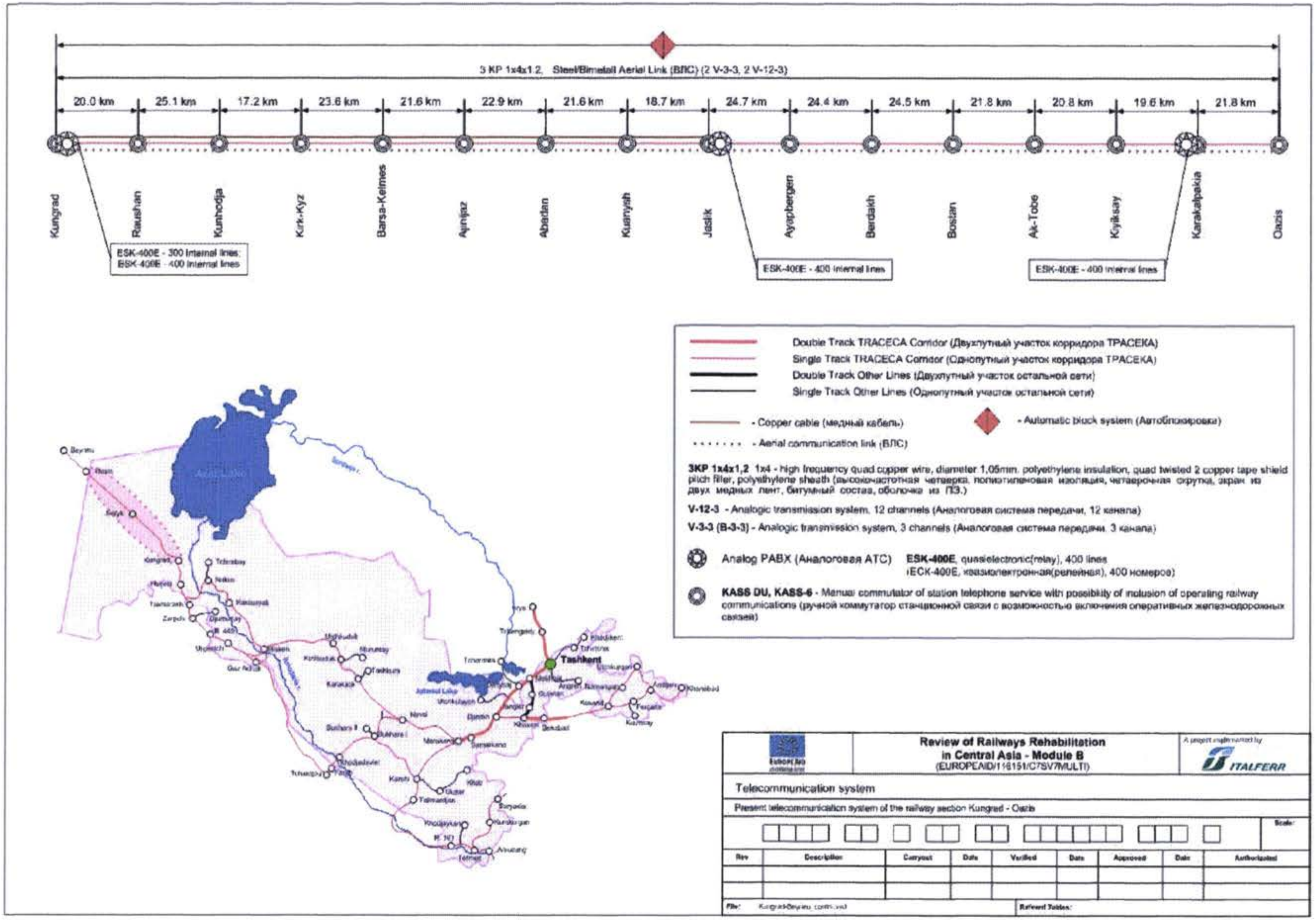


Figure 4.1-1 - Present telecommunication system of the railway section Kungrad - Oasis

4.2 Description of the new telecommunications system

The Consultant has recently developed for the European Commission the TACIS/TRACECA project Central Asia Railways Telecommunications (2002-2003). Outputs of that project were the Central Asia Railways Telecommunications and Signalling Master Plan and 8 Feasibility Studies for the modernisation of railways telecommunication systems. The present telecommunication project is consequently in accordance with the indications and recommendations of the mentioned Master Plan and the adopted methodology and the proposed technical solutions are derived by the Central Asia Railways Telecommunications Project.

