COVERING NOTE FOR DETAILED PROJECT REPORT OF UDHAMPUR-SRINAGAR-BARAMULLA NEW B.G.LINK

Udhampur – Srinagar-Baramulla New B.G. Link as per the detailed survey has a total length of 287 kms. The DPR is in ten Chapters and contains a synopsis which briefly explains each chapter and other important aspects of the report.

The report explains about the methodology adopted for detailed survey of the line. It also discusses about the various routes which had been studied before arriving at the final alignment. For this purpose, the alignment has been divided in two distinct sections namely Udhampur – Qazigund covering a length of 167 kms and Qazigund – Baramulla spanning the valley with a length of 120 kms.

A study to assess the Impact of the project on the environment has also been carried out. Report covers briefly all important aspects of this study. As a result of this study, it is revealed that the project even without an environment management plan is eco friendly.

The report also gives the details of the quantity of earthwork, span arrangements of various major bridges. Minor bridges required for the project have also been listed. Standard of construction for permanent way have also been discussed. Details of the facilities required to be provided at each station including quarters have also been incorporated. The important specifications for executing the Civil Engineering works and important design considerations have also been detailed. Since tunnelling covers approximately 53% of the length in Udhampur – Qazigund Section, the details of the tunnelling aspect have also been covered in the report.

Separate chapters are devoted to the Signalling and Telecommunication as also for Electrical Engineering. Keeping in view the modern developments, the project envisages the use of modern telecommunication equipment also. To avoid failures, stand by telecommunication links through satellite have been envisaged for the project.

Though a separate volume is devoted to traffic survey, this volume also gives the summary of the important aspects of the projected traffic. The traffic earnings contained in the report have been incorporated after a detailed traffic survey. Since the B.G. line is likely to be opened in the first phase between Udhampur – Katra and Qazigund – Baramulla, the traffic projections have been given for :

i) Udhampur-Katra

ii) Qazigund – Srinagar

iii) Srinagar –Baramulla

iv) Udhampur – Katra – Qazigund

v) Entire Section.

The total passenger potential for these sections is projected as 32809 per day at the commencement of the operation which has been assumed to be 2007-08. The total passenger gross earning has been estimated to be approximately Rs.5398 Lacs per annum likely to accrue from the 12 trains most of which will terminate in the Valley. The working expenses for the coaching traffic will be approximately Rs.5325 Lacs per annum. The detailed traffic survey report duly vetted by Finance is also attached as a separate volume.

FREIGHT TRAFFIC

The total earning from the freight traffic is estimated as Rs.3233 Lacs per annum. Working expenses being Rs.1880 Lacs, the net earning will stand at approximately Rs.1353 Lacs.

The report also contains the construction schedule in the form of the PERT charts developed through the use of MS Project. For this purpose, the project has been divided in three separate parts namely Udhampur – Katra, Katra – Qazgiund and

Qazigund – Baramulla. Since sufficient funds have been made available w.e.f. 1998-99 onwards, the project commencement has been assumed as 1-4-98. The completion time for Udhampur – Katra and Qazigund- Baramulla has been taken as 2002-03 and that for the entire section has been taken to be 2007-08. These dates can only be adhered to if the requisite funds are made available for the project.

The narrative report gives the summary of the total cost which stands at Rs.3077.2376 Crores inclusive of all the departments. This however does not include the cost of the rolling stock which has been estimated in the traffic report as Rs. 166.92 Crores.

RATE OF RETURN

Taking all the inputs and outputs into account, the project gives a negative rate of return of – 13.84% .

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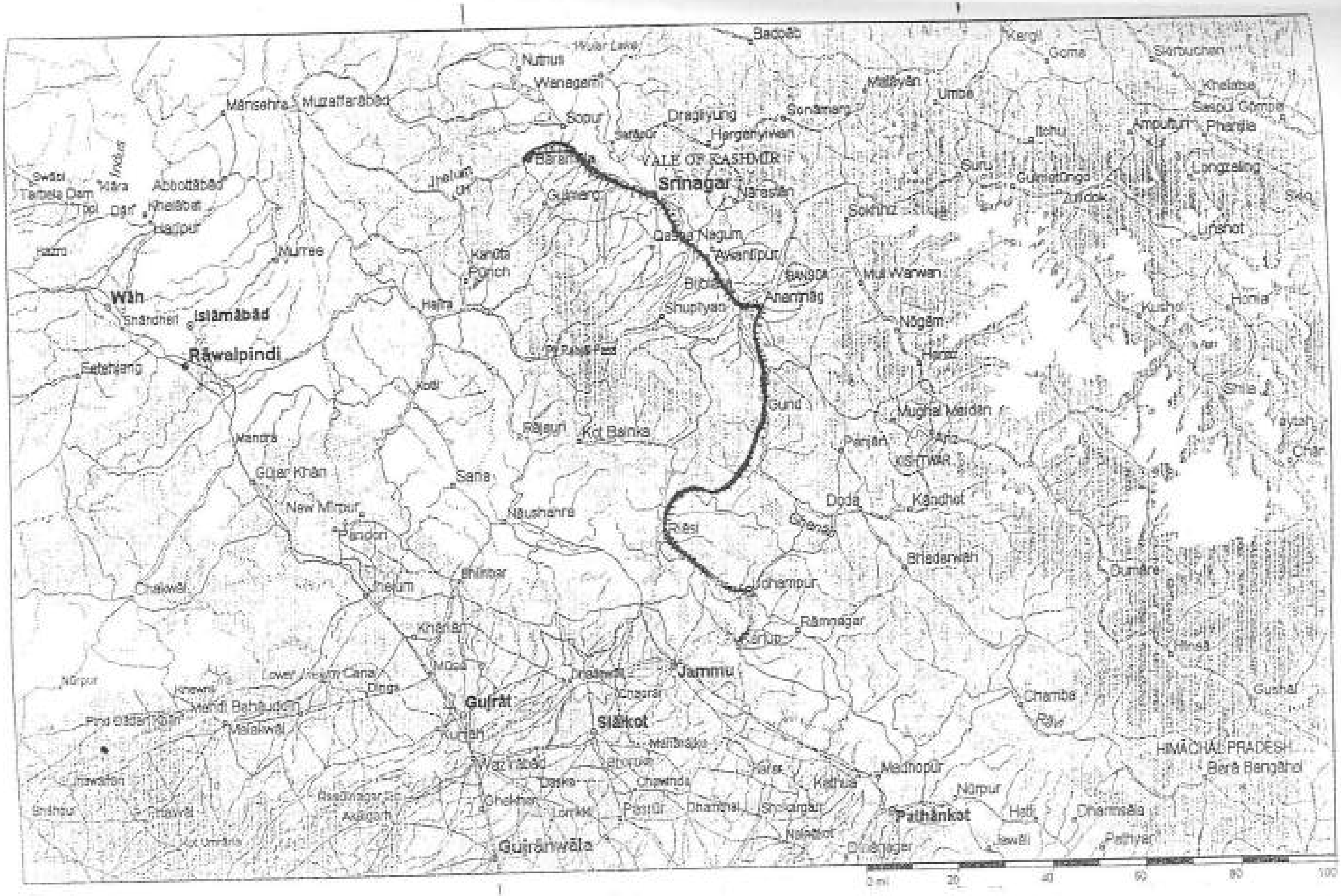

Wular Lake
Nutnus
Wanagam
Baopab
Mānsehra
Muzaffarābād
Sopur
Dragiyung
Hergenyiwan
Sonāmarg
VALE OF KASHMIR
Srinagar
Narastan
Bāramula
Gulmarg
Jhelum
Swābi
Tarbela Dam
Abbottābād
Haripur
Murree
Hazro
Wāh
Islāmābād
Rāwalpindi
Fatehjang
Kahuta
Poonch
Haira
Qasba Nagum
Avantipur
Bijbiara
Shupiyan
Anantnāg
BANSOL
Sokhhz
Mul Warwan
Nogām
Kargil
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Umba
Matāyān
Itchu
Suru
Skirbuchan
Khelatse
Saspul Gompa
Ampuhum
Phanjila
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Kot Bainka
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Mandra
Gujar Khān
Saria
Naushahra
New Mirpur
Pandori
Riasi
Udhampur
Bhimbar
Chakwāl
Jhelum
Kharian
Rāmnagar
Kathua
Lower Jhelum Canal
Dinga
Gujrāt
Jammu
Mandi Bahāuddin
Malakwal
Pind Dadan Khān
Sialkot
Kunjah
Wazīrābād
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SYNOPSIS

UDHAMPUR – SRINAGAR – BARAMULLA NEW B.G. LINK

GENERAL

The work of new B.G.Link from Udhampur – Srinagar was included in the Pink Book of 94 -95 at a total cost of Rs.1500 Crores. Later on the scope of work was extended upto Baramulla. For all the new lines, the construction of the line is first introduced in the pink book under demand 2 to conduct a survey for the new alignment. However, keeping in view the extra ordinary conditions existing in the state of J&K, the construction of this line was introduced in the pink book without any survey. Consequently the survey of the alignment was taken up only after the introduction of work under demand 16.

SURVEY

Initially it was envisaged to plan the line at a ruling gradient of 1in 40 (C) between Udhampur – Qazgiund and 1 in 80 (C) between Qazigund -

Srinagar. However, keeping in view the low speed potential of the line at such steep gradients, the ruling gradient with the approval of the Railway Board was changed to 1 in 100 (C) for the entire stretch from Udhampur – Baramulla. // The survey for the new line was done through the use of modern gadgets to reduce the requirement of time and man power. Thus after the paper alignment was marked on the toposheets, the feasibility of the line was studied with the help of satellite imageries wherever required. The final alignment which has been adopted was finalised by the use of aerial photographs obtained from Survey of India and after digitizing the terrain through the use of Digital Terrain Modelling .

OBJECTIVE OF THE NEW B.G. LINK

The existing National highway is the sole link of Kashmir Valley with rest of the country. Due to increase in the traffic, the National highway is now choked. Moreover, because of the land slides and the snowfalls there are numerous occasions of blockade of traffic. The new B.G. link will not only provide an alternative to the National highway but will also be in a position to boost up the tourists potential of the State. It is also expected that the pace of industrialization will also pick up once the benefit of the B.G. Link is extended to the State. Finally since the B.G. line will be an all weather line, it will effectively integrate the State with the rest of the country.

ALTERNATIVE ROUTES EXAMINED

For finalising the route from Udhampur – Baramulla, the survey had been divided in two sub sections namely from Udhampur – Qazigund and from Qazigund - Baramulla. In both the sub sections, three alternative routes had been studied. In the first sub section, three possible corridors namely Western corridor, North Eastern Corridor and Eastern corridor had been studied. The Eastern corridor did not find favour because of the requirement of high gradients particularly near Chenani. The North Eastern corridor was dropped because of its length being high as also because of the fact that it necessitated an engine reversal at Udhampur. Both the Eastern and North Eastern Corridor were quite close to the existing National highway for a greater part of its length. The Western Corridor was found to be suitable from the overall techno-economic considerations. It also had an advantage of passing via Katra which is an important tourist destination. This alignment skirted the Pir Panjal range from Western side and passed from an area of the State which was hitherto unexplored. As such finally the Western alignment between Udhampur – Qazigund has been chosen.

The width of the Valley being restricted, the choice of routes in the second sub section namely between Qazigund – Baramulla was rather limited. However to choose the best possible alignment, three routes were studied in this sub section also. Finally the alignment which has been adopted for this section touches important habitation centres. While deciding the final alignment care has been taken to locate the alignment so as to reduce land acquisition from agricultural areas/orchards.

DESCRIPTION OF THE COUNTRY

The B.G. line from Udhampur – Baramulla negotiates two completely different type of terrain. While the terrain between Udhampur – Qazigund passes from a very difficult area which is largely hilly with steep slopes interspersed by a number of rivers and deep gorges, the lay of the land between Qazigund – Baramulla a length of approximately 120 kms is relatively flat. The construction of the

B.G line in the Valley, barring a short length near Qazigund, is technically not a difficult proposition.

ENVIRONMENT IMPACT ASSESSMENT STUDY

The proposed alignment has been studied for its impact on the environment. M/s.RITES had been entrusted for the job. The study conducted by the specialists working with M/s. RITES have carried an in depth study of various positive and negative impacts likely to occur as a result of the project. These impacts have been quantified by using different formulae. It has been concluded that even without an environment management plan, the project is environment friendly.

STANDARD OF CONSTRUCTION

The proposed line would fall under group D route and will be laid on 52 kg per m 90 UTS rails on PSC sleepers. As stipulated in Railway Board's letter No. Track/21/95/0800/7 dated 6/2/95, head hardened rails will be required to be used on all sections where the gradient is steeper than 1 in 150 and/or the curves are sharper than 2 degrees. The track will be laid on 30 cm ballast cushion on the main lines and 20 cm cushion for the loops.

As far as possible, the design of bridges provides for ballasted decks to avoid frequent change of track structure.

All the bridges in the section have been designed to MBG standards. To bring about an element of uniformity in the design of various elements of the bridges, DPR lists out the relevant clauses of various codes applicable for the individual elements. The listing will also guard against the designs in contravention to the codal provisions.

The entire earthwork in the project will be done with mechanical compaction. For improved stability of the embankment, sub berms for every 6 m height has been envisaged. By testing the soil, the stability of all slopes for high embankments will be ensured during the construction of the embankments.

LAND

The width of land proposed to be acquired is for a single BG line as it would not be feasible to construct a double line parallel to the proposed line.

The land width has been proposed as per the guide lines of the Indian Railway Code for the Engineering department. However depending upon the importance of the station, sufficient land to cater for its expansion is proposed to be taken over keeping in view the fact that expansion of the yard will not be possible at a latter date since the land around the stations becomes heavily built up as soon as train operation starts.

FORMATION

Formation width has been kept as 6.85 m on all stretches other than station yards. The formation width will be increased at the rate of 5.30 m for every additional line in the yard. Retaining walls have been proposed at locations where the toe falls on a side long ground.

TUNNELS

In Udhampur – Qazigund section, approximately 53% of the track lies in tunnels. No tunnel was necessary in Qazgiund – Baramulla section. Tunnels have been proposed at all locations where the depth of cutting exceeds 20 m or at locations where a cutting is infeasible because of the nature of the strata. Portals of the tunnels have been located at such locations where the slope at the top would remain stable. However the actual location of the portal will be decided depending upon the dictates of the geology of the overburden.

BRIDGES

The line in question traverses deep gorges which have necessitated provision of 106 No. of major / important bridges. All the bridges have been designed to M.B.G. loading standard. A cable straight bridge on river Chenab between Km. 49 and 50 has become inevitable on account of the height of the formation above the river bed being in the order of 390 meters. Keeping in view the experience gained in JURL about the difficulty in designing, long continuous spans on PSC girders, the bridges in this project have been designed, as far as possible, with simply supported girders have been avoided. The linear waterway of the bridges between Udhampur to Qazigund has been calculated based on the CWC report for Western Himalayas Zone - 7. For bridges in Qazigund Baramulla section, the water way has been decided based on the bridges already provided on the National Highway since the alignment passes quite close to the National Highway. Clearance for these bridges has been based on the HFL considerations. The HFL of these bridges have been taken from the Irrigation Deptt. of J&K. Between Udhampur to Qazigund the total bridging length for Major / Important bridges is 15458.70 M. For Qazigund Baramulla section however this figure reduces to 1461.50 M since valley is relatively flat.

CURVES

Initially it had been envisaged to provide horizontal curves of 6 degree and 5 degree for the section between Udhampur to Qazigund and Qazigund to Srinagar respectively. These curves would have required severe permanent speed restrictions. An attempt was therefore made during the detailed survey to reduce the curvature of the curves. Finally the entire line has now been proposed with 2.75 degree curves which will have a speed protential of 100 KMPH. All the transition curves will be designed for 100 KMPH. The curve compensation @ 0.04% per degree of curve has been taken for designing the gradients on the curves. Percentage of curved track for the entire alignment is 25.73%.

RULING GRADIENT

Ruling gradient of 1 in 100 (C) has been adopted for this project as this gradient will not require catch / slip sidings. Provision of catch sidings would have sharply brought down the speed protential of the line since GR makes it mandatory for all trains to stop short of catch siding. Moreover these catch sidings would have required construction of separate long tunnels resulting in heavy escalation of the cost and time required to construct the project. Secondly provision of LWR is possible upto a gradient of 1 in 100. Since the terrain between Udhampur to Qazigund is highly undulating, approximately 78% of track had to be provided on the ruling gradient. Though the ruling gradient between Qazigund to Baramulla section has also been kept as 1 in 100 (C), this gradient was required only in the short reaches after Qazigund. Subsequently the entire alignment has been provided with much flatter gradients.

STATION YARDS

The alignment will have 28 number of stations. Though attempt has been made to keep the yards at a gradient of 1 in 1000, it had not been possible to adhere to this value for most of the yards in view of the hilly terrain. However no yard has been provided at a gradient of more than 1 in 400. High level platforms have been proposed for important stations. Minimum two loops have been provided at all the crossing stations. For the facility of operation the maximum distance between two crossing stations is 15.09 Kms with the sole exception of distance between Surukot and Barala which is 19.80 Kms. A block hut can be provided between these two stations to reduce the length of the block section depending upon the need of operation at the material time. At alternate stations a short spur has been provided to act as a hot axle siding. A.R.T. siding has been provided at Qazigund which is the commencement of the valley. Tourist sidings have been provided at Katra and Srinagar.

RESIDENTIAL ACCOMMODATION

Quarters have been proposed for essential staff on cent percent basis. A total number of 1077 quarters have been proposed for the entire project.

PROJECTION OF TRAFFIC

A separate volume gives projection of the traffic. The narrative report in this volume also gives a synopsis of the detailed traffic report. Since construction activity in Qazigund - Baramulla is likely to finish much earlier than the difficult alignment between Katra to Qazigund, this portion of the section will be operated as a stand alone line for the intervening period. Similarly the section between Udhampur to Katra is also likely to finish much earlier than Katra to Qazigund. The traffic projection therefore has been done in different sections at the commencement of the operation. The table given below summarises the passenger traffic projections in various years in different sections.

Section	Passengers per day each way	Year
Udhampur - Katra	3564	2002-03
Qazigund - Srinagar	7031	2002-03
Srinagar - Baramulla	1821	2002-03
Udhampur - Katra – Qazigund	10924	2007-08
Katra - Qazigund	7360	2007-08
Qazigund – Srinagar	7031	2007-08
Srinagar - Baramulla	2109	2007-08

COST AND INVESTMENT SCHEDULE

The capital cost of the construction of the proposed new B.G. link is Rs. 3077.24 Crores. This cost excludes the cost of the rolling stock which has been assessed as Rs. 166.92 Crores. Since the project has already commenced from 98-99 onwards when increased allotments were made to the project, the investment schedule starts from that year. The actual allotments made during 1998-99 and 1999-2000 have been shown as investment for these years. The required investment given hereunder is without inflation. The chapter of construction schedules also gives the requirement of funds considering an inflation rate of 8% per annum.

Year	Investment in crores
1998-99	75
1999-2000	100
2000-2001	422.82
2001-2002	441.45
2002-2003	407.54
2003-2004	396.90
2004-2005	403.86
2005-2006	395.56
2006-2007	189.50
2007-2008	166.17

SIGNALLING AND TELECOMMUNICATION

The project will have standard III interlocking with MACL signalling with CTC control. Keeping in view the modern developments, the entire signalling has been planned with solid state interlocking. The choice of this technology has primarily been made since this system is much safer than the conventional system of interlocking. Solid state interlocking will not only be easy to maintain but will also result in saving of considerable manpower for maintenance.

Communication system will work on optical fibre system which is a proven system for better efficiency. Since the communication in the system is vital for maintaining the train operation, no interruption for the communication can be tolerated. As such to ensure an uninterrupted service at all points of time, communication system has also been planned through satellites as a back up measure. For this purpose, there will be three dedicated hubs and one hired hub. Initially, it is proposed to hire the hub from NIC. The hired hub will have two channels, one for round the clock working and the second channel will serve as a back up support for disaster prevention measures like landslides, terrorists activities etc. For being cost effective, the second channel will be hired only on a weekly basis for one hour for testing the equipment.

ELECTRICAL

The normal standard for provision of electrical installation and services have been adopted. However, as this line has a large number of long tunnels of the type not existing on the Indian sub-continent, adequate provision has been kept for ventilation of such tunnels. This assumes special importance on this line as it will have diesel traction. The DPR lists out the acceptable pollution levels inside the tunnels. In keeping with the experiences gained in Konkan Railway and Koraput Raigada, a provision of artificial ventilation has been made for all tunnels longer than 2 kms.

INDEX

CHAPTER - I

HISTORY AND GEOGRAPHY

1.1 GOVERNMENT ORDERS

1.1.1 Construction of the new B.G.Line between Udhampur – Srinagar was included in the Pink Book of 94-95.

1.1.2 The Ministry of Railways (Railway Board) sanctioned the survey estimate amounting to Rs.1.27 Crores vide their letter No.86/W2/NL/N/25/Pt. dt. 11/11/94 & 15/3/96.

1.2 OBJECT OF THE PROPOSED LINE

1.2.1 The present transportation system in the predominantly mountainous terrain of Jammu & Kashmir is totally dependent on road transport which is characterised by high construction, maintenance as well as operation costs. The distance of the present rail head at Jammu is about 300 Kms. from Srinagar which is covered by the National Highway No.1-A of limited capacity. The cost of transportation of fuel and spare parts by road considerably increases their prices. The absence of other modes of transport also makes the rates of road transport monopolistic which are sustained at an abnormally high level.

1.2.2 The growth of agriculture, horticulture and industries under lines the need for reaching larger markets available in the rest of the country which are presently in-accessible in many cases owing to high transportation cost, which makes the goods produced in the valley incompetitive. Secondly, expansion of economy also requires larger volume of imports of construction and industrial raw materials, agricultural inputs etc. The provision of an alternative and cheaper mode of transport from Udhampur to Baramulla via Katra, Reasi, Salal, Qazigund and Srinagar is of prime importance to stimulate the economic development of the State of J&K. With the increased activity for transit to Vaishno Devi, agriculture, horticulture, forest and industrial sectors, under the various schemes envisaged by the J&K State Government, it is anticipated that there will be sufficient volume of trade within the Valley as also between the valley with the rest of the country. With the growth of economy as well as increase in tourist traffic, the traffic prospects of the line will improve. Thus construction of railway line between Udhampur - Baramulla via Srinagar will facilitate the transport and will remove a serious bottleneck being faced in the expansion of the economy of the state.

1.3 DESCRIPTION OF THE COUNTRY

1.3.1 The area covered under the scope of the present survey lies between latitudes 32° - 45' and 34° - 20' north and longitudes 74° - 15' and 75° - 15' east. The projected line traverses through the districts of Udhampur, Doda, Anantnag, Pulwama, Budgam and Baramulla.

1.3.2 Udhampur - Katra section of the railway alignment lies in the Jammu region of the State. The B.G. line in question is situated in Southern portion of the Great Himalayas. The portion of the line from Udhampur - Kashmir Valley will pass through a highly undulating terrain intercepted by deep gorges, valleys and numerous khuds. Most of these khuds will pose a challenge to the bridging acumen of the Civil Engineers. The terrain in question between Katra - Qazigund will negotiate the Chenab Valley and will require extensive tunnelling for crossing the Patni ranges and Pir Panjal ranges. Railway alignment enters into Kashmir valley at Qazigund after crossing the high mountains of the aforesaid ranges.

1.3.3 Kashmir valley is formed by the basin of the upper Jhelum river which flows through its middle and with its outlet at Baramulla which is the western end of the valley. The river again enters the deep gorge pierced by Pir Panjal ranges. While the portion of the alignment between Katra - Qazigund is extremely rugged, the valley portion from Qazigund - Baramulla is relatively flat and is not expecting to pose much difficulty for the construction of the alignment. The valley is guarded by the outside world on the North and East by a series of ranges. The valley is also cut off from the plains of the the Punjab by rocky Pir Panjal and the Tosh Maidan mountain ranges, which run north-west to form the high southern rim of the valley. The Pir Panjal ranges have peaks upto 5130 m and are 90 to 100 Kms. in width nurturing deep wooded valleys and torrents on their southern flank and fine alpine pastures on their northern rim. The wide mountain track with white crested waves on the north and north-east have a few peaks reaching great altitudes - Kohalai (5424 m) between Liddar and Sindh valleys, Haramukh (5143 m), the grim mountain over locking the entrance to the Sindh valley and the peak of Amarnath, the sacred mountain. These mountain ranges dip something over 2750 m in the south where the Banihal pass affords an exit from the valley towards Jammu. Close to Srinagar city on the north stands the mahadeo range.

1.4 GEOLOCICAL FEATURES

1.4.1 The initial stretch of the project from Udhampur - Katra section lies within outer or sub Himalayas which essentially comprises of low linear strike ridges. The terrain is made up of recent to sub recent sediments, Siwalik and Muree rocks. The prominent tectonic elements of the region are summarised below:-

1.4.2 KISHANPUR THRUST

The upper murees are juxtaposed against middle/upper Siwaliks along Kishampur thrust. This outermost prominent thrust extending between

Basoli and Waishnodevi Limestone inlier near Riasi merges with the Waishnodevi thrust.

1.4.3 MUDUM THRUST

This is a prominent thrust extending for 80Km. from west of Ravi river to north of Udhampur. The lower Muree on the north is justaposed due to this fault against upper Muree on the south. This thrust dies out 10Km. north of Udhampur within the lower Muree and the dip of this thrust is about 55° towards north-north east.

1.4.4 VAISHNODEVI THRUST

This thrust overlaps the Kishanur thrust in the east has a north or north west trend in the south and gradually swerves westerly. The thrust brings the Vaishnodevi Limestone against the eastern limit of an over turned anticline in the Siwalik. The railway alignment is situated south of Vaishnodevi thrust.

1.4.5 MUREE THRUST

This is a regional fault separating the Muree to the south from the pre-Muree sequence (Panjal Volcalnic of Permo-Carbioniferous) to the north and is also referred to as the Main Boundary Fault in the area to the east of Ravi river. The regional NW-SE trend of this fault is deflected to E.W. for about 80Km. west of Ramban. The syntaxial bends in the region coincide with the course of both major and minor rivers.

1.4.6 The regional geology and tectonic frame work of the area indicate that the region is capable of generating earthquakes of severe intensity. The area falls in seismic zone IV of Indian Standard seismic zoning map of the country.

1.4.7 On its way to the Kashmir valley, alignment in Katra - Qazigund section passes through a very rugged terrain intercepted by deep gorges, valleys and numerous torrential khuds.

1.4.8 Among the many interesting geological facts connected with the valley, none are of greater interest than those which support the tradition, that the valley was once covered by the waters of a vast inland lake, which dried up when nature afforded an outlet at Baramulla and the theory of its lake origin best explains the slopes and ledges which renders the configuration of the valley striking and unique. It is observed in the first place that the valley is distinctly basin shaped; and there are a number of lakes and swamps. Where the mountains cease to be steep, some table lands with flat arid tops and is denude of trees start running towards the valley. Some of these dry table lands stand up isolated in the middle of the valley, but whether isolated or attached to the mountains, they offer the same sterile appearance. These table lands are locally known as 'Karewas'. It is believed that karewas are remnants of lake sediments which once covered the whole valley from end to end. Subsequent up lifts connected with mountain formation rejuvenated the streams whereby the once continuous sediments got dissected, leaving behind a number of isolated plateau or table lands. These table lands are composed of regional lake sediments comprising predominantly clay with sand, silt and at places gravel bands and impure lime stone nodules known as 'Kankar'. The low lying areas especially, towards the central part of the valley which till recent times were occupied by lakes and meandering river Jhelum are filled with alluvial deposits brought down by streams and rivers from the karewas. These alluvial deposits as such, are not much different from karewa deposits. A striking difference, however, is the presence of partly decomposed vegetable matter and has greater dominance of sand and silt in these alluvial deposits.

1.4.9 In its course, the river Jhelum below the town of Anantnag, flows through a plain of low level recent alluvium, which has been formed by the river in floods. The width of the plain varies from 5 to 40 Kms. It is composed chiefly of loam and clay. Below Srinagar in the land reclaimed from the swamps the soil is black to brown in colour and peaty in long stretches.

1.4.10 Kashmir valley running in the north west - south east direction is a structural valley lying between Zanskar range bounding it on north east and Pir Panjal range on the south-west. The geological set-up of the valley with its surrounding mountain ranges is unique. The rocks are closely folded and faulted due to the tectonic movements that have been connected with the mountain building forces. Various types of rocks - igneous, metamorphic and sedimentary in origin are seen in and around the valley. These rocks vary in age from the oldest Precambrians through palaeozics and tertiary to recent. The dominant rock types around the valley are volcanic in origin and are known as 'Panjal traps'. This rock is an andesite basalt with varied colours ranging from light shades of grey, green and blue to dark grey colours. It is the chief building stone in the area and is used for construction of foundations and plinths of buildings. The other type of rock in the valley is the lime stone with varying percentage of Ca0 ranging in grade from chemical grade, through cement grade to low grade lime stone - suitable for building purposes. These lime stones can easily be cut into blocks and chiselled and dressed and can take a good polish. At some places the lime stone has changed into marble which is used locally as decoration stone. The lime stones are younger than Panjal traps and over-lie the traps along the Zanskar foot hills towards north east of the valley. High deposits of lime stones are available in Anantnag district towards upper reaches of the Jhelum river.

1.5 RIVER SYSTEM

1.5.1 The area through which the projected alignment will traverse lies in the drainage basin of the Tawi and Chenab river and its tributaries like Birhen, Dudhar, Jhajjar. The river Tawi and Chenab lie in Jammu region, The river Tawi starts from the valley near Patni ranges and the river Chenab comes from

Kishtwar area. Both the rivers flow downwards to the plains of Pakistan.

1.5.2 The river Jhelam and its tributaries lie within the valley of Kashmir. The catchment area of the river within the valley is about 185 Kms. long with a width that varies from 64 to 112 Kms. The only outlet from this valley is the narrow gorge at Baramulla where the placid river leaves the smooth grassy banks and hurries down its rocky course to the plains of Punjab in Pakistan. The river is navigable without a single rock from Baramulla to Khanabal, a distance of 163 Kms. 40 Kms. down stream of Srinagar, the river forms the Wular lake which varies in extent from 130 to 135 sq. Kms., according to the season. It leaves the Wular lake near Sopore about 25 Kms. up-stream of Baramulla. The great Wular lake may be regarded as a delta of the Jhelum in the Kashmir valley. In its course from Khanabal to Wular lake the fall of the river is 50.3 m in the first 49 Kms. and 16.9 m in the next 48 Kms. From Wular lake to Baramulla the fall is very slight. In the month of December, the river is at its lowest.

1.5.3 The Jhelum flows from the grand spring of deep blue water at Verinag which bubbles up beneath a steep scrap of mountain clothed with pines. Above Srinagar, the mountain streams which joins the river Jhelum from the north are the Sandran, Brinji, Liddar, Aripal and also the springs of Kokarnag and Achabal. Amongst these streams, the Liddar is the most important tributary, which comes from the ever lasting snows which overhangs the head of the Liddar valley and the lake of Tarsar. The Vishva, Rambiara and Ramoshi join from the south side. The Sind river is the most important tributary which joins the Jhelum at Shadipur on its right bank down stream of Srinagar and Pohru is another stream which joins on the right bank at Dubgah below Wular lake. The chief tributaries of the left bank below Srinagar are the Dudhganga, Sukhnag and Ferozpora which loose themselves in the large marshes on the left bank of the river. The Ningli is another stream on the left bank which falls into Wular lake.

1.5.4 The rivers are fed by a large number of steeply sloping mountains. The mountain streams derive their flow from the melting snows on the mountains or from the spring and autumn rains. They swell to big dimensions during floods and become a mere trickle during winter. The streams are flashy and the peak discharge lasts only for few hours during and after heavy and continuous rains. In ordinary times the river Jhelum flows gently between high stable banks, but at times of floods the river over-tops its banks and has been known at times to cross the marginal bunds that have been constructed causing great damage to standing crops and property. The loss caused by the floods is the greatest below Srinagar, as the fall of the country is very slight in this region. In fact, below Srinagar, the level of the country on its left bank is below the bed of the river resulting in series of swamps. The drainage of the streams on the south side amalgamates into these swamps. The flood waters of Jhelum above Srinagar (which flows through flood channel pass) and from which there is no outlet to the river except during the winter months, also contribute to these swamps. The situation is further complicated by the gradual silting up of the great Wular lake which refuses to accept the full discharge of the river Jhelum aggravating the problem of the swamps.

1.6 MEANS OF COMMUNICATIONS

1.6.1 The National Highway No.1-A which connects Pathankot-Jammu-Udhampur-Banihal-Srinagar-Baramulla is one of the busiest highways in the country and is the life line for carrying all the traffic of the State by road. The important road which takes off from this highway within Kashmir valley is the Srinagar-Leh road. A large number of feeder and village roads which comprises of bitumen painted, water bound macadam and fair weather roads connecting the town and villages in the valley take off from this highway on either side. With the existence of this net work of roads, communication facilities have been extended to the rural areas as far as possible.

1.7 CLIMATE

1.71 The J&K State climatically is distinctly divided in three parts namely the Jammu region, the Valley region and Leh Ladkh region. The Railway alignment in question passes only from the first two regions. The climatic condition of Jammu region is almost same as prevalent in plains. The climate in the Valley for the most parts of the year is temperate. Thus there is a wide variation in the climatic condition of the two regions.

1.7.2 **RAIN FALL**

1.7.2.1 In Jammu region, there is a considerable rainfall in the monsoon months i.e. from June to Sept. like the rest of the country. The southern ranges in the Valley also show a similar pattern. However, the greater part of the valley is sheltered from the monsoon by Pir Panjal ranges. Not in-frequently the currents pass over the valley and bring heavy rain to the north of it. On the other hand, rest of the valley is much more affected by the western disturbances from December to May and the maximum precipitation is in the form of heavy snow-fall in these ranges. While there is rain fall throughout the year in the valley, March is generally the wettest month and November, the driest.

1.7.3 **TEMPERATURE**

1.7.3.1 The day temperature in the lower reaches of Jammu region shoots upto 45 centigrade and the night temperature may touch 35 centigrade during the summer months.

1.7.3.2 There is a Meteorological Observatory at Srinagar and the records of this observatory may be taken as representative of the climatic condition prevailing in the whole of Kashmir valley in general from

Qazigund to Baramulla. The temperatures, however, are comparatively lower at places having higher altitudes and also at the foot of the hills, which surround the valley. The temperatures of the southern parts of the district of Anantnag and northern parts of the Baramulla district are lower than those of the other parts of the valley. There is a rapid increase in temperature from March till July which are generally the warmest months in the valley having almost the same temperature as in the months of March and April in the Punjab plains. The normal mean daily maximum temperature in July hovers is a round 30 - 31° C. The temperature varies during individual year and reaches upto 37 to 39° C in day time and from 10 to 11° C during nights in the hottest months, When the summer heat becomes excessive in June, a heavy thunder storm cools the air for days. The night temperatures are comparatively lower and pleasant even in the month of July. With the advance of monsoon by end of July, the temperature starts dropping gradually during both day and night. At the end of September, there is a further rapid fall in the day temperature, whereas the night temperature starts dropping from the end of August itself. This rapid fall in the day and night temperatures continues with the progress of the winter season till the end of January, which is the coldest month. The normal mean daily maximum temperature in the month of January is 4.4° C. Since the temperature falls to sub zero range, the valley witnesses snowfall during the winter months. Heavy snowfall at times has been known to cause disruption of the traffic in the Valley. During the winter season, depending upon the amount of snow fall on the high mountains surrounding the valley, the minimum temperature drops down upto -14.4° C in January which is the coldest month but it had also fallen once upto (-) 20° C in the month of February. The normal temperatures below 0 C (freezing point of water) are recorded from the month of November onwards. In severe winter, the cold in Kashmir valley becomes very intense and the Jhelum and the lakes some time freeze. The lowest minimum temperature recorded in the Valley was (-) 20° C witnessed on 6^{th} February,1895.

1.7.5 **HUMIDITY**

1.7.5.1 Jammu region witnesses dry months particularly from March to May . The relative humidity in these months is comparable to that in the plains. The Valley region however records high humidity. The high humidity prevailing in the valley is attributed to its being a closed valley with the existence of a large body of water, such as rivers and lakes. Comparatively high humidity prevails during the morning hours than in the evening hours. In the morning hours during the cold months from October to March, the humidity exceeds 80% during the rest of the year the humidity is comparatively low. In the evening hours during the coldest months from December to March the humidity exceeding 60% prevails and during the remaining months the humidity is comparatively less. Since the humidity is more than 40% throughout the year, there is practically no dry season.

1.8 SEISMICITY

1.8.1 The tectonic movements in the Himalayas has resulted in overlapping of the rocks of different geological periods and is marked by the presence of three major thrusts and faults. Because of the presence of these tectonic lineaments, the area is prone to seismicity.

Bulk of the alignment lies in the seismic zone V. The minor portion of the length between Udhampur - Katra lies in seismic zone IV.

The area has experienced the impact of about 11 major earthquake between 1828 and 1980, besides a number of minor shocks. The most disastrous earthquake in this period occurred on 30.5.1885 in Kashmir Valley which had its epicentre about 20 km west of Srinagar. The Kathua earthquake in 1980 with magnitude 5 in Richter scale rocked the area around Patni top. The whole area lies in seismic Zone V of Seismic zonning map of India (IS : 1893). The important structures will be designed to take care of forces/movements that the structures may be required to with stand.

1.9 POPULATION AND PEOPLE

1.9.1 POPULATION

1.9.1.1 The district wise area and population as available with the State Administration are summarised below:-

District	Area (Sq. km)	Population	Headquarters
Anantnag	3,984	826,291	Anantnag
Badgam	1,371	497,346	Badgam
Baramulla	4,588	826,291	Baramulla

Doda	**11,691**	**497,346**	**Doda**
Jammu	**3,097**	**861,214**	**Jammu**
Kargil	**14,036**	**525,326**	**Kargil**
Kathua	**2,651**	**1,207,996**	**Kathua**
Kupwara	**2,379**	**81,067**	**Kupwara**
Leh	**82,665**	**492,288**	**Leh**
Pulwama	**1,398**	**410,404**	**Pulwama**
Poonch	**1,674**	**89,974**	**Poonch**
Rajouri	**2,630**	**516,441**	**Rajouri**
Srinagar	**2,228**	**250,000**	**Srinagar**
Udhampur	**4,550**	**417,333**	**Udhampur**

1.9.1.2 The alignment from Udhampur - Qazigund covering a length of approximately 167 kms passes through thinly populated area. In fact the alignment beyond Riasi passes through almost virgin land thinly interspersed with villages. Beyond Qazigund which is approached through a long tunnel, the demographic scenario undergoes a vast change and witnesses thickly populated areas.

1.9.1.3 For want of avenues of employment opportunities and adverse climatic conditions, the people are generally poor, but under the various social welfare measures for economic uplift undertaken by the Government, their condition has considerably improved in recent years.

1.9.2 LANGUAGE

1.9.2.1 The Dogri is the language commonly used for Udhampur , Katra and Riasi area of Jammu region whereas "Kashur" or Kashmiri which is the language of the valley is a dialect belonging to the Indo-Aryan group and of Indo-Iranian sub family. It is an ancient Sanskrit tongue of Kashmir which has in the course of centuries received the addition of many foreign words, particularly, from Persian and Arabic. It is rich in folk tales and mythological lore. The history of Kashmir is enshrined in Sanskrit books.

1.10 OCCUPATION

1.10.1 Over the years, the pace of industrialisation in an around Jammu has picked up particularly after extension of the B.G. Link from Pathankot to Jammu. This industrialisation has resulted in an overall prosperity of Jammu region. People around Katra i.e. from Udhampur upto Riasi mostly depend on tourist traffic visiting Vaishno Devi Shrine. Agriculture is also the main stay of a sizeable chunk of the society in this region.

1.10.2 There are a few industries in the valley. Agriculture and horticulture are the main stay of the bulk of the population and almost 80% of the people are engaged in earning their livelihood by toiling on the land. Animal husbandry also has been adopted as a profession by a section of the society. In the hilly regions, where the yield from the crop is very poor large flocks of sheep, goats and ponies are taken to up-land pastures by nomads, Gujjars and others. Good quality wool is woven into cloth which is locally known as 'Puttoo' and the finer variety 'Pashmina' is made use of in shawls. Kashmiris have artistic instincts and are famous for their skill in art manufactures. With bountiful supply of indigenous raw materials, a large number of people are engaged in weaving shawls and carpets, and also wood carving , embroidery manufacture of woollen blankets, willow baskets, leather goods, cricket bats, silver and copper works. Sericulture, spinning and weaving of silk is also practised which dates back from the Mughal times. The cultivation of saffron noted for its yellow dye and excellent food flavouring agent is also an age-old industry in the Valley. Lumbering and timber industries give employment to a large section of the people. Another source of income has for long been the tourist industry. House boats are hired out to the visitors for use on rivers and lakes. Huts and tents are rented to tourists at the holiday and pleasure resorts. Camp equipment suppliers and travelling agents cater for larger trips. All these activities however have suffered a temporary setback due to the insurgency in the State though recently the signs of revival of the economy are distinctly discernible.

1.11 **AGRICULTURE**

1.11.1 The fertility of the Valley region of the alignment far exceeds that in the Jammu region Jammu. Notwithstanding the same, agriculture in the Valley has failed to achieve its potentials due to limited scope for expansion, climatic and other factors and the hard work put in by the farmers has not been able to substantially improve the lot of the farmers. Recently however, with the introduction of high yielding varieties of seeds, the use of fertilisers, adoption of plant protection methods through Govt. subsidies, loans and also provision of additional irrigation facilities, the agricultural production has reached a stage of break through.

1.12 **CROPS AND VEGETAION**

1.12.1 Most of the area in the valley is devoted to the cultivation of food crops noteably paddy and maize. In addition, wheat, barley rap seed, pea and gingili are raised during the spring. Pulses like moong, rajmah, mah and also chillies and potatoes are cultivated on an extensive scale. Saffron is grown on the high table land near Pampore. Kashmir is a country of fruits and due to the impetus given by the State Government for the promotion of horticulture by way of providing loans, plant, material and technical assistance, the area under orchards has registered a many fold increase during the last decade. There are orchards of apples, pears, apricots, cherries, mulburries, poaches, almonds and walnuts. Vegetables are also grown in the valley. 'Kadam' or 'Hak' is widely used vegetable of the people. In recent years, appreciable progress towards increasing the production of mushrooms has also been made.

1.12.2 The plants and trees of the entire area from Udhampur to Baramulla are of economic value for the people and practically every plant and tree is put to some use or the other. Between Udhampur & Katra. Khair trees are found, which are of great economic value. In the valley on the road side there are beautiful avenues of stately poplar trees. Willows grow luxuriantly in every village where there is water and moisture and its leaves are used as sheep fooder during the long winter. The magnificent chinar and mulberry grow every where in the valley.

1.13 **FOREST WEALTH AND WILD LIFE.**

1.13.1 The area between Udhampur to Chenab Crossing and valley has well developed forest resources. Large area are under conifers which are in short supply in the rest of the country. The various type of trees that grow in the valley and which are useful as timber are deodar, spruco, birch, yew, alder, elm, ash and walnut.

1.13.2 Wild life found in the mountain wastes and forests of the area include black and brown bears, markhor, ibex, antelope, gazelle and the snow leopard. Many game birds including vast number of ducks come on migration during the winter.

1.13.3 The hill cattle (cows and buffaloes) are poor in physique and the yield of milk is very low. The Animal Husbandry Department have plans to improve the breed of the cattle and augment the supply of milk and dairy products.

1.14 **PLACES OF INTEREST**

1.14.1 An important Hindu Shrine at 'Vaishno Devi' is situated very near Katra from where the trekking to the Shrine starts. This Shrine is main source of attraction of people all over the country.

Valley, with its lofty snow capped mountains numerous blue lakes, sparkling streams, dark green forests, lush-green meadows and well laid out gardens has been a tourist paradise and a large number of tourists from all over the country are pouring in every year to escape the sweltering heat of summer to spend a holiday. The construction of the proposed railway line is bound to become an added tourist attraction. Some of the places of interest which are worth visiting are briefing described below:

1.14.2 **LAKES**

1.14.2.1 Nature has endowed Kashmir with numerous lakes. Of the lakes - the Wular, the Dal and the Manasbal are the most beautiful owing to the varied scenery of the lofty mountains which surround them.

1.14.2.2 **WULAR**

It is the largest fresh water lake in India measuring about 26 kms x 8 kms. and is almost surrounded by lofty mountains which tower over the north and north-east of the valley. The river Jhelum on its course below Srinagar to Baramulla seeks a passage through it, while three other streams flow directly into this lake. In its north-east corner is a beautiful island converted into a pleasure resort by the Great Kashmir Sultan, Zain-ul-Abdin, who reigned in the 14^{th} century.

1.14.2.3 **MANASBAL LAKE**

It lies on the route to the Wular lake from Srinagar. Though it is comparatively smaller, the charm of Mansbal chiefly lies in its deep clear water. It is laden with lotus during summer. It is also a bird watcher's paradise, being one of the largest nature's haunts of aquatic birds in Kashmir. It has behind it a grand mountain which forms an effective contrast with the gentle beauty of the lake.

1.14.2.4 **DAL LAKE**

It measures about 6 kms by 4 kms. and lies close to Srinagar. There are actually three lakes in one - Garibal, Lokut Dal and Buddal. The mountain ridges which are reflected in its water are grand and varied; the trees, vegetation on its shores and the floating gardens are of exquisite beauty. Connected to a net work of canals and the river of Jhelum, the Dal lake is the main thoroughfare for beat traffic within Srinagar city. Scores of house boats which are floating houses are moored along the banks of the Dal. Dal lake is Srinagar's aquatic plaza - the venders sitting in 'Shikaras' have a variety of wares to sell - vegetables, fruits, shawls, carpets and handicrafts. The beautiful island of Char Chenar and also Nehru park are worth a visit. There is the Muslim shrine of Hazarat Bal on the shores of the Dal in which a relic of the Prophet Mohammed is preserved. Nagin and Anchar lakes are other lakes in Srinagar city. Nagin lake though smaller is a popular avenue for water sports like water skiing, swimming, sailing etc. Shankaracharya's hill on the one side of the lake gives an enchanting view of the busy thoroughfares of Srinagar. Dal and Nagin lakes from its top. A small ancient shrine built with massive stones dedicated to Lord Shiv is perched on the top of this hill. On the other side of the Dal is the hill of Hari parvat with its picturesque fort.