Services to be guarantee

The telecommunication services to be guaranteed in the strictly railway context can be grouped into the following categories:

Signalling telecommunications (train spacing and protection). The role of this type of telecommunications is to transmit information regarding the status of the signalling field elements such as: signal condition, track circuit clear, points setting, etc. This information serves to space and protect trains in circulation; therefore they must be securely transmitted. In and around stations, the flow of information from track to signal boxes and vice versa utilises a local cable network. For full line section information can travel from track to station as well as from station to station.

Operating telecommunications (traffic and energy command and control). The term "Railway operating telecommunications" covers all telecommunications directly connected with train circulation other than signaling information, like for example: railway operations and electric line control; control over various line elements (for example, level crossings); dedicated station to station lines; lines dedicated to maintenance; shunting radio; ground to train radio; etc.

Applications telecommunications (management information system, invoicing, ticketing, etc.). In terms of global development of computer applications, the railway sector has also experienced a significant increase of requirements for high-speed data transmission systems, and an equally significant increase in the demand for high quality and secure connections. The network to design must therefore respond to these needs by guaranteeing adequate transmission capacity.

The role of these services affects the choice of the type of telecommunications system to adopt, with particular reference to the type of cabling.

Naturally, other functions have to be considered as well, such as: short and long distance automatic telephone services; data transmission; radio communications; public services.

Definition of needs of the telecommunication system

The increase in the demand for ever higher volumes of information and transmission speed has been such an incentive for technological development as to lead, especially in the case of telecommunications, to the replacement of perfectly functioning systems with others of the latest generation with lower investment and maintenance costs. This type of replacement intervention had never been before part of the railway logic. Now it has, however, become a standard of new trends in the sector. Multi-service networks, for services companies, are coming to the fore as a strategic medium: all the various types of communication (data, voice and video) being channelled along the same transmission medium.

The multi-service networks that have to meet these requirements have, also, to respond to the following major criteria:

- use of a multi-hierarchical level architecture, based on the most recent technology adopted in Western Europe;
- secure transmission;
- open and flexible structure to facilitate extension and upgrading;
- management systems compatible with local and long distance operability;
- the capacity to interface with all types of terminals;
- an adequate number of spare channels to implement advanced level services, considering also the future expansion of the demand in communications;
- and the possibility of marketing residual capacity.

To meet these basic requisites it is essential to consider the adoption of digital technology as an inevitable fact, because it permits cost reductions for both constructors and users, as well as increased performance.

Among the many existing transmission technologies, the most respondent ones to the explained needs could be based on the utilization of copper cable or optic fibre cable.

For the same transmission capacity the sheer dimensions of copper cables compared to optic fibre is a point in favour of fibre optics cable, because it allows smaller ducting as well as junctions and terminals. Also, the adoption of optic fibre cable, together with PCM (Pulse Code Modulation) technology transmission systems, allows a great number of channels with high quality transmission characteristics, because the system, using optic fibre transported light impulses, is practically immune to the electromagnetic interference normally induced in copper cables and even more so in aerial lines. Moreover, optic fibre is a dielectric component and therefore not subject to breakdown due to lightning strikes or other sources of overload by contact with overhead traction power lines (if present). There are no drawbacks in using fibre optics for railway operating and telecommunications applications. Local copper cable networks are only necessary for certain signalling telecommunication services and for short distance and limited bandwidth communications.

The technical/economic comparison between aerial and buried cable leads to the conclusion that the recommended solution for railway applications should be that of a cable buried in a High Density Polyethylene (HDPE) conduit for the high degree of protection this offers, coupled with advantages in terms of functional reliability, operational costs, ease of maintenance and cable life span.

Network availability and flexibility

Availability is one of the indicators that measures quality of service and refers to the probability that a certain system, operating in a given environment, is available at a certain time.

Redundancy is used to increase network availability. Fundamentally, redundancy for SDH networks can be obtained with a ring-shaped structure achieved by connecting the extremities of the transmission system together, which permits access to the apparatus from two different directions.

The flexibility of the network refers to its attitude toward low cost modification to respond to the requirements of changing demand.

For this purpose, modular structure is required, especially for transmission equipment, and, if necessary, for increased transmission capacity simply by adding other modules.

Importance of standard protocol

It has to be stressed the importance of using systems based on standard protocols. Although a solution based on proprietary protocol can be valid from the technical point of view and can be competitive from the financial side, it will have strong implications for the future steps too.