1.14.2.5 **Other lakes**

There are also more than 50 smaller high altitude lakes within about 50 kms distance in the north eastern part of the valley, between Sonmarg and Sindh river valley. These include the famed ones of Vishansar, Kishansar, Gadsar, Gangabal, Mandkol and Satsaran. Tarsar lake is located at the head of the Liddar valley. Apharwat above Gulmarg and Konsanag in the Pir Panjal are other lakes situated in the Valley.

1.14.3 **SPRINGS**

1.14.3.1 The entire State of J&K is rich in springs. Spring water is highly valued for drinking purposes and is also used for cultivating gardens and crops. Water of some of the springs is cold in summer and hot in winter. The water from Chashma -e - Shahi or 'Royal Spring' near Srinagar is credited with medicinal properties and is highly prized for drinking. Verinag at the foot of Banihal pass is another spring of great importance and beauty with its deep blue water. It emanates from the bottom of a mountain spur and is considered as the source of river Jhelum. Achabal also gushes from the bottom of the Sosanwar hill. Anantnag is the place of numerous springs some of which are known to have medicinal properties because of their sulphurous contents. The water of Kokarnag, another spring in the valley is believed to have the finest drinking water which satisfies both thirst and hunger.

1.14.4 **GARDENS**

1.14.4.1 There are a large number of well laid out gardens around lakes and springs in varied locations in the valley since the Mughal times and each garden has its distinctive appeal and beauty. Shalimar Bagh was laid out by Mughal Emperor Jehangir and the magnificient chenar trees form its background. The terraces, black marble pavilions, fountains and cascades erected by the Emperor pleases the visitors. The Nishat Bagh or the "garden of pleasure" which rises from the Dal lake against the background of blue mountains has an inimitable charm. On the eastern edge of Dal is Masim Bagh or the "garden of morning breeze" laid out by Emperor Akbar the Great. There are also beautiful gardens around the springs of Chasma - e - Shahi, Achabal, Kokarnag and Verinag.

1.14.5 **PAHALGAM**

1.14.5.1 This is a sleepy little village of shepherds lying at the head of the Liddar valley, and is one of the most beautiful places in the Kashmir valley. The unspoiled beauty of the landscape with fir blanketed steep mountains and snow fed roaring streams abounding in trout is a unique sight. The pilgrim route to Amarnath via Chandanwari lies beyond Pahalgam.

1.14.6 **ARCHAEOLOGICAL MONUMENTS**

1.14.6.1 The valley is dotted with relics of antiquity. Burzahom situated 24 kms north-east of Srinagar is an archaeological site of the oldest settlers of the valley.

There are a large number of ancient temples some of which have undergone a vast deterioration and in some cases have been reduced to a mere heap of masonry . These temples suffered extensive damage at the close of the 14^{th} century. The temple of Marthand devoted to the Sun God near Anantnag is a precious specimen of ancient art and is a synthesis of Hellenistic and Hindu traditions of temple architecture which can be classed as belonging to a distinct style. It is one of the highest part of the 'Karewa' occupying undoubtedly the best position in Kashmir valley. This noble ruin is the most striking in size. Its solid walls, bold outline towering over fluted pillars of colonnade give it a most imposing appearance. The temples at Awantipora, Pandratan (on the outskirts of Srinagar) Pattan on the Srinagar-Baramulla road which are now in ruins, bear testimony to the artistic genius of Kashmiris.

1.15 EARLIER SURVEYS

1.15.1 Prior to partition, Jammu was connected by rail from Sialkot which was located in the erstwhile North Western Railway. As such, the surveys prior to partition were mostly aimed at the extension of the railway line from Jammu to Akhnur and Srinagar. The construction of the Pathankot-Jammu Rail Link gained importance only after the partition of the country in 1947.

1.15.2 During the past 83 years several surveys were undertaken in the J&K State, which are detailed below:

1.15.2.1 **PRIOR TO PARTITION**

(i) In 1889, Major General Do Bourbel, R.E. conducted the survey for a railway line from Jammu to Akhnur as part of his Punjab-Kashmir Project.

(ii) In 1902, as Advisor to Jammu & Kashmir State, Major General De Bourbal reviewed his earlier alignment on the basis of proposals by Messers. Weightman Adams, Bell and Callaghan and adopted the Gulabgarh route commencing from Jammu and passing through Akhnur, Gulabgarh before touching Srinagar.

(iii) In 1903, Mr. Benslay Thornhill, Chief Engineer of Jammu-Riasi Railway Survey suggested the railway line from Jammu to Akhnur as a part of his Tawi-Talwara Project.

(iv) In 1904 while surveying the extension of the Tawi-Talwara project to Srinagar along Gulabgarh route, Mr. Benslay Thornhill revised his earlier alignment due to the construction new Ranbir canal. The revised alignment from Jammu to Akhnur followed the route of Ranbir canal in comparison to earlier route on the north of the canal..

(v) In 1928, the survey of line from Jammu to Akhnur was again discussed between the Jammu and Kashmir Durbar and North Western Railway Administration as a part of the Jammu-Riasi Railway in view of the recommendations made by Mr. R.R. Simpson, Mining Specialist of Geological Survey of India and Mr. C.S. Middlemis in his Minieral Survey Report of 1904. The matter was, however, dropped and no survey was actually carried out.

(vi) In 1937, Shri Karnail Singh, Engineer-in-charge (who retired as Chairman of Railway Board) conducted the survey from Jammu to Akhnur with the alignment remaining south of Rambir canal. The extension from Jammu Tawi station was proposed to be taken over the road bridge across the Tawi after strengthening the same to M.L. standards. Also, Akhnur station yard was designed as a terminus of Broad Gauge with the idea to connect Riasi by a Narrow Gauge Rail Link. An extension from Akhnur to Mirpur by a Narrow Gauge link was also contemplated.

1.15.2.2 **AFTER PARTITION**

(i) A special Reconnaissance Survey was undertaken in July,1961 for the rail link from Kathua to Jammu and Jammu to Riasi via Akhnur as well as via Negrota, by Sh. S.C. Uppal, Dy. Chief Engineer.

(ii) A Preliminary Engineering Survey from Kathua to Jammu was conducted in January,1962 by Sh. Rai Kartar Singh, Executive Engineer (Survey). Simultaneously with the Preliminary Engineering Survey from Kathua to Jammu, a Reconnaissance Engineedring Survey from Jammu to Riasi was conducted in 1962 with a view to exploiting the mineral resources including coal in the Riasi, Kalakot-Jangal Gali belt.

(iii) In 1964, at the instance of Ministry of Defence, a rail link to Udhampur by taking the alignment behind the first row of hills was investigated. The Engineering appreciation suggested a 53 mile long route from Kathua to Udhampur running behind the Sundrikot Dhar and following the Dhar-Udhampur road. Concurrently, a paper alignment to connect Jammu from a place called Manwal on Kathua-Udhampur route was also examined. The traffic appreciation fro Kathua-Udhampur Rail Link revealed that the line to Udhampur though shorter in length than the road by about 40 miles was not justified on commercial grounds.

(iv) The Final Location Engineering Survey for Kathua-Jammu Rail Link was carried out in 1968 by Sh. N. Gopalan, Executive Engineer (Survey) along the southern alignment recommended in Preliminary Report of 1962 and this line has since been constructed and opened to traffic in 1972.

(v) The Final Location Engineering Survey from Qazigund to Baramulla for MG electrified line was carried out in 1971.

(vi) The Final Location Engineering Survey for Jammu to Udhampur via Manwal was carried out in 1982-83. The work on this line is now progress.

1.15.3 SURVEY METHODOLOGY

1.15.3.1 For completing the survey of the entire alignment expeditiously an innovative technique which is a deviation from the traditional survey methodology adopted by the Railways in yester years. While the earlier technique relied heavily on the field work, the new technique depends as far as possible on the desk job. Broadly speaking the technique may be explained as under:-

1.15.3.2 To start with the paper alignment has been marked on the toposheets as in any conventional survey. Normally the paper alignment thus marked on the toposheet is required to be changed, at times extensively, depending upon the period which elapses between publishing of the toposheets and the actual date when the paper alignment is drawn. The feasibility of the paper alignment was required to be studied in detail through elaborate field visits evolving a number of parties depending upon the extent of the work. Such field visits not only make the survey activity slow but also result in considerable expenditure. In the present instance, a reliance has been put on the satellite imageries of the area in question. The satellite imageries being very recent show clearly the development of the area. Thus it is possible to know the housing cluster and other infrastructure works of the area. Armed with these details, the surveyor is in a position to rectify the paper alignment to a very large extent. The field visits now are made with a much greater confidence to prove the veracity of the desk job already done rather than to find out the feasibility of the paper alignment. This greatly saves the field time. Having successfully completed the exercise of the paper alignment followed by brief visits , the terrain on either side of the paper alignment marked on the toposheet is digitised through the use of any of the softwares available for the purpose. The digitisation of the terrain is accomplished with the use of digitiser and PC wherein the requisite software has been loaded. The process of digitisation does not require high skill and can be done through operator with relatively low skill. The paper alignment which has previously been marked and the digitised terrain now appears on the screen with higher of clarity. This permits the surveyor to fine tune the alignment. The soft ware available in the market permit precise location of the tangent point and also permit experimentation with curves of different radii. Thus the surveyor is able to fit in the flattest curve depending upon the terrain. At locations where the alignment meets rapidly changing contours, the surveyor has made use of stereoscopic aerial photographs to a scale of 1 : 10,000 obtained from Survey of India. The use of aerial photographs has permitted fine tuning of the alignment at such locations. Through the use of this technology, the advantages of repeated field visits to carry out detailed survey on either side of the proposed alignment are obtained without the need of physically visiting the site and carrying out the surveying. The L-section of the proposed alignment can now be drawn to any scale chosen by the operator. The software also permits fine tuning of the river crossings as well. Thus the surveyor is able to locate the alignment at a place found to be technically most suitable. The subsequent steps after digitisation require a high of skill to decide the final alignment.

1.15.3.3 The alignment so decided has been pegged in the field through the use of global positioning system (GPS) and the total station theodolite. The use of GPS for the survey has resulted in considerable saving of time since it does not require felling of trees for clearing the line of sight. Thus the time required for conducting survey went down sharply. Over the years, the technology of GPS has been improving and with the latest instruments which are available sub centimetre accuracy is possible. Successful implementation of this method has resulted in improving the accuracy of the survey work while giving the advantage of shrinking of the time frame. The exact method which has been used is briefly described in the ensuing paragraph.

1.15.4 FIELD WORK

1.15.4.1 The field work was carried out in three phases as follows.

Reconnaissance survey

GPS survey

Alignment survey

Before the GPS survey was carried out , the entire alignment was studied thoroughly and two points on every straight were established in the field. These points served as control points. The objective of the GPS survey was to find out the exact x,y co-ordinates of the control points as also the exact deflection angles between the various straight .

1.15.4.2 During reconnaissance survey, control points of every straight along the proposed routes were visited by the survey team. Along the route, some clearance was made to get the clear line of sight. In case of big obstacle such as big tree or a house some geometrical figures were planned to bypass the obstacle,

1.15.4.3 **GPS SURVEY.**

To keep check on the distance and the directional error alongwith the proposed railway route, a GPS survey was planned. The work was carried out in following four phases.

GPS Session designing
GPS field observation
GPS Data transfer
Net work adjustment

1.15.4.4 **GPS SESSION DESIGNING**

A network of triangles consisting of all terminal points as vertices of the triangle was established. Three vertices (we may call them GPS station also) of each triangle were occupied by GPS receiver 4000SST. The GPS is used in differencial mode. Before starting the GPS field observation, a session was designed with the information as given below,

1. Unique name of the GPS station.
2. Updation of ephemeris date file i.e. file containing instantaneous position of satellite and other information.

3. Latitude and longitude of the place of observation.
4. Duration of time of observation depending on the length of the vector i.e. length of a side of the triangle or as in our case the length of the straight between terminal points.
5. Decision on starting and ending time of observation, depending upon the analysis of the satellite visibility chart, time verses azimuth chart, time verses elevation chart.

These information were fed in the receiver at appropriate prompt and the receiver was ready for the field observation.

1.15.4.5 **GPS FIELD OBSERVATION**

All the three receiver were then taken to the three different GPS station/vertices of a triangle, whose sides are to be measured. The GPS antenna mounted on a tripod was centred and levelled precisely on the GPS station. Receiver was connected with the battery and also with the antenna. The procedure was adopted at all the three GPS station. All the three receivers were put on at the sane tune as decided earlier. The system also prompts for temperature, pressure and antenna height at place of observation, shown in annexure….. Once these values are given at appropriate place the receiver starts logging the data. After desired interval of time i.e one and a half hour observation were stopped. Similar procedure was adopted for all other triangles of the network. With this the GPS field observation part ends.

1.15.4.6 Knowing the exact co-ordinates of the control point on every straight the final task of filling the gaps between the two control points was carried out with the help of Electronic Distance Meter and a theodolite. Since the technology of GPS was used for the first time, a check was also made for the deflection angles between various straights. The actual observations at the site revealed that both the values were in close tandem.

1.15.4.7 Since the accuracy of GPS for the Z co-ordinate has still not been established, the fly levelling as in any conventional survey was done to find out the levels of various points along the alignment.

CHAPTER - II

2.0 GAUGE, LENGTH, GRADES & CURVES

2.1 GAUGE

2.1.1 At present BG direct rail link is available upto Jammu Rly. station. Further construction of BG line from Jammu Railway station. Upto Udhampur is in progress. The JURL project is in an advance stage of completion. The projected Rly. Line from UDM to Baramulla via Katra, Riasi, Qazigund and Srinagar has also been proposed to be constructed as a BG Railway line to serve as a logical extension of JURL Project.

2.2 FIXED POINT

2.2.1 The centre of the Udhampur station yard is taken as the first point of the survey of Udhampur-Baramulla line. The centre of the proposed Baramulla Rly. Station will be the terminal point of the survey.

2.3 LENGTH

2.3.1 The total length of the projected line i.e. from the first point Udhampur station to the terminal point (Baramulla station) is 287 Kms.

2.3.2 The distance from Udhampur station to the centre of station building at Katra is 24.6 Km. and the distance from centre of the Katra station building to centre of Qazigund station is 141.8 Km.

The distance from the centre of the proposed Qazigund station to that of Baramulla is 120 Kms.

2.4 LEVELS

2.4.1 All the levels refer to the mean sea level as the datum. The levels were taken and recorded in metric units with the help of total station theodolite with an accuracy of one second. The standard surveying practice of closing the traverse from the standard G.T.S. bench marks has been followed. Great care was exercised to minimise the changes of error while recording the observations.

2.5 GRADIENT

2.5.1.1 In terms of office letter No.133-W/242/Survey/Pt.II dated 18/2/94, Northern Railway had given three alternatives for the alignment between Udhampur -

Srinagar via Qazigund. In these three alternatives the gradients which had been proposed are as follows:-

Section	Alt. 1	Alt. 2	Alt. 3
Udhampur-Qazigund	1 in 50 (C)	1 in 40 (C)	1 in 100 (C)
Qazigund-Srinagar	1 in 80 (C)	1 in 80 (C)	1 in 100 (C)

2.5.1.1 In all these alternatives the degree of curves between Udhampur - Qazigund and Qazigund - Srinagar had been proposed as 6 and 5 respectively.

2.5.1.2 Board in terms of their letter No.86/W 5/NL/N/25/ J&K dated 29/3/94 conveyed the decision of the Board for selecting the parameters suggested in alternative 2. However later on in terms of their D.O.No. No.86/W2/ NL/N/25/Pt. dated 15/6/95, Board have approved a gradient of 1: 100 (C). Accordingly for the entire alignment between Udhampur - Baramulla a gradient of 1 in 100(C) has been followed.

2.5.1.3 An attempt has been made to confine the gradient in the station yard to 1 in 1000. Because of the undulating terrain, it has not been possible to provide this gradient in Udhampur - Qazigund Section with the sole exception of Katra yard. For the station yards in the Valley, the gradient of 1 in 1000 has been provided on a number of stations. No station yard however is at a gradient steeper in 1 in 400. The ruling gradient has been compensated for the curvature at the rate of 0.04% per degree of curve as per the standard norms. .

2.5.2 The total length of the alignment on ruling grade is 141.475 Km which works out to 49.38% of total length. This was inescapable because of hilly/rough terrain and over-riding consideration of keeping the cost as low as possible. The longest continuous stretch of the ruling grade extends over a length of 12.100 Kms. between Km.120.000 & Km.132.100.

2.5.3 A statement of gradients showing their locations and lengths is attached at Annexure-II/I.

2.6 SAFETY SIDING

2.6.1 Since the ruling gradient adopted is 1 in 100 (C) which is flatter than 1 in 80 as such there is no necessity for providing safety sidings in view of the instructions contained in Rly. Board's letter No.62/W/80/BD/16 dt. 9/5/68.

2.7 CURVES

2.7.1. HORIZONTAL CURVES

2.7.2 The maximum curvature adopted for this section is 2.75 degrees with the exception of the first curve starting from Udhampur yard. Main line of Udhampur yard finishes with a curve. Same curve has been extended beyond Udhampur in Udhampur – Katra section with a degree of 3.5. 2.75 degree curves have been adopted for the project to permit a speed potential of 100 kmph on the curves. All the transition curves will be designed to cater for this speed potential. There are 118 No of curves in whole of the section out of which 91 are 2.75 degree. The total length of the line on curvature is 73.80 Kms, which works out to 25.74% of the total length. The minimum distance between reverse curves is sufficient to accommodate the transition lengths of both the curves and to accommodate a minimum straight of 30m between transition portions of both the curves.

The list of curves proposed alongwith locations a relevant data is attached as Annexure-II/II.

2.8 VERTICAL CURVES

2.8.1 All efforts have been made to avoid abrupt change of grade at short intervals. Vertical curves have been provided in accordance with the para 419 of the P.Way Manual.

CHAPTER - III

3.0 ALTERNATIVE ROUTES

3.1 For deciding the route between Udhampur and Baramulla Qazigund is a compulsory point from where the Valley commences. As such Qazigund becomes an obligatory point for the alignment. Two broad alternatives for reaching Qazigund from Udhampur were studied. As has been discussed in the preceding paragraphs the alignment has to cross the Patni ranges before reaching Banihal. As such there is a choice of skirting the mountain either from the eastern corridor or through western corridor. The national highway NH 1 A skirts the mountain from the eastern side. Initially it had been tried to finalise the alignment through the eastern corridor. This choice however ran into trouble because of steep gradients required particularly near Chenani. The choice of the eastern corridor necessitated a gradient 1 in 40 - a gradient which has been initially envisaged but which would have required construction of catch and slip sidings. These sidings would have necessitated separate tunnels. Provision of separate tunnels for these sidings would have brought up the total cost of construction of the alignment. Moreover, the steeper gradient would have sharply brought down the speed potential of the line because of the need for all trains to stop short of the catch siding. Furthermore the haulage capacity of the trains negotiating such steep gradients would also have been severely limited.

3.2 Another alignment going further on the eastern side than the alignment which has been discussed above has also been studied. This alignment was feasible at a gradient of 1 in 100 (C) but had a serious drawback of the compulsion of reversal of the locomotives at Udhampur. Moreover this alignment was also much longer than the alignment passing through the western corridor and also suffered from the drawback of need for sharper curves.

3.2.1 In short choice of both the eastern corridors for the B.G. alignment would have fallen far short of the aspiration of the people who have a dream of witnessing fast communication between the Valley and rest of the country.

3.2.2 Against this background the western corridor permitted a relatively flatter gradient of 1 in 100(C), provision of flatter curves which permitted speeds upto 100 kmph and which also had the advantage of least percentage of track on curves. This corridor passes via Katra and Salal. The former is an important tourist destination while the latter is important on account of its vicinity to Salal Hydel Project. As such the choice of the western corridor appeared to be a logical choice.

3.3 Salient features of the alternative routes are summarised below:-

SALIENT FEATURES OF THE ALTERNATIVE ROUTES

S.No.	Particulars	1 in 40 (C) grade Eastern Corridor	1 in 100(C) grade Western Corridor	1 in 100(C) grade North Eastern (
1.	LENGH			
	Route	122.59	167.60	198.10
2.	GRADE			
	Ruling Grade	1 in 40 (C)	1 in 100(C)	1 in 100 (C)
	Longest continuous length on Ruling Gradient.	53.80 km	14.90 km	15.80 km
3.	CURVES			
	Max.	6 °	2.75 ° (except take off point which is at 3 °).	6 °

	Total No. of curves	108	84	174
	Length of track in curves in km.	44.06	44.87	60.24
	Percentage of track in curves	35.94%	26.78%	30.41 %
4.	**TUNNELS**			
	Total No.	96	81	112
	Percentage of track in tunnels	71	53.40	50.86
	Longest Tunnel	14.08 km	10.03 km	15.62 kms
	Across Patni range		6.08	10.25
5.	**MAJOR BRIDGES**			
	Total Number	39	69	76
	Length of opening in km	6.163	15.55	9.56
	Bridging in metre per km.	50.27	92.8	48.27
	Longest Bridges	860	1000	768.6
	No. of Cable stayed Bridge	2 No.	1 No.	2 No.

6.	**Stations** **Total No. of stations (excluding UDM).**	**10**	**14**	**16**
7.	**ENGINE REVERSAL AT UDHAMPUR**	**No.**	**No.**	**Yes.**
8.	**IMPORTANT PLACES SERVES**			
	Chaneni **Mehala** **Bagna** **Tabela** **Banihal** **Charil** **Qazigund**	**Painthal** **Katra** **Riasi** **Jyotipuram** **Salal** **Sangalan** **Nachlana** **Banihal** **Charil** **Qazigund**	**Dhanori** **Udhampur Town** **Chenai** **Banihal** **Charil**	

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Plan showing these three routes discussed above are attached as a separate Annexure III/I.

The western corridor finally decided was then studied in detail to optimise the alignment. The decision about the choice of the alignment finally adopted has been taken based on the general considerations discussed in the ensuing paragraph. Description of the final alignment has also been discussed in the subsequent paragraphs. For this purpose, the alignment has been divided in sub sections of suitable length.

3.4 Qazigund - Baramulla Section

3.4.1 In a similar fashion the alignment between Qazgiund - Baramulla was also finalised after studying various routes. The plan showing these routes has been attached as an Annexure III/II. The salient features of these routes are summarised below:-

QAZIGUND - BARAMULLA
SALIENT FEATURES OF ALTERNATIVE ROUTES

Particulars	I	II	Alternative III A	III B	Revised II
Length					
Route Km	123.25	121.35	116.80	112.30	120.15
Grade					
i) Ruling gradient	1 in 100	1 in 100	1 in 100	1 in 100	1 in 100
ii) Length of ruling grade (km).	17.85	13.05	13.87	9.00	13.05
Curve					
i) Max. degree	2.75	2.75	2.75	2.75	2.75
ii) Total No.	32	26	17	17	25
iii) Length of curved track (km)	14.92	13.60	9.47	9.79	14.15
iv) % of track in curves.	12.11	12.23	8.11	8.72	11.75

v) No. of curves > 2°	16	12	4	4	6
vi) Length of curves >2° (m)	9163	7133	1855	1855	3548
Tunnels					
i) Total No.	-	-	-	3	-
ii) Length of tunnels (km)	-	-	1.25	5.71	-
Major Bridges					
i) Total No.	44	32	28	31	32
ii)No. of Bridge across Jhelum	3	1	-	-	1
iii) Waterway (m)	1565	1525	1460	1675	1425
Station					
i) Total No.	15	15	12	12	14
ii) Longest Block section (km)	11.25	12.10	13.6	11.7	12.10
iii) Shortest block section (km)	5.20	4.80	6.5	6.5	4.65
Formation					
Peat/Marshy formation/orchards. (%)	Yes 17.75	Yes 7.83	small stretch 11.15	No 9.13	- 7.83
Land Acquisition					
Orchards & cultivated area	Max.	Very much less than Alt. 1	Minimum	Minimum	Minimum
District served	Anantnag Srinagar Baramulla	Anantnag Srinagar Baramulla	Anantnag Srinagar Baramulla Pulwama Budgam	Anantnag Srinagar Baramulla Pulwama Budgam	Anantnag Srinagar Baramulla
Important places served	Anantnag 5 km	Anantnag 4 km	Anantnag 15.5 km	Anantnag 15.5 km	Anantnag 4 km

Awantipora **1.5 km**	**Awantipora** **3.5 km**	**Awantipora** **18 km**	**Awantipora** **18 km**	**Awantipora** **3.5 km**
Pampore **3 Km**	**Pampore** **1.5 Km**	**Pampore** **9 Km**	**Pampore** **22 Km**	**Pampore** **1.5 Km**
		Kulgam **6 Km**	**Kulgam** **6 Km**	**Kulgam** **17 Km**
		Pulwama **6 Km**	**Pulwama** **3.50 Km**	**Pulwama** **10 km**
		Budgam **1 Km**	**Budgam** **1 Km**	**Budgam** **1 Km**
Srinagar **4 Km**	**Srinagar** **7 Km**	**Srinagar** **7 Km**	**Srinagar** **15 Km**	**Srinagar** **7 Km**
Pattan **0.5 Km**	**Pattan** **1 Km**	**Pattan** **1 Km**	**Pattan** **1 Km**	**Pattan** **1 Km**
Sopore **3 Km**	**Sopore** **3 Km**	**Sopore** **3 Km**	**Sopore** **3 Km**	**Sopore** **3 Km**
Baramulla **4.25 Km**	**Baramulla** **5.25 Km**	**Baramulla** **4.25 Km**	**Baramulla** **4.25 Km**	**Baramulla** **4.25 Km**

3.4.2 Following conclusions emerge from the table above:-

Alt. 1

This alternative has a length of 123.25 km and touches all the important city centres. In fact this was a consideration for this alternative. The alignment has a drawback that river Jhelum has to be crossed thrice. In addition this alignment also passes from important agricultural areas and orchards. This is also the costliest alternative among all the possible routes which had been studied.

Alt. 2

This is an improvement over alternative 1. The total length of the alignment is approximately 120 kms. It involves only one Jhelum crossing and passes close to the city centres. It also has an added advantage that percentage of orchards/marshy lands required to be negotiated is minimum.

Alt.3(a)

Though the total length of this alignment is 116.83 kms. The alignment has a serious drawback in so far as it passes away from most of the city centres and as such will not be of much use to the users. It also requires a tunnel of length 1.25 kms.

Alt3 (b)

This alignment is almost same as 3 (a) except for the detour which has been given to the alignment alternative 3 (a) at Srinagar to bring it closer to the city centre. As such other than Srinagar it passes away from all other city centres.

Considering various merits and demerits of the various proposals, alternative 2 has been finally chosen. The approval of the Railway Board for this alternative has been communicated in terms of their letter No. 86/W2/NL/N/25/Pt. dated 21/3/96.

CHAPTER IV

4.0 DESCRIPTION OF ALIGNMENT

Alignment has been finalised based on the following considerations.

4.1 GENERAL CONSIDERATIONS

4.1.1 The topography and the physical features, the need for selecting suitable sites for stations/yards/road crossings/bridges etc. have considerably influenced the choice of the alignment. Desirability of locating the station sites in close proximity of towns and populated areas to foster their development has also governed the choice of the alignment. Some important factors considered for selecting the route of the proposed alignment are listed below:

(a) Ideal locations for station yards.

(b) Best possible location for river crossing.

(c)Adequate free board for the bridges.

(d) Avoiding acquisition of built up areas and rich agricultural land.

(e) Proper location of road crossing and other accommodation works.

(f) Easiest possible grade & curves.

(g) Minimum length of tunnelling.

(h) Least quantity of earthwork.

(i) Suitability of alignment from geological stand point.

4.1.2 The sites of the stations have been fixed, taking into consideration the length of the block sections, availability of land and its configuration, scope for future expansion, position of grades, curves and nearness to the population to be served.

4.1.3 The locations of the crossings over natural streams and irrigation channels have been fixed to obtain crossings with adequate vertical clearance over the HFL/FSL to the underside of the superstructure. Wherever possible, the gullies and nallah have been proposed to be diverted to reduce the number of bridges. The location of the crossings in close proximity of bends in streams or where scour, erosion and waves are expected, have also been avoided. However, with a view to avoiding the need for introduction of unnecessary curves in long stretches on approaches to small bridges, some skew bridges have also been proposed.

4.2 DETAILED DESCRIPTION OF THE FINAL ALIGNMENT

4.2.1 Optimisation of the alignment from Km.0.00 to Km.30.00

For arriving at the final alignment, three alternatives have been studied within the selected corridors. The features of these three alternatives are discussed hereunder:

(a) **Examination of the alternatives**.

i) Base alignment

ii) Apex 5 shifted by 100m South and running parallel to Base alignment upto Apex 7 and thereafter joining at Apex 8 of base alignment.

iii) Apex 5 shifted west of Birhun Khad and Apex 7 shifted west of apex 6 of base alignment.

(b) The quantity of earthwork, the length of tunnels and major bridges upto 27.3 Km. for the three alternatives are tabulated below:

Particulars	Alt. (i)	Alt. (ii)	Alt. (iii)
Earthwork in cutting (lakhs cum)	23.34	21.81	23.34
Earthwork in filling (lakhs cum)	10.46	18.72	16.06
Length of tunnels (m)	11,200	10,400	10,815
Length of major Bridges (m)	1866	1820	1983
Details of Aquisition of inhabited areas	Firing range at Km.5.3, stadium at km.6.8, structures at Chakarawaha yard, fishery farm at km. 21 & structures in Katra yard.	Firing range at Km.5.3, stadium at km.6.8, structures at Chakarawaha yard, fishery farm at km. 21 & structures in Katra yard.	Avoids generally built up areas.

(d) Alternative (iii) has been considered the best alignment in view of the following advantages.

i) Overall cost is less.

ii) The general L section is superior.

iii) Yards at Chakarawaha and Katra are better located with minimum earthwork and bridging.

iv) Yards at Chakarawaha and Katra avoid acquisition of too many built up structures.

v) Exit from Katra yard is better.

(e) In view of the above, alternative (iii) has been chosen as the optimized final alignment.

4.2.2 DESCRIPTION OF THE FINAL ALIGNMENT BETWEEN KM 0 TO 30

4.2.2.1 The centre of Udhampur station building is taken as the 'Zero Point'. The existing yard at Udhampur in a grade of Km.1.175 which is 57m away from existing TP-2 of 3.5° curve in the yard.

4.2.2.2 The alignment swings to the left at Km.1.272 with a curve of 3.5°_ and deflection angle of 66° - 33'-40" to skirt the soft hill. It passes along the existing road from Km.1.850 to 2.050 which requires to be diverted.

4.2.2.3 At Km. 2.095, it takes a turn to the left with a curve of 2.75° and deflection angle of 43° - 22'-22". The alignment enters a long tunnel No.1 at Km.2.040 having a length of 3194 m. The provision of a tunnel at this location is inescapable as rapidly rising ground with a very large width extending on both sides of the alignment has been encountered. However, commencement of the tunnel has been proposed at a location where the depth of cutting increases 20 M. This location however has undergone a slight change with a view to construct portal at a location found to be technically feasible by geologist of M/s.NHPC.

4.2.2.4 Emerging from the tunnel at Km.5.234, the alignment runs straight for 2168m. It crosses Birhun Khad at Km.6.150 is then deflected through a small right hand curve of 2° with a deflection angle of 10° - 02'-56".

4.2.2.5 At Km.6.667 the alignment enters Tunnel No.2 having a length of 1625m. Emerging from the tunnel at Km.8.302, it enters Chakarawaha station yard.

4.2.2.6 After leaving the yard, it is deflected at Km.12,314 through a left hand curve of 1 with a deflection angle of 5° - 19'-37" to avoid the inhabited areas.

4.2.2.7 The alignment enters tunnel No. 3 at Km. 12.190 having a length of 2523 m thereafter it crosses Dudhar Khad at Km. 14.775 before entering tunnel No.4 at Km. 14.904 having a length of 1308m.

4.2.2.8 The alignment is on a long straight from Km.12.477 to Km.17.169 before it swings to the right through a 2.75° curve and deflection angle of 40° - 20'-12". It passes through 2 small tunnels viz. 862 m long tunnel No.5 at Km. 16.985 and 163m long tunnel No. 6 at Km.19.679.

4.2.2.9 The alignment is on a long straight from Km.17.617 to 23.256. it crosses Jhajjar Nalah at Km. 20.50 which is in a deep gorge. Thereafter it crosses Sugal Khad at Km.21.450.

4.2.2.10 A left hand curve of 2.75° with a deflection angle of 56° - 47'-06" is introduced at Km.23.256. Before negotiating the curve the alignment enters tunnel No.7 at Km.23.146 having a length of 358m.

4.2.2.11 The alignment then enters Katra yard at Km.24.000. The site for the yard has been so chosen as to avoid acquisition of built up areas and to provide for adequate expansion of the yard at a future date. The yard is also conveniently accessible from Katra township.

4.2.2.12 At Km. 24.829, the alignment swings to the right with a curve of 2.75° and deflection angle of 86° - 32' -57".

The higher ground is negotiated busy tunnel No.8 at Km. 25.758 having a length of 563m.

4.2.2.13 Banganga river is crossed at Km. 26.650 before the alignment enters tunnel No.9 at Km. 27.181 having a length of 477m and tunnel No.10 at Km.28.137. the alignment runs in a long straight from Km. 25.790 to Km.30.817.

4.2.3 OPTIMISATION OF ALIGNMENT FROM KM. 30.00 TO KM.50.00

4.2.3.1 In this stretch, the optimization had to be done taking into account the following obligatory features. Consequently the options were limited:

4.2.3.2 Emerging from km 30 at an elevation of 770 m, the alignment has to cross Anji Khad having a bed level of 590m at a suitable location to avoid provision of a bridge of unmanageable span.

4.2.3.3 A suitable yard near km 40 is to be provided for connecting Riasi and for avoiding extra long block section.

4.2.3.4 Bridge across the Chenab has to be located in such a way that a convenient cable stayed bridge can be constructed. Also the formation at the bridge is to be kept at about 840 m, so that it is possible to rise progressively to reach Qazigund at an elevation of 1730m.

4.2.3.5 The following three alternatives were accordingly examined in the stretch of alignment.

4.2.3.6 i) Keeping Apex 10 as same and shifting the alignment by 100m right and parallel to the base alignment from Apex 11 to Apex 16.

ii) Keeping Apex 10 as same and shifting alignment by 100m left and parallel to base alignment from Apex 11 to Apex 16.

iii) Base alignment.

4.2.3.7 The quantity of earthwork, the length of tunnels and major bridges of the three alternatives are tabulated below:

Particulars	Alt. (i)	Alt. (ii)	Alt. (iii)
Earthwork in cutting (lakhs cum)	2.03	1.73	4.29
Earthwork in filling (lakhs cum)	4.02	4.15	9.13
Length of the	15516	12432	13699

tunnels (m)			
Length of major bridges (m)	**3056**	**5679**	**2689**
Constraints	**Block section between Katra & Salal is 23.2 km.**	**Block section between Katra & Salal is 23.2 km.**	**Nil**

4.2.3.8 Alternative (iii) has been considered as the best alignment in view of the following advantages.

i) The general L section is superior
ii) Overall cost is less
iii) Maximum block section is 15.3 km.
iv) Riasi station is better located.

4.2.3.9 In view of the above, alternative (iii) has been chosen as optimized final alignment.

4.2.4 DESCRIPTION OF ALIGNMENT FROM KM 30 TO KM 50

4.2.4.1 The long straight from Km.25.790 is deflected to the right at km.30.704 with a curve of 2° and deflection angle of 15°- 15'-09" . Pie Khad is crossed at Km.Km.31,075 and the alignment enters tunnel No.11 at Km. 31.248 having a length of 5091 m, this is the second longest tunnel in this segment from Km30 to Km.50.

4.2.4.2 A right hand curve of 2 degrees with deflection angle of 13° - 25'-59" is introduced at Km. 31.468 to follow the ground features.

4.2.4.3 After exit from Tunnel No. 11, the alignment swings to the left at Km. 36.41 with a curve of 2.75 degree and a deflection angle of a 49° - 31'-06" before crossing Anji Khad at Km.36.545.

4.2.4.4 At Km. 36.735, the alignment is deflected to the left through a curve of 2.75 degrees and deflection angle of 80° - 08'-57" before entering tunnels No.12 & 13 at Km. 37.026 and Km.37.631 having a length of 575m and 748m respectively.

4.2.4.5 The alignment passes through ' Tunnel No.13 at Km. 37.631 having a length of 740m. Thereafter the alignment swings to the right at Km.38.141 with a curve of 2 degree and deflection angle of 40° - 24'-41" before entering tunnel No.14 at Km.38.818 having a length of 416m.

4.2.4.6 A right hand curve of 1.55° with a deflection angle of 49° - 15'-55" in introduced at Km. 39.348 before entering

RIASI yard. After crossing the deep nallah at Km. 40.625 the alignment enters tunnel No.15 at Km.41.129 having a length of 6.056 km, which is the longest in this segment.

4.2.4.7 Keeping the topography of country the alignment is deflected to the right at Km. 41.997 through a curve of 2.5 degrees and deflection angle of 64°_ - 46'-5" and again swing to the left at Km. 46.675 through a 2° curve with a deflection angle of 89° - 49'-25".

4.2.4.8 Salal road station yard is provided from Km.47.30 to Km.48.50. The alignment then crosses the Chenab River at Km. 49.100 by a cable stayed bridge of 850m module, since the bed level to formation is 383m. The alignment runs on a straight upto Km.49.734, where a right hand curve of 2.75 degrees and deflection angle of 122° - 05'-18" is introduced.

4.2.5 <u>OPTIMISATION OF ALIGNMENT FROM KM 50 TO KM 100:</u>

4.2.5.1 In this stretch, the optimisation has to be done taking into account the following obligatory features:

4.2.5.2 Emerging from Chenab at Km.49.10 with a formation level of 840m, the alignment has to be taken on a rising gradient progressively to reach Qazigund at an elevation of 1730m.

4.2.5.3 Proper crossing of Talsuen Khad at Km. 77.85 and nallah at km 68.85 and Chainj Nalah at Km 99.70 at suitable locations, so as to provide bridges of manageable span.

4.2.5.4 Provision of suitable yard near km.94.70 for connecting Sangaldan and provision of intermediate yards to avoid long block section.

4.2.5.5 The following three alternatives were accordingly examined in the stretch from Km. 50 to Km.100.

i) Keeping Apex 18 & 47 as same and shifting the alignment by 25m right and parallel to the base alignment from Apex 19 to Apex 46.

ii) Keeping Apex 18 & 47 as same and shifting alignment by 25m left and parallel to base alignment from Apex 19 to Apex 46.

iii) Base alignment with considerable improvements.

4.2.5.6 The quantity of earthwork, the length of tunnels and major bridges of the three alternatives are tabulated below:

Particulars	**Alt. (i)**	**Alt. (ii)**	**Alt. (iii)**
Earthwork in cutting (lakhs cum)	**14.25**	**18.11**	**19.09**
Earthwork in filling (lakhs cum)	**25.27**	**18.29**	**22.90**
Length of the tunnels (m)	**29,724**	**35,984**	**31,984**
Length of major bridges (m)	**8928**	**4,394**	**5,723**
Approx.Cost of the above works (Rs. Crores)	**380**	**388**	**369**

4.2.5.7 A comparison of the salient features of the three alternatives will reveal the following:

In Alternative (i), the tunnelling involved is the least amongst the three alternatives. However a large number of major bridges has to be provided across the nallahs and khads. Also as the alignment is taken on the down stream, provision of many viaducts has become necessary. Consequently bridging of about 8928 metres is involved in this alternative.

In Alternative (ii), the earthwork in cutting and filling is optimised. Also as the alignment is taken on the upstream, minimum number of bridges will have to be provided. However this alternative will involve maximum length of tunnelling (35,984m). Consequently this alignment becomes the costliest of the three alternatives.

Alternative (iii) strikes a balance in the provision of tunnels and bridges. The overall cost is also the lowest amongst the alternative. Besides the longitudinal section is better, allowing adequate provision for siting future station sites.

4.2.5.8 Alternative (iii) has therefore been considered as the best alignment in view of the following advantages.

i) The general L section is superior

ii) Overall cost is less

iii) Sangaldan station site is better located.

4.2.5.9 In view of the above, alternative (iii) has been chosen as the optimized final alignment.

4.2.6 DESCRIPTION OF THE FINAL ALIGNMENT BETWEEN KM 50 TO KM 100

4.2.6.1 Curve No.18 which is continued from Km. 50 passes through tunnel No.16 at Km.50.186 having a length of 1816m. The alignment is thereafter deflected to the right at Km.51.557 with a curve of 2.75° and deflection angle of 66° - 30'-6". After crossing the nallah at Km.52.135, the alignment enters Tunnel No. 17 at Km.52.262 having a length of 916m.

4.2.6.2 A left curve of 2.75° with a deflection angle of 128° - 26'-24" is introduced at Km. 52.837. The alignment passes through Tunnel No.18 and 19 at Km. 53.421 and Km.54.340 having a length of 675m and 458m respectively. Thereafter the alignment takes a detour to cross Dhansal Nallah at a convenient location.

4.2.6.3 At Km. 55.317, the alignment is deflected to the right through a curve of 2.75° and deflection angle of 99° - 37'-8". It enters Tunnel No.20 at Km. 55.322 having a length of 386m. After crossing Dhansal Nallah at Km.56.080 the alignment passes through Tunnel No.21 at Km. 56.266 having a length of 2.172 Km.

4.2.6.4 The alignment has to take a reverse curve at Km.57.950 with a 2.75° left hand curve followed by a right hand curve of 2.75° at Km. 58.521, where it enters Tunnel No.22 at Km.58.883 having a length of 2.492 km. This is the second longest tunnel in this segment.

4.2.6.5 Thereafter, the alignment is running parallel to the right bank of the Chenab for a considerable distance. At Km. 61.789 the alignment is deflected to the right through a curve of 2.75° and deflection angle of 29° - 40'-4" and enters Surukot station at Km. 61.800.

4.2.6.6 Two left hand curves of 2.75 degrees are introduced at Km. 62.287 and Km.62.927, before the alignment enters tunnel No.23 at Km. 63.018 having a length of 378m. it is deflected to the right at Km. 63.850 through a curve of 2.75 degrees and a deflection angle of 48° - 41'-31". Thereafter the alignment is taken straight for about 4.50 km.

4.2.6.7 The alignment passes through two tunnels No.24 and 25 at Km. 64.246 and Km.64.464 having a length of 136m and 1669m respectively before crossing Masil Khad at Km. 66.225.

4.2.6.8 The bridge across Sawal Khad, at Km.68.425 is preceded a followed by Tunnel No.26 & 27 at Km. 66.309 and Km.68.594 having a length of 1845m and 2194m respectively. The alignment swings to the left at Km.69.825 with a curve of 1° and deflection angle of 37° - 8'-49". It enters Tunnel No. 28 at Km. 71.355 having a length of 1291m.

4.2.6.9 The alignment passes through three tunnel No. 29m 30 and 31 at Km. 71.722, Km.72.260 and Km.73.898 having a length of 271m, 1414m and 246m respectively. It is deflected to the right at Km. 73.942 through tunnel No.32 at Km. 74.759. This is a the longest tunnel on the segment from Km. 50 to Km. 100 having a length of 3.004 km

4.2.6.10 At Km. 75.008, the alignment is deflected to the left through a curve of 2.75° and deflection angle of 35° - 42'-47". It is followed by 2° right hand curves of 2.75degrees each at Km. 76.482 and Km.77.639 before crossing Taslsuen Khad at Km. 77.850.

4.2.6.11 The alignment enters Tunnel No. 33 & 34 at Km. 78.018 and Km.79.430 having a length of 696m and 457m respectively. Thereafter, it runs parallel to the right bank of the Chenab for a considerable distance. A left hand curve of 2.75° with a deflection angle of 42° - 9'-21" is introduced at Km.79.562, before it enters Tunnel No.35 at Km.80.462 having a length of 397m.

4.2.6.12 Two left hand curves of 2.75 degrees each are introduced at Km. 81.701 and 83.395 before the alignment enters tunnels No. 36 & 37 at Km. 83.840 and Km.84.819 having a length of 638m and 891m respectively.

4.2.6.13 At Km.85.534, the alignment is deflected to the right through a curve of 2.75 degrees and deflection angle of 34° - 54' before it enters Tunnel No.38 at Km. 86.054 having a length of 779m. It runs straight upto Km.87.351 where a left hand curve of 2.5° with deflection angle of 149° - 17'-34" is introduced.

4.2.6.14 The alignment enters through two tunnels No.39 and 40 at Km. 87.426 and Km.89.088 having a length of 797m and 755m respectively. It negotiates a right hand curve of 1° and deflection angle of 18° - 44'-29" at Km. 89,642 before entering Tunnel No.41 at Km.90.306 having a length of 885m.

4.2.6.15 A left hand curve of 1° with a deflection angle of 21° - 53'-23" is introduced at Km. 90.678 before encountering three tunnels No. 42, 43 and 44 at Km.91.343, Km.91.858 and Km.92.571 having a length of 74m, 283m and 306m respectively.

4.2.6.16 The alignment is deflected to the right at Km. 92.588 with a curve of 2.75° and deflection angle of 66° - 00'-33" before entering Tunnel No.45 at Km. 93.323 having a length of 671m. At Km.93.736, the alignment swings to the left through a curve of 2.75 degrees and deflection angle of 39° -56'-04" before reaching Sangaldan.

4.2.6.17 The station yard at Sangaldan is provided from Km.94.100 to Km. 95.300. A right hand curve of 2.75 degrees with a deflection angle of 29° - 49'-31" is introduced near the end of the yard at Km. 94.904 before entering Tunnel No.46 at Km. 95.447 having a length of 1536m.

4.2.6.18 The alignment thereafter follows the topography of the country and the appropriate contours in order to cross Chainj Nallah on the upstream at a convenient location. Consequently two curves of 2.75degrees each are introduced at Km.95.636 and Km.96.919 before entering Tunnel No.47 at Km. 97.292 having a length of 2321m. The alignment runs on a straight upto Km. 98.763 where a right hand curves of 2.75° and deflection angle of 117° - 58'-58" is introduced to cross Chainj Nalah at Km.99.70. After exist from the bridge, the alignment enters Tunnel No. 48 at Km. 99.765 which continues beyond Km. 100.

4.2.7 OPTIMISATION OF ALIGNMENT FROM KM 100 TO KM 168:

4.2.7.1 In this stretch, the optimisation has to be effected taking into account the following obligatory features:

Emerging from the bridge across the Chainj Nalah at Km.99.70 with a formation level of 1273m, the alignment has to be taken on a rising gradient progressively to reach Qazigund at an elevation of 1730m.

4.2.7.2 Proper crossing of Karalgali Nalah at Km 101.93, Anchah Nalah at Km.114.11, Dasa Nalah at Km.114.97, Dohal Nalah at Km.126.95, Badarkot Nalah at Km.128.51, Mohu Mavgot Nalah at Km. 134.87 and Bichlari river at Km. 151.113 at suitable locations, so as to provide bridges of manageable span.

4.2.7.3 Provision of suitable yards at Nachlana, Arpinchla, Charil and Qazigund towns and provision of other intermediate yards to avoid long block sections.

Crossing of the high mountain range of Pir Panjal with an elevation of 4550 m by a tunnel of manageable length.

Restricting the formation level suitably to avoid crossing the snow line at RL 1750m.

Bye passing the landslide zone near village Draman at Km. 125.126 and taking the alignment through a tunnel in this reach to have a stable formation.

4.2.7.4 In a corridor of 150 metres on either side of the base alignment, possible alternative alignments were examined with the help of DTM model. The base alignment was also considerably refined. Three feasible alternative were examined in each of the following stretches:

- Km. 100 to Km. 120
- Km.120 to Km. 140
- Km.140 to Km. 168

Consideration of the alternatives and choosing of the best alignment in the above stretches are covered in the ensuing paragraphs.

4.3 <u>OPTIMISATION OF ALIGNMENT FROM KM 100 TO KM 168:</u>

4.3.1 In this stretch, the optimisation has to be effected taking into account the following obligatory features:

4.3.1.1 Emerging from the bridge across the Chainj Nallah at Km.99.70 with a formation level of 1273m, the alignment has to be taken on a rising gradient progressively to reach Qazigund at an elevation of 1730m.

4.3.1.2 Proper crossing of Karalgali Nalah at Km 101.93, Anchah Nalah at Km.114.11, Dasa Nalah at Km.114.97, Dohal Nalah at Km.126.95, Badarkot Nalah at Km.128.51, Mohu Mavgot Nalah at Km. 134.87 and Bichlari river at Km. 151.113 at suitable locations, so as to provide bridges of manageable span.

4.3.1.3 Provision of suitable yards at Nachlana, Arpinchla, Charil and Qazigund towns and provision of other intermediate yards to avoid long block sections.

4.3.1.4 Crossing of the high mountain range of Pir Panjal with an elevation of 4550 m by a tunnel of manageable length.

4.3.1.5 Restricting the formation level suitably to avoid crossing the snow line at RL 1750m.

4.3.1.6 Bye passing the landslide zone near village Draman at Km. 125.126 and taking the alignment through a tunnel in this reach to have a stable formation.

The description of alignment in this stretch of 68 kms is discussed below.

4.4 **Description of alignment from Km.100 to Km.120**

4.4.1 The long straight from Km. 100.07 is deflected to the right at Km. 102.520 with a curve of 2.75degrees and deflection angle of 88° - 27'-03". After crossing the Karalgali nallah at Km. 101.930, the alignment enters tunnel No.49 at Km. 101.953 having a length of 1685m.

4.4.2 A left hand curve of 2.75° with deflection angle of 35° - 35'-54" is introduced at Km. 103.351. The alignment passes through Tunnel No.50 & 51 at Km. 104.037 and Km.104.616 having a length of 127m and 277m respectively. Thereafter, the alignment runs parallel to Chainj nalah upto Km. 109.

4.4.3 At Km. 104.736, the alignment is deflected to the left through a curve of 2 degrees and deflection angle of 17° -53'-50" and enters Kohli station yard. The alignment has to take a reverse curve at Km. 105.655 with a 2° left hand curve followed by a right hand curve of 2.75 degrees at Km. 106.110. After having the station yard, it enters Tunnel No.52 at Km. 106.643 having a length of 867m.

4.4.4 The alignment has to take a reverse curve at Km. 106.751 with a 2.75° left hand curve followed by a right hand curve of 2° at Km. 107.610, where it enters Tunnel No.53 at Km. 107.945 having a length of 1022m.

4.4.5 At Km. 108.541, a right hand curve of 2° is introduced followed by a left hand U curve of 2.75° to follow the contours and to negotiate the viaduct. It enters Tunnels No. 54 & 55 at Km. 109.359 and Km.110.994 having a length of 1331m and 472m respectively.

4.4.6 The alignment is deflected to the right at Km.111.448 through a curve of 2.75° and deflection angle of 51° - 21'-41". After crossing a deep Nalah, it enters Tunnel No.56 at Km. 111.875 having a length of 616m.

4.4.7 A left hand curve of 2.75° is introduced at Km. 112.451 having a deflection angle of 65° - 06'-21" before the alignment enters Tunnel No.57 at Km. 112.965 having a length of 1007m.

4.4.8 In order to cross Anchah Nalah and Dasa Nalah at suitable locations, the alignment has to take a U turn from Km. 113.559 with two right hand curves of 2.75°, having a common tangent point. It enters Tunnel No. 58 and 59 at

Km. 114.318 and 115.080 having a length of 447m and 1426m respectively.

4.4.9 The alignment then runs parallel to Sumbar Nallah. Three curves are introduced at Km. 116.468, Km.117.150 and Km.117.548, before the alignment enters Tunnel No.60 at Km. 117.656 having a length of 560m.

4.4.10 Emerging from Tunnel No.60, the alignment enters LAOLE station yard at Km. 118.250. A left hand curve of 2.75° with deflection angle of 119° - 18'-04" is introduced at Km. 118.699, to follow the contours, before it passes through Tunnel No.61 at Km. 119.389 having a length of 522m.

4.5 Description of alignment from Km. 120 to Km.140

4.5.1 In this reach, the alignment follows the right bank of Bichlari river for about 10 Km. upto Km. 130.

4.5.2 Consequently, the alignment swings to the right at Km. 120.330 with a curve of 2.75° and deflection angle of 29° - 27'-04", before it enters Tunnel No. 62 at Km. 120.443 having a length of 1199m.

4.5.3 At Km.121.055, the alignment is deflected to the left through a curve of 2.75° and deflection angle of 87° - 22'-22". It enters Tunnel No.63 at Km. 121.954 having a length of 1047m. Thereafter, it is deflected to the right at KM.122.391 through a curve of 2.75° and deflection angle of 83° -55'-08". This also bye passes the land slide Zone near Village Draman.

4.5.4 The alignment passes through two short Tunnel No. 64 & 65 at Km. 123.314 and Km.123.929 having a length of 332m and 2859m respectively. It is then deflected to the left at Km. 126.357 through a 2.75° curve and deflection angle of 67° - 35'-09".

4.5.6 After crossing Dohal Nalah Km. 126.950, the alignment enters Tunnel No.66 at Km.127.077 saving a length of 1311m. Thereafter it crosses Badarkot Nalah at Km. 128.510 before entering Tunnel No.67 at Km. 128.609 having a length of 797m.

4.5.7 At Km. 129.043, the alignment is deflected to the right through a curve of 2.75°_ and deflection angle of 61° - 25'-54". Thereafter it takes detour to cross Mohu Mangat Nallah at a proper location by following the right bank of this nallah upto Km.134.80.

4.5.8 The alignment enters Tunnel No.68 at Km. 129.751 having a length of 457m. A left hand curve of 2.75° with a deflection angle of 32° - 34'-57" is introduced at Km. 130 before it enters Tunnel No.69 at Km. 131.251 having a length of 272m..

4.5.9 At Km. 131.330, the alignment takes a turn to the left through a curve of 2.75° and deflection angle of 76° - 48'-48" before entering Nachlana station yard in Km.132.100. A right hand curve of 2° with a deflection angle of 25° - 47'-30" is introduced at Km. 132.935.

4.5.10 The alignment enters two small tunnels No. 70 & 71 at Km. 133.377 and Km. 133.973, having length of 466m and 715m respectively before crossing Mohu Mangat Nalah at Km. 134.870.

4.5.11 The alignment takes a U turn to the right at Km. 134.199 by two curves of 2.75° with a common tangent point. Thereafter it follows the left blank of Mohu Mangast Nalah upto Km. 139.50.

4.5.12 The alignment enters Tunnel No.72 at Km. 135.024. This is the longest tunnel in this 20 km. segment having a length of 2588m.

4.5.13 The alignment negotiations a left hand curve of 2.75° at Km. 137.396 with a deflection angle of 24° - 16'-37" before entering Arpinchla station at Km. 138. The station yard extends from Km. 138 to 139.20.

4.5.14 At KM.138.516, the alignment is deflected to the right through a curve of 2.75° with a deflection angle of 31° - 58'-46" before it enters Tunnel No.73 at Km. 139.267 having a length of 710m. Thereafter it negotiates a left hand curve of 2.33° and deflection angle of 89° - 23'-11" at Km. 139.507.

4.6 <u>Description of alignment from Km. 140 to Km. 168.</u>

4.6.1 In this stretch, the alignment runs parallel to the right of the Bichlari river for about 11 Km. upto 151. Consequently, it follows the topography of the country and the appropriate contours.

4.6.2 The alignment negotiates three left hand curves at Km. 141.245, Km. 141.945 and Km.143.419 before entering tunnel No.74 at Km. 143.824 saving a length of 150m.

4.6.3 At Km. 144.084, alignment is deflected to the right through a curve of 2.75° and deflection angle of 37° - 50'-20" before it enters Tunnel No.75 at Km. 145.175 having a length of 144m. The alignment then swing to the right at Km. 145.324 with a curve of 2° and deflection angle of 28° - 13'-56".

4.6.4 The alignment passes through Tunnel No.76 at Km.145.549 having a length of 1066m. It is then deflected to the left at Km.146.166 through a 2° curve and deflection angle of 56° - 59'-20" before entering Banihal station yard at Km.147.00,

4.6.5 The alignment negotiates a 2° left hand curve at Km.148.188 having a deflection angle of 1° - 07'-05" before entering two short tunnels No. 77 & 78 at Km. 148.213 and Km.149.409 having lengths of 851m and 594m respectively.

4.6.6 At Km. 149.581, the alignment is deflected to the right through a curve of 2.75° and deflection angle of 81° - 15'-`12" before crossing Bichlari river at Km. 151.113. It then negotiates a left hand curve of 2.75°° at Km. 151.162 having deflection angle of 67° - 04'-22".

4.6.7 The alignment passes through Tunnel No.79 at Km. 151.749 having a length of 274m. It is then deflected to the right at Km. 153.475 through a curve having a deflection angle of 23° - 44'-24"

4.6.8 The alignment enters the longest Tunnel No.80 across the Pir Panjal range at Km. 153.756 having a length of 10.08 km. It is then deflected to the left at Km. 163.198 by a 2° curve and deflection angle of 54° - 56'-01"

4.6.9 After crossing Walnar Nar at Km. 166.475, the alignment enters Quazigund station yard at Km. 166.60.

4.6.10 The stretch beyond Qazigund traverses the Valley which is relatively a flat land. The survey methodology adopted for this survey is more or less on the lines of the conventional surveys since lay of the land permitted fast job even with conventional techniques. However the use of total station theodolite was made to accelerate the job. For describing the alignment in the Valley, zero was reckoned from centre line of Qazigund station building.

4.7 OPTIMISATION OF ALIGNMENT FROM KM. 0 TO KM.40:

4.7.1 In this stretch, the optimisation has to be effected, taking into account following obligatory features:

4.7.2 After leaving Qazigund yard at an elevation of 1731m, the alignment has to be taken on a falling gradient progressively to reach the valley at an elevation of 1600m.

4.7.3 Siting of the bridge across the Jhelum River near Km. 2.600 at a suitable location.

4.74 Proper crossing of Sandran River at Km. 9.40, Sandran nadi at Km.15.95. Vishwa nadi at Km.26.150 and Rambhiara Nadi at Km.28.25.

4.7.5 Provision of suitable yards at Sadura, Anantnag and Panjgam to avoid long block sections.

4.7.6 The following alternative alignments were examined with the help of DTM model. The base alignment was also considerably refined based on the features as reflected in the aerial photographs:

i) Improved base alignment

ii) Shifting the alignment on to the left by 100m and running parallel to the improved base alignment as mentioned at (i) above.

iii) Shifting the alignment on to the right of 100m and running parallel to the improved base alignment as mentioned at (i) above.

4.7.7 The quantity of earthwork, the length of major bridges and other details of the alternatives are tabulated below:

Particulars	Alt. (i)	Alt. (ii)	Alt. (iii)
Earthwork in cutting (lakhs cum)	**0.43**	**0.23**	**0.49**
Earthwork in filling (lakhs cum)	**52,62**	**51.60**	**50.48**
Length of major bridges (meters)	**701**	**1019**	**1505**

4.7.8 A comparison of the salient features of the alternatives will reveal that the quantum of earthwork involved in Alternative (i) is higher. However, the extent of bridging is the least in Alternative (i). Thus the cost of bridges involved in Alternative (ii) and Alternative (iii) greatly outweighs the advantage of the saving in earthwork. Also the river crossings and station sites are better located in Alternative (i). Keeping all technical aspects into consideration, Alternative (i) has been chosen as the optimised final alignment.

4.8 OPTIMISATION OF ALIGNMENT FROM KM. 40 TO KM.80:

4.8.1 In this stretch, the optimisation has to be effected, taking into account following obligatory features:

4.8.2 Keeping the alignment from Km.40 to Km.59 away from the flooding zone to the extent possible.

4.8.3 Siting of the bridge across the Roushmi River near Km.46.10 and Dudhganga river at Km.65.10 at a suitable location.

4.8.4 Siting of the yards at Pampur and Srinagar to suit the requirement of the State Government.

4.8.5 Provision of suitable yards at Kakapor and Badgam to avoid long block sections.

4.8.6 Locating the alignment clear of the marshy and swampy areas and avoiding acquisition of heavily built up areas.

4.8.7 The following alternative alignments were examined with the help of DTM model. The base alignment was also considerably refined based on the features as reflected in the aerial photographs:

i) Improved base alignment

ii) Shifting the alignment on to the left by 100m and running parallel to the improved base alignment as mentioned at (i) above.

iii) Shifting the alignment on to the right of 100m and running parallel to the improved base alignment as mentioned at (i) above.

4.8.8 The quantity of earthwork, the length of major bridges and other details of the alternatives are tabulated below:

Particulars	Alt. (i)	Alt. (ii)	Alt. (iii)
Earthwork in cutting (lakhs cum)	0.25	0.22	01.39
Earthwork in filling (lakhs cum)	27.51	28.41	24.67
Length of major bridges (meters)	282	282	282
Acquisition of built-up areas	Minimal	Considerable	Considerable
Alignment falling in marshy area	none	Inescapable	Inescapable

4.8.9 A comparison of the salient features of the alternatives will reveal that the quantum of earthwork and bridging involved in all the three alternatives are not significantly different. However heavy acquisition of built up areas and orchards are involved in alternatives (ii) and (iii). Also, the alignment falls in marshy and swampy areas in these two alternatives. Alternative (i) does not have these disadvantages. Also the alignment from Km. 42 to Km. 64 as per alternative (i) has the approval of the State Government. Besides, the river crossings and station sites are better located in Alternative (i). Keeping all technical aspects into consideration, Alternative (i) has been chosen as the optimized final alignment.

4.9 OPTIMISATION OF ALIGNMENT FROM KM. 80 TO KM.119.1:

4.9.1 In this stretch, the optimisation has to be effected, taking into account following obligatory features:

4.9.2 Near Watalpur Bandapur village, the alignment has to pass through a narrow land strip between the foot of hills on the left and swamps on the right.

4.9.3 There are three large tributaries of Jhelum River, namely Suknag, Firozpur I and Firozpuir II, which have to be crossed between Km.84 and 93. The alignment should achieve good, normal crossings without resorting to provision of long or sharp curves.

4.9.4 There are a few but rich orchards and heavily built up areas beyond Km 97 on one side and marshy banks of Halgam Jhil on the other. The alignment should avoid both to the maximum.

4.9.5 Beyond Km. 108 the alignment is required to skirt high ground features. There are also extensive, rich orchards which have to be avoided to the maximum and at the same time keeping the alignment on high ground between Jhelum River and the foot of hills.

4.9.6 The following alternative alignments were examined with the help of DTM model. The base alignment was also considerably refined based on the features as reflected in the aerial photographs to the extent made available:

i) Improved base alignment

ii) Shifting the alignment on to the left by 100m and running parallel to the improved base alignment as mentioned at (i) above.

iii) Shifting the alignment on to the right of 100m and running parallel to the improved base alignment as mentioned at (i) above.

4.9.7 The quantity of earthwork, the length of major bridges and other details of the alternatives are tabulated below:

Particulars	Alt. (i)	Alt. (ii)	Alt. (iii)
Earthwork in cutting (cum)	5,304.36	155,062.94	119,100,00
Earthwork in filling (cum)	942,452.08	588,830.34	1202,661.00
Length of major bridges (meters)	500.2	500.2	500.2
Acquisition of built-up areas	Minimal	Considerable	Considerable
Alignment falling in marshy area	none	Inescapable	Inescapable

4.9.8 A comparison of the salient features of the alternatives will reveal that the quantum of earthwork and bridging involved in all the three alternatives are not significantly different. However acquisition of built up areas and orchards is minimal in alternatives(i). Also, the alignment in alternative (i) does not falls in marshy and swampy areas . Keeping all technical aspects into consideration, Alternative (I) has been chosen as the optimized final alignment.

4.10 <u>Description of the alignment from Km.0 to Km. 40</u> (QAZIGUND - BARAMULLA)

4.10.1 In this stretch of 40 kms. there are only 8 curves and the longest straight is about 9 kms. The curves are introduced mainly to provide better river crossings and avoid built up areas.

4.10.2 After leaving Qazigund yard, the alignment is deflected to the right at Km. 1.535 by a 2.75° curve with the deflection angle of 85° 38'-15" for providing a proper crossings across the Jhelum River.

4.10.3 Jhelum is crossed at Km. 2.60 and the National Highway at Km.3.10. A left hand curve of 2.75° is introduced at Km. 3.043 having a deflection angle of 59° - 43'-48" and the alignment runs parallel to the National Highway.

4.10.4 At Km.6.031, the alignment has to take a reverse curve with a 2° right hand curve followed by 2° left hand curve after crossing of Sandran River at Km. 9.45. A station yard is provided at Sadura at Km.10.900.

4.10.5 After leaving Sadura yard, the alignment runs parallel to bring river for about four kms. In this stretch, the railway line is taken between Bring river and Sandran river to follow the ridge line. The alignment is deflected to the left at Km. 13.808 through a curve of 0.50° and deflection angle of 10° -23'-55".

4.10.6 Thereafter, the alignment runs in a long straight for about 9 kms. Sandran river is again crossed at Km. 15.95 by a suitable bridge. In the stretch between Km. 16 and Km.26, the alignment is taken between Vishwa Nadi and the Jhelum River to follow the ridge line. Anantnag station is provided at Km. 19.80. A left hand curve of 1° and deflection angle of 8° - 36'-01" is introduced at Km. 23.46 and the alignment runs in a long straight for about 7 kms.

4.10.7 After crossing Vishwa Nadi and Rambhiara Nadi by suitable bridges, the alignment is deflected to the right at Km. 30.786 through a curve of 2.75° and deflection angle of 34° -39'-30".

4.10.8 From Km. 28 to Km. 59, the alignment is taken on the left of the Jhelum River for about 31 kms. and kept away from the flooding zone to the extent possible. Panjgam station is provided at Km. 32.40. After leaving the station yard, the alignment is deflected at Km. 33.091 to the left through a curve of 2° and deflection angle of 51° - 07'-31". Thereafter, it runs in a long straight for about 6.70 kms.

4.11 Description of alignment from Km. 40 to Km.80

4.11.1 In this stretch of 40 kms, there are 13 curves and the longest straight is about 7 kms. The curves are introduced mainly to provide better river crossings and avoid built up areas.

4.11.2 The alignment after negotiating curve No.8 at Km.33.87 runs in aling straight for about 6.70 kms. The alignment upto Km.59 is taken on the left of the Jhelum river and kept away from the flooding zone to the extent possible.

4.11.3 At Km. 40.676, the alignment is deflected to the right by 3.75° curve with a deflection angle of 25° - 37'-43" in order to avoid the orchards on the left and marshy area on the right.

4.11.4 A left hand curve of 2° is introduced at Km. 43.984 having a deflection angle of 35° - 02'-41". Roushmi river is crossed at Km. 46.10 by a suitable bridge.

4.11.5 The alignment is then deflected to the right at Km. 48.116 through a curve of 1° and deflection angle of 22° - 52'-19".

A station yard is provided at Km. 49.60 close to Kakapor town.

4.11.6 After leaving Kakapor yard, the alignment swing to the right at Km. 52.436 by a 2° curve and deflection angle of 39° - 11'-05".

4.11.7 Pampur station is located at Km.54.80 close to the feeder road connecting the road bridge across the Jhelum. On exit from Pampur, the alignment is deflected to the left at Km.55.951 through a curve of 1° and deflection angle of 82° - 06'-56" to be farther away from the Jhelum.

4.11.8 Thereafter, the alignment up to Km.65 is kept south of the National Highway Bye-pass.

4.11.9 The location of Pampur and Srinagar station yard as also the entry and exit from the yard have been fixed to suit the requirements of the state Govt. and site conditions and in consultation with the railway officials during visit to the site in Dec.96. The alignment in this stretch has also been finalised in consultation with Chief Town Planner of J&K State.

4.11.10 At Km. 59.978 a left hand curve of 1° is introduced having a deflection angle of 8° - 13'-29" before Srinagar station yard at Km.61.10.

4.11.11 Two left hand curves of 1° and 2.75° are introduced at Km. 63.210 and Km. 65.03 respectively before crossing Dudhganga river by a suitable bridge.

4.11.12 Thereafter, the alignment has to negotiate three curves in order to avoid heavily built up areas and to run in the narrow vacant strip between Asthanpur village on the right and Begh Mahtabju on the left.

4.11.13 From Km. 68, the alignment is located on the left of Nambai-I-Nirakur marshy ground and swampy area. The alignment is deflected to the right at Km.69.572 by a 1° curve with deflection angle of 14° - 46'-6".

4.11.14 Badgam station is provided at Km. 71.950 at a convenient location to have an easy access to the township. A left hand curve of 1° is introduced at Km. 73.419 having a deflection angle of 12° - 55'-54". Thereafter, the alignment runs in a long straight for about 7.84 kms.

4.12 Description of alignment from Km. 80 to Km. 120

4.12.1 In this stretch of 39 kms, there are 10 curves and the longest straight is about 10.5 kms. between Pattan and Sopore stations. The curves are introduced mainly to provide better river crossings and avoid built up areas, heavy cut and fill.

4.12.2 The alignment after negotiating curve No.22 at Km. 81.99 and keeping Watalpur Bandapur village on right runs in a long straight of about 2.65 km. between the foot of hill and the swamp at Rajwian Sher station.

4.12.3 There are four short curves between Km.84.648 and 92.508 of 1 to 2.75 0 in order to have proper crossings for Suknag (Km.85.41) and Firozpur 1 (Km.88.3) and Firozpur II (Km.91.46) and for avoiding built up areas at Kanyihom.

4.12.4 The alignment runs straight from Km. 92.069 to 92.203 through Pattan station. It also crosses NH-1A at Km.93.100 by a suitable bridge.

4.12.5 The alignment is deflected at Km. 97.203 to the left by a curve of 1° for providing a proper crossing of Gund Ara Nallah, keeping Palhatan village on left. The alignment then runs straight for about 10.5 km. in gentle grades, minimising length through orchard areas. Proper crossings have been achieved on Bolgan Nadi and Babal Kol and at the same time Halgam Jhil is avoided, while passing through Hamre station.

4.12.6 Between Km. 108.477 and 114.692 the alignment is deflected to the left by three short 1° to 2.75° curves through 51° -09'-59", 30° - 38'-44" and 28° - 51'-38" deflection angles, skirting high ground and extensive orchards areas.

4.12.7 Before approaching Baramulla, the alignment deflects at Km.116.889 to the right by a 2.75° curve through 64° - 47'-23" deflection angle, keeping NG-1A on the left, for a convenient site for Baramulla station.

4.12.8 Baramulla station is located just after crossing the channel (Km.118.400) with the terminal dead end at Km. 119.100. The station is located between the NH-1A and Jhelum River, about 3 km. short of the Baramulla town. An existing feeder road provides a convenient road approach form NH-1A.

CHAPTER – V

ENVIRONMENT IMPACT ASSESSMENT STUDY

5.0 GENERAL

The environment impact assessment studies have been conducted for the entire project by the environment experts and detailed EIA report has been submitted by them. Salient features of the report are highlighted below:

5.1 METEROLOGY

5.1.1 Extreme variations in climate is observed in project area. Owing to its location and topography from the Alpine (Ladakh region0 to the sub-tropical (Jammu), the temperature in the region varies spatially. Mean monthly temperature is lowest in January and highest in July except in Jammu where the highest temperature is experienced in June.

Jammu reflects a humid sub-tropical climate with average monthly temperatures ranging between 13 degee C (January) to 33 degree C (June). Temperature decreases from 24 degree C at Srinagar (1600m) to -10 degree C at an elevation of 3600m at Pir Panjal.

Precipitation in the region is both in the form of rain and snow. Average rainfall is about 675 mm in

Kashmir valley and 1150 mm in Jammu region. Monsoon generally approaches the region in the 1st week of July and lasts till September. November is the driest month with less than 1.0 cm of precipitation.

5.1.2 High relative humidity, cloudy skies, fog, mist and the winter climate in most of Kashmir. The snowfall ranges higher incidence of snow are the common characteristics of from 20 to 30 cm at Srinagar and 80-90 cm at Sonmarg. It is more on Pir Panjal ranges and decreases rapidly eastwards. Meteorological conditions of the area are summarised below.

METEROLOGICAL CONDITIONS IN J & K

	JAMMU			SRINAGAR		
Months	Mean Temp (oC)	Humidity (%)	Rainfall (mm)	Mean Temp (oc)	Humidity (%)	Rainfall (mm)
January	13.3	68	71.3	4.4	88	72.8
February	15.8	64	59.4	7.0	87	72.3
March	20.6	55	57.0	8.5	84	64.1
April	26.8	42	25.2	13.3	77	-
May	32.4	32	17.0	17.9	71	63.4
June	34.0	41	60.9	21.7	75	-
July	30.7	71	320.7	24.6	73	61.0
August	29.1	81	319.1	23.9	79	62.8

Sept.	28.6	71	150.8	20.5	77	31.8
Oct.	25.4	57	29.5	14.15	82	28.7
Nov.	19.8	48	7.9	7.7	85	17.5
Dec.	15.2	64	29.5	4.2	88	35.9
Total	24.3	58	1148.3	14.0	80	510.3

5.2 WATER RESOURCES

5.2.1 The railway corridor passes through two major river system namely Chenab and Jhelum.

5.2.1.1 Chenab originates from southern side of Pir Panjal range and flow through Jammu district and enters Pakistan, beyond Akhnoor. It is not suitable for boat traffic because of steep gradients, but the section is used for transporting logs from the forest area, upstream. J&K has a hydro-power potential of about 10,000 MW of which only 2% has been harnessed so far.

5.2.1.2 Jhelum, originates from Verinag spring at foothills of Pir Panjal range, joins the Wular lake and takes a westward direction in Baramula district and later enters Pakistan. This river is navigable for about 200 kms between Khanabal and Baramula.

5.3 WATER QUALITY

5.3.1 In order to assess the water quality, samples were collected from Jhelum and Chenab rivers and lake Hokarsar. The collected samples were analysed for physical and chemical parameters as per standard methods. The results so obtained are summarised in table below.

SURFACE WATER QUALITY OF THE STUDY AREA

Parameters	Limits for drinking Water (IS 10500)		Jhelum Pampura	Hokarsur Lake	Jhelum Sringar	Chenab (Quazigund)
	Desirable	Permissible				
Colour (Hazen)	5	10	Colourless	Colourless	Colourless	Colourless
Odour	-	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
PH Value	6.5-8.5	-	8.3	8.35	8.35	8.40
Taste	Agreeable	-	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity (HTU)	5	10	18	9	6	4
TDS (Mg/1)	500	2000	170	164	174	176
Total Hardness (mg/1)	300	600	132	130	137	140
Calcium (mg/1)	75	200	36.81	36.59	38.00	38.50
Total Alkalinity (mg/1)	200	600	108	112	116	112
Chlorides (mg/1)	250	1000	16	18	16	14
Sulphates (mg./1)	200	400	24	16	20	24
Iron (mg/1)	0.3	1.0	0.28	0.20	0.14	0.10
Aluminium (mg./1)	0.03	0.02	0.04	0.06	0.04	0.06
Coliforms (count per 100 ml)	0	0	0	0	0	0

Coper (mg/l)	0.05	1.5	M.D.	M.D.	M.D.	M.D.
Manganese (mg/l)	0.1	0.3	M.D.	M.D.	M.D.	M.D.
Nitrate (mg/l)	45	100	1.06	1.13	1.31	1.06
Fluride (mg/l)	1	1.5	0.04	0.08	0.08	0.04
Phenolic Compounds (mg/l)	0.001	0.002	M.D.	M.D.	M.D.	M.D.
Mercury (mg/l)	0.001	-	M.D.	M.D.	M.D.	M.D.
Cadmium (mg/l)	0.01	-	M.D.	M.D.	M.D.	M.D.
Arsenic (mg/l)	0.05	-	M.D.	M.D.	M.D.	M.D.
Cyanides (mg/l)	0.5	-	M.D.	M.D.	M.D.	M.D.
Lead (mg/l)	0.05	-	M.D.	M.D.	M.D.	M.D.
Chromium (mg./l)	0.05	-	M.D.	M.D	M.D.	M.D.
Detergents (mg/l)	0.2	1.0	M.D.	M.D.	M.D.	M.D.
Boron (mg/l)	1	5	M.D.	M.D.	M.D.	M.D.
Zinc (mg/l)	5	15	0.12	0.05	0.05	0.03

5.4 VEGETATION

5.4.1 Forest vegetation is one of the important resources of J&K. It is spread over an area of 27,360 km2 and accounts for about 20% of the total geographical area of the State inside the line of control. More than 99% of forest area is confined to the province of Jammu & Kashmir with largest area of 5,848 km2 in Doda District. The area under different type of forests are as follows:

Coniferous (Pine)	19,236 km2
Non-coniferous	946 km2
Fir	3,355 km2
Kail	1,874 km2
Chir	1,773 km2
Deodar	1,122 km2

In addition to above forests, social forestry scheme was launched during 1982-83. As a part of this scheme it is envisaged to cover 4400 hectares of land with 110 million plants under social forestry.

5.4.2 The vegetation varies from ever green conifers at high altitude on gentler slopes to Himalayan meadows in rocky areas. Scrub jungle is observed on foot hills and deciduous forest in the lower areas. Kashmir valley is most 'thickly forested where districts of Baramula and Anantnag have 71% and

60% of their area under forest respectively. Conifer forests account for about 70% of forest area. The main vegetation species observed in the area are:

Chinar,
Poplar,
Deodar,
Fir,
Pine,
Kail,
Partal,
Mulbery and
Walnut

5.5 **FISH AND FISHERIES**

5.5.1 Jammu & Kashmir is known for lakes, rivers and streams. More than 36 species of fish are found in the valley. Wular lake which is near the project area is an important habitat for fish fauna. It accounts 60% production of the fish of Kashmir valley. The dominant fish species found in the lake are : Cyprinus carpio var, communis, Cyprinus carpio Var, specularis, Barbus conchonius, Gambusia affinis, Nemacheilus sp., Crossocheilus latius, Schizothorax curvifrons, S. esocinus, S. planifrons, S. micropogon, S. longipinus, and S. niger. The lake has a good potential for fish production. Trout of Kashmir is famous.

About 10,015 tonnes of fish production is estimated during a year in J&K. About 6,000 fishermen are engaged in fisheries activities. Out of which 1,200 are working in Wular lake.

5.6 **LAND USE**

5.6.1 Land use maps were super imposed on project layout. Built up area which includes urban and rural settlements, occupy about 6% of study area. Two types of forests namely dense forest and open forest, forms the majority of the area. Low lands are mainly found in valley hills near river courses. It is not possible at this stage to divide the agriculture lands into different cropping patterns. Grassy land on hills forms the major portion of land use. The length of alignment passing through different type of land use are reported in table below.

PROJECT LENGTH IN DIFFERENT LANDUSE

S.No.	Type of land use	Length (km)
1.	Dense Forest	15.25
2.	Open Forest	58.50
3.	Farm Land	12.50
4.	Scrubs	0.50
5.	Water Bodies	18.22

6.	Grass Lands/Barren Land	185.03
	Total	290.00

A 10 Km Corridor on either side for analysis of impact has been prepared. The land use in the corridor has been computed and summarised in the table below.

LAND USE IN PROJECT CORRIDOR

S.No.	Type of land use	Area in Ha.	Percentage
1.	Built up land	348.0	6.0
2.	Dense Forest	800.4	13.8
3.	Open Forest	1155.6	18.2
4.	Farm land	274.8	4.6
5.	Scrubs	23.2	0.4
6.	Water Bodies	116.0	2.0
7.	Grass Lands/Barren	3190.0	55.0
	Total	5800.0	100.0

From this table, it could be concluded that 55% of the area is grass land and about 32% of the area is forest land 2% of the corridor is covered with water bodies such as lakes and rivers.

5.7 AIR QUALITY

5.7.1 In order to assess the existing air quality in the study area, a sampling network was designed. In all 6 sampling stations were established. These stations were Katra, Banihal, Baramula, Qazigund, Srinagar and Udhampur. The parameters selected were monitored for:

Suspended Particulate Matter,

Sulphur dioxide, and

Nitrogen Oxides.

The high volume sampler (HVS) in combination with gaseous adjustment, was used for collection of samples. The maximum concentration of SPM was observed at Katra village being 127 ug/m3 and minimum at Banihal. This variation is due to the influence of urban development. The table on the next page shows the details.

AMBIENT AIR QUALITY DATA FOR SPM (8 HOURLY)

Location	Date	6.00 AM to 2.00 PM	2.00 PM to 10.00 PM	10.00 PM to 6.00 AM
Katra	28.02.96	127	119	90
	02.03.96	122	114	100
Udhampur	03.03.96	78	67	52
	04.03.96	71	61	51
Banihal	05.05.96	37	28	21
	06.03.96	39	31	18
Qazigund	07.03.96	115	108	92
	08.03.96	109	101	91
Srinagar	09.03.96	98	85	67
	10.03.96	103	93	75
Baramulla	12.03.96	106	97	73
	13.03.96	103	93	70

SULPHUR DIOXIDE CONCENTRATION

The concentration through out the corridor is lower than 6 ug/m3 except in Srinagar and Udhampur site where it has been monitored between 6 to 9 ug/m3. The table on the next page depicts the position in detail.

AMBIENT AIR QUALITY DATA FOR SO2 (8 HOURLY)

Ug/m3

Location	Date	6.00 AM to 2.00 PM	2.00 P.M. to 10.00 PM	10.00 PM to 6.00 PM
Katra	28.02.96 02.03.96	< 6	< 6	< 6
Udhampur	03.03.96 04.03.96	7.36 9.80	6.11 6.50	< 6 < 6
Banihal	05.05.96 06.03.96	< 6 <6	<6 <6	<6 <6
Qazigund	07.03.96 08.03.96	<6 <6	<6 <6	<6 <6
Srinagar	09.03.96 10.03.96	9.00 8.50	7.30 <6	<6 <6
Baramulla	12.03.96 13.03.96	<6 <6	<6 <6	<6 <6

NITROGEN OXIDES CONCENTRATION

The nitrogen oxides concentration are more in Srinagar and Udhampur being 22-61 ug/m3 while at other sites it has been observed lower than 22 ug/m3. The table given below gives the details.

AMBIENT AIR QUALITY DATA FOR NOx (8 HOURLY)

Ug/m3

Location	Date	6.00 AM to 2.00 PM	2.00 P.M. to 10.00 PM	10.00 PM to 6.00 PM
Katra	28.02.96 02.03.96	20.00 22.00	17.00 16.00	14.00 13.00
Udhampur	03.03.96 04.03.96	61.20 58.30	53.30 51.70	43.70 40.80
Banihal	05.05.96 06.03.96	16.47 12.31	14.35 10.81	12.37 5.71
Qazigund	07.03.96 08.03.96	32.34 25.26	28.34 21.70	22.80 18.50
Srinagar	09.03.96 10.03.96	45.80 41.30	38.30 36.46	30.35 22.43
Baramulla	12.03.96 13.03.96	9.18 11.23	7.51 8,34	8.53 6.59

The above concentrations have been compared with the Standards available in Environmental Protection Act (1986) has indicated that levels are well within the limits. Attached table gives the details.

AMBIENT AIR QUALITY STANDARDS

S.No.	Category of Area	Concentrations in ug/m3			
		SPM	SO2	Nox	CO
1.	Industrial and Mixed use	500	120	120	5000
2.	Residential and Rural	200	80	80	2000
3.	Sensitive	100	30	30	1000

IMPACT DUE TO PROJECT CONSTRUCTION

5.8 IMPACT DUE TO PROJECT CONSTRUCTION

5.8.1 POSITIVE IMPACT

Potential impact that are likely to result from the proposed railway project, have been quantified. This section deals with positive impacts of the project. The introduction of this project will yield benefits from non-tangible parameters such as saving due to vehicle operating costs and socio-economic benefits of travel time, better accessibility, better comfort and quality of life. However, all benefits cannot be evaluated in financial terms due to non-availability of accepted norms. Positive impacts have been listed under the following headings:

- Employment opportunities,

- Enhancement of rural economy,

- Mobility

- Quick service and safety,

- Traffic congestion reduction,

- Less fuel consumption,

- Reduction in air pollution and

- Carbon-di-oxide reduction

5.9 EMPLOYMENT OPPORUNITIES

5.9.1 Depending upon the availability of funds the project is likely to be completed in a period of 09 to 10 years. During this period manpower will be needed to take part in various project activities. About 10,000 persons are likely to work during peak period of activity. The total input will be about 0.6 to 0.7 million man months. In post-construction phase about 1,000 people will be employed for operation and maintenance of the system. Thus, the project would provide substantial direct employment equal to above number. In addition to these more people would be indirectly employed for allied activities.

5.10 ENCHANCEMENT OF RURAL ECONOMY

5.10.1 The project will connect Udhampur to Baramula via Srinagar. This will facilitate the rural population to move from one end of the State to another end to bring and sell their produce. The proposed transport facility will facilitate rural population to move quickly towards urban centres and return therefrom. With the development of project, it is likely that more people will be involved in trade, commerce and allied services.

5.11 QUICK SERVICE AND SAFETY

5.11.1 The optimised network is estimated to carry 14,979 persons per day leaving present trips to be carried by the buses in the year 2015. The passenger time saved will be about 30%.

Project will provide improved safety and lower the number of accidental deaths. The accidental death risk involved may still be about 172 person per year per million. This figure is lower than United States being 200 persons per year per million.

5.12 TRAFFIC CONGESTION REDUCTION

5.12.1 To meet the forecast transport demand in the year 2015, it is estimated that the number of buses will have to be at least ten times. During this period personalised vehicles may grow twenty five times. Together, they will compound the existing problems of congestion and delay. The proposed project will reduce journey time.

5.13 LESS FUEL CONSUMPTION

5.13.1 On implementation of the project, it is estimated that both petrol and diesel consumption will be getting reduced. The saving will be due to two factors namely,

- reduction in vehicles and

- decongestion on roads

It is observed that a passenger train consumes about 5.32 litres of diesel per 1,000 tonnes Km and goods train 2.56 litres per 1000 tonnes Km. The passenger train will have 18 coaches of 720 tonnes and goods train of 1,525 tonnes. It is estimated that about 24,419 litres of diesel will be consumed in ultimate year per day by railway.

It is assumed that heavy vehicles and cars/taxis will travel about 200 km per day while others about 40 km per day. Based on these, it is estimated that 1,03,575 litres of diesel and 2,986 litres of petrol per day will be saved due to the implementation of the project.

This means that 44% of diesel and 14% of petrol is likely to be saved due to the implementation of project. This will directly benefit in foreign exchange to the tune of Rs.360 million per year.

5.14 LESS AIR POLLUTION

5.14.1 Based on available data, an attempt has been made to predict the emissions with and without proposed project. The present and future fuel consumption have been multiplied by emission factor to work out emissions of different pollutants.

FUEL CONSUMPTION (2015)

Vehicle	No./ Day		Km./Litre	Fuel consumption/day in litres	
	With project	Without project		Without project	With project
Taxi / Car	736	840	9.0	18,667	16,336
Buses	1270	1706	3.5	97,542	72,571
Tankers/Trucks	640	2443	3.5	139,600	36,571
Others	2429	27678	20.0	5,536	4,856
Rail	-	-	-	-	24,419
Total	5074	7758	9.0	261,345	154,772

About 21,217 and 24,203 litres per day of Petrol and 133,567 and 237,142 litres per day of diesel are likely to be consumed every day between Udhampur and Baramula with and without project respectively in ultimate year i.e. 2015.

The concentration of pollutants in the vehicles exhaust varies with the type of engine namely spark ignition (petrol) or compression ignition (diesel engine); two stroke or four stroke and also mode of engine operation.

The attached table gives the emission factors of various major pollutants from petrol and diesel engines.

EXHAUST EMISSION FACTORS (Kg/1000 Litres)

Pollutants	Exhaust Emission Petrol	Factor diesel
Particulate Matter	1.9	18.7
Sulphur di-oxide	1.5	6.8
Oxides of Nitrogen	19.2	37.7
Carbon Mono-oxides	391.0	10.2
Hydro carbon	34.0	23.1

5.15 CARBON DIOXIDE REDUCTION

5.15.1 About 4,337 tonnes per year of carbon monoxide will be emitted in 2015. The corresponding carbondioxide emissions will be 6,815 tonnes in 2015 per year. However the CO_2 emission with the project will be only 6,146 tonnes/year in 2015. Hence the CO2 reduction due to project is estimated as 670 tonnes in ultimate year. The cumulative reduction in CO2 will be about 0.21 million tonnes in the life time of project (70 years). However with more share of rail trips and improvements in fuel efficiency and energy use efficiency in transport sectors, the cumulative CO2 reduction could be about 0.42 million tonnes. This means that the project will also be beneficial at global level.

EMISSION OF AIR POLLUTANTS WITH AND WITHOUT PROJECT IN YEAR (2015)

(Tonnes/Year)

Parameter	Without Project	With Project
Particulate Matter	1,635.4	926.4
Sulphur Di-oxide	601.8	343.1
Nitrogen Oxides	3,432.0	1,986.6
Carbon Mono Oxide	4,337.0	3,910.9
Hydro Carbons	1,426.2	1,389.5
Total	11,432.4	8,556.5

5.16 NEGATIVE IMPACT DUE TO PROJECT

5.16.1 During this phase, those impact which are likely to take place due to the lay out of the project, have been assessed. These impacts are:

- displacement of people,
- change of land use,
- loss of trees/forests,
- drainage problems, and
- risk due to earthquakes

5.16.2 CHANGE OF LAND USE

Land is proposed to be acquired for construction of the single line only. The alignment from Udhampur to Quazigund mainly passes through forest and scattered agriculture land. For the portion of the alignment between

Quazigund to Baramulla, acquisition of agriculture land has become inevitable since the width of the valley is narrow and most of the land is agriculture land. However efforts have been made to plan the alignment from waste land as far as possible. Near Srinagar the alignment passes through the flood plains of Jhelum since the high land in that area has already been inhabited. Because of the land acquisition for the Railway project, the land use of the area is likely to under go a change. Under the present study, project layout maps were superimposed on land use maps to find out the change in land use. Land likely to be lost due to the construction of railway lines, yards and other developments have been quantified and is summarised in the attached table.

LAND LIKELY TO BE UTILISED FOR THE PROJECT

S.No.	Corridor	Land required (ha.)
1.	Udhampur – Qazigund	748
2.	Qazigund – Baramulla	1381
	Total	2129

The land falling in different category likely to be utilised for the project is documented in ensuing table.

UTILISTATION OF LAND

S.No.	Land use	Area in ha		Total
		Udhampur – Qazigujnd	Qazigund – Baramulla	
1.	Dense Forest	53.0	6.0	59.0
2.	Open Forest	98.9	44.0	142.9
3.	Agriculture / Orchards	328.0	502.0	830.0
4.	Grass/Scrubs / Barren	190.2	807.8	998.0
5.	Water bodies	77.7	21.4	99.1
	Total	747.8	1381.2	2129.0

The tunnel having a length of 90.0 km has been excluded as it is not likely to effect present land use. About 360 ha and 402 ha will be utilised for stations between Udhampur-Qazigund and Qazigund-Baramulla sections respectively. Details on station land use are shown below.