Telecommunications works as a system; which means that to talk about railways telecommunications generally doesn't mean to talk about a single railway line you are considering, but of the telecommunications system needed for the operation of that line. Consequently during the technical evaluation of the possible solution also the following aspects have to be considered in discarding "proprietary protocols based-solutions":

- there will be no fair competition in the tenders once a proprietary protocol will be starting colonizing the area;
- additional costs will be born for allowing different part of the network (with different protocols) to talk each other, providing that this is possible;
- maintenance and future provisions of spare parts can't take the advantage of economy scale (with different systems in place) but mainly will be in the hands of the protocol owner with uncontrollable consequences on the costs.

4.2.1 General description

Telecom Works consists in the installation of a new telecommunication system based on digital technology and on the adoption of optic fibre cable together with PCM (Pulse Code Modulation) technology transmission systems.

The adoption of the following system is proposed:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

A scheme of the works to be performed along the line is attached in Figure 4.2.1-1.

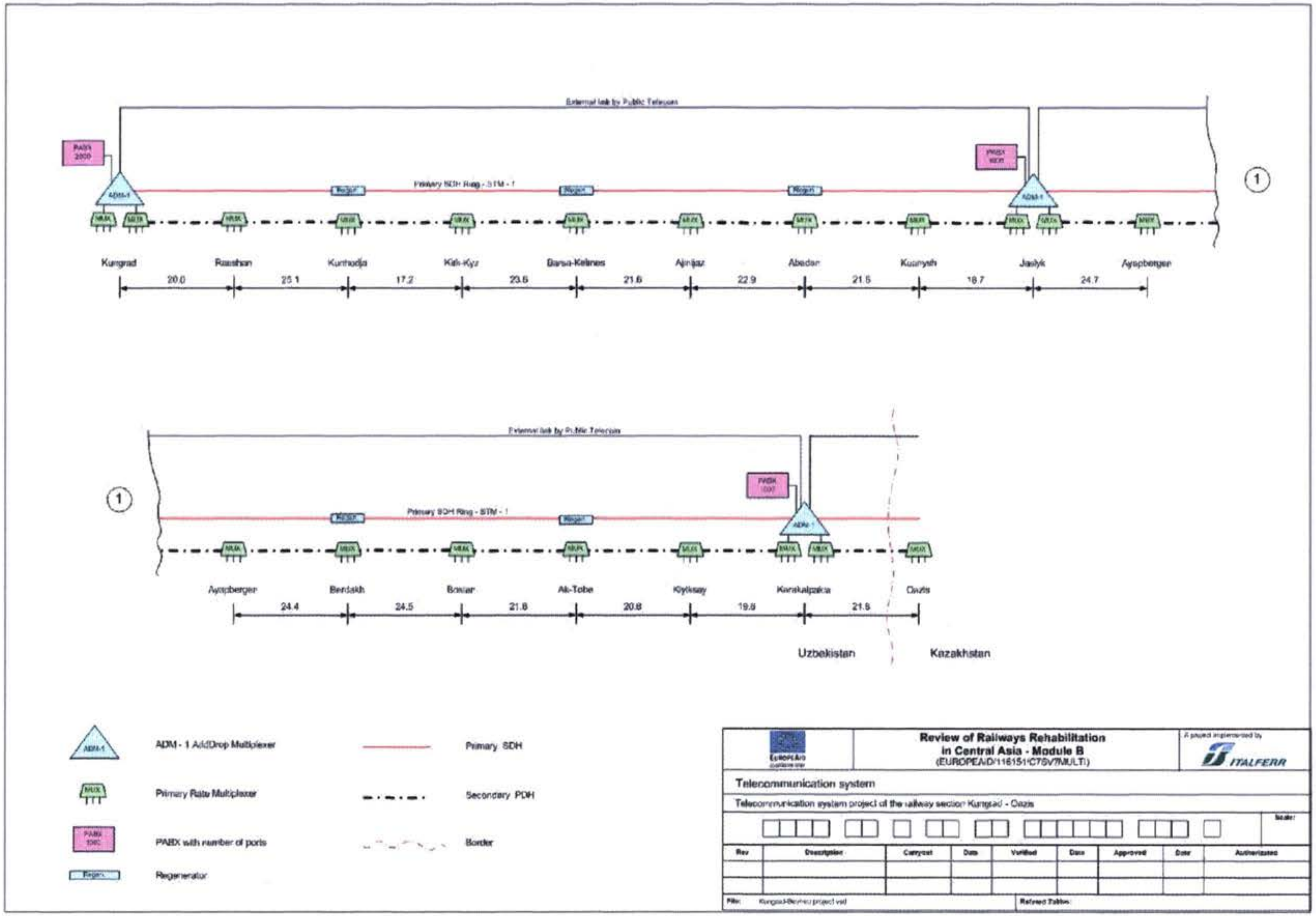


Figure 4.2.1-1 – The proposed telecommunication system for the railway section Kungrad – Kazakh Border

4.2.2 Detailed description

The Consultant has developed a parallel Feasibility Study for the railway section Oasis – Beyneu in Kazakhstan for the rehabilitation the entire line Kungrad – Beyneu. The technical solution studied for the Kungrad – Oasis section is therefore the very same solution designed for the section in Kazakhstan and they can be seen as two parts of the same project.

The following telecommunication system, suitable for low traffic lines, is proposed and has been evaluated for the Kungrad - Oasis line:

- STM1 (155 Mbps) + E1 (2 Mbps) - using a SDH (Synchronous Digital Hierarchy) based system for the primary backbone complemented by PDH (Plesyocronous Digital Hierarchy) based system for the secondary backbone.

The system is based on two level network solution, with a first level of backbone assured by SDH 155.52 Mbps technology and a secondary provided by PDH technology with multiplexer of 2 Mbps capacity.

The highest backbone of the system is a ring structure using STM1 (155 Mbps) for the transport between the Add/Drop Multiplexers (ADM1) at the higher order stations (Kungrad, Jaslyk, Karakalpakia) which are equipped also with PABX.

The secondary backbone uses PDH technology, adopts E1 (2Mbps) for transport and uses PRMs (Primary Rate Multiplexer) for the transmission and for interfacing with higher level.

A scheme of the system proposed for the line Kungrad – Oasis is represented in Figure 5.4.2-1.

The system uses:

- 2 fibers of the optic cable for the functionality of the primary connection
- 2 fibers of the optic cable for the functionality of the secondary connection
- 2 fibers of the optic cable for redundancy reason (closure of the line).

Fibers for the primary and secondary connections are normally in the same cable while fibers for redundancy should be physically located in another cable and in another place.

Since the second cable is needed to ensure the redundancy of the system in case of problems with the first one (a cut of the cable, a card out of order or not functioning properly and consequent need of substitution), this measure allows for safety conditions of trains running along the line. In order to do that, it is "necessary" to maintain the two cables physically separated so to prevent the simultaneous cut of both.

Every cable is supposed to be of the current international standard: 32 fibres. Thus the cable's capacity is redundant in respect to the real use for the railways purpose (4 fibres in one cable and 2 fibres in the other one). Because of that and to reduce costs, the two-cable solutions are adopted only when there are no other possibilities, so to reduce costs.

Therefore for the Kungrad – Oasis line, as far as the redundancy is concerned, it has been considered the following two possibilities:

- implement a second cable for the redundancy, or

- renting of channels or a fibre pair from third party.

A preliminary screening of the just mentioned possibilities has excluded the first-one, namely the adoption of a second cable, for costs reasons: major cost vis-à-vis an oversized system composed by two optical fibres cables (the "two-cable solution" is - in so far the total cost of the solution - at least 40 percent to 60 percent more expensive than the alternatives with the "one-cable solution").

Therefore, as a transitory measure, the closure of the ring will be by external link and the suggestion is to use the existing facilities of public Telecom along the railway line. For the closure of the ring 5 links at 2 Mbps are needed. In the near future, an optic cable will be also laid by the Ministry of Communications and it has been agreed that Railways will be use this cable for redundancy and in the same way the cable of the Railways will be used for the redundancy of the public telecom system.

It has to be remarked that the use of a link external to the railway network could be seen as a transitory measure in the time being up to when long distance transmission will be in operating on the primary railway network (in this case, involving also the Kazakh network, Kandagach – Makat – Beyneu – Miskent – Samarkand – Tashkent – Arys – Kandagach) and consequently the closure of the ring can be actuated directly by the railways.

Taking into consideration optical signals attenuation and distances between higher order stations, additional regenerators of optical signals have been introduced in correspondence of stations every time distances appears to be critical for the efficiency of the transmission.

The suggested solution covers also copper cable transmission for service telephones (those in open line in correspondence to the signals for neighbouring track circuits, additional future needs like remote signals control, interlocking station systems, central control of power supply for the line contact, remote level crossing control).