LAND USE OF PROPOSED RAILWAY STATIONS

S.No	Name of station	Location Km.	Land use
A.	UDHAMPUR & QAZIGUND		
1.	Chakarwah	9.450	Sparsely cultivated
2.	Future Painthal halt	21.850	-do-
3.	Katra	24.500	-do-
4.	Raisi Road	39.550	Forest
5.	Salal Road	47.500	Sparsely cultivated
6.	Suru Kot	61.800	-do-
7.	IND	77.900	-do-
8.	Sangaldan	92.150	-do-
9.	Kohli	105.400	(Partly cult. & forest)
10.	Laole	118.500	Sparsely cultivated
11.	Nachlana	131.600	Partly cult. & forest
12.	Arpinchla	139.00	Sparsely cultivated
13.	Charil	153.200	-do-
14.	Qazigund	167.575	-do-
B.	QAZIGUND & BARAMULLA		
1.	Vesu	7.46	Barren & sparsely cultivated
2.	Khanabal	15.50	Sparsely cultivated and orchard
3.	Bijbehara	23.40	Barren and sparsely

			cultivated
4.	Kaichikkot	30.05	-do-
5.	Awantipore	37.60	-do-
6.	Letpora	46.50	Partly cultivated and partly orchard
7.	Pampore town	52.40	Cultivated
8.	Pampore	56.88	-do-
9.	Natipore	65.35	Parlty cultivated and partly orchard
10.	Srinagar	73.645	Barren and sparsely cultivated
11.	Zainakot	80.10	-do-
12.	Miragund	87.875	Sparsely cultivated and partly orchard
13.	Pattan	97.70	Barren and sparsely cultivated
14.	Hamari	104.95	Partly cultivated and partly orchard
15.	Sopore	114.50	Cultivated
16.	Baramula	122.35	Partly orchard, partly barren and sparsely cultivated

Out of this land about 9.5% is forest, 39.0% agriculture/orchards, 4.6% water bodies and 46.9% grass/scrubs barren lands.

5.16.3 LOSS OF FORESTS

The proposed railway line will pass through dense and open forests. About 59 ha of dense forest and 143 ha of open forests are likely to be lost due to the project. It is assumed that there will be about 1000 tree per ha in dense forest and about 250 trees/ha in open forests. The tree bio mass likely to be lost and cost involved are reported in the attached table.

LOSS OF FOREST

Loss of Trees (Nos.)	95,750
Av. Cost of Tree (Rs.)	7,000
Total cost (Rs. Million)	670

There will be no encroachment on nature reserves.

5.16.4 DRAINAGE PROBLEMS

The railway line is mostly planned to run along the side of hills. The alignment will cross two major river systems namely Chenab and Jhelum. The drainage problems likely to develop will be of two types:

- Surface drainage, and

- Underground drainage

In all about 137 km of length is in embankment and 48 km in cutting. Hence about 185 km of length is subject to some changes in drainage pattern. In addition, there will be about 81 tunnels. The seepage water from these tunnels have to be collected in drains and disposed off. In order to negotiate the levels about 113 bridges are also planned. No major blockage of drainage system is anticipated due to this project. To obviate the surface drainage problems, diversion of the nallahs and provision of adequate minor bridges has been resorted to.

The most likely hazards related to the construction works are:

- soil erosion and pollution at construction site,

- health risks and cultural hazards,

- problems due to geological faults, and

- excavated soil disposal problems

5.17 SOIL EROSION AND POLLUTION AT CONSTRUCTION SITE

5.17.1 The soil erosion is likely to take place due to project activities such as cutting, embankment and construction of station areas. About 1830 ha of area is subjected to erosion. The details of these are summarised below.

AREA SUSCEPTIBLE TO SOIL EROSION

S.No.	Area/Location	Length (Km)	Width (Km)	Total (ha)
1.	Embankment	136.8	80.0	1094.4
2.	Cutting	48.4	50.0	242.0
3.	At-grade	104.6	18.0	188.3
4.	Station	-	-	304.8
	Total	289.8	-	1829.5

The risk of water pollution is more due to steep slopes. Runoff from unprotected excavated areas, quarry sites and under ground tunnel faces can result in excessive soil erosion, especially when the erodability of soil is high. Mitigation measures include careful planning and timing of cut-and-fill operations and re vegetation.

Problems could arise from dumping of construction spoils (concrete, bricks) waste materials (from contractor camps) etc. causing surface and ground water pollution. However, for most of the important works requiring bulk quantities of concrete, the work will be done through the use of batching and mixing plant.

5.18 HEALTH RISK AND CULTURAL HAZARDS

5.18.1 The technology adopoted for the project is to transfer the people through railway which provides better safety, less pollution and energy consumption. All these lead to better human health and hence reduction in health risk. However, migration of labour from one place to another may lead to cultural conflicts. This could be avoided by employing local labour.

5.19 EXCAVATED SOIL DISPOSAL

5.19.1 Construction activity involves cut and cover, tunnel (bored and rock), foundation, fill and embankment. All these activities will generate about 36.18 Mm3 of soil. Out of this about 20.7 Mm3 (57%) is likely to be reutilised in filling of rail corridor and about 4.64 Mm3 (13%) in back filling. The balance 10.84 Mm3 (30%) will need to be disposed off at appropriate places.

5.20 IMPACT DUE TO PROJECT OPERATION

5.20.1 The project may cause the following negative impact during operation of project.

- oil pollution
- noise, and
- water demands

5.20.1.1 OIL POLLUTION

No major workshop for maintenance of locomotives is likely to be situated in the project area. However depots are planned at Baramula, Srinagar and Udhampur. The oil is spilled during change of lubricating oil, cleaning and repair processes. Moreover, cleaning of compartments, platforms and yards will generate wastewater and solid wastes at above sites. The spilled oil will be trapped and grit and suspended matter settled out. The collected oil could be either sold or incinerated to avoid any water pollution problem.

5.20.1.2 WATER DEMANDS

Public Health facilities such as water supply, sanitation and toilets are very much needed at the stations, CPHEEO has recommended 45 litres per day, water supply to persons working at railway stations. The people working on each station will vary from 25 to 150. The water demands on each station will be for following components:

- Personal use of Railway staff,
- Passengers
- Fire demands
- Make up water for cooling/heating, and
- Wastage

5.21 CONCLUSION

5.21.1 Both the negative and positive impact have been transformed to environmental quality scale. Value function curves have been utilised for the purpose. Each environmental parameter is assigned a weight by a team of experts and averaged out. The Environmental Impact Units (EIUs) before and after the project are computed and net values in mathematical form have been calculated. The net change due to the project is summarised below.

5.22 SUMMARY OF ENVIRONMENTAL IMPACT UNITS

5.22.1 The foregoing discussion regarding comparison of the scenario with and without the project is summarised below.

S.No.	Parameter	Environmental Impact Units		
		Without Project	With Project	Net change
1.	Trees/Plants	23	0	- 23
2.	Wildlife	5	5	0
3.	Land use	70	63	- 7
4.	Surface/Sub-surface flow	10	9	- 1
5.	Water Pollution	10	9	- 1
6.	Air Pollution	50	300	+ 250
7.	Land Pollution	70	63	- 7
8.	Noise Pollution	10	9	- 1
9.	Rehabilitation & Resettlement	30	15	- 15
10.	Historical/Cultural Monuments	30	30	0
11.	Employment opportunity	10	70	+ 60
12.	Fuel saving	0	75	+ 75
13.	Mobility & safety	30	60	+ 30
14.	Soil erosion	15	10	- 5
15.	Health	10	20	+ 10
16.	Seepage	15	10	- 5
17.	Infrastructure	15	30	+ 15
18.	Rural Economy	10	20	+ 10
	Total	413	798	+ 385

It is thus obvious that the net change due to the project, even with out any management plan, is positive.

CHAPTER VI

CONSTRUCTION AND ENGINEERING

6.1 EARTHWORK

6.1.1 GENERAL

Entire earthwork for the project will have a top width of 6.85 meters in the embankment portion and a width of 6.25 meters (excluding side drains) for the cutting portion. The width in the station yards will be decided based on the number of lines with the top width being increased @ 4.72 meter for every line in the yard. The top of the formation will be dressed with a cross slope of 1 in 30. All the cuttings will be provided with pucca side drains. Provision of catch water drain has been made for all the cuttings to ensure their safety by intercepting the water above the cuttings. Special catch water drain will be provided at locations wherever there is possibility of natural drainage course running across the alignment and where the cutting is sufficiently long. The section of the catch water drain will depend upon the discharge required to be carried by the drain. Since the discharge varies very widely from site to site, it has not been possible to standardise the section of the catch water drain. Catch water drains for the cuttings wherever necessary will also be pucca drains. Pitching of the side slopes will be done at all locations where the alignment passes from areas having stagnant water. Pitching in long stretches is essential for the alignment between Pampore, Kakapore and Srinagar where the alignment passes from areas being used as a flood spill channel. The entire earthwork may be done with the use of mechnical means for better control of the quality of earthwork as also to reduce the time of completion of the work.

6.1.2 SOIL FOR CONSTRUCTION OF EMBANKMENT

Wherever possible the construction of the embankment is envisaged through the soil obtained from the cutting. This advantage however will not be available if the soil obtained from the cutting is unsuitable for the purpose of constructing the embankment or the lead of the earth obtained from cutting makes the operation uneconomical. Thus, there is no alternative except to throw away the earth obtained from cuttings sandwiched between the tunnels. In such situations the embankment is proposed to be constructed through fill material obtained by the contractor from outside the railway land as no land is proposed to be acquired for borrow pits.

The soil classified as OL, OI, OH and Pt (Peat) is not recommended for use in the embankment. For a trouble free embankment RDSO's stipulation for the "preferred fill material" is recommended. Following are the specifications of the preferred fill material

i) Fine particles (less than 75 micron size) less than 50%.
ii) Liquid limit under 35% and Plasticity Index under 15.
iii) Uniformity co-efficient (Cu) greater than 7.
iv) Minimum achievable dry density with heavy compaction as per IS: 2720 Part VIII, should be greater than 1.85 g/cc.

6.1.3 **DESIGN OF SLOPES OF THE EMBANKMENTS**

A typical cross section of the embankment is shown in the annexure VI/1. This cross section provides a slope of two horizontal to one vertical with a berm having a width of 3 meters after a height of every 6 meters. This cross section is proposed to be followed in all cases where such a slope is found to be stable. For fill materials having poor C, Phi values, the side slopes may be designed to suit the soil characteristics of all such soils. Checking of the slopes stability of different cross sections with varied nature of the soil is rather cumbersome. As such this aspect is often ignored by the field engineers resulting in provision of slopes which, at times, are not stable. This difficulty can now be obviated through the use of special softwares which take care of this aspect. One such software designed by C.B.R.I. takes C & Phi as the input and checks the stability of any slope. This software is quite simple to operate may be used for the purpose.

6.1.4 Keeping in view the problems of the slope compaction, no compaction of the side slopes is being provided. However care has to be taken to ensure that the actual work in the field is done to an extent of 50 cm extra on both sides. This extra earth will be removed after the construction of embankment is over. This will ensure that the earth including that of the side slopes is firm and is adequately compact.

6.1.5 **SIDE SLOPES OF CUTTINGS**

A typical cross section showing the side slopes of the cuttings is attached as an Annexure. The side slopes of 1:1 may be provided unless a flatter side slope becomes visibly necessary at the site. Hard rocks wherever encountered will be provided with steeper side slopes depending on the nature of the rock. For deeper cuttings, a berm of 3 meter width will be provided after a depth of every 6 meters.

6.1.6 **COMPACTION OF THE EMBANKMENTS**

Fill material will be compacted in such a fashion so as to obtain 98% of the maximum dry density. Earthwork will be completed in layers with each layer not exceeding 30 cm. The subsequent layer will only be permitted after the lower layer has achieved the stipulated density. For better and faster control of the field compaction of each layer, instant compaction meters may be used.

6.1.7 EROSION CONTROL MEASURES

For both embankments and cuttings, sodding may be resorted to. For deep cuttings comprised of boulder studded soils not amenable to sodding, use of local flora like Ipomea and Agave which are capable of growing in such an environment may be planted in consultation with the forest department. At locations which are not amenable even to this treatment, use of nylon netting may be resorted to.

6.1.8 BLANKETTING MATERIAL

One meter thick blanket may be provided for the banks as stipulated in Board's Letter No.94/CE-II/MB/2 dated 10.12.98. The specification of the blanketing material may conform to RDSO's Letter No. RS/G/95/NR dated 3/4.5.99. Copy of the circulars is attached as separate Annexure VI/II.

6.1.9 QUANTITY OF EARTHWORK

Quantity of cutting and filling for the entire project is summarised below:

S.No.	Zone From - To	Cutting in lakhs cum	Filling in lakhs cum
1.	0 – 30	25.72	22.89

2.	30 - 50	4.92	10.11
3.	50-100	20.22	24.6
4.	100-168	19.05	37.79
5.	168-208	0.43	52.62
6.	208- 248	0.25	27.51
7.	248-287	0.05	9.42
	Grand Total	**70.64**	**184.94**

6.1.10 SIDE DRAINS

Side drains shall be constructed in the cuttings and will be 1.22m wide at the top and .305m deep having side slope of 1:1. It has been proposed to leave the side drains kacha at such places where the depth of cutting is nominal. However, in deep cuttings they will be protected with pitching and grouted with cement mortar to facilitate for better maintenance.

6.1.11 BREAST/RETAINING WALLS

Retaining wall/breast wall will be provided at places where banks are located on steep ground and at the locations where the embankment may foul the nallahs/roads running parallel to the toe of the bank. Breast/retaining walls will be provided on economic considerations.

6.2 MAJOR/IMPORTANT BRIDGES

6.2.1 As per the prevalent norms, Bridges having individual span of 12.2 meter and above and total water way of 18.3 meter and above have been classified as major bridges. Out of these, bridges having a linear water way of 300 m and above/1000 sqm have been classified as important bridges. In the entire project there are 106 No. of major/important bridges. The linear waterway of bridges has been dictated by the formation level since bulk of the major bridges are located in gorges. As such the water way of the bridges actually provided in most cases is much more than required by the theoretical considerations. However, for all major bridges, a calculation of the waterway has been verified by calculating the catchment area of each bridge. For each of the zones, the method stipulated in the joint publication of C.W.C. and R.D.S.O. for calculation of catchment area of the bridges has been followed. The method adopted for the purpose is briefly described below:

6.2.3 ESTIMATION OF DESIGN FLOOD DISCHARGE

The bridges have been designed for the 50 years frequency flood. The flood discharge has been evaluated based on RDSO report R.B.F. – 16 for the streams having catchment area upto 25 sqkm. For streams having catchment area greater than 25 sq.km, discharge has been evaluated by Synthetic unit hydrograph method based on CWC report for Western Himalayas Zones. The methodology adopted for calculating design flood discharge based on above mentioned reports is briefly discussed below:-.

(i) <u>Design discharge for catchment area up to 25 km</u>

For these bridges Rational formula described below has been used.

Q_{50} = 0.278 CIA , Where

Q_{50} = 50 Years design flood discharge (m^3 per second)

C = Run of coefficient = 0.498 $(R.F)^{0.2}$, for hilly soils

R = 50 Year . 24 hour. point rainfall (cm) and duration of rainfall

F = A real reduction factor depending upon catchment area.

The values of R and F to be taken from relevant table of the report.

I = 50 Years Rain Fall intensity (mm/h) lasting for t_c hours duration where t_c is the time of concentration to be calculated using Bhatnagar's formula/William's formula. The value of 'I' is to be adopted from the relevant figure based on the corresponding sub-zone.

A = Catchment area (sq. km)

(ii) <u>Design discharge for catchment area greater than 25 sq km.</u>

The procedure followed to compute the design flood of 50 years return period by Synthetic Unit

Hydrograph (SUG) approach is summarized below. The estimation of the flood discharge by the formulae of this method is more realistic than earlier method using empirical formulae given by Dickens, Ryves, Inglis etc. since these formulae do not work on the concept of frequency of the flood discharge. These formulae also do not take into account the basic meteorologic factor of rainfall component. Moreover proper selection of constants in these empirical formulae is left to the design engineer involving subjectivity. To overcome these deficiencies, the exercise of the flood discharge estimation was undertaken at the National level by dividing the country into 26 hydrometeorologically homogeneous sub zones . Based on the data collected in these zones, CWC has published the flood estimation reports for these sub zones. Udhampur – Qazigund lies in Zone No.7. The flood estimation for the bridges falling in this portion has been done based on this report. Annexure VI/III indicates list of Major/Important bridges and catchment area of each bridge calculated by the help of this method. Steps required to be adopted for the calculation of the flood discharge have been briefly explained in annexure VI/IV.

Annexure VI/IV

Following steps are required for estimation of the flood discharge.

(i) Preparation of catchment area plan of the ungauged catchment.

(ii) Determination of physiography parameters viz: catchment area (A), Length of the longest stream (L), Length of stream from CG of the catchment (LC) and equivalent stream slope (S).

Determination of 1- hr SUG parameters and plotting SUG by using following emperical formula.

$$t_p = 2.498 * (L*Lc / S)^{0.156}$$

$$q_p = 1.048 * (t_p)^{0.178}$$

$$W_{50} = 1.954 * (L*Lc / S)^{0.099}$$

$$W_{75} = 0.972 * (L*Lc / S)^{0.124}$$

$$WR_{50} = 0.189 * (W_{50})^{1.769}$$

$$WR_{75} = 0.419 * (W_{75})^{1.246}$$

$$TB = 7.845 * (t_p)^{0.453}$$

$$Qp = qp * A$$

(iii) Q_p = Peak Discharge of Unit Hydrograph (Cumecs.)

t_p = Time from the Centre of Effective Rainfall duration to the U. G. Peak (hr.)

W_{50} = Width of the U.G. measured at the 50% of peak discharge ordinate (hr.)

W_{75} = Width of the U.G. measured at 75% of peak discharge ordinate (hr.)

$W_R 50$ = Width of the rising limb of U.G. measured at 50% of peak discharge ordinate (hr.)

$W_R 75$ = *Width of the rising limb of U.G. measured at 75% of peak discharge ordinate (hr.)*

T_B = *Base width of Unit Hydrograph (hr.)*

A = *Catchment Area (Sq.km.)*

q_p = Q_p/A = *Cumec per sq. km.*

(iii) *Estimation of design storm duration (TD). has been adopted as 1.1 t_p*

(iv) *Estimation of point rainfall and areal rainfall for design storm duration (TD) and to obtain areal rainfall increments for unit duration intervals from the relevant tables and graphs given report.*

(v) *Estimation of effective rainfall increments by substracting the design loss rate from the areal rainfall increments.*

(vi) *Estimation of base flow.*

(vii) *Computation of design flood peak and flood hydrograph.*

6.2.4 SPAN ARRANGEMENT OF MAJOR BRIDGES

No clear cut rules are specified for deciding the span arrangement of the major bridges. However, following factors have been kept in view while finalizing the span arrangements. Following factors have been kept in view while finalizing the span arrangements of the major bridges.

i) Overall span arrangement of bridge, as far as possible should be in conformity with the general stipulation of the cost of sub structure being almost equal to that of the super structure.

ii) Use of spans the detailed design of which is already available either in JURL project or elsewhere in Northern Railway.

iii) Founding the pier at a location which is suitable strata and which also permits the load dispersion at an angle not exceeding 60 degrees with the horizontal.

iv) Founding the pier at a location which results in the minimum height of pier.

v) For the bridges in the valley, the central span has been kept wider with a view to permit navigation in the river/nallah.

6.2.5 CHOICE OF FOUDNATIONS

The strata encountered for this project may be broadly classified in two groups. The first type is typical of the stretch between Udhampur to Quazigund while the second type extends in the valley from Quazigund to Baramulla. In the former stretch typical geology of the Himalayan region has been witnessed. This strata comprises of silty sand mixed with boulders and cobbles. At some bridge sites seams comprising of pure clay have also been found. At certain other locations in deep nallahs, sand stone has also been identified. This type of strata has varying structural properties. At locations where sand stone has been encountered, the bearing capacity tends to be very high and has enabled the designers to adopt a value upto 100 tonnes per meter square. Other locations which are comprised of scree have not permitted a value of more than 25 tonnes per square meter at the founding level. In this region, neither the bored piles nor deep wells could be proposed for the foundation. The foundations of all the major

Thus, as far as possible P.S.C. girders having a length of 22.8 meters, 34 meters and 45 meters have been used as simply supported spans. Keeping in view the difficulty encountered in JURL, the continuous P.S.C. spans have been avoided unless the use of the same became inescapable on account of site compulsions.

6.2.6 SUB SURFACE INVESTIGATION OF MAJOR BRIDGES

Sub surface investigation of major bridges was carried out through core drilling varying in depth from 18 meters to 50 meters. The job was completed through the use of diamond bit by taking the samples of NX size. The annexures attached along with the report depict the bore logs of different bridges for which the drilling had been done. The undisturbed samples which had been obtained through this process were subjected to laboratory testing in respect of (I) Unconfined compressive strength (ii) density (iii) specific gravity (iv) porosity. Keeping in view the nature of strata, the S.P.T. and plate load test have not been conducted as the results of such tests in this type of strata tend to be erroneous. The bearing capacity of the strata was decided based on the codal provisions as per the test results.

6.2.7 DESIGN OF MAJOR BRIDGES

All bridges for the project have been designed as per MODIFIED BROAD GAUGE STANDARDS 1987. Annexure VI/V gives the details of the relevant clauses applicable for the design of various elements of the bridge. The interpretation of the clause wherever considered essential, has been done therein. Of particular importance is the aspect of the temperature stresses and the differential settlement (applicable only for continuous PSC girders). For uniformity in the design of all the bridges, the project report describes the load combination required to be adopted for all the major bridges.

6.2.7.1 TEMPERATURE STRESSES

The existing clause of the I.R.S. Code speaks of a linear temperature range of 5 degree centigrade to 10 degree centigrade between the top and bottom fibres. The provision of this clause for deep P.S.C. girders was considered to be on a lower side. Following this clause could have therefore paved way for increase in the actual stresses beyond the permissible stresses. For deep P.S.C. girders the contribution of the temperature stresses may go upto 20 % of the maximum permissible stresses in the girder. As such these stresses assume a considerable importance. B.S. code 5400 gives greater details about the variation of temperature across the depth of the girder. For designing the P.S.C. girders the temperature distribution across the depth of the girder has been assumed as per clause 5.4.5 of B.S. Code 5400.

6.2.7.2 CONCRETE MIX FOR THE SUPER STRUCTURE

All the concrete to be used for the construction of various elements of the bridges shall be controlled concrete with weigh batching and proper mix design. The mix design shall be as per IS-10262. Unless there are reasons to justify a lower value of the standard deviation, mix design will be done with a value of 6.6 by considering the standard of quality control at site as "Good". The mix design shall be further checked by Trial mixes at site. The trial mix will be checked for the following two design requirements.

(i) Workability criteria to be ascertained through the checking of slump.

(ii) Strength criteria i.e the 28 days cube strength should be more than designed Target Mean Strength (TMS). Based on these two criteria, trial mix confirming to the requirement will be approved for the relevant grade of the concrete and the same will be followed for further construction .

However before doing the trial mix at site, various ingradients of concrete i.e. coarse aggregate, fine aggregate and water will be tested as per codal provisions given in IS-2386 and IS-3025 and the values of the various tests should conform to the acceptance values given in IS-383 and IS-456 before the sources for these constituents are approved.

The design of the super structure has been made with M 45/M 40 grade of concrete. The trial mixes for M 40 have been successful with 43 grade cement. For girders required to be cast with M 45, 53 grade cement will be used .

6.2.7.3 DIFFERENTIAL SETTLEMENT

Differential settlement which is not an issue for simply supported P.S.C. girders assumes a considerable importance while designing a continuous P.S.C. girders. Both the I.R.S. and I.R.C. codes do not stipulate any maximum value for the same. A value of 25 mm has been adopted which is in conformity with the practice being followed for M.O.S.T. design for continuous super structures.

6.2.7.4 CALCULATION OF EARTH QUAKE FORCES

A sizeable number of major bridges are high bridges. Their height from the bottom of foundation to the top of pier cap is more than 30 meters. As per the stipulation of the present I.S.I. 1893, for such bridges the dynamic analysis for calculation of earthquake forces is mandatory. For such bridges the earthquake forces are to be calculated based on static co-efficient method and dynamic analysis. The higher of the two forces are to be considered for the design. Accordingly, for all major bridges having a height of more than 30 meters, dynamic analysis as per the Roorkee University Report has been done.

6.2.7.5 BEARINGS

All major bridges have been designed with neoprene elastomeric bearings for PSC girders upto 40 m. span. Only bearings manufactured by reputed manufacturer shall be used. The manufacturing and installation of bearings shall confirm to IRC-83 part-II.

For girders of longer span, POT-PTFE bearings shall be provided. These bearings shall be got tested at approved test house as approved by Railway/RDSO. The manufacturing and installation of bearings will conform to IRC-83 , UIC-772R and BS-5400.

6.2.7.6 **EXPANSION JOINT**

The type of expansion joint used at any location will depend upon the expansion/contraction calculated after considering coefficient of linear expansion of concrete. For PSC girders "Stripseal expansion joint" conforming to modified Interim specification for expansion joints issued by MOST may be provided. The use of other expansion joints may also be made depending upon the merit of each individual case .

6.2.7.7 LOAD COMBINATIONS

LIVE LOADS AND LOAD COMBINATION TO BE CONSIDERED FOR STRAIGHT BRIDGES

Load Cases (LC)

1. DL1: Ist Self Load + Constn. Load, if any.
2. DL2: 2nd stage: Ballast retainer + Kerb + Railing + Footpath
3. DL3: Ballast + sleeper + Track + Pipes & Cables.
4. LL: Live load + Footpath live load (FPL)
5. Temp. effect(TE)
6. Longitudinal Force (LF)
7. Raking force (RF)
8. Wind effect (WE)
9. Seismic effect (SE)
10. Prestressing Effect (First stage = PE1, second stage PE=2)
11. Differential Settlements (DS)
12. Derailment Effect (DE)
13. Prestressing effect after losses (First stage KPE1, second stage KPE2)
14. Loads due to Bearing Friction (FB)

Load Combination	Reference of draft IRS code
Pre-Service stage.	
DLI + PE 1	Not mentioned in the draft code.
LC 1 + TE	-Do-
LC1 + SE	-Do-
LC1 + WE	-Do-
DL1+DL2+KPE1+PE2	-Do-
DL1+DL2+KPE1+KPE2	-Do-
LC6+DL 3	-Do-
LC 7 + DS	-Do-
LC 8 + TE	-Do-
LC9 + WE	-Do-
LC8 + SE	-Do-
Service Stage	
LC7+LL+LF+TR	Combination 1
LC 12 + DS	
LC13+TE	Combination 3
LC 13+SE	Combination 2
LC13+WE	Combination 2
LC8+DE	Combination 5
LC8+FB	Combination 4

6.2.8 CONSTRUCTION METHODOLOGY AND QUALITY CONTROL

6.2.8.1 LAY OUT

For better control of the layout, the use of total station theodolite with a least count of one second may be made. Alignment will be controlled between the control pillars already established during final location survey. The levels in the Z direction will be controlled with the help of temporary benchmarks established at convenient locations at or near the bridge site. Reference pillars will be established for each abutment and pier in perpendicular directions so as to control the alignment of individual member of bridge during construction.

6.2.8.2 CONSTRUCTION OF PIERS

The construction of the piers even for a low height of 8 to 10 m will be done by using slipform technique as the use of this technique ensures faster construction and results in a better surface. The detail of the slipform technique has been discussed in annexure VI/VI.

The inside of all hollow piers will have an access from the top through a manhole of suitable dimensions provided in the pier cap.

6.2.8.3 CONSTRUCTION OF SUPERSTRUCTURE

PSC superstructure will not have more joints than permitted by the designer. In case it becomes essential to provide more joints than anticipated by the designer , the case must be referred back to the designer for recalculation of the total stresses. Use of additives is permissible in consultation with the Engineer incharge .

6.2.8.4 SAMPLING AND TESTING OF CONCRETE CUBES.

The samples shall be collected from the concrete produced for use in the structure as per the sampling criteria laid down in IS-456 i.e four samples for 50 m^3 of concrete plus one additional sample for every subsequent 50 m^3 or part thereof. Each sample will comprise of six cubes i.e three cubes to be tested after 7 days and three after 28 days. The average strength of these three cubes per sample shall be treated as the strength of the sample provided the variation in individual cube strength from average value is not more than 15%. The average cube strength should be more than the characteristic strength of the concrete.

6.2.8.5 **SITE LABORATORY**

As various tests will be required to be conducted at site, a properly equipped site laboratory will be established with following minimum equipment.

1. Sieve sets for doing sieve analysis for coarse and fine aggregate with suitable weighing apparatus.

2. Slump test apparatus

3. Compression testing machine for testing of cubes.

4. Apparatus for checking moisture contents of fine aggregate.

5. Vicat apparatus for checking the setting time of cement.

6.4.9 QUALITY CONTROL DURING CONSTRUCTION

To effectively monitor the construction and to ensure a proper quality control, a system of check request will be followed . As per this, contractor will be required to submit a check request on the specified proforma to inspector-in-charge of the bridge before taking up any concreting. Various stages before which contractor will submit such check request are :

1. Lean Concrete in foundation.
2. RCC in foundation.
3. RCC in pier/abutment.
4. RCC in pier cap.
5. Concrete in superstructure.
6. Prestressing of girder.
7. Grouting of superstructure.
8. placement of bearings.
9. Fixing of expansion joints.

The Inspector-in-charge of the work will check various parameters as filled in the check request which will finally be approved by the officer-in-charge at site.

The contractor will take up the concreting only after receiving back the copy of check request duly approved. Sample performa of check request are given in annexure VI/VII.

6.3. MINOR BRIDGES

6.3.1 There are a total of 227 minor bridges in the entire project. Waterway of these bridges has been decided based on estimation of the flood discharge evaluated as per RDSO report R.B.F. – 16 The height of the bridges has been decided based on the HFL established after local inquiry and inspection of the site. As far as possible, direction of stream has not been changed. Because of very steep slopes and water falls occurring within the alignment, the existing slope of some of the nallahs had to be changed. However attempt has been made to restrict the extent of cutting by providing suitable steps at short intervals. Since very high embankments are being encountered in Udhampur – Qazigund section, the minor bridges in this section are very long. Provision of pipe culverts for these bridges would have posed a difficulty in cleaning these bridges. Such situations in hilly areas, which are prone to flash floods, have at times resulted in breaches. To obviate such problems, all the minor bridges in Udhampur – Qazigund section have been planned as box culverts. In Qazigund – Baramulla section, the height of the embankment at most of the locations is less. In this section, a large number of kuchha drains have been encountered. These drains play an important role for irrigating the fields. As such most of these kuchha drains have been continued below the embankment through provision of pipe culverts. All the pipe culverts will be provided with a concrete cradle to increase the load carrying capacity of the pipes. Construction of pipe culverts will be done as per RDSO's approved drawing No B-1609. The pipe used for culverts will be as per the ISI Code 458.

6.3.2 Construction of the box culverts will be done as per the standard plans issued by Northern Railway, Head quarter office. These bridges will be constructed with 43 grade cement.

6.3.3 Though the structural requirement of the concrete will be fulfilled with a lower grade of concrete, M - 25 grade of concrete designed as per IS Code 10262 – 1982 is proposed to be used for the construction of boxes because of durability consideration. Coarse aggregate and fine aggregate will be used as per the acceptance criteria laid down in IS-383 – 1970.

List of minor bridges in the project is attached as an Annexure VI/VIII

6.4 LAND

6.4.1 Land is proposed to be acquired for single line only. There is no likelihood of providing double line in near future. Though an attempt has been made to avoid the side long ground, because of the compulsion of topography it has not been possible to avoid such ground at all locations. At such locations, toe distance of formation on either side of bank differs too much. The following points have been considered while proposing the acquisition of land width.

UDHAMPUR – KATRA

i) No land either for borrow pits for spoil bank has been proposed to be acquired at such locations, where the spoil earth from cutting will be utilised for earth filling in the adjoining bank.

ii) On side long ground having steep slop the acquisition of land width required for spoil earth from cutting, has been proposed on lower side of the track and also in deep khads wherever they happen to be nearer and parallel to the track.

iii) At such cuttings where it will not be possible to acquire the land in the transverse direction due to the existence of Nallah on one side and high hillock/road on other side, the acquisition of land for spoil has been proposed longitudinally away from the affected cuttings. For Qazigund – Baramulla section. No land for spoil banks or borrow pits proposed to be acquired.

6.4.2 Sufficient land at proper location has been proposed to be acquired to permit diversion of Nallah, roads, construction of catch water drains, guide bunds and marginal bunds etc.

6.4.3 For the entire project 27,211 kanals of land is required to be acquired.

6.4.4 No difficulty is anticipated in the acquisition of land upto Qazigund in view of the fact that the proposed alignment mostly passes through barren land. The proceeding of land acquisition have already been started and most the land between Udhampur – Katra has been acquired and notification is under process for other sections. For Valley, land for station yards of Srinagar, Pampore and Kakapore has already been acquired and land for Baramulla, Budgam and Qazigund yard shall be acquired soon.

6.4.5 Every endeavor has been made to avoid acquisition of houses, but it has not been possible to eliminate it completely. Necessary provision has been made for payment of compensation for houses which fall within the land width proposed for acquisition.

6.4.6 The rates adopted for framing the estimate of land acquisition are based on the rates supplied by State Revenue Authority. The State Govt. has agreed to create a special cell for the purpose of land acquisition for this line at the cost of the project. Cost of their establishment has been included in the estimate.

6.5 TUNNELS

6.5.1 Generally, whenever the depth of cutting exceeds 20-25m, a tunnel has been proposed on economic considerations. Initially the position of portals had been fixed taking into account the requirement of cover of three times the diameter of the tunnel. The location of portals has however been finally decided based on the geological consideration and stability of the slope above the tunnel portal. Cut and cover has been proposed at locations where requisite cover is not available. There are a total of 81 tunnels totaling to a length of 89.565 kms. in the entire project. All these tunnels are confined between Udhampur and Qazigund. The total length of the alignment in this reach being approx. 168 kms., 53.31% of the alignment is negotiated through tunnels. In the first leg of the project namely from Udhampur to Katra 9.865 kms of tunneling spread in seven tunnels is involved. Annexure VI/IX showing the location, length of each tunnel and other salient features is attached alongwith the report:

6.5.2 GENERAL GEOLOGY AND STRATIGRAPHY :

The Udhampur – Katra rail section lies within Outer or Sub-Himalaya which essentially comprises of low linear strike ridges. The elevation in this area rarely exceeds 1000 m. The drainage pattern is controlled by gently dipping sedimentary formation. The Tawi river, which is an important tributary of Chenab, drains the area. In general, the area shows manifestation of Siwalik group of rocks. The geology of area has been studied from time to time and the stratigraphic succession has been worked out. Geologists have carried out mapping of this Territory belt. The stratigraphy of the area as worked out in different structural units by the geologists is as follows :

Structural position	Group\	Age formation	Lithology
ALLOCHTHON	Dogra/Salkhala	Early Cambrian to Archean.	Slate, phyllite schist, quartite, limestone.
----------Panjal thrust----------			
Hazara Formation	Lower to Middle Eocene		Shale, variegated phyllitic limestone, grey formaniniferal.
----------Unconformity----------			
Zewan beds	Permain		Quartzite, limestone, shale alternations.
Panjal Trap	Permo-Carboniferous		Bedded lavas green epidotic ash beds.

Agglomeratic slate.	**Upper Carboniferous.**	**Slate, Quartzite siltstone, sandstone alter.**
Baila formation.	**- do -**	**Shale, slaty, laminated limestone lenticular, nodular.**
Gamir formation	**- do -**	**Quartzite, limestone, slaty, shale, alternations.**
Panjal Trap	**- do -**	**Lavas, phyllite ash beds.**
	--------Murree Thrust--------	
Upper Siwalik	**Pio-Plistocene**	**Conglomerates, sand rocks, clay**
Middle Siwalik	**Pliocene**	**Micaceous sand stone clays, siltstones.**
Lower Siwalik	**Mio-Pliocene**	**Grey, brown clays, sandstones.**
Upper Murree	**Miocene**	**Massive grey, sandst. siltstone, grey yellow clay.**
Lower Murree Upper Eocene	**Lower Miocene**	**Brown, red sandstone, siltstone, clay alternations.**
Subathu	**Middle Eocene Paleocene**	**Green shales & formaniferal limestone bands coal layers in the bottom**
	--------Unconformity--------	
Vaishnodevi	**Late precmabrian**	**Cherty dolomitic limestone, quartzite.**

6.5.3 The tunnels in Udhampur – Katra section fall in the Siwalik Group and Pilestocene to Recent deposits. The Siwaliks can be further divided into following sub-groups :-

6.5.3.1 **Lower Siwalik :-** The lower Siwalik topography is characterised by well developed dip slopes. This sub-group is made up of sandstone and claystones. The sandstones are light grey, thick bedded, jointed, fine to medium grained calcareous and micaceous at few places. They are comparatively softer than upper Murree sandstone. The claystones are light red and greenish grey coloured, micaceous with calcareous veins. The thickness of this formation is around 1830m and it overlies the upper Murree and has a transitional relationship with it.

6.5.3.2 **Middle Siwalik :-** The middle Siwalik country exhibits low relief with fairly extensive dip slope intervened by gaps mostly carved out of the differential erosion of clays. The middle Siwalik sandstones are distinctly coarser than the sandstone in the preceeding lower Siwalik sequence with pebbles of varying size and composition. The unit as a whole is arenaceous and the heterogenity of the pebbles in the sandstone increases towards the top. The sandstones are medium to coarse grained greenish grey to greyish white highly micaceous.. The sandstone are arkosic and include significant amount of feldspar. Calcareous aggregates in the form of modules and concretions are often noticed towards the base of the succession.

The clays are soft mostly of pale red or orange coloured, occasionally with reddish tinge. At many places, laterally, they pinch out in infra formational conglomerates. In some sections, the clays are variegated with botches of blue and green colour. Where the middle Siwalik is seen with its upper and lower contacts, it can be divided into three members. The lower most is the massive sandstone member which is not very thick. This is followed up immediately by a alteration where clay predominate. The sand – clay ratio of this unit is nearly 1:4. These clay units are succeeded by a thick sandstone unit where the clays are very minor.

The complete thickness of middle Siwalik is about 1700m. The middle Siwalik has a comfortable relationship with a underlying lower Siwalik and underlying upper Siwalik.

6.5.3.3 **Upper Siwalik :-** The upper Siwalik sequence consists of massive sandrock with inter bedded thin conglomerate bands This is overlain by massive conglomerates in the upper part. The lower unit consists of thick sandrock which is coarse grained, loose, friable poorly cemented and occasionally micaceous. They are of light Grey colour with a Grey and pale white tinge. The upper unit consists of massive conglomerates with liberally inter stratified sandrock which is separated by thin bentonitic sandy clay.

The Pleistocene and Recent deposits are essentially terrace deposits and slope wash material. Most of the terrace deposits are overlain by a thin soil cover consisting of clayey silt, which is suitable for cultivation.

6.5.4 REGIONAL TECTONICS AND SEISMICITY:

Assessment of seismic hazard i.e. the expected magnitude, locale and frequency of earthquakes are the fundamental inputs for seismic design of civil structures. For this purpose, a critical study of the records of previous earthquakes, the nature of geological faults and thrusts, their activity and relation to the seismicity pattern and neotectonics activity is to be undertaken. The rail link project lies within map of India prepared by I.M.D.

6.5.4.2The seismicity of the area has been studied in detail in view of many important hydroelectric projects coming up in the North West Himalayas. The seismo-tectonic status of the Himalayas has been intensely deliberated by a number of authors. Similarly, the problems associated due to folding, faulting and thrust movements have also been addressed by number of organisations like GSI, ONGC, MEC, NHPC etc. However, recently, Professor Tapponnier, an expert on tectonics and others in their report on Recent" Tectonics and Seismic Risk region of DULHASTI PROJECTS", Feb 1991 has made following pertinent observation on seismotectonic status of this region :-

6.5.4.3 The most violent and best known historically recorded earthquake to have affected the region in Kangra earth quake on 4th April 1905. The magnitude of this earthquake was between 8 and 8.4 on Richter scale. The meoseismal area of about 300 Km long along the frontal area of the Himalaya was characterised by two maxima extended of intensity VIII or more at Kangra and Dehradun separated by a 200 Km wide area where intensities were less than VII.

6.5.4.4 The Kara koram faults is relatively far from the project area but it is the fastest moving strike fault in the entire western Himalayan region area having a rate 3.5 cm/year. Observations in the fields as well as spot images suggest that it causes earthquakes of great magnitude with rather short period of return which would there fore very critical over a large area.

6.5.4.5 Vertical displacements of 2-3mm can be expected along the tso-Murari active normal fault, extensional fault system of South Tibet which is also related to some of the seismic shocks in the region.

6.5.4.6Based on morphotectonic analysis of spot images it has been possible to more accurately determine the traces, nature and degree of activity of main steeply dipping active faults in the region.

6.5.4.7The fault whose morphological trace is sharpest on the SPOT images corresponds cartographally to the Main Boundary Thrust (MBT) (located in the vicinity of Katra). This fault places the basement in contact to the south with a series of steep anticlines and synclines that folds the thick Murees sandstones. The whole sandstone sequence is detached from the basement.

6.5.4.8The images reveal that the recent movement of this fault is in fact oblique with the right latral component which is evidenced by the offset of several rivers of various sizes. More specifically two major river tributaries of Chenab and of the Ravi respectively or offset by about two Km. Some smaller streams as well as the ridges separating their valleys have also been offset by 100 to 200m.

6.5.4.9Tapponnier and other have further observed two frorntal thrust ramps on spot images. In map view they do not appear to extend as far as the MBT. They are located at the

Northern edge of two small, flat basins filled with pliestocene sediments, which apparently formed as "piggy-back" basins on top of the folded, detached tertiary sediments (Murees and /or Siwaliks). The outermost ramp on the images places a North-dipping monoclinal wedge of murrees red sandstone on the Plioquaternary Siwaliks to the North of Jammu. Like the MBT, and the Salt Ranges Thrust ramps probably root into the decollement that underline the frontal part of the Himalayas and causes the great earthquake of this region (Kangra 1905 type). It is possible that such earthquakes activate such structures.

6.5.4.10Similar views were expressed earlier by Indian workers also. Notably, Raina et al 1978, has described the neo tectonic activity in the vicinity of Riasi Thrust (MBF). It has actually brought the late Palaezoic Riasi dolomites and Oliocene to the early Miocene Murree formations in juxtaposition with Miopliestocene Siwalik rocks. The latest phase of rejuvenation of this thrust has taken place in the Holocene time, which is indicated by the thrusting of older formations over the Recent to sub-recent terrace material and landslide debris indications of which have been observed in the Aghar Nala section near Riasi.

6.5.4.1 Technical investigation:

6.5.5.1 In order to have reasonably fair idea about geology along the tunnel alignment, latest methodology of conducting seismic refraction survey was used. In addition geological mapping and confirmatory drilling was also conducted along the tunnel alignment. Seismic refraction survey technology was used for the first time in Indian Railways.

6.5.5.2 Seismic refraction survey is a method of subsurface exploration using seismic energy and recording the travel times of P-waves (longitudinal or compressive waves) in the subsurface media, at known points along the surface. Since the method has been used for the first time, a brief explanation of the principles and its methodology are discussed below.

6.5.5.3 The underlying principle:

The refraction method consists of measuring the travel time of compressional waves generated by an impulsive energy source. Different types of waves are generated when a 'shock' – natural or artificial occurs on or within the surface. These waves are broadly classified as P & S waves with the former being compressional waves and the latter being shear waves. The seismic refraction method relies on P waves as these waves are not only the fastest but also the strongest. Their velocity is related broadly to the medium through which they pass in terms of the following equation –

$$V_p = [E(1-\nu)/\rho(1+\nu)(1-2\nu)]^{1/2}$$

E = Modulus of elasticity.

ρ = Density.

ν = Poisson's ratio (generally assumed as ¼) of the medium.

Different type of geological media permit the P waves at a velocity which has a definite co-relation with that media. Thus, if the velocity of the P wave in a media is known, the media through which the wave has passed can also be identified.

6.5.5.4The energy source used for generating the shock wave is usually a small explosive charge/falling of weight and the energy is detected, amplified and recorded by special equipment designed for this purpose. The instant of the explosion or 'zero time' is recorded by the seismograph. The raw data, therefore, consists of travel times and distances, and this time distance information is then manipulated to convert it into the format of velocity variations with depth.

6.5.5.5The earth crust comprises of various layers. The P waves while travelling down through the various layers get refracted like a light wave. These shock waves after travelling through different geological media finally emerge out of the earth surface and are detected by the geo phones installed at various predetermined locations. Thus the time elapsed between the zero time and the first arrival of the shock wave is registered on each geo phone. Knowing these travel times and the emperical relations establishing co-relation between the travel time and the type of medium, it is possible to draw the geological maps of underground strata.

6.5.6 Methodology adopted – The seismic refraction survey was carried out using OYO's 24 channel signal enhancement seismograph with a profile length of 187.5m to 227.5m with geophone spacing of 7.5m each and 3 to 5 shot points. For seismic energy source a hammer of 10 lbs with 10mm thick mild steel plate has been used. The output of seismograph obtained by converting the energy of the seismic wave into electrical energy was amplified, stacked and recorded by photographic means and displayed on the Cathode Ray Tube. In addition manual gain control was used to prevent overloading by the stronger signals and bring out the weaker signals. The seismic wave recorded is a complex wave containing different components each with varying amplitude, rate of attenuation and phase relationship. The quality of the record for visual interpretation was improved by the selection of filters. The filter used for the purpose varied from 48 Hz. to 192 Hz. This filter was necessary to obtain maximum current and voltage at certain desirable frequencies and to reject or suppress the undesirable frequencies. The exploratory seismic data generated by field survey was then interpreted using automatic seismic refraction programme analysis with the help of the computer. Through the successful application of this technique it has been possible to assess the following:

a) Thickness and nature of soil overburden.

b) Bed rock configuration.

c) Thickness and condition of weathered layers.

d) Compressional wave velocity for various layer.

e) Depth of ground water saturated zone.

There are various advantages of using this technology, which are as follows:

6.5.7 Advantages:-

6.5.7.1 Time saving investigation e.g. about 500m to 750m can be done in a day whereas drilling bore hole is a very time consuming process. It can thus help in rapid assessment for any geotechnical problems related to tunnel, dam sites, land slides and foundations.

6.5.7.2Very cost efficient method vis-a-vis drilling bore holes. Cost of this is approximately Rs.1.0 lacs/Km whereas in case of drilling it is about Rs.2500/- per meter. Hence cost of one bore hole of about 40m itself may be Rs.1.0 lac.

6.5.7.3Instrument is very handy and hence can be easily carried at all types of sites.

6.5.7.4Since the information gathered with this method is in a continuous stretch along the length, it is possible to obtain a geological profile along the tunnel axis.

6.5.8 Limitations

6.5.8.1 Possible existence of hidden layer i.e. layers having insufficient velocity contrast or thickness, can not be detected. In most cases the hidden layer or the blind zone lies between the surface and a high speed layer. Thus it can be a serious set back to shallow surveys with refraction seismograph. This problem has been tackled by using exploratory drills in conjunction with seismic surveys.

6.5.8.2 Velocity reversals because of a low velocity layer between two high velocity layers. The effect of a low velocity layers is to make computed depths larger than actual depths. Fortunately this problem seldom occurs in shallow survey.

6.5.8.3 Problem in interpretation arise if the shallow bed rock surface is irregular and eroded and or weathered.

6.5.8.4 If the material is anisotropic i.e. difference in velocity of horizontal and vertical direction or even in between different horizontal directions, the results may be erroneous. Rocks with finely bedded structure such as sand-stones and shales generally exhibit some degree of anisotropy.

6.5.8.5Surface slope should be less than 45 ° generally.

6.5.8.6All the limitations of this method enumerated above can be easily tackled by resorting to confirmatory drilling at suitable locations. Accordingly, for assessing the strata for the tunnels in this project, the method had been used along with the confirmatory drilling.

6.5.8.7Along the confirmatory drilling Permeability Tests were also got conducted in situ to assess the permeability value as well as to have the idea about groutibility of the media. In addition, following tests were also got conducted on the rock samples.

- Bulk Density (Dry)
- Bulk Density (Saturated)
- Specific gravity (Grain density)
- Water content at saturation (%)
- Apparent porosity(%)
- Ultra sonic wave velocity (Compressive & shear-in both dry and saturated states) & Dynamic elastic constants.
- Point load strength index
- Shake durability index.

6.5.9 Support classes

6.5.9.1Based on geo-technical investigation overall five classes of support systems have been designed depending upon the overall characteristic of the tunneling media. A separate support system has also been designed for the **cut and cover** portion. These support classes are as under:

6.5.9.2Good tunneling media

A CSIR rock mass rating average value of 70 has been considered appropriate to represent rock condition in this support category. Overall RMR range for this class was taken to be in the range of 61 to 80.

The support system for this category is applicable for the rock with initial stress varying from 1.89 Mpa to 6.79 Mpa depending upon the rock cover. The modulus of elasticity of rock was assumed as 40 Gpa. The values for cohesion intercept and angle of internal friction have been taken as 0.25 Mpa and 42^{o} respectively in this category for analysis.

50 mm thick shotcrete, with 7 Nos. 3m long rock bolts per section of tunnel, in crown, at 1.5m longitudinal spacing, has been nominated as support in this type of rock. Spot bolts may also be required in walls depending upon the discontinuities and their orientation.

6.5.93 **Fair tunneling media**

6.5.94 Average RMR value of 50 has been taken for these rock conditions. Overall RMR range for this class was taken to be 41 to 60.

The support system for this category is applicable for the rock with initial stress varying from 0.75 Mpa to 7.5 Mpa depending upon the rock cover. Young's modulus has been taken as 10 Gpa in convergence confinement analysis. The 'C' and 'Phi' values were taken as 0.15 Mpa and 30^{o} respectively for this kind of rock conditions.

Eleven Nos. 3 meter long rock bolts per section of tunnel with a longitudinal spacing of 1.5m along with a 100mm thick shotcrete **with wire mesh** was the nominated support for this class of rock after comparing the results of analysis and the precedent practice.

6.5.9.4 Poor tunneling media:

An RMR value of 30 was taken as a representative value for this type of tunneling media for rock support interaction analysis. Overall RMR range for this class was taken to be 21 to 40. The initial stress was varied between 0.3 Mpa and 2.2 Mpa. The values 'C', 'Phi" and 'E' were taken as 0.1 Mpa, 32 degree and 3.2 Gpa respectively.

Steel ribs, ISHB 150 (30.6 kg/m), @ 750mm with lagging and 100mm shotcrete with wire mesh have been provided in crown. The shotcrete with wire mesh has also been suggested in walls with steel ribs. However, the size of the steel ribs in walls had to be increased to ISHB 200 (40 kg/m) with reduced spacing of 375mm c/c, due to the height of the vertical posts being about 5m, to resist the side pressures.

6.5.9.5 Very poor tunneling media

An RMR value of 12 was taken for "Very poor" rock conditions. Overall RMR range for this class was taken to be less than 21. The initial stress was varied between 0.5 Mpa and 6.5 Mpa with 'E', 'C' and 'Phi" as 1.1 Gpa, 0.05

Mpa and 30 degree respectively. Steel rib section ISHB 150 (30.6 kg/m) @ 750mm c/c in crown and ISHB 200 @ 375mm c/c in sides with lagging over a 100mm thick shotcrete with wire mesh were provided as support measures.

The ultimate support indicated for "poor" and "very poor" conditions is similar. .However, the methodology for supporting differs. As it would be very difficult to excavate full height of walls in one go in "very poor" ground conditions, provision of a temporary invert strut at the time of half benching has been shown.

6.5.9.6 Overburden tunneling media:

The supporting measures for "overburden" reach are same as in "very poor" rock type but with reduced spacing of steel ribs i.e. ISHB 150 @ 500 mm c/c in crown and ISHB 200 @ 250mm c/c in side walls.

As the rock condition in the "very poor" and "overburden" category are likely to be very difficult, pre-support may be necessary to keep the opening stable till all the support elements are installed. Provision of forepoling, pre-grouting and consolidation grouting has been included in BOQ.

As full pressure relief can not be assumed through pressure relief holes, 350mm RCC lining has been suggested in the tunnel in "very poor" and "overburden" reaches to take care of water and part of ground loads.

Concrete lining (M20) thickness of 300mm has been provided for protection from weathering, long term stability and also to encase the ribs.

6.5.9.7 Cut and Cover tunneling media:

The cut and cover portion of the tunnels was designed using STAAD-III software. 500mm thick RCC box was designed for a 12m high backfill load and 6 m of water pressure loading. The foundation media was modelled as springs. The maximum axial force and moments were calculated for a load combination of self-weight, backfill and water load. Reinforcement was designed by limit state method.

The specifications and drawings for various classes of support are annexed as Annexure.

6.5.10CROSS SECTION OF THE TUNNEL:

The cross section of the tunnel has been decided so as to accommodate side drains of sufficient width to carry the possible seepage water likely to be encountered in the tunnels. The tunnel cross section has been designed to cater for electrification with 25 KV . Even properly constructed tunnels encounter the problems of the seepage water which at times trickles on the track resulting in the formation underneath losing its bearing capacity. This results in perennial maintenance problems of the permanent way in the tunnels. To avoid these problems the cross section has been designed with concrete flooring having a top cross slope of 1 in 40 for proper drainage.

6.5.10.1 **VENTILATION FOR LONG TUNNELS:**

6.5.11.1 Normally no artificial ventilation is required in tunnels of relatively short length as natural airflow is able to keep air quality and thermal effects within desirable limits. Even for somewhat longer tunnels, the piston effect caused due to movement of train inside the tunnel, causes considerable train induced airflow through the tunnel, which is able to keep the air quality and thermal effects within the limits for the operation of the trains in the tunnel. However in longer tunnels, natural air flow velocity decreases as one traverses inside the tunnel and hence contaminants inside the tunnel are not removed effectively.

6.5.11.2 The need for artificial ventilation system inside the tunnel arises mainly on account of operation of diesel locomotives. The line from Udhampur to Baramulla will have all trains hauled by diesel locomotives. The diesel power locomotive engines (compression ignited) release exhaust fumes containing hazardous contaminant gases of combustion (such as Oxides of Nitrogen i.e. NO, No2, Oxides of Carbon i.e. Co, Co2 and hydrocarbons i.e. acrolein and aldehydes etc.) and smoke at high temperature and in addition radiate heat from the radiating regions of the engine. These contribute to creating of undesirable thermal environment and air quality in the tunnel that may interfere with the efficient functioning of the locomotives, at times leading to stalling. In various operating conditions, normal and abnormal e.g. stalling of locomotives inside a tunnel, the concentration of these contaminant emissions is therefore to be maintained within the safe limits.

6.5.11.3 **REQUIREMENTS OF A VENTILATION SYSTEM**

6.5.11.4 The adequacy of ventilation whether induced by piston action or by forced ventilation in relatively long tunnels is to be assessed on its effectiveness.

6.5.11.5 to provide sufficient airflow relative to moving train to prevent its locomotive(s) from overheating and

6.5.11.6 to remove the residual smoke and diesel pollutants emitted by a train so that the succeeding train is exposed to a relatively clean environment.

6.5.11.7For better piston effect the tunnel cross sectional area should be as small as possible. The ratio of the train frontal area to tunnel cross section area adopted in Udhampur - Srinagar - Baramulla Rail project is upto 0.5 to 0.6. In normal running conditions the train traverses a tunnel at a relatively high speed. In such a situation, the train induced

(Piston effect) airflow through tunnel is sufficient and contributes substantially towards maintaining thermal environment within the permissible limits. However, in long tunnels natural airflow/induced airflow due to piston effect is not sufficient to maintain the contaminant emissions and ambient temperature within the tunnel below prescribed limits which are tabulated below:

Contaminant	Threshold limit value (in ppm)	Permissible variation limit (in ppm)	Short term exposure limit (in ppm)
CO	50.0	75.0	400.0
NO	25.0	37.5	35.0
NO2	5.0	5.0	5.0
CO2	5000 (TWA)	-	12000 (TWA)

- Threshold limit values are as adopted by the American Conference of Governmental and industrial hygienists as contaminant limits for working environments.

- Permissible variation limits are the limits upto which variation can be tolerated if they are compensated by equivalent variation levels below the threshold limit during the working day.

- Short-term exposure limits are limits upto which exposure can be tolerated for a short-term duration of about 15 minutes.

6.5.11.8 Temperature limits

6.5.11.8 For WDM2 loco

Threshold temperatures : Jacket temperature : 88 degree C
Ambient temperature : 55 degree C
Ambient temperature for passenger comfort : 50 degree C
Exhaust gas temperature : 600 degree C

6.5.11.8 **Design of Artificial ventilation system:**

6.5.11.9The artificial ventilation system is basically provided to supplement the natural airflow and the induced airflow. It has been found that tunnel with rough side walls will develop less piston effect and correspondingly the airflow augment for effective ventilation will also increase. In addition, power of the fan required to induce the airflow augment will also increase to overcome high friction of tunnel rough walls.

6.5.11.10 Based on the experience of various International Railways, the following coefficient of friction may be adopted for various types of tunnel wall surfaces.

a)	Unlined tunnel	0.065
b)	Fully concrete lined tunnels	0.022

6.5.11.11 The various parameters, which will effect the flow of air inside the tunnel are:

i) Tunnel length,
ii) Train length
iii) Train speed
iv) Train friction factor
v) Tunnel wall friction factor
vi) Ambient temperature outside the tunnel
vii) Tunnel wall temperature
viii) Fuel consumption, which will depend upon ruling gradient and speed
ix) Blockage ratio
x) Pressure drag coefficient
xi) Adverse train movement effect

Based on the various parameters listed above mathematical model for accessing the levels of environment hazards i.e. air quality deterioration and thermal pollution resulting from the gases and heat emissions from the locomotive, along the tunnel length was developed. It was found that if a tunnel is interrupted by a shaft open to the atmosphere or is cross ventilated by a parallel tunnel, the air flow in tunnel is considerably changed. Where the shafts divided the tunnel into sections, the pattern of air flow ahead of shaft is same as that of entering a new tunnel.

6.5.11.12 The output of model gave the following information:

1. The cumulative distance moved by pollution front from entrance.
2. The residual velocity of air inside tunnel minute by minute.
3. Flow rate required for blower fan, if ventilation is necessary.
4. Fan pressure in mm water gauge.
5. Temperature of air inside tunnel after passage of train.
6. Wall temperature inside tunnel after passage of train.
7. Average temperature and pollution concentration after passage of train.

The temperature, pollution content and position of pollutant gas front created by one train is treated as initial ambient conditions before the passage of next rain and model thus shows super imposed effect of successive trains for the given traffic patterns.

6.5.11.12 Based on model and experience gained in KORPAT - RAIGADA section of South Eastern Railway and KONKAN Railway, it has been found that in general for lined tunnels longer than 2 Km, forced ventilation is required if gradient is 1 in 100 (C). If any shaft or adit is provided in between, then the effective length for ventilation proposed gets reduced as if each section between the shafts or each section on either side of the shaft is a separate tunnel.

6.5.11.13 **<u>METHOD OF ARTIFICIAL VENTILATION</u>**

Proper flushing of pollutants by ventilation is ensured by providing fans and monitoring equipment. Monitoring of the environmental conditions in tunnels ensures that safe conditions prevail. Proper functioning of monitoring system is essential to avoid under or over ventilation. For proper monitoring, the tunnel will have sensors for CO, Nox visibility, temperature and fire detection. The sensors will have electrical out put for ease of processing. The visibility shall be tested by photoelectric devices in which light is passed through a 30 cm long tube and absorption of the light by particles in the contaminated air gives the measure of visibility.

6.5.11.14 **LOCATION OF THE SENSOR**

The location of the sensor will be such that the distance between them can be covered by flushing air in 5 minutes. This value has been arrived at taking into account the response time of the instrument and the interval of about 15 minutes available for flushing the tunnel by forced ventilation. In ventilated tunnels, where shafts are also provided one sensor in each of the tunnel segments of the tunnel is considered necessary. In general, sensor will be placed at about every 500 mtr. intervals. These sensors will run on the power from the service station but will also have battery back up.

6.5.11.15 **OPERATION OF TRAFFIC THROUGH TUNNEL**

The following precautions will have to be taken for proper operation of traffic through tunnel in general and through longer tunnels in particular:

- Fan operation should be carried out only when there is no train inside the tunnel as train movements will induce pressures on fan blades for which they will not be designed. The signals, which admit trains into sections with ventilated tunnels, will be interlocked with fan operation systems for this purpose. The ventilation system will be carried out after passage of up grade train only. It should be operated after every $3^{rd}/4^{th}$ train if the last train before operation is an up grade train.

- The higher the train speed through a tunnel, higher the piston effect and hence, better the clearance of pollutants and heat. Signaling system have been so devised that stop signals are located sufficiently away from either of tunnel portals, to make it possible for a train to come to a stop, completely clear of the tunnel.
- For some time after the passage of train, smoke generated by locomotives may blur the view of signals, especially if the train has passed at slow speed. Repeater signals shall be provided at suitable distance to enable the driver to get an idea of the signal aspect ahead.
- Two level lighting is to be provided in tunnels, so that in case of stalling of trains in tunnel, illumination level in tunnel can be increased immediately to restore confidence among the passengers and crew.
- The electronic warning system is required to be designed to give indication of infringement of permissible levels of Nox, CO, ambient temperature and smoke and also of occurrence of fire. Predetermined plan of action to meet such situations by ventilation system operators, train crew and staff at stations on either side and when necessary by passengers will have to be formulated to avoid delay and confusion after an unusual occurrence.

- Staff with working duties inside the tunnel should have easy access at convenient locations to properly maintained gas masks in case of emergency. The reagent used in these gas masks will be replaced from time to time.
- In tunnels provided with ventilation system, an efficient system of telephonic communication will be established connecting train crew, SM on either side of the tunnel, ventilation system operators and section and Deputy Controllers to enable them to communicate quickly with each other during the unusual occurrence, emergencies etc. as timely action can effectively restrict damage to property or hardships to passengers.

PERMANENT WAY

6.6 RAILS AND SLEEPERS

6.6.1 It is proposed to adopt a track standard using 52 Kg. 90 UTS new rails with PSC sleeper M + 7 density for the main line. The running loops will have a track standard of 52 Kg. Rail with M + 4 sleepers density. As stipulated in Railway Board's letter No. Track/21/95/0800/7 dated 6/2/95, head hardened rails will be required to be used on main line for all sections where the gradient is steeper than 1 in 150 and/or the curves are sharper than 2 degrees.

6.6.2 The points and crossings to be negotiated by passenger train will be of 1 in 12 on PSC sleepers layout and the remaining points and crossings will be of 1 in 8 –1/2 on PSC sleepers layout. 52 Kg. Rails will be used for points and crossings.

6.6.3 As per the provisions of the P.Way manual , it is possible to provide LWR/CWR with the aforesaid track structure at a gradient of 1 in 100 (C). Since the ruling gradient of the line is 1 in 100 (C), it will be possible to provide LWR/CWR on most of the length of the track including the curves since none of the curves in the project is sharper than 500 m radius. However locations with reverse curves will be isolated and may be laid on SWR unless the radii of the curves involved in these reverse curves are laid with a radii of 1500 m or flatter. Similarly the LWR will also be discontinued on steel girder bridges having an overall length of more than 20m and having no ballast.

6.6.4 LINKING OF P.WAY

P.way will be linked by transportation of PSC sleepers through the road transport. Linking of rails may be done by using the service rails for suitable length. This stretch may be used for transportation of 20 rail panels on the BFRs which can then be laid in the track and the service rails can be released. These service rails can be transported ahead and the cycle repeated to get a track with 20 rail panels. Subsequently these 20 rail panels may be welded through in situ Alumino thermic welding by SKV process.

6.6.5 BALLAST

Machine crushed ballast with 30 cm cushion may be provided for the main lines and a cushion of 20 cm may be provided for the loops. This will result in a requirement of 2.158 cum/m for the straight LWR track and 2.243 cum/m run for curved track. The profile of the ballast will be as per the provision of the P.Way mannual.

6.6.5.2 Ballast will be procured as per lattest RDSO's specifications circulated vide Bd's letter No.RS/F/7/4 dated 14/6/99.

6.6.5.3The alignment from Udhampur - Qazigund is criss crossed with innumerable nallahs. Most of these nallahs contain hard and durable stone boulders. These boulders can therefore be used for supply of ballast. However before zeroing on a source, the Los Angeles abrasion test and aggregate impact test may be carried out to ensure that the quality of stone lies within the stipulated norms circulated by RDSO. Stone crushers can be installed at suitable locations for the purpose.

6.6.5.4 For the Valley no difficulty for procurement of ballast is anticipated and it should be possible to procure the ballast from the stone crusher already installed in the area.

6.7.0 STATIONS AND BUILDINGS

6.7.1 There are 28 stations on the proposed on Udhampur – Baramulla line, the most important being Katra , Qazigund, Anantnag and Srinagar. Baramulla is a terminal station. The traffic facilities proposed at various stations are based on the assessment made by CTSO/Const./ Survey as per annexure VI/X. At Srinagar station, the facility of six looplines have been provided and at Qazigund the facility of four loop lines have been provided. At Katra, Banihal, Anantnag and Awantipora facility of three loop lines have been provided. On all other stations, two loop lines have been provided. The minimum length of loop lines at all stations has been kept as 716 M and the minimum length of passenger platform is sufficient to accommodate 18 coaches. Accommodation of the station building has been decided depending upon the volume of traffic likely to be dealt with at a particular station. For this purpose, the standard type plan namely Type A, B, C & D issued by Headquarters Office, Baroda House, New Delhi will be used. However for important stations like Srinagar and Katra which will be handling a large amount of tourist traffic, special plans have been developed. The facility of high level passenger platform shall be provided at stations Katra, Banihal, Qazigund, Anantnag, Srinagar, Pattan, Sopore and at Baramulla. At all other stations, rail level platforms have been provided. The provision for goods siding, goods platform has been kept at station, Katra, Banihal, Qazigund, Anantnag, Srinagar, Pattan, Sopore and at Baramulla as per the requirement reflected by the traffic survey. ART siding has been provided at Qazigund since Qazigund is the commencement of the ghat section. Keeping in view the heavy tourist potential of Katra and Srinagar, tourist sidings have been provided at both these stations. The detailed facilities at each station are attached as a separate Annexure.

6.7.2 **RESIDENTIAL BUILDINGS**

6.7.2.1Detailed list showing the quarters required to be constructed at each station is shown as annexure VI/XI. The different type of quarters are proposed to be constructed in brick masonry with RCC roof slab accordingly to standard drawings having plinth area as fixed by Railway Board.

6.7.2.3 Provision of quarters for essential staff has been made at all the stations on cent percent basis, while keeping in view that the provision of total quarters does not exceed 60% of the total requirement of quarters in whole scheme.

CHAPTER-VII
(SIGNALING AND TELECOMMUNICATION)

SIGNALLING

The project has been planned with standard-III interlocking working with centralized traffic control. The system centralized control has been adopted keeping in view the type of terrain from where the alignment passes particularly in the large stretch of 145 kms. between Katra to Qazigund. Care has been taken to ensure a back-up for the operation in case of failure of the communication cable.

Keeping in view the modern developments, the entire signaling has been planned with solid state interlocking. The choice of this technology has primarily been made since this system is much safer than the conventional system of interlocking. Solid state interlocking will not only be easy to maintain but will also result in saving of considerable manpower for maintenance. The normal schedules for indoor maintenance of conventional system will not be required for solid state interlocking. This system will also permit easy expansion for all future yard remodellings. The failure rate of this system is also very low since it does not have any moving parts. Also as opposed to the conventional system no manpower will be required on the stations on day-to-day basis for indoor maintenance.

The solid state interlocking will also help in standardisation of the design of the signaling system for yards having similar facilities. Thus the design of a three line station once finalised will be reproduced at all other stations requiring similar facility. The system therefore is not only more cost effective but will also result in saving of the design time and ultimately the project execution time.

The signaling system also provides for automatic train stop system wherein the trains will automatically stop in case the driver violates the stop aspect of the signal. The system also provides for a facility to monitor and control the speed of the driver at specified locations such as loops and other locations where tempórary or permanent speed restrictions are in forced.

In the centralised control system all the stations will be controlled from a centralised location. This will facilitate not only day-to-day operation of the train in a more efficient fashion than the conventional manual system but will also permit better scheduling of trains resulting in an overall increase in the line capacity. Since the Centralised monitoring equipment is an integral part of the system, there is a facility for data logging which comes handy for prempting failures and for designing scientific schedules of each element of the system. The entire system therefore works smoothly practically without any failure. The system provides for automatic sensing of block occupation. Cases of the full train not arriving at the station will be detected automatically thus eliminating the human intervention which in the past has been cause of many serious accidents.

Provision has been made for pre warning the approach of the train at all the level crossing gates by providing an audible and visual alarm actuated by occupancy of the train, a track 1 km in advance of the level crossing gates.

Use of LED lamps has been made in place of conventional G type bulbs in signals to ensure that the lamp never goes out i.e. the signal in no case indicates a blank status. The use of LED lamps also reduces the amount of maintenance required.

TELECOM. PORTION

It is presumed that the section will be the single line and will remain non-electrified and no provision for electrification has been catered presently. However, since all the work has been planned either on satellite communication or on underground cable, the telecommunication network will not get affected by electrification of the route.

IMPORTANT FACILITIES CATERED FOR THE SECTION

One control centre controls the movement of all the trains in the section on control communications. All the instructions for despatch and arrival of the train are passed on to and fro from the control central to the way side stations.

Availability of communication from level crossing gates to the nearest station and ensure safe movement of trains and road traffic and also the gate man can inform failures like hot axle box, parting of trains, fire etc. to the nearest station.

Exchanges have been planned at major stations keeping in view the communication facility required with major cities all over country.

Provision of Mobile communication ensures direct communication between driver and guard and their communication from the nearest station. This will facilitate the crew of one train to establish communication with other trains also. This helps in better operation and movement of trains in the section. To help in trouble shooting for minor problems resulting in immobilisation of the trains, the system provides for a communication between driver and the maintenance staff. Thus the presence of the maintenance staff may not be required for attending to the minor problems. This will greatly facilitate the operation resulting in overall enhancement of the line capacity.

Communication system will work on optical fibre system which is a proven system for better efficiency. Since the communication in the system is vital for maintaining the train operation, no interruption for the communication can be tolerated. As such to ensure an uninterrupted service at all points of time, communication system has also been planned through satellites as a back up measure. Satellite communication system has been planned at all the stations by having 26 dedicated terminals and 1 hub of the Railways. Channels/band/ width will be taken on hire on demand assigned basis presently planned to be taken from NIC for the back up support to disaster prevention measures like landslide, terrorists activity etc. The dedicated terminals will act as back up for control lines, mobile communication and for CTC. In case of failure of communication on cable, the communication will be established via satellite. Thus, all the stations can establish communication with any terminal anywhere in the world.

Wayside emergency phones are extensively used for emergency purposes and for maintenance works in the section. They have therefore provided at each km and are connected to emergency control in the control office.

All major yards having shunting facility are planned with yard communication wherein the maintainer in the yard can be paged and called to attend to any emergency situation.

Train display system provides an essential passenger amenity. This indicates the arrival and departure time and platform on real time basis. IVRS and face to face enquiry facility has also been provided.

Passenger reservation system for providing ON LINE RESERVATION facilities at Jammu, Katra and Udhampur from tourists point of view has been catered.

The announcement regarding arrival and departure of trains, any messages from the public and general announcement for security and safety of the passenger has been catered for all the major stations. The public address system at the clock/time display are synchronized by PC based master system.

The facilities provided for communication are summed up below:-

1. Control communication
2. Communication at all wayside stations on optical fibre cable.
3. Communication at all level crossing gates on quad cable.
4. Exchanges at major terminals
5. Interconnectivity between exchanges
6. One divisional office to monitor the entire section of 280 kms having exchanges, intercoms, fax, LAN ,hotline, truck exchange, music system, fire fighting system, control office and video conferencing facility.
7. Emergency communication for drivers and maintainers in the section
8. Mobile communication by providing *leaky* co-axle cable in the entire section or by having *leaky* co-axle cable in tunnels and radio base station where line of sight is available.
9. Provision of v sat hub linking the divisional office with the headquarter and have a control communication from one end to the extreme distant end of the section.
10. Provision of cctv at major stations for surveillance .
11. Provision of public address system, provision of clock on platforms.

12. Provision of computerised reservation system at three major stations – Jammu, Katra and Srinagar.

13. Yard communication at all stations and paging and talk back system at five major stations where shunting is permitted.

14. Train display board, face to face enquiry and IBRS facility at five major stations.
15. Control communication
16. Communication at all wayside stations on optical fibre cable.
17. Communication at all level crossing gates on quad cable.
18. Exchanges at major terminals
19. Interconnectivity between exchanges

CHAPTER VIII

ELECTRICAL

8.0 GENERAL

8.1 Out of 28 stations in the project, 8 railway stations namely Udhampur, Katra, Salal Road, Sangaldan, Banihal, Qazigund, Srinagar & Baramulla would be major stations from electrical point of view. The electrical works which are required to be carried out on this project are listed below :-

(x) Electrification of station buildings and station platforms.

(xi) Electrification of railway yards for general lighting.

(iii) Electrification of service buildings such as, PWI/IOW/TXR/RPF/EFO office and health unit etc.

(iv) Installation of pumping units.

(v) Electrification of level crossings.

(vi) Provision of battery charging/precooling facilities on PFs/washing lines.

(xii) Electrification of railway staff quarters and L.T. distribution network and provision of street lights.

(viii) Ventilation and electrification of tunnels.

(xiii) Generating interface facilities for availing power supply from Electricity Board.

(xiv) Provision of sub-stations.

(xv) Modification of electrical overhead crossings.

8.2 ELECTRIFICATION OF STATION BUILDINGS/ PLATFORMS ETC. :

8.2.1 For the design of electrical installations, the station buildings/platforms will be provided with an intensity of illumination as per Rly. Bd.'s letter No. 86/Elec.1/138/1, dated 2.12.88 and 19.3.96. The station buildings/platforms have been provided with the following facilities as per the laid down norms.

8.2.2 All the covered premises viz. SM/ASM rooms, booking offices, rest rooms, waiting halls, S&T cabins, electrical switch rooms etc. will be wired in concealed conduit wiring with single core PVC multi- strand aluminium cable. Provision of other fittings/accessories such as flush type switches, sockets, ceiling roses, distribution boards, sub-main boards and FSUs/MCBs will be as per relevant ISS. Electrical feed to main distribution board will be taken through L.T./XLPE cables of proper sizes. Small stations will have a switch board in SM/ASM room where electrical connection from state electricity board will be received and energy meters will be installed. This switch board will have controlling switches for lights and fans circuits of different areas.

8.2.3 For non power points flush type sockets and switches of 5A/15A are to be provided, but for air conditioners and water coolers industrial plugs and sockets with 32A MCBs/SPN are to be provided. The elect. control of S&T cabin would be through a separate cable connection from main switch board.

8.2.4 The platform shed will have surface conduit wiring with s/core PVC aluminium cable of proper size for lights and fans circuits with single control sub-main distribution board having MCBs of proper capacity. The connection of this wiring with main LT switch board will be through proper size of L.T. cables. Uncovered area platforms will have 7 M long swaged pole having a span of 30 Mts. The light fittings will be wired with proper size of aluminium conductor PVC single core cable. The inter-connection of poles will be through 2/4 core 16 sq.mm LT/XLPE cable.

8.3 ELECTRIFICATION OF RAILWAY YARDS FOR GENERAL LIGHTING :

8.3.1 The major stations namely Udhampur, Katra, Banihal, Qazigund, Srinagar, Pattan, Sopore and Baramulla will have yards for stabling goods trains sidings/washing lines etc. The yards will be illuminated through flood light towers to be erected at desired locations with HPSV flood light fittings to achieve required level of illumination.

8.3.2 30 Mts. high towers provided with 4 Nos. 2x400 Watts HPSV flood light fittings will be erected. The height of tower may however be reduced as per site conditions and towers can be provided with 4 Nos. 2x250 Watt HPSV flood light fittings on each tower. The wiring is to be done with S/Core PVC aluminium in GI pipe with proper connections. Each tower will have sub-main panel with MCB of adequate capacity for controlling fittings of tower. Electrical feed to tower will be done with L.T. XLPE cable and be connected through feeder pillar/L.T. Panel installed for controlling of Flood light towers.

8.4 ELECTRIFICATION OF SERVICE BUILDINGS :

8.4.1 All major stations will have PWI/IOW/EFO/ RPF/TXR offices and hospital/health unit/pump houses/sub-stations etc. These buildings will have concealed conduit wiring with PVC s/core multi-strand aluminium cable of adequate size and other accessories such as flush type switches/sockets/ ceiling roses etc. to be provided as per practices of relevant ISS. The main/sub-main boards will be connected through L.T. XLPE cables of adequate size matching with load.

8.4.2 The building will have 1x40 Watt. /2x40 watt. box type/ mirror optic tube light fittings to have desired illumination level. An illumination level of 500 lux is recommended at these places. Ceiling fans of 1200/1400 mm sweep will be provided in offices.

8.4.3 Each office building will have 150W HPSV fitting on front wall for lighting/general lighting. The power main for building will be connected through L.T. XLPE cable with O/H network or through cable with feeder pillar.The hospital/health units should have separate electrical wiring for general and emergency load and have separate L.T. main for emergency connected through L.T. XLPE to emergency feeder pillar/panel.

8.5 INSTALLATION OF PUMPING UNITS :

8.5.1 All the major stations will have tube-well and pumping unit to cater the need of staff as well as passengers. The pumping units will be provided at stations having more than 50 quarters/service buildings and other passenger amenities like retiring room, rest rooms, big passenger halls etc. namely at Udhampur, Katra, Salal Road, Sangaldan, Qazigund, Srinagar and Baramulla

8.5.2 Concealed conduit wiring will be provided in pump houses with adequate light and fan arrangement. Driving motor of pump will have starter units with all protection and indicating arrangements as per relevant ISS.

8.5.3 At location of underground tank HS pump of suitable capacity will be provided to raise water to overhead tank. Operation of pump is to be automatic through timer and water level gauge indicator.

8.6 ELECTRIFICATION OF LEVEL CROSSING :

8.6.1 Each level crossing will have a type-I quarter a goomty and two level crossing gates. The goomty and quarter will be wired with concealed conduit wiring. No. of elect. points to be provided in quarter as per scale prescribed vide Rly. Bd. Letter No. 52-Elect/Plg/0/III dated 15.6.89. The goomty will have one ceiling fan of 1200 mm and one 1x40 watt. Box type fluorescent tube light fitting.

8.6.2 10 Mt. Long swaged pole will be erected on each side of gate and 250 Watts. HPSV light fitting will be provided for road lighting connected by an underground LT XLPE cable through underground GI pipe. Separate electrical connection of 3 KW load will be availed from state electricity board for each level crossing.

8.7 PROVISION OF BATTERY CHARGING/PRE-COOLING FACILITIES FOR A.C. COACHES ON PLATFORM AND WASHING LINES

8.7.1 All the major stations will have Battery charging and pre-cooling facilities for coaching stock at washing lines/stabling lines and platforms. For battery charging on platforms adequate no. of battery chargers of 200A capacity, 125-140 DC output will be provided. Input will 3 phase 415 V, AC. DC output will be routed on platform lines through LT XLPE cables of suitable sizes matching.

8.7.2 110 V battery charging points will be controlled by an MCB/DP 63 Amp. D.C. The arrangement of battery charging point will be as per CEE/N.Rly. drawing & specifications.

8.7.3 Pre-cooling facilities will be provided by installing 3 phase A.C. pre-cooling points having 100 Amp. I.C.T.P.N. with 200A bus bar. These pre-cooling points will be 30 metres apart. The A.C. pre-cooling points to be erected along railway lines through a three core 120 sq.mm L.T. XLPE cable will be controlled from L.T. panel placed on platform in battery charger cage.

8.7.4 The battery charger, battery charging points and AC pre-cooling points will conform N.Rly. drawing and specifications and relevant ISS. Arrangement on similar pattern will be made on washing lines for battery charging and pre-cooling facilities.

8.7.5 For illumination of washing lines provision of 9/10 Mts. high swaged steel poles will be made. These poles will have span of 25 Mts. Each pole will be provided with to HPSV fittings of 125 Watts. each. These poles will be fed through suitable underground cables or overhead lines.

The sick line shed will be illuminated internally by 250 Watt. HPSV high bay fittings. 250 Watt. HPSV flood light fittings to be provided in the open area for illumination.

8.8.0 ELECTRIFICATION OF STAFF QUARTERS AND L.T. DISTRIBUTION NETWORK INCLUDING STREET LIGHTING :

8.8.1 On the entire Udhampur-Baramulla section following staff quarters will be constructed which will need electrification.

Type I	748 Nos.
Type II	198 Nos.
Type III	89 Nos.
Type IV	42 Nos.

8.8.2 The electrical points required to be provided for each type of quarters will be as per N.Rly. Hd.Qr. directives. The scale as per which the fittings are provided is described below:-

Type	Light Point		Plug point		Ceiling fan point	Call bell point
	1x40 W FL fittings	Lamp point	5 A	15A		
I	1	5	3	-	2	-
II	2	4	4	1	2	-
III	2	6	3	2	3	1
IV	4	6	4	4	4	1
V	5	11	7	6	6	2

8.8.3 The quarters will be wired with concealed conduit wiring system of single core PVC aluminium and flush type switches and sockets to be used conforming to relevant ISS. Each block of quarters will have one single/three phase distribution board with suitable outlets to connect each quarter with main cable of suitable size (single core PVC cable of 10 Sq.mm/16 Sq.mm). Proper earthing system should be provided with suitable G.I. wire for each quarter. The block main distribution board will be connected through L.T. XLPE cable of suitable size from overhead network or feeder pillar as per LT distribution design. For double/multi storeys blocks, provision of staircase lights will also be made.

Entire wiring and electrification will be as per relevant ISS.

8.8.4 The whole system will be fed through an overhead network by erecting poles and providing suitable size ACSR conductor to cater electrical load. For the roads/parks elect. pole will have FL street light fitting of 1x40 Watt./1x70 Watt. HPSV fitting.

8.9 VENTILATION & ELECTRIFICAITON OF TUNNELS :

8.9.1 There are total 81 tunnels of varying lengths on UDHAMPUR- BARAMULLA section out of which 10 tunnels will have length more than 2 KM each tunnel. A tunnel having length more than 2 KM is considered a long tunnel and a forced ventilation is needed in those tunnels. Details of location/length of such tunnels are indicated below :

Sl. No.	Location at KM	Length of tunnel in Mts.
1.	1/200 to 5/175	3975
2.	11/625 to 14/250	2625
3.	27/325 to 30/025	2700
4.	30/475 to 34/550	4075
5.	40/275 to 46/350	6075

6.	49/200 to 51/475	2275
7.	55/800 to 57/875	2075
8.	58/400 to 60/850	2450
9.	135/625 to 135/125	2500
10.	154/200 to 164/250	10050

8.9.2 The design of ventilation system provides for :

i) Jet fans complete with associated switchgears and timers.

ii) Sensors for sensing the temperature, visibility and pollution level.

iii) Power cum control panel for each tunnel.

iv) Power cables underground and on tunnel walls for giving power supply to jet fans.

v) Multi-core control cables for monitoring system such as temperature sensors, visibility sensors and pollution sensors.

vi) Electric sub-station at each face of the tunnel with a provision of standby DG set to cater for power supply requirements.

8.10 DESIGN PARAMETERS FOR VENTILATION OF TUNNELS WITH JET FANS :

TECHNICAL SPECIFICATIONS :

8.10.1 Power Supply Arrangements :

i) The sub stations provided on each face of the tunnel will depend upon the length of tunnel. For this purpose, the design of the sub stations has been classified in three categories viz. for the long tunnel of 10 kms at Banihal, tunnels with a length of 3 kms and above and tunnels between 2 – 3 kms.

ii) 2x1000 KVA, 11/0.4 KV Sub-station alongwith 1x500 KVA, 415 V, 3 phase DG set is required to be provided at each end face of following tunnel :

SL.No.	KM No.	Length of tunnel in Mts.
1.	154/200 to 164/250	10050

ii) 2x500 KVA, 11/0.4 KV Sub-station alongwith 1x310KVA, 415 V, 3 phase DG set are required to be provided at each end face of following tunnels:

SL.No.	KM No.	Length of tunnel in Mts.
1.	1/200 to 5/175	3975
2.	30/475 to 34/550	4075
3.	40/275 to 46/350	6075

iii) 2x315 KVA, 11/0.4 KV Sub-station alongwith 1x250 KVA, 415 V, 3 phase DG set are required to be provided at each end face of following tunnels :

SL.No.	KM No.	Length of tunnel in Mts.
1.	11/625 to 14/250	2625
2.	27/325 to 30/025	2700
3.	49/200 to 51/475	2275
4.	55/800 to 57/875	2075
5.	58/400 to 60/850	2450

6.	135/625 to 138/125	2500

8.10.2 **THRESHOLD POLLUTION LEVEL**

The ventilation system shall be so designed that the contamination level inside the tunnel is within the acceptable limit. Pollution threshold values are as follows :

CO : 50 ppm

NO : 25 ppm

8.10.3 **STALLING OF TRAINS**

The ventilation system shall be designed for normal train working condition. The condition of TRAIN STALLING inside the tunnel shall not be considered in designing the system.

8.10.4 **INCIDENT OF FIRE**

The design of the ventilation system does not cater for the increased fumes likely to be encountered as result of a fire inside the tunnel. In fact the operator in the control room shall not switch on any fan in case of fire inside the tunnel as the fanning action may propagate fire further.

8.10.5 **INTERLOCKING**

To ensure the safety of the working personnel, general interlocking of the equipment usually provided for traction equipment will also be provided for the ventilation system of the tunnels.

This will ensure that no live part, rotating parts are accessible unless it is shut down and controlled by interlocking system .

8.10.6 CABLING

8.10.6.1 All power cable shall be XLPE insulated, HR PVC sheathed armoured, 3-1/2 core alum. Conductor of requisite capacity conforming to the relevant IS/specification.

8.10.6.2 Cable will be laid underground/in cable trenches (from sub-station to control room and control room to tunnel porter) with warning covers and cable root markers. These can be mounted on tunnel walls also on cable cleats or hangers.

8.10.7 **CONTROL CABLES**

Control cables shall be heat resistant, PVC insulated, PVC sheathed, armoured, multi-core copper conductors of requisite capacity (not less than 2.5 Sq.mm) conforming to relevant ISS.

8.10.8 INTERCONNECTION OF POWER SUPPLY

Inter-connection of the sub-stations at the two end faces of the tunnel with 2.2 KV power supply system will be required. However, remote control system for operation of all the equipment necessary interlocking including supply, laying and connecting of the control cables will also be needed.

8.10.9 INTER-CHANGEABILITY

8.9.9.1 Parts, components, fittings and similar equipment shall be made inter-changeable. The equipment/switchgears etc. shall be so selected that the replacement spares are available indigenously.

8.10.10 JET FANS

8.10.10.1 Jet fans shall be used for ventilating the tunnels where shafts are not provided. Longitudinal ventilation of the tunnels shall be effected by means of jet fans suspended from the ceiling of the tunnels. A series of jet fans shall deliver air in the desired direction at high velocity.

8.10.10.2 The size and no. of jet fans will be designed as to clear the diesel smoke and other pollutants from the tunnel within 15 minutes of operation and maintain an air flow at a velocity of 4-5 M/sec. It shall also be possible to clear the tunnel of the pollutants with half the nos. of jet fans within 25 to 30 minutes time. The overall size of the jet fan unit shall be such as to clear the height for 25 KV AC traction system.

8.10.11 JET FAN MOTOR

8.10.11.1 Jet fan motors shall be non-reversible, horizontal shaft, weather proof, totally enclosed, fan cooled, high torque. Three phase, 400 +- 5% volts, 50 +- 3% Hz AC operation continuous rating, induction type suitable in all respects for driving the associated fan to which it will be connected.

8.10.11.2 Motor shall be suitable for outdoor installations but subject to severe moisture conditions and specifically designed to prevent deterioration from such exposure.

8.10.11.3 The rated horse power shall be such as to limit the temperature rise under continuous rated fully load conditions at the operating site.

8.10.12 <u>POWER SUPPLY AND PROTECTIVE SWITCHGEAR FOR JET FANS</u>

Power supply shall be fed to the fan motor through starter unit with suitable back-up protection like encapsulated circuit breaker/MCCB which shall incorporate under voltage tripping arrangement for taking power supply when the supply voltage is lower than 360 volt, 3 phase 50 Hz.

8.10.13 <u>POWER CONTROL PANEL BOARD/DESK TYPE CONSOLE</u>

8.10.13.1 Floor mounted, totally enclosed with lockable doors, weather vermin proof made of 14 gauge sheet steal, control panel board/desk console shall consist of mimic diagram for indicating train position. MCBs, volt meter, ammeter, frequency meter, selector switches, operating switches shall be provided as per requirement.

8.10.13.2 SENSOR

Following sensor units will be provided :

a) Gas monitoring equipment & sensors.

b) Visibility sensor

c) Tunnel temperature monitor.

8.11 TUNNEL LIGHTING SYSTEM

8.11.1 Adequate lighting shall be provided inside of tunnel by installing 70 Watt. HPSV light fittings at 20 M interval which shall given an average illumination of 8 lux (a minimum intensity of 5 lux and maximum intensity of 10 lux when all the lights are switched on).

8.11.2 For tunnel lighting power supply shall normally be from the tunnels of stations. In case of failure of power supply from sub-station, lighting will be managed from small DG sets of 10-15 KVA to avoid unnecessary running of higher rating DG sets meant for ventilation system.

8.11.3 Light fittings shall be provided on both sides of tunnel.

8.11.4 Only few lights provided near emergency sockets and trolley refuges shall work round the Clock.

8.11.5 In case of stalling of train, all the lights shall be switched on by the control room operator. The control room supervisor will know about the stalling of train through mimic diagram.

8.11.6 Power socket at an interval of 100 M shall be provided inside the tunnel so that major repair and construction activity can be done by using portable flood lights.

8.11.7 Power socket for emergency flood lights as required by the parties working inside the tunnel shall also be distributed on two phases.

8.11.8 All the lights in the tunnel need not to be switched on for working parties inside the tunnel. A stretch of 1 KM shall normally be switched on, where the work is in progress. When the working activity shift to next stretch, the tunnel shall be illuminated to that stretch of 1 KM and the previous stretch shall be switched off. This shall be done by communication between the working party and the control room operator through emergency socket.

8.11.9 This shall be done by providing a small relay in each lighting fitting and running of control cables from light fittings to the control panel where necessary operational switches shall be provided.

8.12 SOURCE OF ELECTRICAL POWER SUPPLY

8.12.1 The electrical power supply connection for various stations will be obtained from J&K state electricity board. For smaller stations a small switch room will be built at station premises to house state electricity board energy meter and other electrical equipment. However, whereas electrical load is 100KW or above 11/0.4 KV sub-station of suitable capacity will be installed. The electrical sub-station will be located at following stations :

a) 2x500 KVA sub-station at :

i) KATRA

ii) SRINAGAR

iii) BARAMULLA

b) 2x250 KVA Sub-station at :

i) QUAZIGUND

ii) SALAL ROAD

Tentative connected electrical load at various stations on the section will be as under :

Sl.No.	Name of Station	Electrical Load
1.	Udhampur	-
2.	Chakarwaha	35 KW
3.	Tikri	35 KW

4.	Katra	438 KW
5.	Riasi	35 KW
6.	Salal Road	330 KW
7.	Surukot	35 KW
8.	Barala	35 KW
9.	Sangaldan	90 KW
10.	Kohli	35 KW
11.	Loale	95 KW
12.	Nachlana	35 KW
13.	Arpinchla	35 KW
14.	Banihal	93 KW
15.	Charil	35 KW
16.	Qazigund	428 KW
17.	Sadura	35 KW
18.	Anantnag	35 KW
19.	Panjgam	35 KW
20.	Awantipur	35 KW
21.	Kakapore	35 KW
22.	Pampore	35 KW
23.	Srinagar	480 KW
24.	Badgam	35 KW
25.	Rajwiansher	35 KW
26.	Pattan	35 KW
27.	Hamre	35 KW

28.	Sopore	35 KW
29.	Baramullah	450 KW

8.12.3 For station building having electrical load 100 KW or more, power supply from J&K electricity board will be availed or 11 KV system because a 11/0.4 KV sub-station will be got up. For stations where electrical load is below 100 KW, 3 phase power connection will be availed on 400 volts CT system.

8.13 PROVISION OF SUB-STATIONS :

8.13.1 The station having large no. of quarters, pumping unit, yard lighting and other electrical load such as battery charging, pre-cooling, facilities will need elect. sub-station of suitable capacity to handle electrical load with more reliability.