The adopted standards will simplify the technical arrangement necessary to operate trans-border train services in the border stations of Karakalpakia and Oasis with Kazakh Railways.

As already explained, the whole architecture would require 6 fibres. The cable to be implemented (a 32 optic fibre cable) will be supplying 4 fibres while the other links will be taken externally as explained previously.

Both the primary backbone and the secondary backbone are protected by a ring configuration, thus the system is able to guarantee the proper functioning in consequence of a single failure and allows point-to-point link.

Point-to-multipoint links, the use bandwidth on demand and the automatic re-routing are not allowed by this system, but some of these just mentioned weak points can be later exceeded because the system has the capability of growing with a minimum of changes (adding other devices, such as IP Router in the main station).

The old telecom exchanges will be replaced with latest generation automatic electronic exchanges (PABX) of adequate potential, that will include the interfaces with the digital junction lines (conforming to ITU-T standard G.703) in output and a fully automatic system for calls, with the adoption of a new national numbering plan that makes calls between different exchanges possible by forming certain telephone number prefixes.

For each connected number it will be possible to allow or deny national and international calls and automatic connection to the public network. It will also be possible to provide each customer, with adequate apparatus, DTMF or digital telephones and all the services of a modern public telephone system (call notice during a conversation, call back in case of number engaged, call transfer, etc.).

The new exchanges will also allow for easy expansion of capacity, foreseeing spaces in the cabinets for inserting user cards without having to add or replace control and switching gear, which must already be adequate at maximum capacity of the exchange model and redundant for greater reliability.

This transmission system is highly suited to replace the service currently provided by telex, now rarely used and with high maintenance costs, especially for the dedicated telegraph exchanges and telex machines themselves.

All stations are also equipped with UPS and every PABX is provided with special electric power supply station, sized on the effective needs of the system, and able to be further expanded by incorporating modules. A storage battery will assure the proper functionality of the PABX for at least 8 hours – in case of blackout of power supply. The battery will also assure the functionality of accessory devices (i.e. service terminals) in the case the system is not equipped with devices for memorising failure signals during blackout.

A system for management, supervision, and maintenance of all PCM equipment of the country has to be implemented. Generally, for a country network railways configuration, such a system is organised on two levels: the first level is formed by Element Manager (EM) spread along the lines supervised by the system, while the second one by a Network Manager (NM), consisting of one only equipment. By this system, the possible alarm will be recorded by both the competent EM and the NM. The NM will be set in Tashkent, while the EM will be set in Kungrad.

The PABX Management System is based in Kungrad; it consists in a Domain Management System that allows centralized management of all the PABX of the line by high-level user interfaces. All the functions are realised on the same HW and SW platforms and use the same database to achieve a global management system with a single access point. The system is implemented on PC and will interface with global network management systems (telecom and data), in accordance with the standard SMNP (Simple Network Management Protocol).

The Synchronisation System allows every apparatus to receive the synchronisation signal from both sides. At the ends of every section and every 30-35 apparatus, a SASE (Stand Alone Synchronisation Equipment) has to be installed. The SASE produces a high-quality clock that is used for synchronisation of all the apparatus. With this system, every apparatus will use the Ck coming from one side as prime priority signal and the Ck from the other side as signal with second level of priority. SASE will be installed in Kungrad and Karakalpakia.

Technical specifications for the equipment are provided separately in Annex C.

The Consultant strongly recommends to continue the technical co-operation with Kazakh Railway because of the possible future synergies able to reduce costs form both sides.

Co-operation with public telecom has also to be carried out. The limited resources to be devoted to the renewing of the existing telecom infrastructure suggest a close collaboration between different possible actors in the sector aiming at optimising the resources utilisation.

Finally it has to be remarked that the proposed system uses standard protocols, as recommended in the basic criteria previously described.

The following table details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system.