8.13.2 2x500 KVA sub-stations are proposed at Katra, Qazigund, Sri Nagar and Baramullah and 2x250 KVA sub-station are proposed at Salal Road, Sangaldan and Banihal.

8.13.3 The electrical sub-station will be set up in a separate building to house electrical equipment. Transformers of 500/250KVA 11/0.4 KV capacity will be used depending on load requirement. Suitable HT/LT boards will be erected depending on load requirements. These equipment will conform to N.Rly. design/specifications and relevant ISS. The sub-station will have separate room for housing metering cubical & HT panel of state electricity board.

8.13.3 Sub-station having 2x500 KVA transformers will be provided with 1x250 KVA DG set and 2x250 KVA sub-station will have 1x160 KVA DG set to meet with the emergency requirement of electrical power. These DG sets will be complete with AMF panel.

8.14 MODIFICATION OF O/H POWER LINE CROSSINGS OF STATE ELECTRICITY BOARD.

8.14.1 Along the route of railway line on the section no. of power line crossing of different voltage grades i.e., 440 V, 11 KV, 33 KV, 66 KV, 132 KV, 220 KV and 440 KV belonging to state electricity board will cross the railway tracks at different locations.

8.14.2 All these crossings will have to be modified as per stipulation of Railway crossing rules of 1987. The 440 V, 11 KV and 33 KV O/H crossings are to be modified with underground XLPE cable of suitable voltage grade and size as desired by the State Electricity Boards. However, 66/132/220/440 KV crossings will be modified by the State Electricity Boards in conformation to 1987 crossing regulations.

8.14.3The detail of these crossings are as under :

Voltage Grade of Crossing		**No. of xings**
1.	440 V	244
2.	11/33 KV	71
3.	132/220 KV	64
4.	440 KV	12

CHAPTER IX

9.0 TRAFFIC SURVEY AND RATE OF RETURN

9.1 The detailed traffic survey report forms a separate volume wherein the assumptions leading to the traffic projections and the details of the cost have been discussed. The synopsis of the report is discussed in this chapter.

9.2 GENERAL

9.2.1 J&K State is presently served by a B.G. line extended from Pathankot to Jammu Tawi in 1972. This rail link is being further extended up to Udhampur and is likely to be available for traffic use by the month of December 2001.

9.2.2 The freight & coaching traffic to and from J&K State is presently, being handled at stations near Jammu Tawi i.e. coal & military traffic at Bari Brahamna and Military coaching and freight at Sambha. Industrial belt of J&K State is located between Jammu-Bari Brahamana.

9.2.3 The districts beyond Jammu are not linked by rail, thereby depending solely on road transport with other parts of the country.

9.2.4 It is due to inadequacy of rail network in the J&K State that the road net work is the life line for transportation. Presently Jammu and Lakhanpur Toll Post are the exit and entry points for rail and road traffic respectively for the State.

9.2.5 The main constraints in the movement of traffic by road, to and from the area, is the frequent traffic blockades on NH-1A because of heavy snowfall in the Pirpanjal mountain ranges and land slides during winter and monsoons.

9.2.6 A well knit and efficient transport system, major constituent of which is rail transport, is a pre-requisite for communication facilities.

9.2.7 The State of J&K has common borders with Tibet and China in the East and North East, U.S.S.R. and Afghanistan in the North and North West and Pakistan in the West and South West.

9.2.8 The State of J&K also holds an exalted status by virtue of its tourist attraction, both for National and

International tourists. The main visiting places are Amarnath, Vaishno Devi, Kheer Bhawani, Hazrat Ball etc.

9.2.9 With the incoming of Mass Transport means all the activities in the area will get manifold boost. It will reduce the journey time and would be much more comfortable, safe, eco friendly and economical.

9.3 ADMINISTRATIVE JURISDICTION AND CONTROLLING.

9.3.1 The proposed new rail section of 287 kms route length would be under the administrative jurisdiction of Ferozpur division till creation of a new division and divisional office at Jammu/Udhampur with Control office at Jammu Tawi/Udhampur as the case may be.

9.3.2 As per the assessment of the traffic potential on the alignment, most of the station will handle passengers traffic only. However, some important stations such as Katra, Qazigund, Anantnag, Srinagar and Baramula will generate passengers as well as goods traffic. Therefore, these stations have been proposed to be opened for both goods and passengers traffic and required facilities proposed.

9.3.3. As per letter No. 24301/14/B/Q1/(OPS) dt.11.5.98, suitable ramps for loading/unloading at least two miltary special trains, at Srinagar, Baramula and Pattan, have been proposed.

9.3.4. The proposed railway stations are to be provided with Standard-III interlocking and multiple aspect colour light signaling throughout the section as per the standing instruction of the Rly. Bd. The traffic density on the project section is, however, not anticipated to be heavy.

9.4 TRACTION FOR NEW RAIL LINK.

9.4.1. Diesel double heading of both passenger and freight trains is proposed between Udhampur-Qazigund as the rolling Gradient is1 in 100.

9.5 RULLING GRADIENT

1 in 100

9.6 SYSTEM OF WORKING

Absolute block single line working with panel instrument for line clear and working of trains.

9.7 ACCIDENT RELIEF MEASSURES.

The accident relief train with necessary ancillary equipment already Headquarter at Jammu Tawi to be headquartered at Udhampur by the time line is constructed and becomes operational in view of extension of Jammu Tawi rail head to Udhampur-Katra etc., would be utilised for attending to all major and minor accidents occurring on the project section.

9.8 MAINTENANCE OF RAKES OF PROPOSED TRAINS.

Primary maintenance facilities at Katra and Srinagar and secondary maintenance at Baramulla and Qazigund.

9.9 REQUIREMENT OF OPERATING STAFF AND STAFF QUARTERS.

For 28 new block stations. The requirement of the staff would be as under:

S.S.(Supervisory) at Katra-Qazigund-Anantnag-Srinagar & Baramula	05	6500-10500
S.M.	28	5500-9000
A.S.M.	28	4500-7000
Pointsman	56	2650-4000
Porter	56	2550-3200

Note:-Anticipated traffic for coaching/goods is not heavy in the initial year. Therefore, E.I. roster is suggested for the proposed new rail section. LR & RG @ 16.7% of the above. Staff quarters would be required as per extent rules for essential categories.

9.10 CHARTED LINE CAPACITY OF THE PROPOSED RAIL LINE AND ITS UTILISATION.

9.10.1 The line capacity of single line section from Udhampur-Baramula has been calculated as per Scott's formula, taking into consideration the critical running time of longest block section between

Surukot-Barala which is falling in Katra-Qazigund section which comes to 19.80 kms. with slowest train speed @25 KMPH the line capacity works out as 10 paths, each way. As regards Udhampur-Katra and Qazigund-Baramula, the line capacity as worked out with Scott's formula comes to 18 and 14 paths each way respectively.

9.10.2 The percentage utilisation of the line capacity of the section would be as under during 2002-03 and 2007-08

Section	Path		During 2002-03				%age utilisation	
	without MTCE Block	With MTCE Block	Total No. of trains each way Pass	Goods	Dep.	Total	without MTCE block	with MTCE block
Udhampur - Katra	18	15	4	-	0.5	4.5	25.0	30.0
Qazigund-Baramula	14	12	3	-	0.0	3.0	21.4	25.0

Section	Path		During 2007-08				%age utilisation	
	without MTCE Block	with MTCE Block	Total No. of trains each way Pass	Goods	Dep.	Total	without MTCE block	with MTCE block
Udhampur - Katra	18	15	11	7.4	1.5	20	111	133
Katra-Qazigund	10	8	8	7.4	1.5	17	170	212.5

Qazigund-Srinagar	14	12	8	7.4	1.5	17	121.4	141.7
Srinagar-Baramula	14	12	2	-	0.5	2.5	17.8	20.8

9.11 SPECIAL FEATURES OF THE PROJECT SECTION.

9.11.1 In terms of Appendix 'D' to G&SR issued by the N.Rly., section from Udhampur to Qazigund will be treated as Ghat section as the ruling gradient is 1 in 100. As such, special Ghat Rules would be applicable to this part of the project section for working of trains.

9.11.2 The project section will play a vital role in the socio-economic integration and development of the state.

9.12 SURVEYS IN THE PAST

9.12.1 In the past, Reconnaissance Engg-Cum-Traffic survey was conducted by M/s. RITES during 1987 and survey report for the same was submitted in the year 1988. This survey was for a B.G. rail link between Udhampur to Qazigund only. 1999-2000 was assumed as 1st year of commissioning of that survey. While projecting traffic, the procedure adopted by RITES has been kept in view.

9.12.2. The Ministry of Railways vide their letter No. 64/W4/CNL/N/2 dated 6.7.1971 ordered a PET survey for an electrified MG rail line between Qazigund-Baramula and a report for that survey was submitted by Northern Railway in 1973 for MG & BG lines.

9.13 TRAFFIC POTENTIAL OVER THE PROJECT SECTION

9.13.1 J&K State is one of the largest States of the Indian Union. For administrative convenience, the State is divided into three regions, namely (I) Jammu, (ii) Kashmir Valley and (iii) Ladakh. Srinagar is the summer capital and Jammu, the winter capital of the State. Ladakh area is accessible by road from June to October. Due to snowfall, this region remains cut off in rest of the months. Kargil is a district town located on the high way between Srinagar-Leh and located near the International Border of Pakistan. The passenger traffic beyond Srinagar is of tourists going to Leh and Ladakh and Defence Personals from June to October every year. The bulk freight traffic is constituted of POL, Coal, Food grain, iron & steel, Fertilizers, Military stores, and cement both for civil and Defence forces. Nearly 80% of the requirement of the area will be carried by rail after commissioning of the project.

9.13.2 Kashmir valley, North of Pirpanjal mountain range through which approximately 125 Kms. of track of the proposed rail link passes, is one of the largest valleys in the world. The main agriculture and forest products of the area are Saffron, Rice, Apple, Walnut, almonds, peaches for export qualities out of State. Other export quality of products of the area are silk, woollen shawls Pashmina shawls and carpets etc. Due to mountainous region and cold climate conditions the agriculture produce are insufficient. Thus the food grains, POL products, Coal, Cement, Iron & Steel and fertilizer etc. are imported in the region.

9.13.3 Udhampur to Katra and further up to Pirpanjal Mountains, the height of the ranges varies from 660 mtrs. to 3050 mtrs. Mountain ranges abound in forests. Plenty of rainfall helps in rich coat of grass and shrubs required for animal husbandry.

9.13.4 Vaishno Devi temple near Katra and Amarnath cave in the mountains, accessible from valley are the two major pilgrim places. Pilgrims from all over the country throng these places. Whereas, pilgrimage to Amarnath cave is once a year, pilgrims for Vaishno Devi temple visit the holy place throughout the year.

9.13.5. Udhampur is the Army Hqs. of Northern Command. The entire Jammu region, Kashmir valley region and Ladakh valley region, is controlled from this command. Movement of men and material from railhead Jammu to the command headquarters and further to the other regions is by road. In the existing system coal for Defence utility is received at Bharoli and POL at Chaki Bank and with the extension of rail link to Udhampur these commodities will be received at Udhampur. Similar would be the fate of traffic like Military personal, vehicles, Army ration and ammunition etc.

9.13.6. Jammu region and the Kashmir valley are divided by the Pirpanjal mountain range which can either be crossed by air or by road through Jawahar Tunnel. Lakhanpur Toll Post is only exit/entry point by road from Punjab State to J&K State. Same is the position in respect of traffic movement between Jammu region and Kashmir valley through Jawahar Tunnel near Banihal.

9.13.7. RITES in their survey report submitted in 1988 had worked out traffic projections for the year 1999-2000, assumed 1st year of commissioning of BG rail link between Udhampur-Qazigund and also for 21 years thereafter. The methodology adopted by RITES for projection of passenger and freight traffic adopting alternative methods has been kept in view while projecting the traffic.

9.14 PASSENGER TRAFFIC PROJECTIONS

9.14.1 An over all view of composition, number and classification of the passenger traffic likely to avail rail services when the sub sections and the entire project section is constructed and rail services are introduced, has been given under heading, 'traffic potential over the project section'. Normally, for a new rail line project, a comparative rail section is selected to work out propensity of the people to travel by rail and the same ratio is applied to the new proposed rail link section and the potential of the rail head traffic is arrived at. The project section is quite long i.e. 287 kms. and traffic potential for the proposed rail link is quite different and heavy. RITES in their survey report of Udhmpur-Qazigund section submitted in 1988, worked out propensity of the people of the area to travel on the basis of total population of the state and population of the project alignment. By this method, 0.04 local journeys per head and 0.2 interchanged journeys per head, were found out. Tourist traffic rail share @70% of rail/road share after deducting 31% air share of the total projected tourist traffic and army traffic @85% of the total projected army traffic, were added to the interchanged and local traffic population over the alignment. 5303 rail passengers were, thus, projected by this method for the year 2007-08.

9.14.2 With the availability of demographic data for the year 1991, the actual growth of population of the state works out to 2.8%. By adopting this growth rate (instead of 2.57 growth rate adopted by the RITES in projecting the rail passenger traffic for the year 2007-08 as 5303), the projected rail passenger traffic works out as 6876 passengers per day, each way.

9.14.3 The main traffic report gives the details of the vehicular traffic moving between Jammu-Srinagar-Jammu from 1986-87 to 1995-96. It is clear from that report that percentage growth per annum of this traffic works out to 10% for the traffic Ex-Jammu and 7.5% to Jammu.

9.14.4 Annexure-IX/I depicts pilgrim traffic to Vaishno Devi and Amarnath shrines from 1985 to 1996. Instead of venturing a growth rate to project this traffic in future, the best ever figures i.e. 43.36 lakhs pilgrims for Vaishno Devi and 1.2 lakhs for Amarnath Cave, during 1996, have been adopted as the number of tourist traffic by the year 2002-03, 1st year of commissioning of Udhampur-Katra sub section and 2007-08, 1st year of commissioning of the entire project section i.e. Udhampur-Katra-Qazigund-Srinagar-Baramula. Due to distance from Jammu to Katra by road (45 kms), being shorter than by rail via Udhampur i.e. 77.8 kms, only 30%

diversion from road to rail of such traffic, has been adopted.

9.14.5 For working out passenger traffic projections for the sub section Qazigund to Baramula, where rail services will be operated as a separate independent segment till 2007-08, 1st year of commissioning of the entire project section, local passenger traffic on the basis of methodology adopted for working out rail journeys per person of the project section i.e. @0.4 journeys per head of population, have been taken into consideration

9.14.6 During the year 2007-08, 1st year of the commissioning of the entire project section from Udhampur-Baramula, the Jammu rail head traffic as well as road passenger traffic and local passenger traffic are expected to prefer rail mode of transportation for the entire project length including Jammu Tawi-Udhampur (the project section targeted to be open for rail traffic during the year 2001-2002) on speed, safety, comfort and fares considerations. Annexure-IX/II depicts details of number of buses operated every year from 1993-94 to 1996-97 and number of passengers carried, each way. Consistent growth @6% has been observed in this mode of passenger transportation. Therefore, bus passengers projection for the year 2001-02, have been worked out assuming growth rate @6% & 3% beyond 2001-02 on the base year figures of 1996-97. Only 50% diversion of this projected traffic has been adopted as rail traffic during the year 2007-08.

9.14.7 The number of passengers transported by buses from Jammu to the valley and vice versa include 1.2 lakh pilgrims who visited Amarnath cave. This traffic gets diverted for Pahalgam after crossing Jawahar Tunnel. Therefore, this traffic has been reckoned to move up to Qazigund only. Thus, the number of projected passenger traffic for the sub section Udhampur-Katra to Srinagar during the year 2007-08 is likely to reduce by 1.2 lakh passengers per annum i.e. 329 passengers per day.

9.14.8 The passenger traffic moving by road from Jammu Tawi to the valley and vice versa comprises of local populace, Govt. officials, tourists, pilgrims and military traffic. A major portion of this traffic is destined for Srinagar only. Therefore, beyond Srinagar, only local traffic, military personal and a few tourist only are expected to avail rail passenger services. As such only 30% of the total rail traffic, projected for the year 2007-08, has been assumed to move by rail beyond Srinagar to Baramula. 2109 rail passengers per day each way, have thus been worked out (Annexure-IX/II). However, between 2002-03 to 2007, only local traffic has been calculated @0.4 journeys per head of population who are likely to avail rail services.

9.14.9 The summarised position of the projected rail passenger traffic of the sub sections and the entire project section, during the 1st year of commissioning has been assessed as under

S. No	Name of the section	No. of projected pass. P.D. eachway	1st year of Commissioning
1.	Udhmapur-Katra	3564	2002-03
2.	Qazigund-Srinagar	7031	2002-03
3.	Srinagar-Baramula	1821	2002-03
4.	Udhampur-Katra-Qazigund	10924 (7360+3564)	2007-08
5.	Katra-Qazigund	7360	2007-08
6.	Qazigund-Srinagar	7031	2007-08
7.	Srinagar-Baramula	2109	2007-08

Annexure-IX/III depicts the percentage of upper class passengers to the total passengers who had been booked at rail head Jammu Tawi from 1991-92 to 1995-96. Considering that tourists for the Kashmir valley, which is a well to do segment of the population, would prefer to travel in AC class coaches, the train composition has been proposed considering this fact.

9.15 PROJECTION OF RAIL SERVICES TO CLEAR THE PROJECTED NUMBER OF PASSENGERS.

9.15.1 The pilgrim traffic to Vaishno Devi at Katra, is from all nook and corners of the country. Therefore, train No. 3151/52 Sealdah Express from Sealdah to Jammu Tawi, 9367/68, Malwa Express from Indore to Jammu Tawi and 2471/72, 2473/74, 2475/76 and 2477/78 Swaraj group of Superfast trains from Mumbai, Ahmedabad, Rajkot and Jam Nagar respectively to Jammu Tawi (daily single service as per nominated days), have been planned to be extended to Katra. In addition, one pair of passenger train (with one loco) will run between Jammu-Udhampur-Katra and back to clear the local traffic.

Since the ruling gradient on this sub sections is 1 in 100, double heading, of the coaching services, except passenger trains, has been contemplated to achieve maximum trailing load of 18 coaches and speed of 60 KMPH. Sub section Udhampur to Qazigund is also having similar constraints. Sub section Qazigund to Baramula via Srinagar is, however, comparatively flatter. It will therefore be possible for trains to be worked with single locomotive between Qazigund-Srinagar-Baramula section.

9.15.2 All the above services will be diesel hauled with maximum trailing load 18 = 36, for mail/express trains. The passenger train service has been proposed with 8 coaches. Rake maintenance of all these trains will be at Katra and Srinagar.

9.15.3 Qazigund-Srinagar-Baramula sub section is likely to be connected to Jammu-Katra-Qazigund rail link in the year 2007-08. Till then, DMU services with one unit (one MC and two TC) have been proposed on the sub section. To clear 1821 passengers, 3 trips will be required. When the entire project section is commissioned in 2007-08, DMU services are proposed to be withdrawn.

9.15.4 When the entire project section from Udhampur to Baramula is commissioned in the year 2007-08, in addition to the three proposed Mail/Exp. and one passenger services between Udhampur-Katra, to clear 3564 passengers, one pair of Rajdhani Exp. between New Delhi-Srinagar, one pair of Intercity Exp. between Udhampur-Srinagar-Baramula as new trains and 8101/02 Muri Express from Hatia/Tatanagar to Pathankot, 4805/06 Jodhpur Jammu Tawi Exp. from Jodhpur to Jammu Tawi, 4645/46 Shalimar Exp. from New Delhi to Jammu Tawi, 2403/04 Pooja Express from Jaipur to Jammu Tawi and 4033/34 Jammu Mail from Delhi to Srinagar, as extended trains, to clear interchanged traffic and one pair of fast passenger train between Jammu-Baramula, with nine coaches (WGCZ=7, SLR=2) have been proposed. Load of Jodhpur-Jammu Express, presently running with 11 coaches, is proposed to be augmented by 7 coaches (sleeper – 5 and AC 3 tier –2). 2109 passengers between Srinagar-Baramula are proposed to be cleared by the Intercity and fast passenger services. DMU services are proposed to be discontinued altogether. The summarised position of the proposed train services on the subsections, namely Udhampur-Katra and Qazigund-Baramula, in the year 2002-03, probable 1st year of commissioning of the section for rail services and between Udhampur-Srinagar-Baramula, the total project section proposed to be commissioned in the year 2007-08, is as follows:

A) Between Udhampur-Katra (Sub-section planned for commissioning during 2002-03

S. No	Train No.	Name of the train	From	To/Extended to	No. of pass.
1.	3151/52	Sealdah Exp.	SDAH	JAT/Katra	971
2.	9367/68	Malwa Exp.	Indore	JAT/Katra	946
3.	2471/72 etc.	Swaraj Group	BCT, JAM, ADI, RJT	JAT/Katra	967
4.	Pass. train	JAT-Katra Pass	JAT	Katra	680
				Total	3564

B) Between Qazigund-Baramula (sub-section planned for commissioning in 2002-03)

* DMU	(Three trips)	Qazigund	Baramula	1821

C) Between Udhampur-Srinagar (When entire section from Udhampur to Baramula is planned to be commissioned in 2007-08)

1.	3151/52	Sealdah Exp.	SDAH	JAT/Katra	971
2.	9367/68	Malwa Exp.	Indore	JAT/Katra	946
3.	2471/72 etc.	Swaraj Group	BCT, JAM, ADI, RJT	JAT/Katra	967
4.	Fast Pass. train	JAT-Baramula Pass.	JAT	Baramula	(*)680 3564 (**)+531
5.	8101/02	Muri Exp.	Hatia	PTK/Srinagar	813
6.	4645-46	Shalimar Exp.	NDLS	JAT/Srinagar	1007
7.	4805/06	Jodhpur-Jammu Exp	Jodhpur	JAT/Srinagar	1104
8.	2425/26	Rajdhani	NDLS	JAT/Srinagar	661
9.	4033/34	Jammu Mail	DLI	JAT/Srinagar	821
10.	2403/04	Pooja Exp.	Jaipur	JAT/Srinagar	1000
11.		Intercity	Udhampur	JAT/Baramula	1423

				Total	7360

(*) Up to Katra, (**) Beyond Katra

D) Between Srinagar-Baramula (when entire section between Udhampur-Baramula is commissioned in 2007-08.

1	Intercity	Udhampur	Baramula	1423
2	Fast passenger	Jammu	Baramula	686
			Total	2109

9.16 FINANCIAL IMPLICATIONS OF THE PROPOSED RAIL PASSENGER SERVICES.

9.16.1 The Coaching earnings in respect of the proposed trains, have been worked out on the basis of the fare incorporated in the coaching tariff No.24 Pt.II issued by the IRCA w.e.f. 20.6.98. The cost of haulage of the proposed trains has been worked out by applying functional costs of unit cost data for 1995-96 for coaching traffic issued by the Railway Board. This cost has been updated to the level of 1998-99 by applying an escalation factor of 46.52%. The detailed calculations for the earnings and working expenses have been made for Udhampur-

Katra, for Qazigund-Baramula and for Udhampur-Qazigund-Srinagar-Baramula.

9.16.2 **Net Coaching Earnings.**

The summarised details, sub section and entire section wise, are as follows.

(Rupees in lakhs)

S. No	Train No.	Name of train	Gross earnings	Working expenses	Net earnings
A)	**Between Udhampur – Katra (2002-03, 1st year of commissioning).**				
1.	3151/52	Sealdah Exp.	29.40	61.63	-32.23
2.	4367/68	Malwa Exp.	22.38	61.9	-39.52
3.	2471/72	Swaraj Group	38.41	65.52	-27.11
4.	Pass. train	Jammu Tawi-Katra	26.25	57.94	-31.69
5.	Total		116.44	246.99	-130.55

B) Between Qazigund-Baramula, sub section planned for commissioning in 2002-03.

	1 DMU (Three trips)		292.45	407.03	-114.58

C) Between Udhampur-Srinagar-Baramula, entire project section planned to be commissioned in 2007-08.

1.	3151/52	Sealdah Exp.	29.40	61.63	-32.23
2.	9367/68	Malwa Exp.	22.38	61.9	-39.52
3.	2471/72	Swaraj Group Exp.	38.41	65.52	-27.11
4.	Fast Pass. train	JAT-Baramula Pass. train	206.20	535.21	-329.01
5.	8101/02	Muri Exp.	217.16	480.59	-263.43
6.	4645/46	Shalimar Exp.	377.0	694.97	-317.97
7.	4805-06	JU-JAT Exp.	336.85	654.35	-317.50
8.	2425/26	Rajdhani	1955.43	554.40	+1401.03
9.	4033.34	Jammu Mail	479.25	609.41	-130.16
10.	2403/04	Pooja Exp.	467.77	697.70	-229.93
11.		Intercity	1268.28	909.49	+358.79
12	Total		5398.13	5325.17	+72.96

* Between Srinagar-Baramula-Srinagar in the year 2007-08

9.17 COST OF ROLLING STOCK AND LOCOMOTIVES.

9.17.1 The cost of coaching rolling stock and locomotives required to run the proposed services, has been worked out and the summarised position is as follows.

S. No	No. of train	Total cost of coaching rolling stock and locomotives _
A)	Services to be run during 2002-03 between Udhampur-Katra.	(Rs. in lakhs)
1.	3151/52	NIL (Extended trains from Jammu Tawi during their lie over period.
2.	9367/68	
3.	2471/72	
4.	Pass. train	320.40 (Cost of locos of 1,2,3 M/E trains included).
B).	DMU services to be run between Qazigund-Baramula during 2002-03	272.00
C)	Services to be run during 2007-08 between Udhampur to Baramula	
1.	3151/52	173.46
2.	9367/68	

3.	2471/72	
4.	Fast Pass. train	642.43
5.	4645/46	1228.47
6.	4805/06	1181.16
7.	4033/34	1120.76
8.	2403/04	1247.26
11.	Intercity	1302.94
12.	8101/02	823.36
13.	Rajdhani	1036.35
13.	Total	8756.19

9.18. <u>FREIGHT TRAFFIC PROJECTIONS.</u>

9.18.1As has been stated in the foregoing paras 2.5.1. to 2.5.4., the Jammu region being totally mountainous terrain and Kashmir and Ladakh valleys having altitudes ranging from 2000 mts. onwards and surrounded by snowcapped mountains and heavy snowfall during winter months, cultivation of paddy crops in Jammu region and in the Kashmir valley region, is in small areas and total produce is hardly adequate to meet demand of very small segment of the total population of the state. Therefore, food grains requirements of the state are almost totally met from imports through FCI. Same is the position of the POL products, Coal, Cement, Iron & Steel, Fertilizers and misc. commodities. Army establishments in the state also move ration, military stores, ammunition etc. from outside the state.

918.2 Details of inward wagons received at Jammu Tawi and Bari Barahamna railway stations during the years 1991-92 to 1995-96 have been studied.. Assumed growth rate on POL, military store, Cement and misc. traffic is @5% and on food grains @3% which is based on the traffic receipts in the past in the year 1991-92 to 1995-96. The total projected inward freight traffic per annum and per day, has thus, been worked out for the years 2007-08, 2012-13 and 2017-18 i.e. 1st, 6th and 11th years of commissioning of the project section. The summarised position is shown in the Annexure-IX/IV. Only 50% of this traffic has been assumed for diversion to rail when the entire project section is commissioned in the year 2007-08. Thus, total number of inward four wheeler wagons which are likely to move over the project section, (123 four wheeler wagons) have been worked out.

9.18.3 The traffic details from 1990-91 to 1995-96 indicate consistent growth rate in case of fresh and dry fruits, gum & resins and woollen & woollen goods. A moderate growth rate of 5% in the outward traffic, has been adopted for projections for the year 2007-08, 2012-13 and 2017-18. 1st, 6th and 11th year of commissioning of the project section. Details of commodities and total projected outward traffic per day, has also been shown in the main traffic report. Only 70% of the total export quantity projected by the J&K state, has been adopted as rail share.

9.18.4 The projection of inward freight traffic in para 2.10.2. above is realistic as the same is based on actual materialization of such traffic by rail and delivered at Jammu Tawi and Bari Brahamana rail heads, yet a sizable quantity of such traffic also moves by road into J&K state. Therefore, in order to determine the correct quantum of freight traffic likely to be offered to the rail, a parallel exercise to tabulate, commodity wise, total receipt of such traffic by road as per records maintained by the state, has been undertaken. As per data maintained by the J&K state for the years 1990-91 to 1995-96, total variation for the last 5 years and percentage growth per annum for different commodities varied from +63.4% to +7.4% in case of Coal/Coke, Grain & pulses, Iron & manufactured goods, Cement, K.Oil and Petroleum. By assuming 5% growth rate, traffic projections for the years 2007-08, 2012-13 and 2017-18, 1st, 6th and 11th years of commissioning of the project section, have been worked out. Since the traffic shown above is meant for the entire J&K State, only 50% of the total traffic has been adopted for movement from Jammu area to valleys. Further, only 80% diversion of the 50% traffic adopted above, has been assumed to be diverted from road to rail, in the case of military goods, Urea, LPG, Coal & Coke, Grain & pulses, Cement, K. Oil, and Petroleum products, and 50% diversion in the case of fodder, Iron & manufactured goods, Sugar, Rubber goods and misc. goods.

918.5Records showing the total tonnage lifted by road from Jammu to Srinagar in the year 1993-94 to 1996-97 as per records maintained by the State Road Transport Corporation, J&K region Hq., Jammu have been studied. An average growth rate of 11.62% has been observed in this traffic. However, only a moderate growth in this traffic @5% has been adopted and total number of four wheeler wagons worked out for the year 2007-08, 2012-13 and 2017-18, 1st, 6th and 11th year of commissioning of the project section. Since this traffic is destined for the valley, 70% of the total such traffic moved by road, has been considered to be diverted to rail. In the case of traffic scenario projected in para 2.10.4, the total receipt was meant for the entire J&K state and not for the valley alone, as in this case. That is why only 50% of the total traffic was taken into account for the project section and further percentages of diversion from road to rail was calculated. In addition to the 70% diversion from road to rail contemplated above, military traffic as projected by the MIL Rail for places like Leh, Kargil, Pattan, Srinagar and Baramula, has been added.

9.18.6 As per assessment made by the survey team, 260 four wheeler wagons per day as inward and 107.3 four wheeler wagons per day as outward traffic, during the year 2007-08, 1st year of the commissioning of the project, are likely to materialise as against 277.6 as inward and 104 as outward four wheeler wagon traffic projected by the RITES for the same year.

9.19 FINANCIAL IMPLICATIONS OF FREIGHT TRAFFIC.

9.19.1 The methodology adopted for working out the earnings of the goods traffic projected is based on the commodity wise classification for goods tariff No. 42 part-I in force from 1.1.94 supplied by the IRCA. Similarly for calculating working expenses, latest available cost data supplied for freight services by Railway Board have been applied. The costs have been escalated further at the prescribed scale @39.68% to arrive cost to level 1998-99 over 1995-96 year cost. To calculate the earnings and working expenses for the outward and inward goods traffic, Northern Railway average lead has been adopted. For POL traffic, extended lead ex-Jammu Tawi has been taken.

9.19.2 **NET EARNINGS FROM FREIGHT TRAFFIC.**

The earnings, working expenses and net earnings accruable on account of extended and fresh goods traffic during 2007-08, 1st year of commissioning of the project is as under:-

S. No	Traffic	Earnings	Working expenses	Net earnings
A)	Extended goods traffic			(Rs. in lakhs)
1.	Inward	1458.82	683.61	775.21
2.	Outward	-	-	-
B)	Fresh goods traffic			
1	Outward	403.94	369.82	34.12
2.	Inward	1370.34	826.40	543.94
C)	G. Total (A+B)	3233.10	1879.83	1353.27

9.19.3 **GOODS ROLLING STOCK AND LOCOMOTIVES.**

9.19.4 Keeping in view Ruling Gradient of 1 in 100 between Udhampur-Qazigund, double heading and trailing load limitation of 1290 tonnes, will be required to be adhered to. With single locomotive, the permitted trailing loads for the ruling gradient is 645 tonnes. As such for 7.5 goods/POL trains, i.e. 260 number of BTPNs/TK/box wagons etc., 13 locomotives would be required. Average lead from the source of traffic to the destination, as moving at present in the case of specified traffic, has been calculated and in the case of other traffic received from all over India, Northern Railway average lead has been adopted, to arrive at the total requirement of goods stock and locomotives.

9.19.5 **COST OF GOODS ROLLING STOCK AND LOCOMOTIVES REQUIRED. TO TRANSPORT THE PROJECTED TRAFFIC.**

9.19.6 The requirement of goods rolling stock for outward and inward goods traffic have been worked out on the basis of cost data supplied by CTPM/N.Rly. and the Pink Book for 1997-98. The total cost works out as Rs.7936.50 lakhs.

9.20 **SUMMARY OF EARNINGS WORKING EXPENSES AND NET EARNINGS ACCRUABLE ON ACCOUNT OF COACHING**

1.	Coaching services during 2002-03	
a)	Section Udhampur-Katra	320.40
b)	Qazigund-Baramula	272.0
2.	Coaching services during 2007-08	8576.19
3.	Freight services during 2007-08	7936.50
4.	Total (2+3)	16692.69

9.21 **RETURN OF THE PROJECT**

For finding the rate of return of the project, the total cost of the project has been compared with the projected earnings. As has already been brought out in the proceeding paragraphs, the earnings of the project have been found out after a thorough traffic survey of the passenger and the freight traffic.

9.22 TOTAL COST OF THE PROJECT

The total cost of the project is Rs.307723 Crores. Three separate volumes showing the details of the cost for Udhampur – Katra section, Katra – Qazigund Section and Qazigund – Baramulla Section are accompanying this report. This volume gives the summary of the cost. Summary of the total cost the project is given below:

SUMMARY OF COST OF THE PROJECT

Department	Estimated Cost in Crores of Rs.
Civil Engg.	2822.2501
S & T Works	180
Electrical Works	74.9875
Total:	**3077.2376**

NOTE: Head-wise expenditure is attached as annexure IX/V.

9.23 **Total in flow**

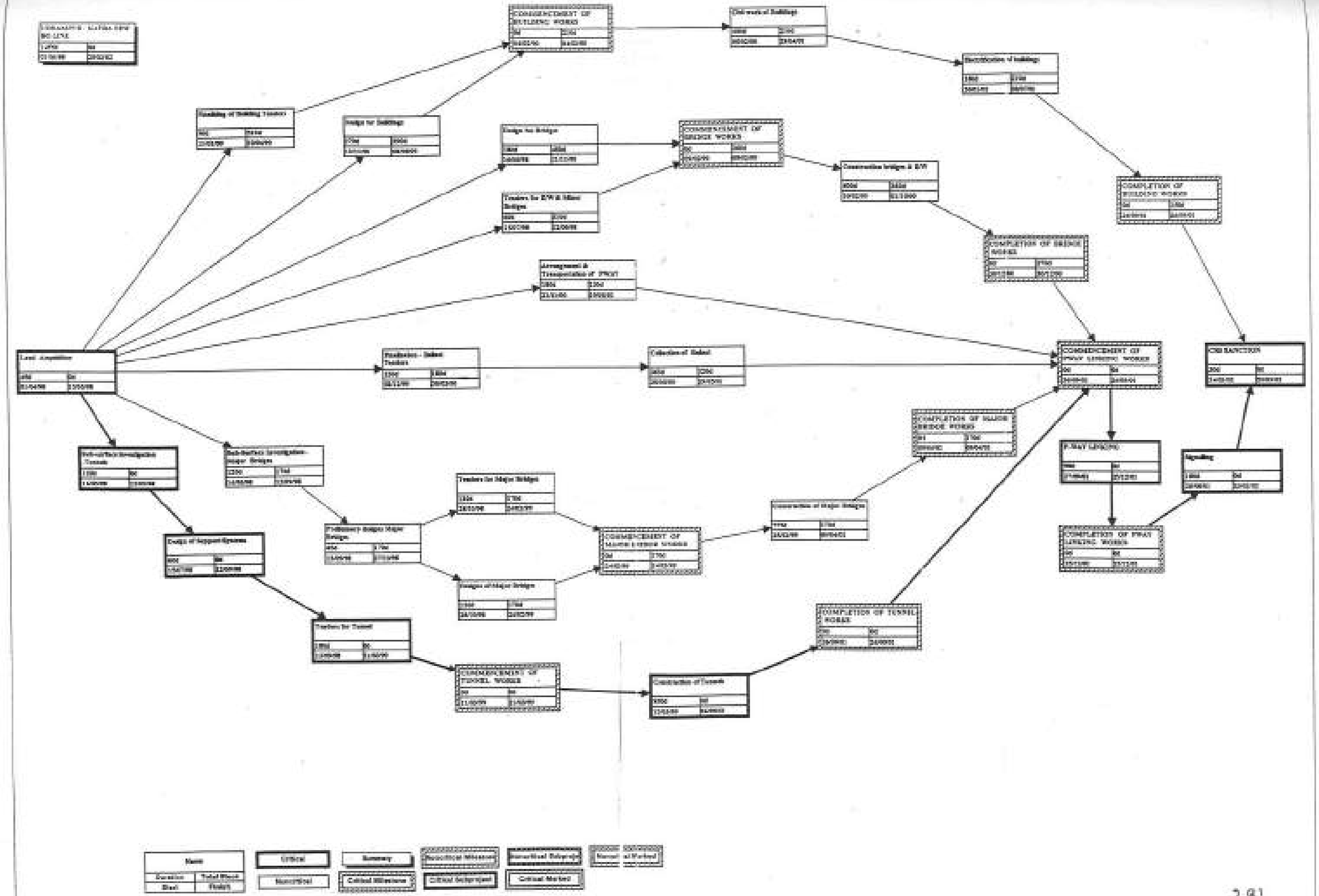
Total earnings have been taken as per the traffic report which details the projected year wise earning of the project during its operation phase by taking into account both the passenger as well as the freight traffic. The salvage value of the assets required to be replaced within 30 years return period has also been considered for calculating the total in flow. The table given below sums up the projected in flow.

Number of years elapsed after	Cash inflow

commissioning	
1	**1426.23**
2	**1426.23**
3	**1426.23**
4	**1426.23**
5	**1426.23**
6	**2307.06**
7	**2307.06**
8	**2307.06**
9	**2307.06**
10	**2307.06**
11	**4485.46**
12	**3093.67**
13	**3093.67**
14	**3093.67**
15	**3093.67**
16	**3093.67**
17	**3093.67**
18	**3093.67**
19	**3093.67**
20	**3093.67**
21	**4755.94**
22	**3093.67**
23	**3093.67**
24	**3093.67**
25	**3093.67**
26	**3093.67**
27	**3093.67**
28	**3093.67**
29	**3093.67**
30	**49444.06**

RATE OF RETURN OF THE PROJECT

Rate of return of the project has been estimated by using the discounted cash flow technique. For calculating the ROR, the cost of replacement of the assets during the project life cycle has also been considered. For this purpose, the life of the individual assets has been assumed as per the para 219 of the finance code. Table showing the life of these assets is attached as annexure IX/VI ROR of the project as a whole has been calculated as – 13.84%. Annexure IX/VII gives the details of the calculations.



Land Acquisition
COMMENCEMENT OF BUILDING WORKS
Design for Buildings
Design for Bridges
COMMENCEMENT OF BRIDGE WORKS
Tenders for R/W & Minor Bridges
Construction bridges & R/W
COMPLETION OF BRIDGE WORKS
COMPLETION OF BUILDING WORKS
Arrangement & Transportation of PWAY
Collection of Ballast
COMMENCEMENT OF PWAY LINKING WORKS
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P-WAY LINKING
COMPLETION OF PWAY LINKING WORKS
Signalling
Sub-surface investigation - Tunnels
Sub-surface investigation - major Bridges
Preliminary designs Major Bridges
Tenders for Major Bridges
Designs of Major Bridges
COMMENCEMENT OF MAJOR BRIDGE WORKS
Construction of Major Bridges
COMPLETION OF MAJOR BRIDGE WORKS
Design of Support Systems
Tenders for Tunnel
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Construction of Tunnels
COMPLETION OF TUNNEL WORKS
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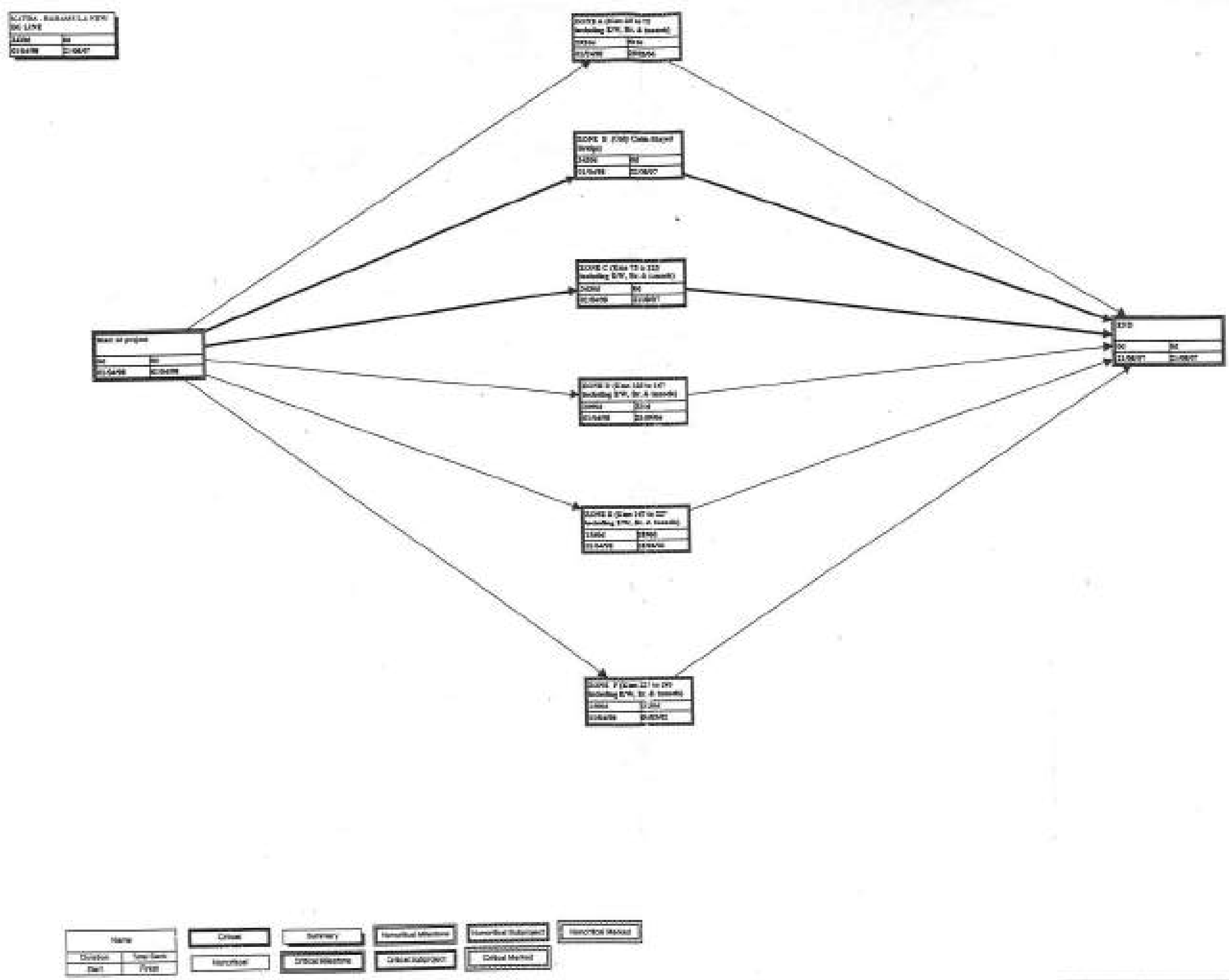