Table 4.2.2-1 Telecommunication work items

Bill of Quantities			
Item	**Q-ty**	**Unit**	**Note**
ADM 4 with installation	0	unit	
ADM 1 with installation	3	unit	
MUX D/I with installation	18	unit	
Regenerators	5	unit	
UPS with installation	15	unit	
PABX 500 with installation	0	unit	
PABX 800 with installation	0	unit	
PABX 1000 with installation	2	unit	
PABX 1500 with installation	0	unit	
PABX 2000 with installation	1	unit	
PABX 2500 with installation	0	unit	
Various item for equipment (frames, cards, etc.)	10%	percentage	percentage of the equipment costs
Stock	10%	percentage	percentage of the equipment costs
PCM management system	1	unit	
PABX management system	1	unit	
Syncronisation system	2	unit	
Fiber Optical Cable	361,13	km	
Other costs for OF cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of the OF Cable costs
Laying of the OF cable	328,3	km	
Copper Cable	361,13	km	
Other costs for Copper cable (junctions, cable ends, tubes, shafts, etc.)	15%	percentage	percentage of Copper Cable costs
Laying of the Copper cable	328,3	km	
Preparation of rooms, big stations	1	unit	
Preparation of rooms, medium stations	2	unit	
Preparation of rooms, small stations	12	unit	

4.3 Costs estimates

The capital cost has been estimated starting from the bill of quantities of the proposed telecommunication system which details the number of every specific equipment to be implemented and the quantity of civil works to be performed for allowing the implementation of the system (see table 4.2.2-1).

In the subsequent stage, these quantities have been associated to the correspondent unit rate in order to produce the final estimation of the global capital costs. The unit rates reflect market prices and conditions prevailing at the end of 2004 and also include costs for installation/set up of the equipment, hypothesis for the discount rates used during tender stage and taxation effects.

As far as costs for installation/set up of equipment are concerned, they have been estimated as percentage of the purchase costs. The percentage to be used has been carefully assessed taking into account the large experience of the Consultant in installing railways telecom equipment in Europe and abroad together with factors like difficulty and possibility to use local expert under supervision of expatriate experts. The percentage ranges from 2% to 10%.

As far as the discount rates during tender stage are concerned, the Consultant has deducted the reduction usually applied by suppliers. The reduction has been evaluated from the Consultant experience in evaluating tenders for the Italian State Railways but with a very cautious approach in order not to underestimate capital costs. Consequently, although deduction is sometime higher, the applied discount rates are ranging form 10% to 20%.

Finally, as the equipment is normally exempt form taxes and duties on imported goods especially vis-à-vis funds from IFIs, all taxes have been omitted in the study.

A provision for contingency has been introduced on the basis of the aggregate investment, as commonly happens for preliminary studies. The suggested percentage is 10%, in accordance with the Consultant experience.

Following the above mentioned assumption, estimates for the capital costs related to the renewing of the telecommunication system are summarised in the following table:

Table 4.3-1 Telecommunication capital cost

Description	Amount (US$)
Equipment	854,000
Fibre optical and copper cables (with junctions, cable ends and conduits)	4,689,000
Laying of fibre optical and copper cables	1,576,000
Civil works	10,000
Contingencies (10 %)	713,000
Total	**7,842,000**

As already explained in the technical analysis, the proposed technical solution needs the closure of the ring for redundancy reason. This necessity would be turning into running costs for renting channels or fibers from third parties.

It is suggested to rent channels from public Telecom for assuring redundancy (5 links at 2 Mbps are needed for the closure of the ring). In this way the cost of renting can not be suffered because of the mutual advantage of the parts. An agreement between Railways and Ministry of Communications on mutual utilization of future optic fibre cables has already been reached.

5. Implementation schedule

The following Table 5-1 shows the implementation plan for the works envisaged for the three Lots:

The scheduled activities will be completed in 34 months.

5. Implementation schedule

The following Table 5-1 shows the implementation plan for the works envisaged for the three Lots:

The scheduled activities will be completed in 34 months.

Table 5.1 Implementation programme Lots 1.1-1.2-1.3

KUNGRAD - KAZAKH BORDER
WORK PROGRAM

OPTION 1

	ACTIVITY/months
1	*Approval of financing*
2	*Final tender document preparation*
3	*Tendering and signature of contract for PW,civil works, new 10 kV line*
4	*Mobilisation*
5	*Topographic survey, final profile*
6	*Emission of orders for material purchase*
7	*Production and handing over of materials*
8	*Welding P65 rails in 100m bars*
9	*Laying down 100 m rail bars along the line*
10	*Starting demolition, excavation, laying down new subballast, ballast, concrete sleepers, P 65 rails (1000m/day)*
11	*First ballasting, first tamping*
12	*Second ballasting, second tamping*
13	*Welding rails in 1000m bars along the line*
14	*Regulation of rail mechanical tension and welding in long bars.*
15	*Final tamping, leveling, aligning*
16	*Dismantling, recovering and classificating materials*
17	*Tests and taking over of rehabilitated line*
	CIVIL WORKS
18	*Ordering materials*
19	*Production and handing over of materials*
20	*Replacement of beams of bridges and repair of piers*
	New double three phase 10 kV overhead line
21	*Ordering materials*
22	*Production and handing over of materials*
23	*Assembling line*
24	*Tests and toking over of new 10 kV line*
	TELEKOM WORKS
25	*Ordering materials*
26	*Production and handing over of materials*
27	*Installation of cable and accessories*
28	*Commissioning*

6. Tender Documents

6.1 Introduction

Purpose of this activity is "to prepare contract packages for international competitive bidding, international shopping, and direct purchase in accordance with standards development bank procedures".