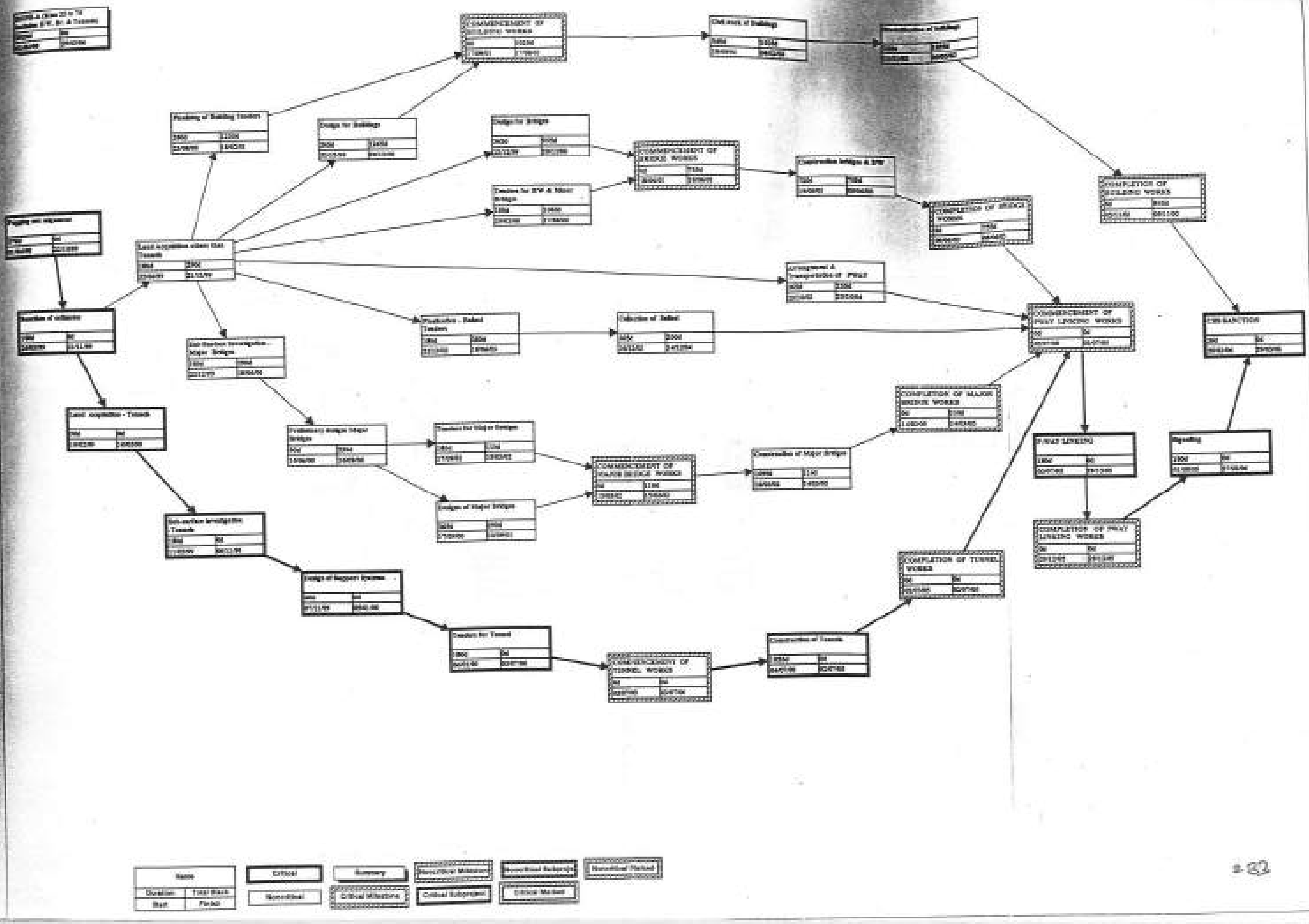
COMMENCEMENT OF BUILDING WORKS
Design for Buildings
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Pegging out alignment
Land Acquisition other than Tunnels
Arrangement & Transportation of PWAY
COMMENCEMENT OF PWAY LINKING WORKS
CRS SANCTION
Finalisation - Ballast Tenders
Collection of Ballast
Sub-Surface Investigation - Major Bridges
Land Acquisition - Tunnels
Preliminary designs Major Bridges
Tenders for Major Bridges
Designs of Major Bridges
COMMENCEMENT OF MAJOR BRIDGE WORKS
Construction of Major Bridges
COMPLETION OF MAJOR BRIDGE WORKS
PWAY LINKING
Signalling
COMPLETION OF PWAY LINKING WORKS
Sub-surface investigation - Tunnels
Design of Support Systems
Tenders for Tunnel
COMMENCEMENT OF TUNNEL WORKS
Construction of Tunnels
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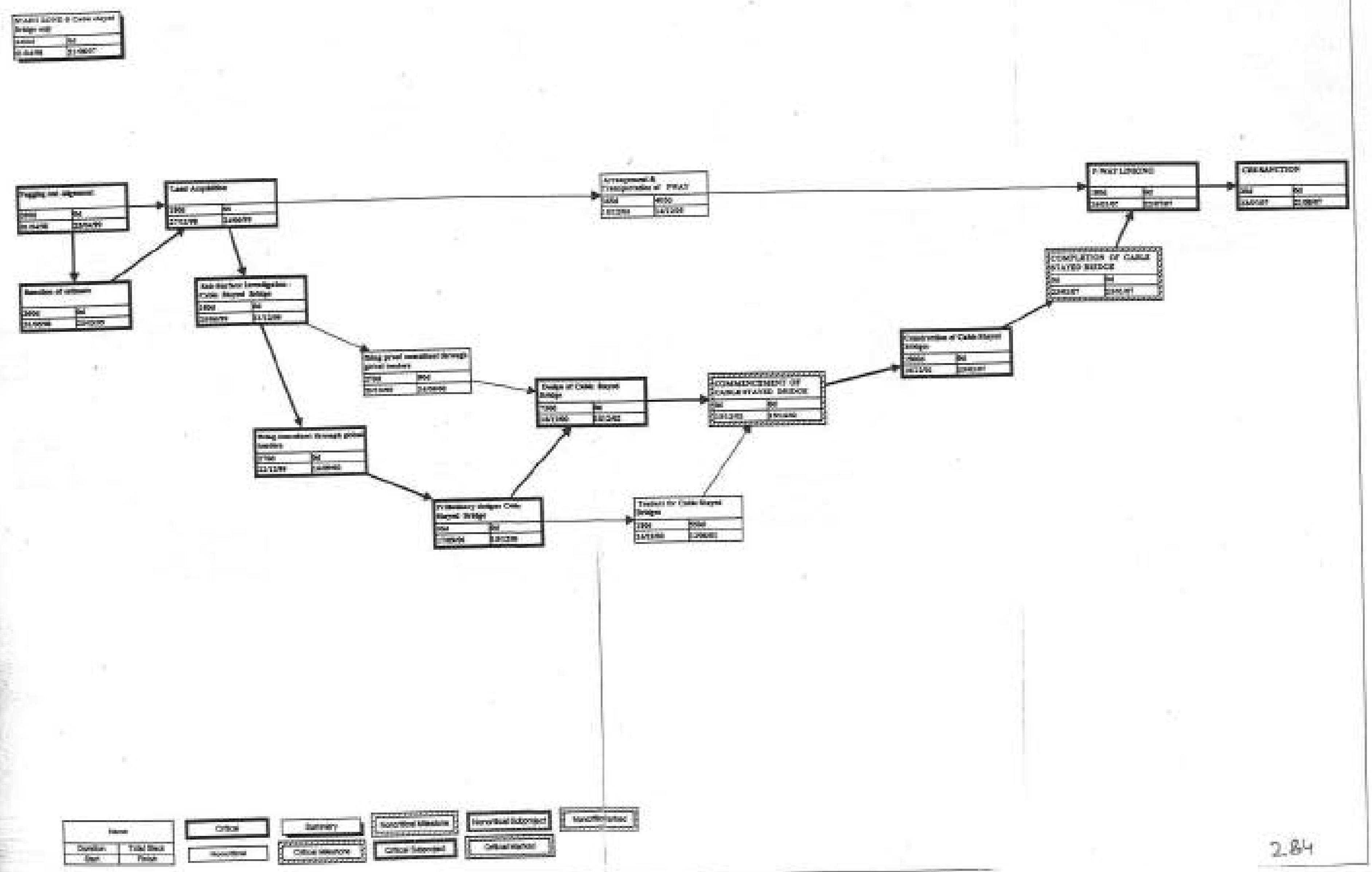
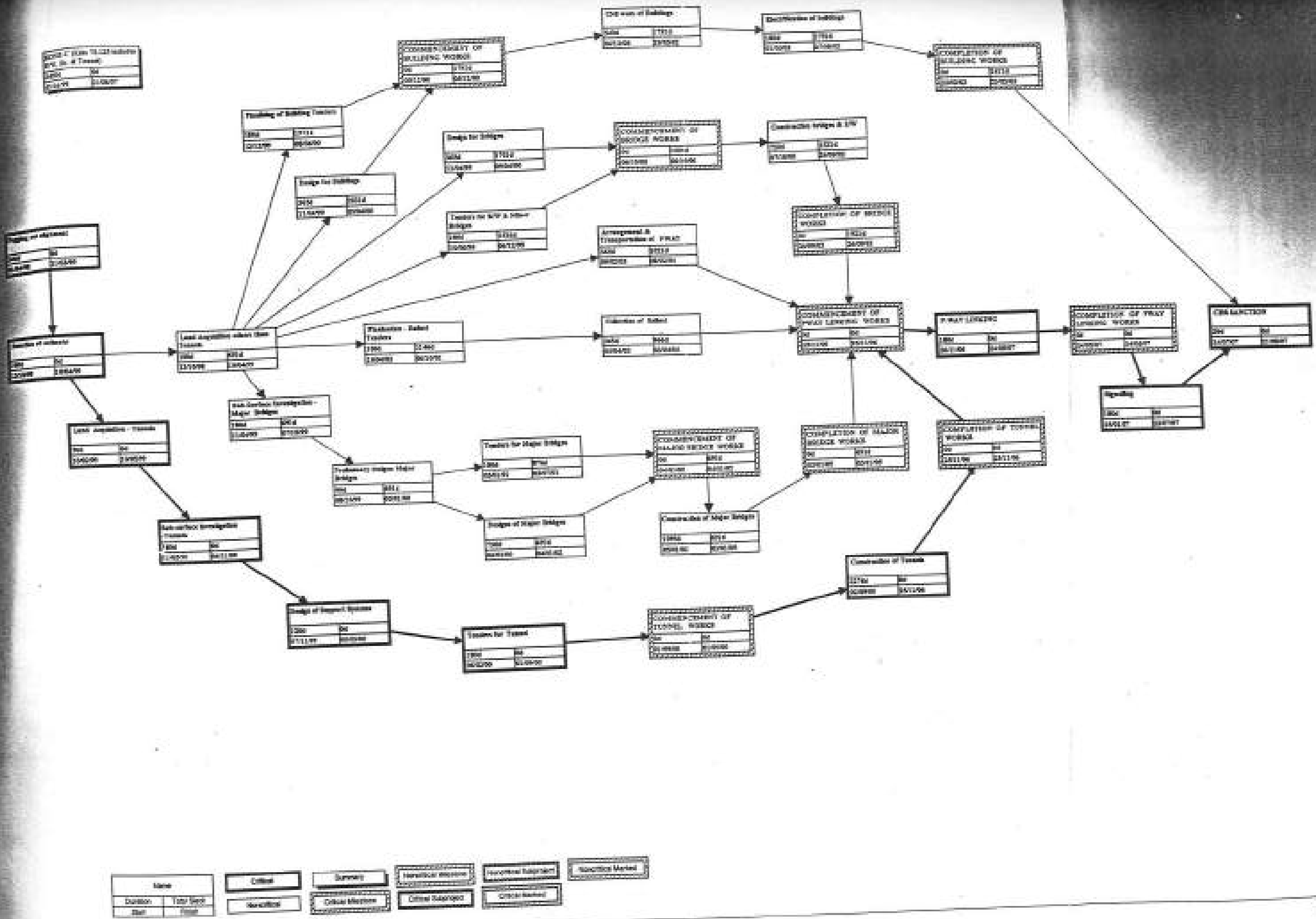


Land Acquisition
COMMENCEMENT OF CABLE STAYED BRIDGE
COMPLETION OF CABLE STAYED BRIDGE
P-WAY LINKING
Critical
Summary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Tenders for Tunnel
Construction of Major Bridges
Tenders for Major Bridges
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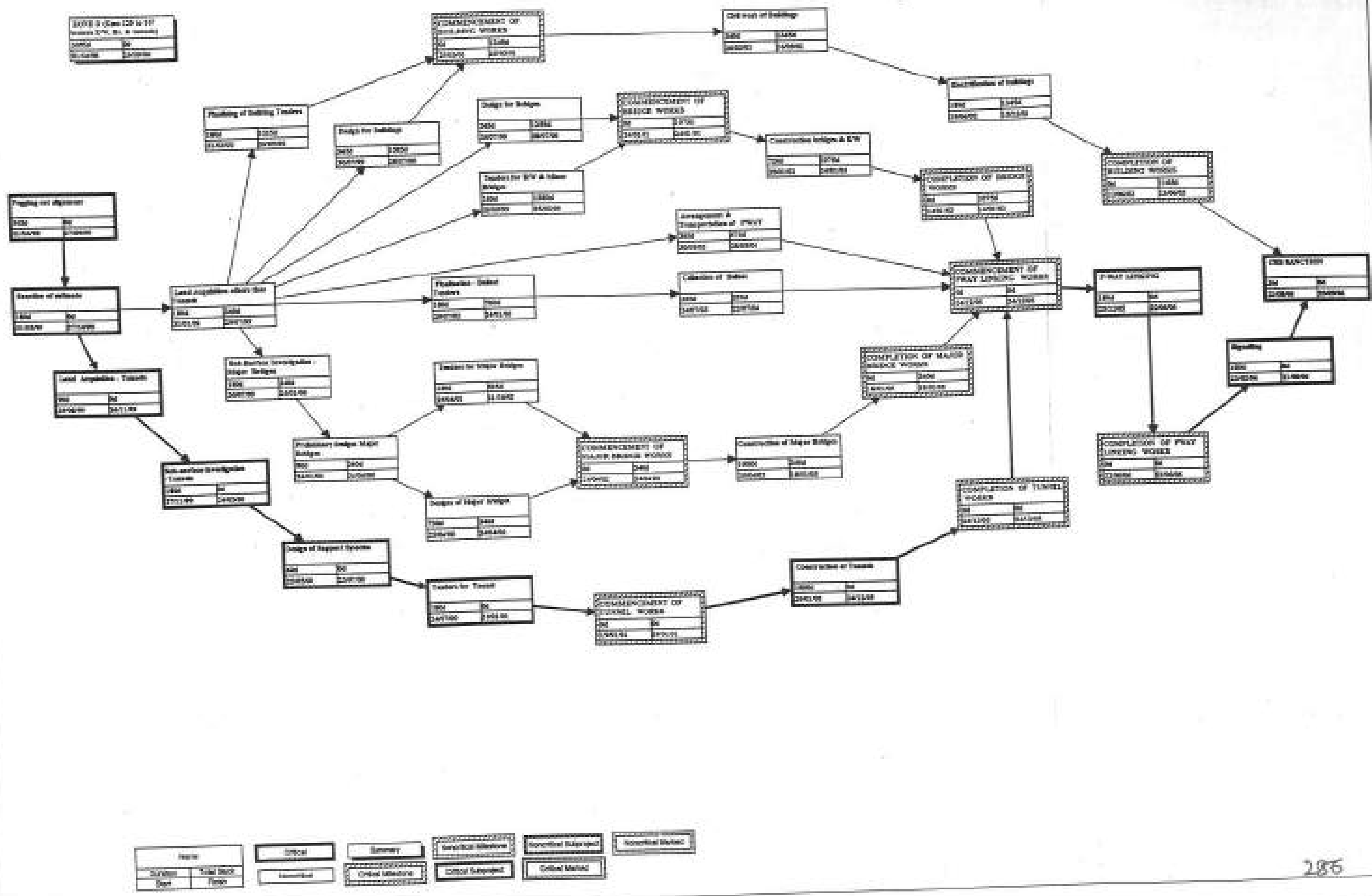
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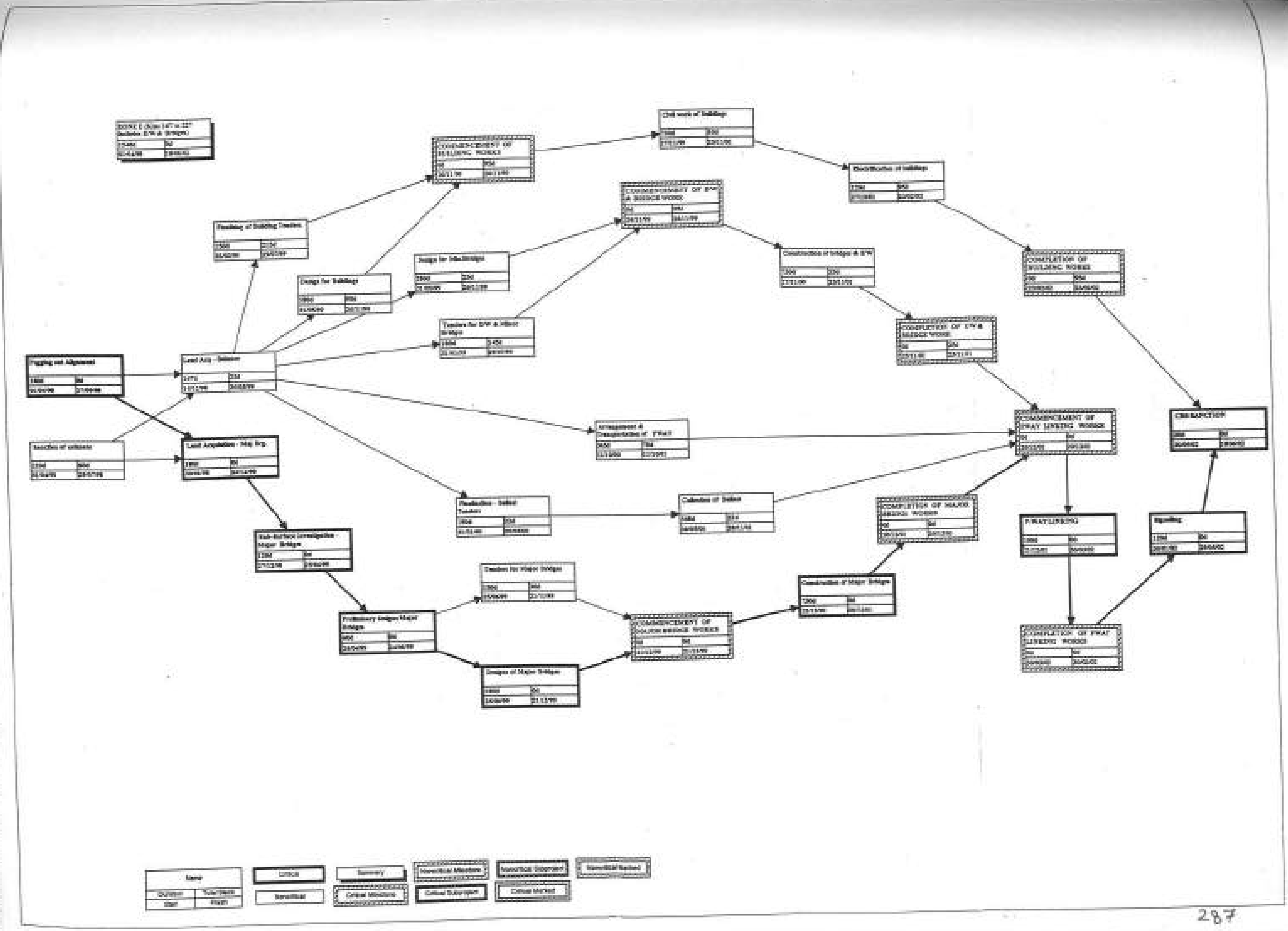
Pegging out Alignment
Land Acq - Balance
Land Acquisition - Maj Brg
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COMPLETION OF BUILDING WORKS
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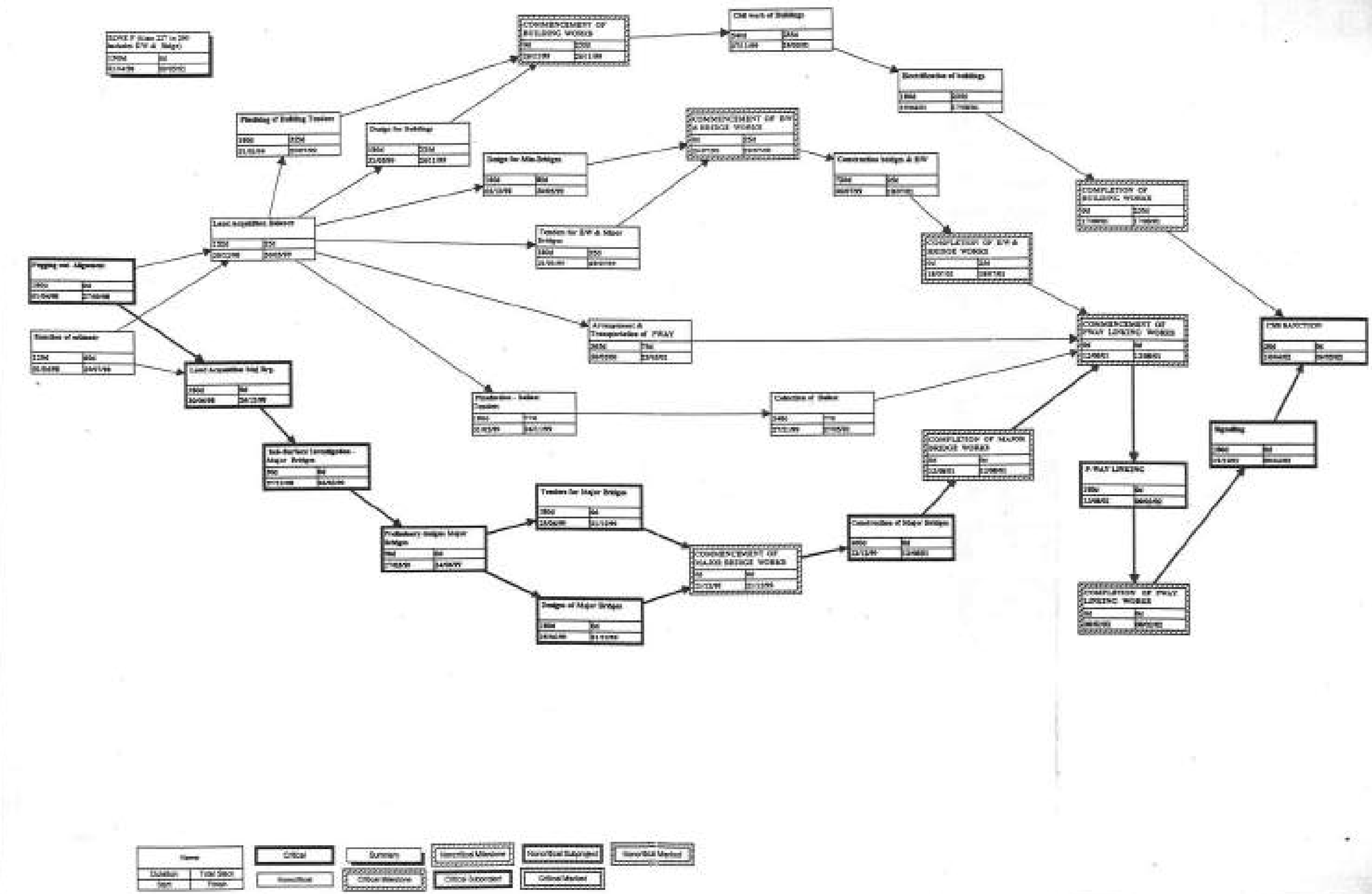
Signalling
CRS INSPECTION
Designs of Major Bridges
Construction of Major Bridges
Tenders for Major Bridges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COMMENCEMENT OF MAJOR BRIDGE WORKS
COMPLETION OF MAJOR BRIDGE WORKS
P-WAY LINKING
COMPLETION OF PWAY LINKING WORKS
Tenders for Major Bridges
Design of Major Bridges
Signalling
Critical
Summary

ANNEXURES

LIST OF GRADIENTS BETWEEN UDHAMPUR - BARAMULLA

(a) UDHAMPUR - KATRA

S.NO	DESCRIPTION	LOCATION IN KILOMETERS		LENGTH IN METERS
1	2	3		4
1.	Rise1 in 100	1.0	6.300	5.300
2.	Fall 1 in 100	6.300	7.342	1.042
3.	Fall 1 in 100	7.342	8.500	1.158
4.	Rise1 in 400	8.500	10.00	1.500
5.	Rise1 in 100	10.300	17.875	7.875
6.	Fall 1 in 800	17.875	19.075	1.200
7.	Fall 1 in 150	19.075	20.200	1.125
8.	Rise1 in 260	20.200	21.500	1.300
9.	Rise1 in 100	21.500	24.100	2.600
10.	Rise1 in 1000	24.100	25.500	1.400
11.	Fl in 100	25.500	26.300	0.800

(b) **KATRA - QAZIGUND**

1	2	3		4
		From	**To**	
12.	Level	26.300	26.900	0.600
13.	F1 in 100	26.900	30.600	3.700
14.	F1 in 500	30.600	30.900	0.600
15	Level	30.900	31.300	0.600
16	R1 in 450	31.300	33.300	2.000
17	F1 in 200	33.300	36.300	3.000
18	Level	36.300	36.800	0.500
19	R1 in 100	36.800	38.725	1.925
20	R1 in 100	38.725	39.200	0.475
21	R1 in 400	39.900	41.100	1.200
22	R 1 in 100	41.100	471.500	6.400
23	Level	47.500	50.150	2.650
24	R1 in 100	50.150	61.800	11.65
25	R1 in 400	61.800	63.000	1.200
26	R1 in 100	63.000	73.600	10.600
27	R1 in 200	73.600	73.800	0.200
28	R1 in 400	73.800	74.800	1.000
29	R1 in 100	74.800	81.350	6.550

1	2	3		4
		From	To	
30	Level	81.350	82.800	1.450
31	R1 in 100	82.800	94.100	11.300
32	R1 in 400	94.100	95.300	1.200
33	R1 in 100	95.300	105.100	9.800
33.	R1 in 400	105.100	106.500	1.400
34	R1 in 100	106.500	118.200	11.700
35	R 1 in 400	118.200	119.500	1.300
36	R1 in 100	119.500	120.000	0.500
37	R1 in 100	120.000	132.100	12.100
38	1 in 100	132.100	133.300	1.200
39	R1 in 100	133.300	137.900	4.600
40	1 in 400	137.900	139.200	1.300
41	R1 in 100	139.200	140.000	0.800
42.	R1 in 100	140.000	147.000	7.000
43.	R1 in 400	147.000	148.100	1.100
44.	R1 in 100	148.100	152.000	3.900
45.	R1 in 400	152.000	153.400	1.300
46.	R 1in 250	153.400	160.000	6.600
47.	F1 in 100	160.000	168.000	8.000

© **QAZIGUND – BARAMULLA**

1	2	3		4
		From	To	
48	F1 in 400	0.000	0.700	0.700
49	F1 in 100	0.700	10.200	9.500
50	F1 in 400	10.200	11.800	1.600
51	F1 in 109	11.800	15.000	3.200
52	F1 in 1250	15.000	17.400	2.400
53	F1 in 600	17.400	20.000	2.600
54	F1 in 500	20.000	25.800	5.800
55	F1 in 6000	25.800	31.800	6.000
56	F1 in 1200	31.800	33.000	1.2000
57	Level	33.000	40.000	7.000
58	F1 in 500	40.000	42.000	2.000
59	Level	42.000	43.000	1.000
60	F1 in 500	43.000	44.000	1.000
61	R1 in 500	44.000	45.000	1.000
62	Level	45.000	47.000	2.000
63	R1 in 500	47.000	49.000	2.000
64	F1 in 500	49.000	50.500	1.500

1	2	3		4
		From	To	
65	R1 in 500	50.500	52.000	1.500
66	Level	52.000	64.000	12.000
67	R1 in 250	64.000	65.000	1.000
68	F1 in 250	65.000	67.000	2.000
69	Level	67.000	69.500	2.5000
70	R1 in 500	69.500	70.500	1.000
71	Level	70.500	73.000	2.5000
72	R1 in 200	73.000	74.600	1.6000
73	F1 in 800	74.600	75.800	1.2000
74	F1 in 200	75.800	77.100	1.3000
75	Level	77.100	78.700	1.600
76	R1 in 250	78.700	80.000	1.300
77	F1 in 250	80.000	81.300	1.300
78	Level	81.300	84.500	3.200
79	F1 in 1000	84.500	87.500	3.000
80	R1 in 1000	87.500	89.000	1.500
81	F1 in 500	89.000	91.000	2.000
82	R1 in 500	91.000	93.000	2.000
83	F1 in 500	93.000	94.500	1.500
84	F1 in 400	94.500	96.100	1.600

1	2	3		4
		From	To	
85	R1 in 375	96.100	98.350	2.250
86	Level	98.350	100.400	2.050
87	R1 in 1500	100.400	101.900	1.500
88	F1 in 800	101.900	104.150	2.250
89	R1 in 800	104.150	106.400	2.250
90	Level	106.400	111.500	5.100
91	F1 in 800	111.500	113.500	2.000
92	F1 in 500	113.500	116.500	3.000
93	R1 in 1000	116.500	117.500	1.000
94	Level	117.500	119.100	1.600

DETAILS OF CURVES BETWEEN UDHAMPUR – BARAMULLA

(UDHAMPUR - KATRA)

S. NO	DEFLECTION ANGLE			DEG REE	RIGH T OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
1.	21	15	00	2	R	875	164.14	324.51	0/230.43	0/555.32
2..	44	00	00	2.95	L	583.33	235.58	447.97	0/670.54	1/118.51
3.	68	15	00	3.5	L	500.00	320.85		1/2972.66	1/85309
4.	43	22	22	2.75	L	500.00	253.06	481.72	2/094.99	2/576.71
5.	10	2	5	2	R	875	76.93	153.46	7/403.15	7/556.61
6.	5	19	37	1	L	17.50	81.41	162.70	12/314.40	12/477.10
7.	40	20	11	2.75	R	636.36	23.374	488.00	17/169.59	17/617.59
8.	56	47	7	2.75	L	636.36	343.97	630.69	23/255.72	23/886.41
9.	86	32	56	2.75	R	636.36	599.14	961.26	24/829.10	25/790.36
10.	15	15	09	2	R	875	117.16	232.93	30/703.73	30/936.66
								3883.24		

(KATRA – QAZIGUND)

S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
11.	13	25	59	2	R	875	103.05	205.15	31/467.89	31/673.04
12.	49	31	06	2.75	L	636.36	293.49	549.98	35/840.99	36/390.97
13.	80	8	57	2.75	L	636.36	535.38	890.18	36/735.37	37/625.55
14.	40	24	41	2	R	875	284.30	616.99	38/140.94	38/757.93
15.	49	15	55	1.55	R	1125	515.84	967.32	39/348.36	40/315.68
16.	64	46	04	2.5	R	700	443.96	791.29	41/996.62	42/787.91
17.	89	49	25	2	L	875	872.21	1371.66	46/675.59	48/047.25
18.	122	5	18	2.75	R	636.36	1150.11	1355.98	49/734.06	51/090.05
19.	66	30	0	2.75	R	636.36	417.23	738.61	51/557.33	52/295.94
20.	128	36	24	2.75	L	636.36	1322.45	1428.38	52/836.95	54/265.33
21.	99	37	08	2.75	R	636.36	753.28	1106.42	55/316.52	56/422.99
22.	20	26	19	2.75	L	636.36	114.72	227.01	57/950.41	58/177.42
23.	14	31	54	2.75	R	636.36	81.13	161.40	58/521.39	58/682.78
24.	29	40	04	2.75	R	636.36	168.54	329.51	61/788.94	62/118.44
25.	28	15	33	2.75	L	636.36	160.23	313.93	62/287.48	62/601.42
26.	54	32	20	2.75	L	636.36	328.02	605.74	62/927.11	63/532.85
27.	48	41	31	2.75	R	636.36	287.94	540.80	63/850.36	64/391.16

12264.35

D	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
28.	37	8	49	1	L	1750	588.04	1134.59	69/825.06	70/959.64
29.	116	54	13	2.75	L	636.36	1036.49	1298.40	71/436.18	72/734.58
30.	19	28	19	1	R	1750	300.27	594.74	73/942.46	74/537.20
31.	35	42	47	2.75	R	636.36	205.01	396.65	75/008.21	75/404.86
32.	104	12	06	2.75	R	636.36	817.46	157.32	76/481.85	77/639.17
33.	109	39	43	2.75	R	636.36	903.13	1217.97	77/639.40	78/857.41
34.	42	09	21	2.75	L	636.36	245.27	468.21	79/562.21	80/030.52
35.	30	09	05	2.75	L	636.36	171.41	334.88	81/701.00	82/035.88
36.	33	49	16	2.75	L	636.36	193.47	375.64	83/394.54	83/770.18
37.	34	54	00	2.75	R	636.36	200.03	287.62	85/533.79	85/.921.41
38	149	17	34	2.50	L	700.00	2549.39	1823.96	87/352.87	89/174.83
39.	18	44	29	1.00	R	1750	288.79	572.42	89/642.42	90/214.84
40.	21	53	23	1.00	L	1750	338.42	668.58	90/677.71	91/346.30
41.	66	00	33	2.75	R	636.36	413.33	773.14	92/558.18	93/321.32
42.	39	56	04	2.75	L	636.36	231.20	443.54	93/736.43	94/179.97
43.	29	49	31	2.75	R	636.36	169.47	331.26	94/904.23	95/235.49
44.	73	37	56	2.75	L	636.36	476.34	817.80	95/636.25	95/454.05
45.	56	24	17	2.75	R	636.36	341.25	626.46	96/919.11	97/545.57

12323.18

S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM., To
1	2			3	4	5	6	7	8	9
46.	117	58	58	2.75	R	636.36	1058.72	1310.38	98/762.85	100/073.24
47.	88	27	03	2.75	R	636.36	619.38	982.39	101/520.26	102/502.65
48.	35	35	54	2.75	L	636.36	204.30	995.39	103/350.95	103/746.32
49.	17	59	50	2.00	L	875	137.78	273.32	104/735.59	105/008.91
50.	13	22	36	2.00	L	875	102.61	204.28	105/654.52	105/858.81
51.	21	45	44	2.75	R	636.36	122.33	241.71	106/109.53	106/351.53
52.	33	47	41	2.75	L	636.36	193.31	375.34	106/751.49	107/126.83
53.	15	41	10	2.00	R	875	120.53	239.55	107/610.35	107/849.91
54.	20	20	50	2.00	R	875	157.02	310.74	108/541.41	108/852.14
55.	157	40	45	2.75	L	636.36	3225.55	1751.28	109/322.44	111/073.71
56.	41	21	41	2.75	R	636.36	306	570.45	111/447.73	112/018.18
57.	65	06	21	2.75	L	636.36	406.23	723.10	112/450.85	113/173.95
58.	101	20	04	2.75	R	636.36	776.57	1125.48	113/559.04	114/684.51
59.	115	55	11	2.75	R	636.36	1016.80	1287.47	114/684.53	115/972.
60.	19	16	31	2.00	L	875	148.65	294.49	116/467.76	116/762.24
61.	20	40	47	2.75	R	636.36	116.10	229.68	117/150.01	117/379.68
62.	38	30	23	2.75	L	636.36	322.27	427.67	117/547.84	117/975.52
63.	119	18	04	2.75	L	636.36	1086.85	1325.03	118/699.30	120/024.32

S. NO	DEFLECTION ANGLE			DEGREE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
64.	29	27	04	2.75	R	636.36	167.25	327.10	120/330.08	120/657.18
65.	87	22	22	2.75	L	636.36	667.83	970.41	121/054.77	122/025.18
66.	88	55	08	2.75	R	636.36	624.46	987.58	122/390.55	123/378.13
67.	67	35	09	2.75	L	636.36	425.89	750.65	126/357.98	127/108.62
68.	61	25	54	2.75	R	636.36	378.08	682.30	129/042.48	129/724.77
69.	32	34	50	2.75	L	636.36	185.98	361.88	130/003.21	130/365.09
70.	76	48	48	2.75	L	636.36	504.49	853.13	131/330.04	131/183.18
71.	25	47	30	2.75	R	875	200.33	393.88	132/934.59	133/328.47
72.	10	31	03	2.75	R	636.36	793.14	1138.62	134/198.70	135/337.32
73.	94	05	52	2.75	R	636.36	683.58	1245.10	135/337.32	136/382.42
74.	24	16	37	2.75	L	636.36	136.87	269.63	137/396.25	137/665.88
75.	31	58	46	2.75	R	636.36	182.35	355.18	137/516.01	138/871.19
76.	89	23	11	2.75	L	750	742.01	1170.07	139/506.98	140/077.05
77	21	44	21	2.00	L	875	168.02	331.99	141/245.21	141/577.21
78.	53	53	59	2.75	L	636.36	322.54	598.64	141/945.24	142/543.89
79.	14	16	58	2.00	L	875	109.63	218.12	143/419.40	143/637.52
80	37	50	20	2.75	R	636.36	218.12	420.21	144/083.52	144/503.78
81.	28	13	56	2.00	R	875	220.05	431.15	145/324.31	145/755.46

S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
82.	56	59	20	2.00	L	875	474.98	870.31	146/165.54	--147/036.86
83.	16	07	05	2.00	L	875	123.89	246.15	148/188.32	148/434.47
84.	81	15	12	2.75	R	636.36	545.94	902.44	149/581.40	150/483.84
85.	67	04	22	2.75	L	636.36	421.78	744.95	151/162.83	151/907.78
86.	23	44	24	2.33	R	750	157.64	310.76	153/474.94	153/785.70
87.	54	56	01	2.00	L	875	454.85	838.93	163/197.71	164/036.64

(QAZIGUND - BARAMULLA)

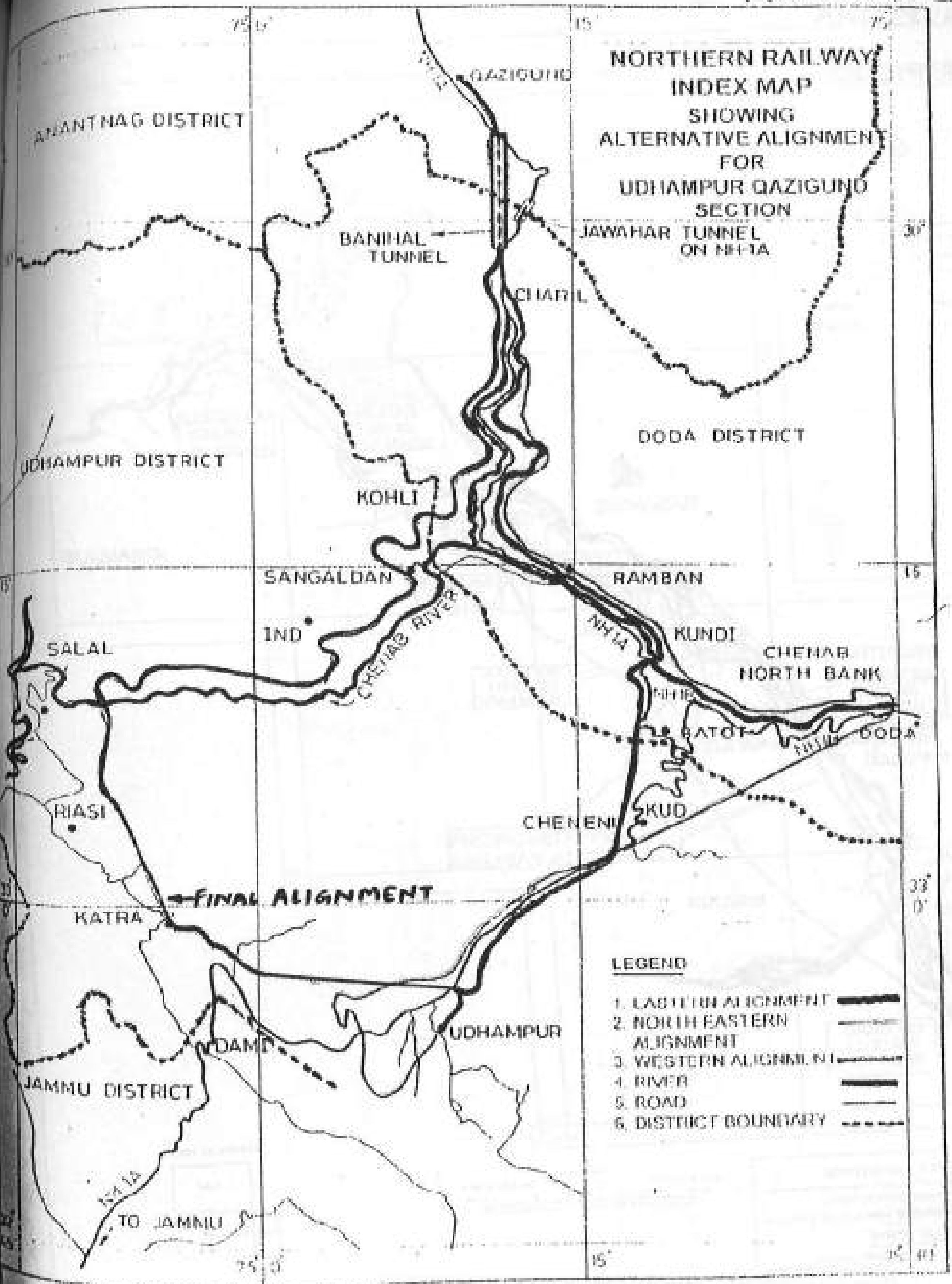
S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
88	85	38	15	2.75	R	636.36	589.66	951.14	01/535.34	02/486.48
89.	59	43	48	2.75	R	636.36	365.41	663.39	03/043.29	03/706.68
90.	29	36	24	2	R	875	234.11	457.51	06/031.02	06/488.52
91.	18	25	25	2	R	875	141.91		09/779.97	10/060.27
92.	10	23	55	2.5	R	3500	317.60	633.46	13/897.75	14/441.22
93.	8	36	1	1	R	1750	131.59	262.68	23/467.74	23/730.42
94.	34	39	30	2.75	R	636.36	198.56	384.94	30/785.77	31/170.71
95.	51	7	31		R	875	418.53	789.77	33/091.12	33/871.99
96.	25	37	42	2	R	636.36	144.74	284.65	40/676.33	40/960.98
97.	35	2	41	2.75	R	875	276.26	535.19	43/984.95	44/520.14
98.	22	52	19	12	R	1750	354.01	698.59	48/115.69	48/814.28
99.	39	11	05	2	R	875	311.44	598.42	52/436.31	53/034.73
100.	82	6	56	1	R	1750	1524.35	2508.00	55/950.91	58/458.98
101.	8	13	29	1	R	1750	125.82	251.21	59/977.61	60/228.32
102.	11	2	20	2	R	1750	169.11	337.18	63/209.74	63/546.92
103.	21	52	47	2.75	R	636.36	123.00	243.01	65/030.33	65/273.34

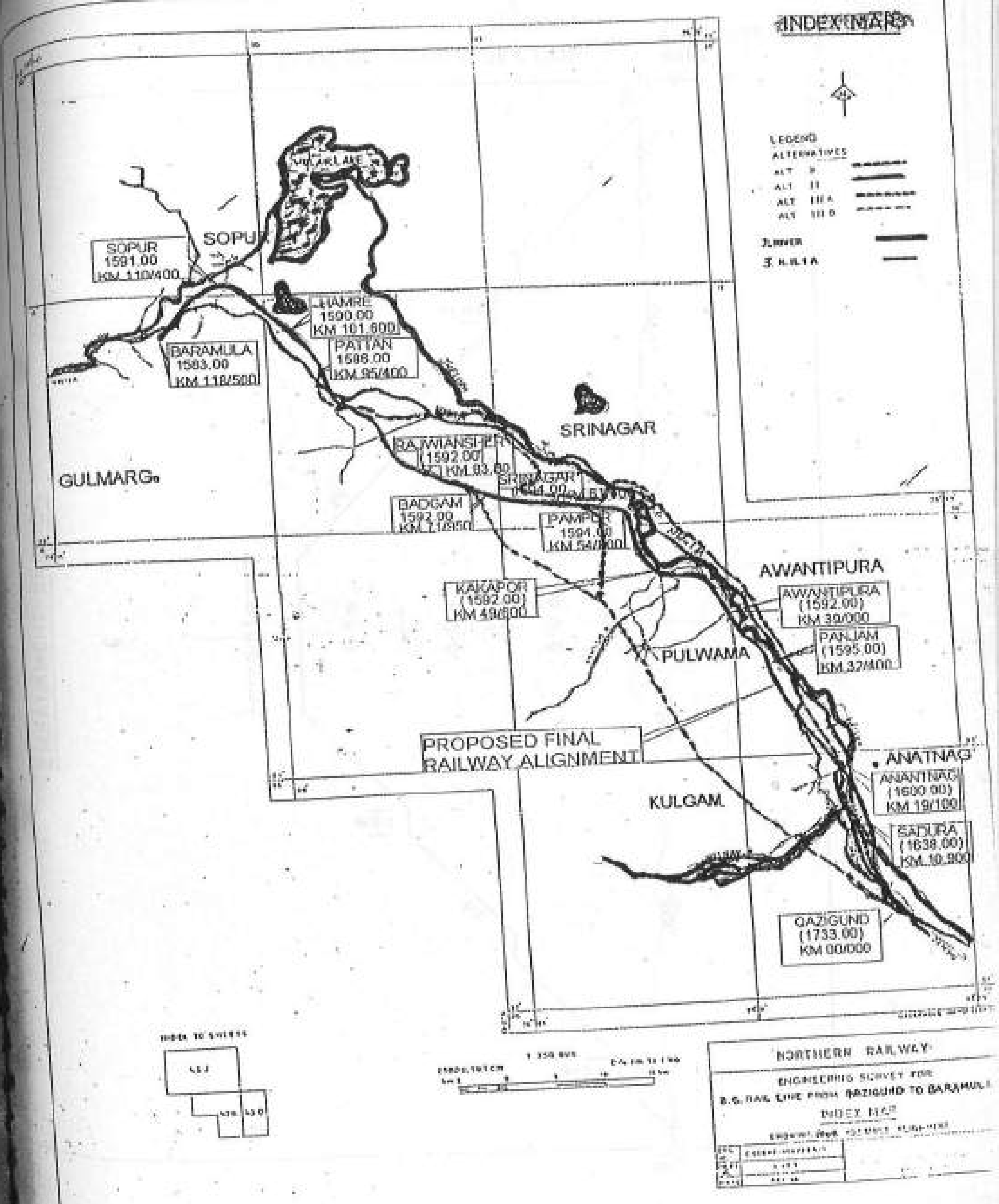
(QAZIGUND - BARAMULLA)

S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
88	85	38	15	2.75	R	636.36	589.66	951.14	01/535.34	02/486.48
89.	59	43	48	2.75	R	636.36	365.41	663.39	03/043.29	03/706.68
90.	29	36	24	2	R	875	234.11	457.51	06/031.02	06/488.52
91.	18	25	25	2	R	875	141.91		09/779.97	10/060.27
92.	10	23	55	2.5	R	3500	317.60	633.46	13/897.75	14/441.22
93.	8	36	1	1	R	1750	131.59	262.68	23/467.74	23/730.42
94.	34	39	30	2.75	R	636.36	198.56	384.94	30/785.77	31/170.71
95.	51	7	31		R	875	418.53	789.77	33/091.12	33/871.99
96.	25	37	42	2	R	636.36	144.74	284.65	40/676.33	40/960.98
97.	35	2	41	2.75	R	875	276.26	535.19	43/984.95	44/520.14
98.	22	52	19	12	R	1750	354.01	698.59	48/115.69	48/814.28
99.	39	11	05	2	R	875	311.44	598.42	52/436.31	53/034.73
100.	82	6	56	1	R	1750	1524.35	2508.00	55/950.91	58/458.98
101.	8	13	29	1	R	1750	125.82	251.21	59/977.61	60/228.32
102.	11	2	20	2	R	1750	169.11	337.18	63/209.74	63/546.92
103.	21	52	47	2.75	R	636.36	123.00	243.01	65/030.33	65/273.34