The scope of each package depends on the recommended solutions in the Feasibility Studies (FS). The following detailed design of the recommended improvement has given the input to the tender documents preparation.

Besides the technical recommended solutions, the procurement activities are deeply affected by standard development bank procedures. Despite a common philosophy, each bank normally has its own Guidelines for Procurement or a standard document to be adapted time by time.

On the other hands, the Consultant can't produce tender documents taking into consideration all factors deriving form all the possible combination among: several feasible packages and four (maybe more) standard documents (EBRD, ADB, IDB, World Bank, national).

All the above results in the following:

- each package has been prepared in accordance with requirements of the Guidelines of possible financing banks, which assure International Competitive Bidding;
- the Consultant can produce only a "draft tender document" since several details (for instance (i) tender Identification Number, (ii) Deadline for submission of the Tender, (iii) time, date and place of tender opening, (iv) date and location of pre-tender or site meeting, (v) Employer's address, etc.) are not known at the moment and will be known in the time being up to end of the project;
- several details are susceptible to be changed before the date of the tender publication.

6.2 The philosophy for procurement to be adopted

The Consultant has developed the philosophy for a successful procurement of the Package taking into consideration the following basic criteria.

The Standard Bidding Documents of Asian Development Bank (ADB) have been adopted.

It is noted that the Standard Bidding Documents adopted from various banks such as WB, EBRD, IDB, ADB, etc. slightly differs one each other.

In fact the above said banks have adopted since many years a policy of homogenization of the Tender Documents.

Such approach of using international standards leaves open the possibility of adopting guidelines of procurement of Institutions other than ADB.

Basically the legal relationships between the Borrower and the Bank are governed by the Loan Agreement. However, in the present circumstance, the procurement procedures are undertaken before signing the related Bank loan.

The rights and obligations of the Borrower and the providers of goods and works for the project are governed by the bidding documents, and by the contracts signed by the Borrower with the providers of goods and works.

For major contracts involving the procurement of advanced technological equipment it is common practice to develop the procurement procedures through an International Competitive Bidding (ICB).

The objective of ICB is to provide all eligible prospective bidders with timely and adequate notification of a Borrower's requirements and an equal opportunity to bid for the required goods and works.

The bidding documents shall clearly state the type of contract to be entered into and contain the proposed contract provisions appropriate therefore. The most common types of contracts provide for payments on the basis of unit prices or a lump sum.

As far as the rehabilitation measures for the Kungrad – Kazakh border section regard, for Lot 1.1, the ADB Standard Tender Documents (STD) for Design-Build and Turnkey have been taken as reference while for Lot. 1.2 and Lot 1.3, the ADB Standard Tender Documents (STD) for Procurement of Goods have been used.

A. STD for Procurement of Goods.

The ADB's STD for Procurement of Goods are used for contracts where the supply of goods and material prevails on the installation works and other related services.

The Single-Stage: One-Envelope bidding procedure is the main bidding procedure used for most of the procurement financed by the ADB. In the Single-Stage: One-Envelope bidding procedure, Bidders submit Bids in one envelope containing both the Price Proposal and the Technical Proposal. The envelopes are opened in public at the date and time advised in the Bidding Document. The Bids are evaluated and the Contract is awarded to the Bidder whose Bid has been determined to be the lowest evaluated substantially responsive Bid.

In accordance with ADB established procedures, prequalification of bidders is required for procurement contract related to expensive and technically complex items to ensure that only experienced and financially capable firms will submit bids.

Therefore a combination of :

- ADB's SPD for Prequalification, and
- ADB SBD for Procurement of Goods with Single Stage – One Envelope procedure

The main data provided by the Consultant are on the results of the Detailed Design, and are namely:

- For the SPD for Prequalification:
  - Short description of the project

- Major contract components
- Estimated quantities of major components
- Contract implementation period

- For the SBD for Procurement of Goods with Single Stage – One Envelope procedure:
  - List of goods and related services
  - Technical specifications of goods and related services
  - Drawings

B. Standard Bidding Documents (SBD) for Design-Build and Turn Key Contract with Single Stage bidding procedure.

There are no universally-accepted definitions of the terms "design-build" and "turnkey", except that both involve the Contractor's total liability for design. For the Employer, such single-point responsibility may be advantageous, but the benefits maybe offset by having less control over the design process and more difficulty in imposing varied requirements.

Under the usual arrangements for a design-build contract, the Contractor is responsible for the design and provision, in accordance with the Employer's requirements, of works which may include any combination of engineering (including civil, mechanical, electrical, etc) and building works; and interim payments are made as construction proceeds.

The Conditions are also intended for use on turnkey contracts, under which the Employer's requirements usually include provision of a fully equipped facility, ready for operation (at the turn of the "key"). Turnkey contracts typically include design, construction, fixtures, fittings and equipment, the scope of which would be defined."

Turnkey contracts involve the contractor's single responsibility for design, manufacture, delivery, installation, testing, commissioning, training, etc.

In the Single Stage bidding procedure the bidders submit one envelope containing the price proposal and the technical proposal. The envelope is opened in public and the total amount of each bid and any alternative bid and other relevant details are read out and recorded. The bid is evaluated and the award of contract is made to the lowest evaluated substantially responsive bidder. The Single Stage bidding procedure is normally utilized for contracts where the plant to be designed and build is very well defined or where the civil works content is very high such as for roads, pipelines and power transmission line projects where there is not likely to be problems in the evaluation of alternative proposals for machinery or equipment.

In accordance with ADB established procedures, prequalification of bidders is required for civil works, turnkey contracts and contracts for the fabrication of expensive and technically complex items to ensure that only experienced and financially capable firms will submit bids.

ADB's Standard Procurement Documents (SPD) for the Prequalification of bidders are based on Master Procurement Documents prepared jointly by multilateral development banks and other public international financing institutions.

The Tender Documents are constituted by a combination of :

- ADB's SPD for Prequalification, and
- ADB SBD for Design-Build and Turn Key Contracts with Single Stage procedure.

The main data provided by the Consultant are on the results of the Feasibility Studies, and are namely:

- For the SPD for Prequalification:
  - Short description of the project
  - Major contract components
  - Estimated quantities of major components
  - Contract implementation period
- For the SBD for Design-Build and Turn Key Contracts with Single Stage procedure:
  - Employer's Requirements. Care must be taken when drafting the Employer's Requirements to ensure that the requirements are not restrictive. In the specification of standards of goods, materials and workmanship recognized international standards should be used as much as possible. Where other particular standards are specified, whether national standards of the Borrower's country or other standards, it should be state that goods, materials and workmanship meeting other authoritative standards and which promise to ensure equal or higher quality than the standards specified, will also be acceptable. Where a brand name of a product is specified it should always be qualified with the terms or equivalent. In addition to stating the requirements of the completed Works clearly the Employer Requirements Section should also include matters related to the execution of the Works to enable the bidders to gauge the extent of responsibility and to price the bid accordingly.

7. Conclusions

The rehabilitation measures suggested in the Feasibility Study submitted in March 2005 for the Kungrad - Kazakh Border railway section mainly consist in the rehabilitation of the existing railway line, excluding the rehabilitation of the stations (permanent way, buildings and passenger services) and including the power supply for 10 kV. It also includes works for the telecommunication system installation all over the line and it does not include any work for the safety devices.

Following the positive results of the Feasibility Study, the Consultant has prepared the detailed design necessary for the development of the related tender documents .

The categories in which the whole rehabilitation works have been divided are:

Lot 1.1 – Permanent Way and Civil Works;

Lot 1.2 – Power Supply

Lot 1.3 – Telecommunications

The Consultant strongly recommends the adoption of international standards documents to assure an International Competitive Bidding (ICB).

In all cases the tender should be an international tender: for Lot 1.1 a Design-build (Single Stage) tender has been adopted, while for Lot 1.2 and Lot 1.3 a Procurement of Goods tender should be lunched.

Consequently tenders documents which have been prepared should be used for launching a tender for Design-Build for the renewing of the Permanent Way and Civil Works and for Procurement of Goods for the renewing of the Power Supply and Telecommunications components.

Tender documents here attached have been prepared using international standards (ADB Guidelines) and can be straight used by the Uzbek Railways for launching the related tenders.