S. NO	DEFLECTION ANGLE			DEG REE	RIGHT OR LEFT	RADIUS	TANGENT LENGTH IN METRES	CURVE LENGTH IN METRES	TP-I	TP-II
	Deg.	Min	Sec						KM. From	KM.. To
1	2			3	4	5	6	7	8	9
104.	55	10	15	2.75	R	636.36	332.58	612.76	65/581.08	66/193.84
105.	33	21	2	2.75	R	636.36	190.62	370.41	66/516.25	66/886.66
106.	28	48	46	2	R	875	224.77	440.02	67/283/09	67/723.11
107.	14	46	6	1	R	1750	226.80	451.08	69/572.22	70/023.30
108.	12	55	54	1	R	1750	198.33	394.98	73/418.68	73/813.66
109.	30	28	40	2.75	R	636.36	173.36	338.51	81/655.44	81/993.95
110.	27	24	42	2	R	875	213.40	418.62	84/648.68	85/067.30
111.	36	10	42	2.75	R	636.36	207.86	401.82	86/824.89	87/226.71
112.	10	21	25	1	R	1750	158.60	316.34	89/983.51	90/290.85
113.	39	31	5	2.75	R	636.36	228.59	438.91	92/069.77	92/508.68
114.	27	2	49	1	R	1750	420.89	826.10	97/203.47	98/029.56
115.	51	9	59	2	R	875	418.91	781.39	108/477.47	109/258.86
116.	30	38	44	1	R	1750	479.50	936.02	111/240.85	112/176.87
117.	28	51	38	2.75	R	636.36	163.75	320.54	371.85	114/692.39
118.	64	47	23	2.75	R	636.36	403.77	719.59	116/889.16	117/608.75

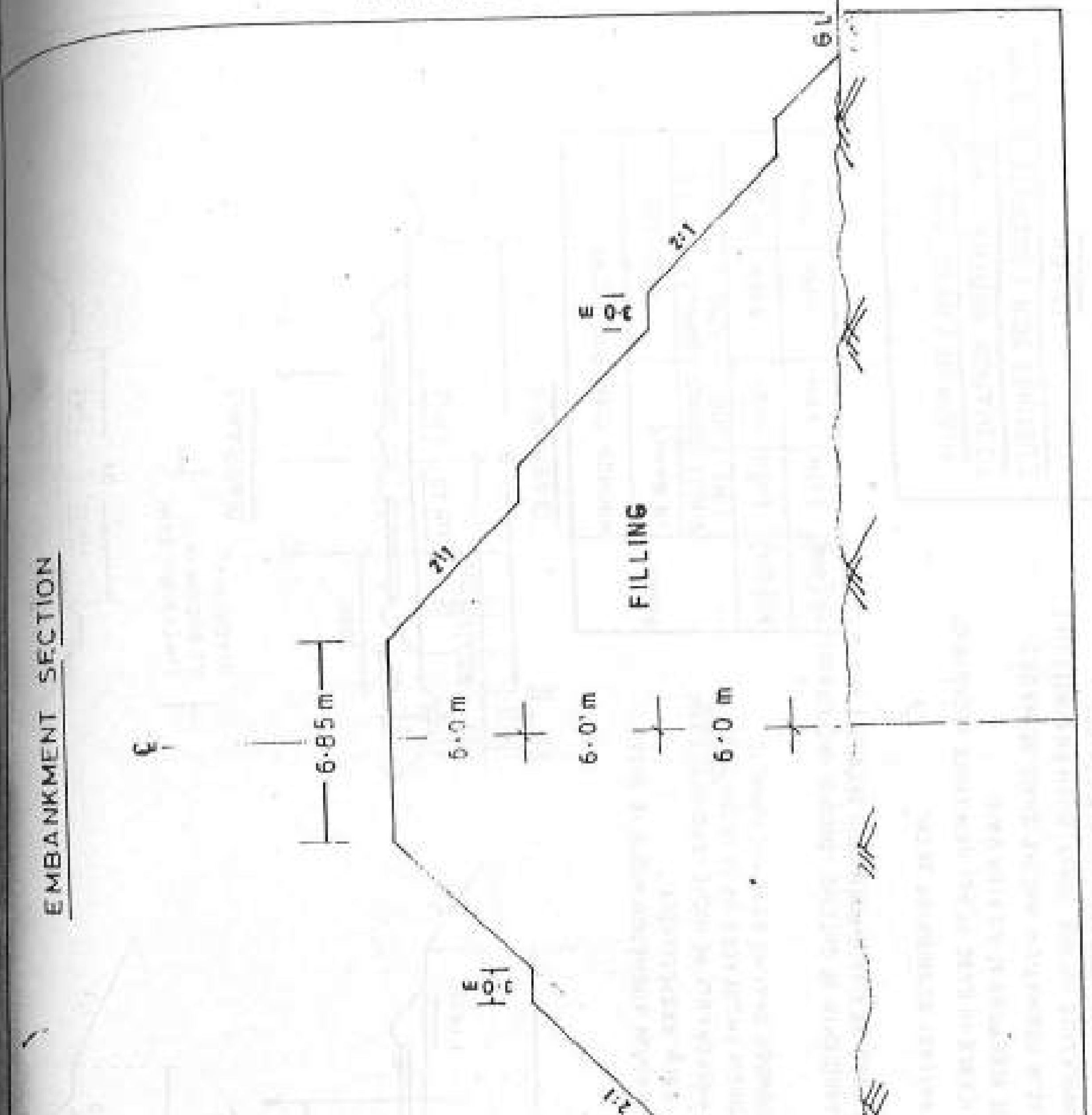
ANNEXURE-III/I




INDEX MAP
LEGEND
ALTERNATIVES
ALT II
ALT III A
ALT III B
SOPUR
SOPUR
1591.00
KM 110/400
HAMRE
1590.00
KM 101.600
BARAMULA
1583.00
KM 118/500
PATTAN
1586.00
KM 95/400
SRINAGAR
RAJWANSHER
1592.00
KM 83.80
GULMARG
SRINAGAR
BADGAM
1592.00
PAMPOR
1594.00
KM 54/800
AWANTIPURA
KAKAPOR
(1592.00)
KM 49/600
AWANTIPURA
(1592.00)
KM 39/000
PANJAM
(1595.00)
KM 37/400
PULWAMA
PROPOSED FINAL
RAILWAY ALIGNMENT
ANATNAG
ANANTNAG
(1600.00)
KM 19/100
KULGAM
SADURA
(1638.00)
KM 10.900
QAZIGUND
(1733.00)
KM 00/000
NORTHERN RAILWAY
ENGINEERING SURVEY FOR
INDEX MAP

ANNEXURE - VI/I
SHEET - 1

TYPICAL CROSS SECTION



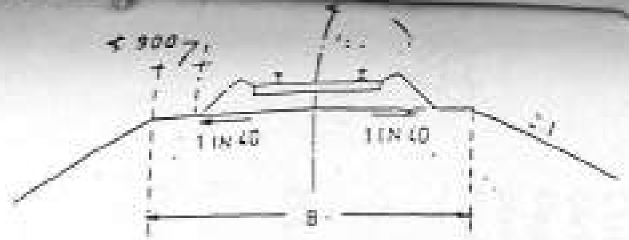


DIAGRAM-1

DIMENSIONS SAME AS SHOWN IN DIAGRAM 4

DIAGRAM-3

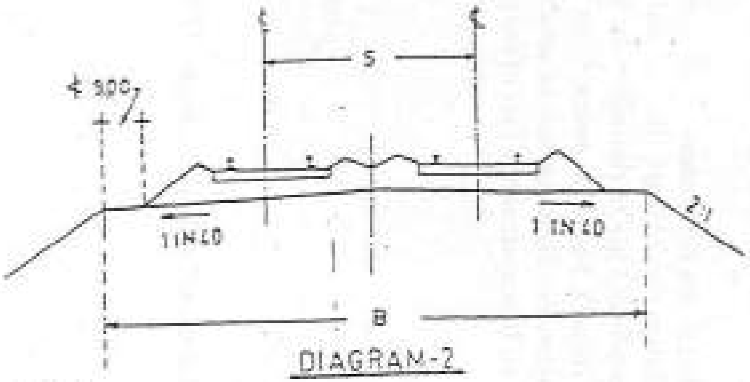


DIAGRAM-2

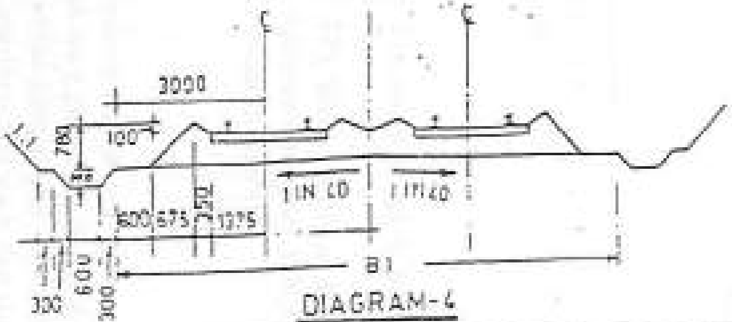


DIAGRAM-4

GAUGE	MINIMUM FORMATION WIDTHS			
	IN BANKS		IN CUTTING	
	SINGLE LINE	DOUBLE LINE	SINGLE LINE	DOUBLE LINE
BG [1676]	6.85M	11.58M.	6.25M.	10.98M.
MG. [1000]	5.85M	9.81M.	5.25M	9.21M.

NOTES

1. ON BG. AND MG. DOUBLE LINES, THE MINIMUM FORMATION WIDTH IS BASED ON TRACK CENTRES OF 4.725M AND 3.96M RESPECTIVELY.
2. ON BG. THE TRACK CENTRES SHOULD PREFERABLY BE INCREASED UPTO 5.25M AND FORMATION WIDTH CORROSPONDINGLY INCREASED UP TO 12.10M FOR BANKS AND 11.50M IN CUTTING , PROVIDED THAT NO REVERSE CURVE IS INTRODUCED ON THIS ACCOUNT.
3. IN FLAT TERRAINS, THE HEIGHT OF BANK/DEPTH OF CUTTING SHOULD PREFERABLY BE NOT LESS THAN 1 M FOR ENSURING GOOD DRAINAGE, FORMATION STABILITY AND TO AVOID TRESSPASSING.
4. THESE DIMENSIONS ARE BASED ON A BALLAST CUSHION OF 30 CM.
5. THESE DIMENSIONS ARE ALSO APPLICABLE IN CASE OF ALL NEW LINES BECAUSE OF THE POSSIBILITY OF USE OF CONCRETE SLEEPERS AT A LATER DATE.
6. ON CURVES THE FOLLOWING INCREASE IN FORMATION WIDTHS SHALL BE MADE :-
   I. FOR EXTRA BALLAST CUSHION ON OUTERSIDE OF THE CURVE, 0.15M ON SINGLE LINE AND 0.30M ON DOUBLE LINE (INCLUDING 0.15M INCREASE IN TRACK CENTRES).
   II. FOR EXTRA CLEARANCE REQUIRED ON DOUBLE LINE DUE TO EFFECT OF SUPER ELEVATION ETC. AS STIPULATED IN THE APPENDIX TO THE SCHEDULE OF DIMENSIONS FOR BG, MG.

MINIMUM / RECOMMENDED FORMATION WIDTHS FOR BANKS/ CUTTINGS FOR CONCRETE SLEEPER TRACK.

ANNEXURE-VI/II

टेलेक्स : 0535-2424 RDSO-IN
फैक्स : 91-0522-458500
तार : 'रेलमानक' लखनऊ
Telegram : 'RAILMANAK', Lucknow
टेलीफोन/Tele : 451200 (PBX)
450115 (DID)

भारत सरकार - रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ - 226011
Government of India-Ministry of Railways
Research Designs & Standards Organisatio
LUCKNOW - 226011

सत्यमेव जयते

NO: RS/G/95/NR   Dt: 3.5.99

CAO/Construction,
Northern Railway,
Kashmeregate,
Delhi – 6

Sub: Provision of sub ballast – Guidelines for earthwork in Railway Projects.

Ref: ED, Works Railway Board DO letter no: 99/W-2/N/DL/2 dated 8.4.99 addressed to Shri V.K.Jain, EDGE, RDSO and copy to CAO (Construction), Northern Railway.

In reference to above, it is requested that the details of the project and the progress of earthwork may please be given in the proforma enclosed, so that the further action mentioned in the above referred letter may be taken by RDSO. The stretches where the progress of earthwork is such that the present level is more than 1m below the formation level, minimum 1m thick blanket should be provided in accardance with the Railway Board letter no: 94/CE-II/MB/2 dated 10.12.98

It is [illegible]ested that the details of soil testing done which should include IS Classificati[illegible] [s]oil, particle size distribution, liquid limit, plastic limit, plasticity index, coefficient o[f un]iformity (Cu), Coefficient of curvature (Cc), Maximum Dry Density, Degree of co[m]paction achieved, Quality control organisation at site etc may also be communicated so that suitability of existing earthwork can be assessed.
Further action in this connection will be taken on receipt of the above details.

DA: as above

(V.K.Jain)
Executive Director / GE

Copy to: ED/Works, Railway Board in reference to his above referred letter.

S.No.	Name of Project	Total Length	Details of section		
			Earthwork has been completed upto formation level	Earthwork is more than 1m below formation level.	Earthwork is less than 1m below formation level.

ANNEXURE-

भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS
(रेलवे बोर्ड RAILWAY BOARD)

No. 94/CE-II/MB/2 रेल भवन, नई दिल्ली-110001, तिथि
Rail Bhavan, New Delhi-110001, dated 10.12.98

Chief Engineers,
All Railways.

Sub: Provision of sub-ballast.
Ref: Railway Board's letter of even no. dt. 6.8.98.

Vide Board's above referred letter, different thickness of sub-ballast have been prescribed in the track, depending upon the axle load, GMT and maximum speed of trains. According to it, the thickness of sub-ballast layer varies with change of speed and traffic density etc. The speed and the track density of routes is a variable factor and therefore the thickness of balla: which will be required to be increased in future depending upon the speed and traffic density will pose a serious problem as the work will be required to be carried out under traffic conditions.

A reference has been received from CAO (C)/C. Rly. suggesting to lay down uniform thickness of sub-ballast for all routes. This has been examined in Board's office and Board have decided that in future, for all new lines and doublings, the thickness of sub-ballast (blanket layer of one metre should be provided irrespective of the present axle load, GMT and sectional speed of these lines unless the thickness of layer required for the needs of axle loads, GMT and speeds are greater than one metre.

The provisions made for blanket layer for existing lines have also been re-examined. The railways are embarking upon heavy axle load and trailing loads. These features will have significant effect on formation. Gradually, the heavy axle load wagons will cover the entir railway net work. In order not to create any handicap at a later date on this score, it has been decided to provide a minimum of 60 cm. thick layer wherever the work is executed unless the thickness required from the needs of axle loads, GMT and speed is greater than 60 cm.

..../2

5N.97

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY BOARD

No.94/CEII/MB/2 New Delhi,dt. 6-8-98

The General Manager(Engg.)
All Indian Railways.

Sub:- Provision of Sub-ballast on existing lines.

....

Railway Board vide their letter No.95/W1/Genl/0/39 dated 9.10.96 have issued Correction Slip to Guidelines for Earthwork in Railway projects, May 87 indicating provision of sub-ballast(blanket) on all new constructions on Indian Railways. Board have decided that provision of ballast and sub-ballast depending upon axle load, GMT and speed are to be followed for existing routes also. Depth of ballast and sub-ballast to be provided for various combinations of axle load, GMT and speed of train operatio on existing routes are indicated in Annexure-I.

These depths of ballast and sub-ballast are for preferred category of soils. Characteristics for preferre category of soils are enclosed as Annexure-II(Ref.:Guideli for Earthwork in Conversion Projects - Sept.,1995).

For other stretches, depth of ballast & sub-ballast are to be determined based on threshold stress value of th soil dertermined under dynamic triaxial testing.

Formations on all the stretches where higher axle loads/speeds are to be introduced, should be upgraded in line with above instructions. Existing stretches where problems of weak formations are being experienced also nee to be investigated properly and provided with suitable lay of sub-ballast. Specifications for sub-ballast(Blanket) material as per RDSO's Guidelines for Earthwork,May97.

(DEEPAK KRISHAN)
Exe.Director Civil Engg.(P)

Encl.As above.

Annexure

DEPTH OF BALLAST & BLANKET/SUB-BALLAST FOR PREFERRED SOILS DEPENDING UPON AXLE LOAD, GMT AND SPEED

DEPTH OF BALLAST (CM.) + DEPTH OF SUB-BALLAST (CM.)

AXLE LOAD (TONNES)	GMT	SPEED OF TRAIN (KMPH) UPTO 100	100-130	MORE THAN 130
20.32	UPTO 15	20 NO SUB-BALLAST	25+15	25+15
	15-35	25+15	25+20	25+30
	MORE THAN 35	25+25	25+30	25+50
22.1	UPTO 15	25+15	25+15	30+15
	15-35	25+25	30+25	30+40
	MORE THAN 35	25+50	30+50	30+60
23.5	UPTO 15	25+20	30+20	30+25
	15-35	25+40	30+40	30+55
	MORE THAN 35	25+60	30+60	30+70
25.0	UPTO 15	25+25	30+25	30+30
	15-35	25+55	30+55	30+65
	MORE THAN 35	25+70	30+70	30+80
30.0	UPTO 15	25+60	30+60	30+65
	15-35	25+85	30+85	30+95
	MORE THAN 35	25+100	30+100	30+110

SPECIFICATION FOR PREFERRED FILL MATERIAL

order to ensure a trouble free formation, soils having following characteristics shall be preferred:

i) Fine particles (less than 75 micron size) less than 50%.

ii) Liquid Limit under 35% and Plasticity Index under 15.

iii) Uniformity coefficient (Cu) greater than 7.

iv) Minimum achievable dry density with heavy compaction as per IS: 2720 Part VIII, should be greater than 1.85 g/cc.

following soils should preferably be avoided :

* Peat and Organic Soils
* Chalk etc. which are likely to disintegrate
* Poorly graded sands with Cu less than 2.

NOTE: Ref: Guidelines for Earthwork in Conversion Projects, 1995)

Railway Board's Letter No.91/CE-II/BF/7 dated 2 General Manager(Engineering), All Indian Railw. amended vide Corrigendum No.2 Circulated Vide Rly. Letter No.F3/W1/Genl/0/37 dated 9.10.96.

SPECIFICATION FOR BLANKET MATERIAL

1. MATERIAL FOR BLANKET

2. Material for blanket shall possess following characteristics.

2.1 It must be sufficiently impervious to divert most of the water falling over it to sides so as to prevent softening of subgrade soil.

2.1.2 It must be reasonably pervious to permit escape of capillary or seepage water to prevent accumul-tion of water below it and development of pore pressure.

2.1.3 It must possess sufficient strength to withstand the imposed loads.

2.1.4 It should get easily compacted to a degree so as to have minimum plastic deformation in it. In compacted state, it should disperse the load in a better way.

2.1.5 Finished surface of the blanket should give a stable platform for placing track ballast without any rutting or other surface irregularities which may accumulate water.

2.2 Guidelines for Earthwork in Railway Projects, issued by RDSO stipulate definite parameters for blanket material, which do not meet all the requirements. Therefore, these stipulations need to be supplemented with following so that all the above mentioned characteristics are met.

- The blanket material should be coarse, granular and from hard rock.
- The material should have small quantity of fines. If the fines are plastic the percentage of fines i.e. particles upto 75 microns should be between 2 to 5%. If fines are Non-plastic these should be between 8% to 12%.

2.3 Normally, there is hardly any single material in the country which meets specifications given in the Guidelines or those modified as above. However, it can be obtained by blending silty clay soil with fine sand, coarse sand and quarry grit/caked up ballast.

Laboratory tests conducted in RDSO indicate that mixing up to 12% of silty clay having clay contents of 60-40% with coarse sand of FM more than 2.5 gives material which meets all these requirements. As an illustration, properties of original materials blended ones are given below:

PROPERTIES OF ORIGINAL AND BLENDED MATERIALS FOR SUB-BALLAST BLANKET.

	IS Class	M.A. in % G	S	M	C	Consistency Limits in % LL	PL	PI	Direct Shear C'	φ'	Lab Compac. OMC	MDD	Permeability Kx10^{-2}cm/sec	Gradation Cu	Cc	Total Fines %
[illegible]	SP	5	94	1	Nil	NP	NP	NP	.02	33	-	1.856* 1.572*	1.853	3.48	0.68	1
[illegible]	CI	Nil	Nil	58	42	41	22	19	-	-	12	1.85	-	-	-	100
[illegible]	SW-SM	3	85	8	4	NP	NP	NP	.06	30	8	2.07	0.886	12.50	2.27	12

@ M1 & M2 are Original Materials.

@ MB is a Blended Material using 89% of M1 and 11% of M2 materials.*

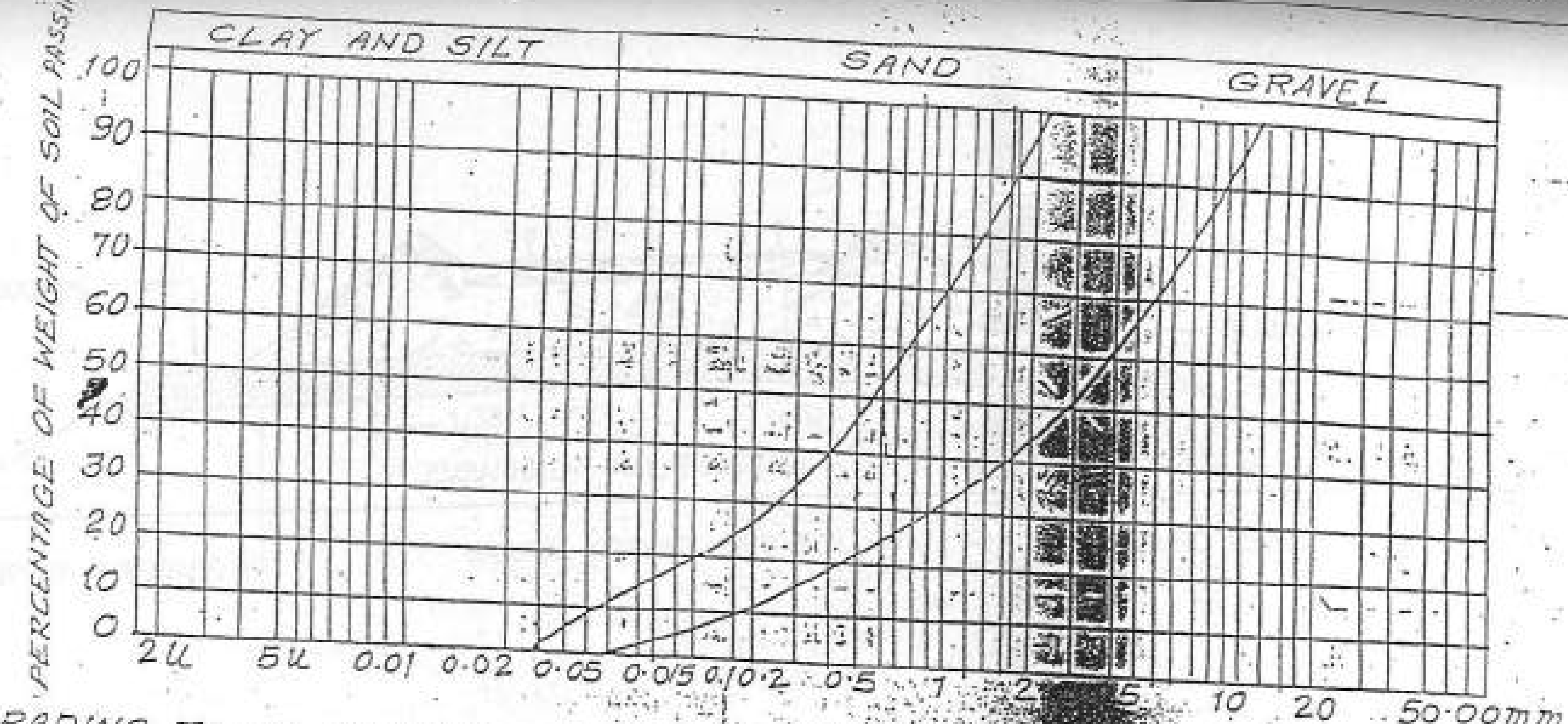
* Ymaximum and Yminimum values(MDD) as determined during Relative Density Tests.

2.4 Exact ratio of blending soil in coarse sand shall be determined based on grain size analysis in each case.

2.5 Blending of soil can be done with the help of disc harrows/cultivators attached to a tractor which are available in every part of the country.

2.6 The Blended material shall have grading so as to meet all the stipulations given in the "Guidelines for Earthwork in Railway Projects."

16.7.97



NOTES:-

NO SKIP GRADING TO BE ALLOWED.

THE BLANKET MATERIAL SHOULD BE COARSE, GRANULAR AND FROM HARD ROCK.

THE MATERIAL SHOULD HAVE SMALL QUANTITY OF FINES.

IF THE FINES ARE PLASTIC, THE PERCENTAGE OF FINES i.e. PARTICLES UP TO 75 MICRONS SHOULD BE BETWEEN 2 TO 5%. IF FINES ARE NON-PLASTIC, THESE SHOULD BE BETWEEN 8% TO 12%.

UNIFORMITY COEFFICIENT $\left(\frac{P_{60}}{D_{10}}\right)$ IN NO CASE SHOULD BE LESS THAN 4. PREFERABLY IT SHOU[LD BE MORE] THAN 7.

THE COEFFICIENT OF CURVATURE $\left(\frac{D_{30}^2}{D_{60} \times D_{10}}\right)$ TO BE WITHIN 1&3.

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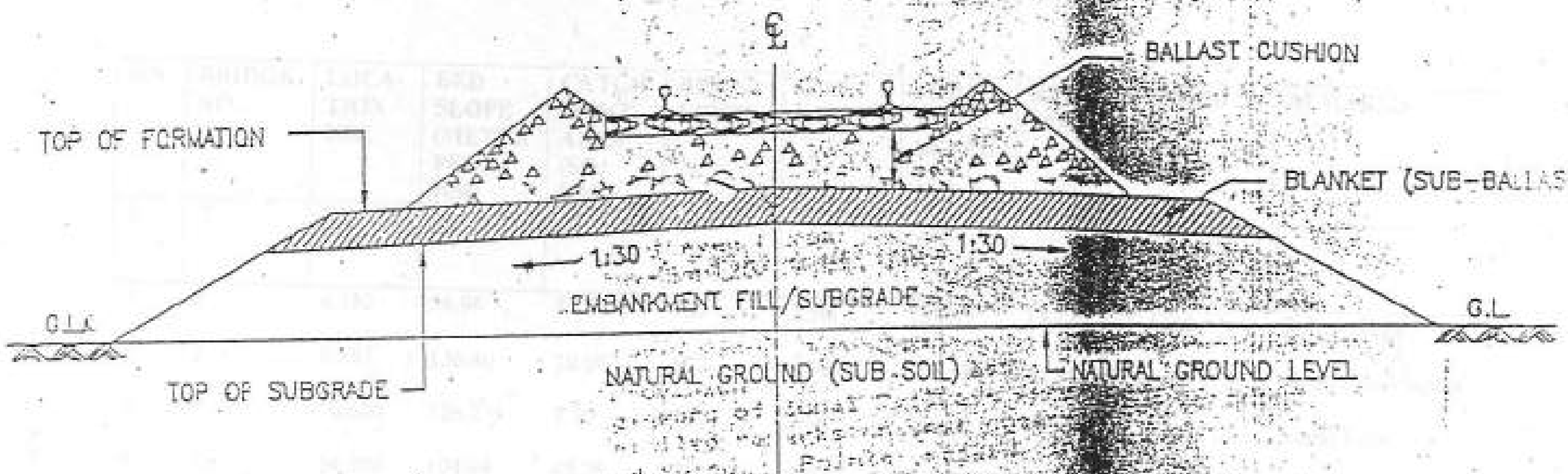

PROFILE ... ANE
(SUB- ... ST)

AWN BY– Akhtar JCA	TRACED BY ---	APPROVED BY

DETAILS OF MAJOR & IMPORTANT BRIDGES BETWEEN UDHAMPUR – QAZIGUND

S.N	BRIDGE NO.	LOCATION KM.	BED SLOPE (METER PER KM)	CATCHMENT AREA (SQ. KM.)	BED LEVEL	H.F.L. / F.S.L.	FORMATION LEVEL	RECOMMENDED SPAN (M)	REMARKS
1	2	3	4	5	6	7	8	9	10
1.	2	6.150	96.96	55.00	702	2.50	708.97	3X22.8 PSC Girder	Birhun Khad
2	3	8.585	136.40	10.00	687	2.00	708.68	3X34 PSC girder	Nalah cum Viaduct
3	8	10.600	126.21	7.50	707	2.00	718.22	9X22.8 PSC girder	Nodal Khad
4	13	14.900	104.94	48.75	739	3.00	759.90	3X34 PSC girder	Dudhar Khad
5	20	20.173	167.22	19.50	688	2.00	783.92	2X120+2X30.5+1x12.2 m Steel girder	Jhajjar Khad- **Important Bridge**
6	24	21.515	281.18	4.75	755	1.50	788.73	2X62.5 PSC girder	Suqal Khad
7	26	22.680	363.89	1.80	745	1.00	800.92	1X70+2X50 PSC girder	Viaduct cum Nalah
8	27	23.998	321.58	0.70	789	0.60	811.27	6X34 PSC girder	Nalah
9	31	26.650						3x120m steel	**Important Bridge**

1	2	3	4	5	6	7	8	9	10
10	34	31.079	279	13.25	702	2.0	763.31	86+120+86 Steel girder 252	PIE Khad
11	35	36.545	116	87.50	590	3.5	752.75	86+120+86 Steel girder 252	ANJI Khad
12.	37	37.580	552	0.95	722	0.75	759.77	1x50 PSC girder 50	Nalah
13.	40	39.600	790	0.03	742	0.20	776.76	34+45+34 PSC girder 113	Nalah
14.	42	40.625	336	4.63	692	1.50	779.31	4x120+5x30.5 Steel girder [illegible]	Nalah- **Important Bridge**
15.	45	48.133	309.5	0.72	800	0.60	840.10	3x50 PSC girder 150	Viaduct cum Nalah
16.	46	49.100	3	2104	457		840.10	850m Cable stayed 850	Chenab river- **Important Bridge**
17	47	49.800	-	-	793	-	840.10	7x86 Steel girder 602	Viaduct – **Important Bridge**
18	48	52.135	601	0.625	829	030	858.15	2x45 PSC 90	Nalah
19.	49	53.270	540	0.250	830	0.2	868.72	50+34 PSC 84	-do-
20.	50	54.230	346	1.250	808	0.75	877.27	3x45 PSC 135	Nalah Viaduct
21	51	55.060	192	0.500	828	0.30	885.46	18.3+4x86+18.3 Steel 380.6	-do- **Important Bridge**
22	52	56.000	270	22.500	825	1.25	894.04	18.3+4x85+18.3 Steel 380.6	Dhansal Nalah- **Important Bridge**

1	2	3	4	5	6	7	8	9	10
23	53	58.635	328	5.25	843	0.70	919.28	86+120+86 Steel 292	Nalah
24	54	61.520	348	15.50	867	1.00	947.91	61+120+120 Steel girder 301	-do- Important Bridge
25	57	63.850	389	7.75	847	0.75	961.41	30.5+5x120+30.5 Steel 661	-do- Important Bridge
26	58	66.225	548	4.375	930	0.60	984.50	3x45m PSC 135	Masil Khad
27	59	68.425	621	4.50	933	0.60	1006.50	120+120+86 Steel 216	Sawal Khad
28	60	71.013	814	0.875	983	0.30	1033.27	18.3+4x86+18.3 Steel 380.6	Nalahcum Viaduct- Important Bridge
29	61	72.200	1233	0.20	985	0.20	1043.37	120+86 Steel 206	Nalah
30	63	74.265	1047	0.75	1015	0.20	1058.38	3x34 PSC 102	-do-
31	64	74.567	1107	0.75	1025	0.20	1059.13	1x45 PSC 45	-do-
32	65	77.850	196	36.25	1077	1.50	1088.84	5x22.8 PSC 114	Talsuen Khad
33	66	78.900	260	6.125	1035	1.0	1097.43	2x86 Steel 176	Nalah
34	68	80.100	431	1.125	1026	0.50	1108.77	4x120 Steel 410	Nalah cum Viaduct
35	69	80.952	948	1.000	1052	0.50	1117.27	24.4+2x86+24.4 220.50 Steel	Nalah

1	2	3	4	5	6	7	8	9	10
36	70	81.460	404	1.625	1032	0.75	1121.36	30.5+3x120+30.5 Steel 421	Nalah
37	74	83.035	350	2.250	1072	1.0	1123.40	2x86 Steel 172	Important Bridge Nalah
38	75	84.670	268	2.750	1103	1.0	1139.51	3x50 PSC 150	Nalah
39	76	85.885	404	2.000	1115	0.75	1151.21	3x45 PSC 135	-do-
40	78	88.630	350	0.500	1138	0.20	1176.00	7x45 PSC 315	-do-
41	80	90.020	429	2.000	1128	0.50	1190.35	61+120+61 Steel 242	Important Bridge Nalah
42	89	97.120	312	6.750	1210	1.0	1249.30	3x50 PSC 150	-do-
43	90	99.700	235	50.000	1247	2.0	1273.40	3x22.8 PSC 68.40	Chainj Nalah
44.	91	101.930	265	57.000	1260	2.50	1294.72	1x45 PSC 45	Karalgali Nalah
45.	92	103.800	752	0.750	1248	0.30	1312.16	2x86 + 2x61 Steel 304	Nalah cum Viaduct
46	93	104.400	617	0.750	1274	0.30	1318.16	5x50 PSC 250	-do-
47	94	104.989	67	0.500	1288	0.20	1323.92	4x34 PSC 136	-do-
48	97	106.000	598	0.750	1270	0.30	1327.12	4x50 PSC 200	-do-
49.	99	107.645	549	2.25	1277	0.50	1339.21	120+30.5 +120 Steel 270.50	-do-

1	2	3	4	5	6	7	8	9	10
65.	120	131.900	-	-	1489	-	1556.86	2x120+2x30.5+ 1x12.2 Steel girder	282.70 Viaduct
66	121	132.294	366	2.50	1512	1.00	1559.12	3x40 PSC	120
67	123	133.911	368	5.50	1544	1.25	1567.70	1x40 PSC	40 Dhandwar Gad
68	124	134.870	110	164.00	1528	3.50	1576.48	4x40 PSC	160 Mohu Mangat
69	130	140.800	428	0.10	1586	0.20	1622.70	5x40 PSC	200
70.	131	141.265	480	0.75	1592	0.30	1627.28	1x20 & 3x40 PSC	140
71.	132	141.943	-	-	1595	-	1633.74	6x40 PSC	240 Viaduct
72.	133	142.500	691	0.35	1609	0.20	1638.70	1x20 & 4x40 PSC	180
73.	134	143.358	539	0.35	1596	0.20	1647.16	5x40 PSC	200
74.	135	144.115	389	1.25	1619	0.50	1654.40	3x20 PSC	60
75.	137	144.800	536	0.45	1632	0.40	1660.75	5x40 PSC	200
76.	138	145.407	360	0.45	1620	0.40	1666.72	2x40 PSC	80
77.	145	151.113	125	59.75	1686	2.50	1713.07	10x40 PSC	400 Bichlari
78.	146	151.590	-	-	1710	-	1717.31	1x20 PSC	20 RUB
79.	151	166.475	182	12.00	1726	2.00	1735.46	3x12.2 PSC	36.6 Walnar Nar

1x30 Steel

Km to Ozgye 3 15985.80

LIST OF MAJOR BRIDGES (QAZIGUND - BARAMULLA)

S. NO.	BRIDGE NO.	LOCATION KM.	BED SLOPE (METER PER KM.)	CATCHMENT AREA (SQ. KM.)	BED LEVEL	HT. OF FLOOD LEVEL ABOVE BL(M)	FORMATION LEVEL	RECOMMENDED SPAN (Mtr.)	REMARKS
1	2	3	4	5	6	7	8	9	10
1.	3	2,600	77.35	72.68	1685	5.0	1713.82	4X30.5 & 2X18.3 PSC	Jhelum
2.	13	9.400	59.53	52.70	1639	2.5	1647.12	3x30.5 & 2x12.2 PSC	Sandran
3.	17	15.950	51.66	74.00	1598	2.5	1605.28	5x18.3 & 2x12.2 PSC	Sandran
4.	27	26.150	22.83	*	1586	2.5	1595.94	6x18.3 & 2x12.2 PSC	Vishwa
5.	32	28.250	36.18	*	1584	2.0	1505.59	4x18.3 & 2x12.2 PSC	Rembhiara
6.	37	31.125	6.10	17.73	1592	1.0	1595.11	3x12.2 PSC 36.6	Wankar
7.	53	46.100	76.64	*	1588	1.00	1590.00	6x12.2 PSC Girder 73.2	Romushi Nala
8.	76	59.530		*	1587	2.00	1594.00	1x12.2 PSC Girder	Flood opening
9.	77	59.900		*	1587	2.00	1594.00	1x12.2 PSC Girder	Flood opening

1	2	3	4	5	6	7	8	9	10
10.	78	60.200		*	1587	2.00	1594.00	1x12.2 PSC Girder	Flood opening
11.	81	62.100		*	1586	2.00	1594.00	1x12.2 PSC Girder	Flood opening
12.	83	62.545		*	1585.50	2.00	1594.00	1x12.2 PSC Girder	Flood opening
13.	84	62.975		*	1587	2.00	1594.00	1x12.2 PSC Girder	Flood opening
14.	87	63.300		*	1591	2.00	1594.00	1x12.2 PSC Girder	Flood opening
15.	92	65.012	40.66	*	1588	3.00	1598.00	5x18.3 PSC Girder	Dudh Ganga River
16	122	85.410	212	306.00	1586.50	2.00	1591.08	6x18.3 PSC	Sukh Nag Nala
17.	131	88.830	50.75	150.00	1586.00	3.00	1590.33	6x12.2 PSC	Ferozpur Nalah 1st crossing
18.	136	91.460	31.7	150.00	1583.80	3.00	1587.42	6x12.2 PSC	Ferozpur Nalah 2nd crossing
19.	139	93.100	-	-	-	-	1590.50	2x12.2 PSC 1x28	NH1A ROB
20.	145	97.475	27.2	94.00	1583.50	3.00	1587.17	6x12.2 PSC	Gund Ara Nala
21.	147	99.170	-	-	1586.50	1.00	1589.50	1x12.2 PSC	Flood opening
22.	148	99.700	-	-	1587.00	0.50	1589.50	1x12.2 PSC	Flood opening
23.	149	100.170	-	-	1587.00	0.50	1589.50	1x12.2 PSC	Flood opening

1	2	3	4	5	6	7	8	9	10
24.	150	100.930	-	-	1587.50	0.30	1589.85	1x12.2 PSC	Flood opening
25.	152	103.140	13.2	38.00	1584.00	1.00	1588.95	3x12.2 PSC	Babal Kol
26.	156	105.580	-	-	1586.00	1.00	1589.50	1x12.2 PSC	Flood opening
27.	157	106.310	56.30	144.00	1586.00	1.30	1590.38	6x12.2 PSC	Ninghal Nala

1320.90

3118.70

Annexure VI/IV

Following steps are required for estimation of the flood discharge.

(i) *Preparation of catchment area plan of the ungauged catchment.*

(ii) *Determination of physiography parameters viz: catchment area (A), Length of the longest stream (L), Length of stream from CG of the catchment (LC) and equivalent stream slope (S).*

Determination of 1- hr SUG parameters and plotting SUG by using following emperical formula.

$$t_p = 2.498 * (L*Lc / S)^{0.156}$$

$$q_p = 1.048 * (t\,p)^{0.178}$$

$$W_{50} = 1.954 * (L*Lc / S)^{0.099}$$

$$W_{75} = 0.972 * (L*Lc / S)^{0.124}$$

$$WR_{50} = 0.189 * (W_{50})^{1.769}$$

$$WR_{75} = 0.419 * (W_{75})^{1.246}$$

$$TB = 7.845 * (t_p)^{0.453}$$

$$Qp = qp * A$$

(iii) Q_p = Peak Discharge of Unit Hydrograph (Cumecs.)

t_p = Time from the Centre of Effective Rainfall duration to the U. G. Peak (hr.)

W_{50} = Width of the U.G. measured at the 50% of peak discharge ordinate (hr.)

W_{75} = Width of the U.G. measured at 75% of peak discharge ordinate (hr.)

W_{R50} = Width of the rising limb of U.G. measured at 50% of peak discharge ordinate (hr.)

$W_{R}75$ = Width of the rising limb of U.G. measured at 75% of peak
discharge ordinate (hr.)

T_{B} = Base width of Unit Hydrograph (hr.)

A = Çatchment Area (Sq.km.)

q_{p} = Q_{p}/A = Cumec per sq. km.

(iii) Estimation of design storm duration (TD). has been adopted as 1.1 t_p

(iv) Estimation of point rainfall and areal rainfall for design storm duration (TD) and to obtain areal rainfall increments for unit duration intervals from the relevant tables and graphs given report.

(v) Estimation of effective rainfall increments by substracting the design loss rate from the areal rainfall increments.

(vi) Estimation of base flow.

(vii) Computation of design flood peak and flood hydrograph.

MAJOR BRIDGES

As per the standard classification in Railways, Bridges with spans 12.2 meter and above have been classified as major bridges. In the entire project there are 106 No. of major bridges. The linear waterway of bridges has been dictated by the formation level since bulk of the major bridges are located in gorges. However, for all major bridges, a calculation of the waterway has been verified by calculating the catchment area of each bridge. For each of the zones, the method stipulated in the joint publication of C.W.C. and R.D.S.O. for calculation of catchment area of the bridges has been followed. The method adopted for the purpose is briefly described below:

A separate Annexure shows the catchment area of each major bridge.

SPAN ARRANGEMENT OF MAJOR BRIDGES

No clear cut rules are specified for deciding the span arrangement of the major bridges. However, following factors have been kept in view while finalizing the span arrangements. Following factors have been kept in view while finalizing the span arrangements of the major bridges.

i) Overall span arrangement of bridge, as far as possible should be in conformity with the general stipulation of the cost of sub structure being almost equal to that of the super structure.

ii) Use of spans the detailed design of which is already available either in JURL project or elsewhere in Northern Railway.

iii) Founding the pier at a location which is suitable strata and which also permits the load dispersion at an angle not exceeding 60 degrees with the horizontal.

iv) Founding the pier at a location ~~which results~~ in the minimum height of pier.

v) For the bridges in the valley, the central span has been kept wider with a view to permit navigation in the river/nallah.

CHOICE OF FOUDNATIONS

The strata encountered for this project may be broadly classified in two groups. The first type is typical of the stretch between Udhampur to Quazigund while the second type extends in the valley from Quazigund to Baramulla. In the former stretch typical geology of the Himalayan region has been witnessed. This strata comprises of silty sand mixed with boulders and cobbles. At some bridge sites seams comprising of pure clay have also been found. At certain other locations in deep nallahs, sand stone has also been identified. This type of strata has varying structural properties. At locations where sand stone has been encountered, the bearing capacity tends to be very high and has enabled the designers to adopt a value upto 100 tonnes per meter square. Other locations which are comprised of scree have not permitted a value of more than 25 tonnes per square meter at the founding level. In this region, neither the bored piles nor deep wells could be proposed for the foundation. The foundations of all the major bridges have, therefore, been proposed as open foundations in this region. Fortunately the type of strata of most of the major bridges is not scourable. The depth of foundation has therefore been largely based on the bearing capacity consideration of the strata.

In the valley, the founding media for the major bridges is largely comprised of clay which falls in C.I. category as per I.S.I. classification. The depth of this layer is varying between 2 / 3 meters to 10 meters. Below this depth, the sandy strata has been encountered. The bouldry strata which has been encountered in Udhampur – Quazigund section is largely missing in lower reaches of the valley. Upper reaches of the valley particularly within a distance of 25 kms. from Quazigund have bouldery strata. This strata, therefore, attracts a similar solution for the foundation as has been proposed for Udhampur – Quazigund section. The rivers falling in this reach in the alignment are the Veth (Jhelum) river Vishwa and Rambiara which are major tributaries of Jhelum. For other major bridges, in the valley foundation has been proposed on bored piles with Drill Mud Circulation method.

Thus, as far as possible P.S.C. girders having a length of 22.8 meters, 34 meters and 45 meters have been used as simply supported spans. Keeping in view the difficulty encountered in JURL, the continuous P.S.C. spans have been avoided unless the use of the same became inescapable on account of site compulsions. While deciding on the span arrangement of individual major bridges, attempt has also been made.

SUB SURFACE INVESTIGATION OF MAJOR BRIDGES

Sub surface investigation of major bridges was carried out through core drilling varying in depth from 18 meters to 50 meters. The job was completed through the use of diamond bit by taking the samples of NX size. The annexures attached alongwith the report depict the bore logs of different bridges for which the drilling had been done. The undisturbed samples which had been obtained through this process were subjected to laboratory testing in respect of (I) Unconfined compressive strength (ii) density (iii) specific gravity (iv) porosity. Keeping in view the nature of strata, the S.P.T. and plate load test have not been conducted as the results of such tests in this type of strata tend to be erroneous. The bearing capacity of the strata was decided based on the codal provisions as per the test results.

DESIGN OF MAJOR BRIDGES

All bridges for the project have been designed as per MODIFIED BROAD GAUGE STANDARDS 1987. The ensuing paragraphs highlight the provisions of various codes and their correction slips considered important for the design of various elements of the major bridges.

The following is prepared for the listed standards and reflect the salient features as a ready reckoner for the design of various elements and construction material. They may not be construed to be a substitute of the relevant provision of the codes

PART 1 : SUPERSTRUCTURE

S.No.	ITEM		Reference of Relevant Code / Clause
1.0	Material Properties		
1.1	Cement	: OPC 43 grade : OPC 53 grade	IS : 8112 IS : 12269
1.2	Coarse & fine aggregates		IS : 383
1.3	Water used for concreting and curing		Cl.4.4 & A/c slip 20 &Cl. 3.3 IRC18

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1.4	**Reinforcement**	: Hot Rolled deformed bars/ Cold Twisted Bars Dimension for round and square Steel Bar for Structural and Gen. Engineering purpose	**IS 1139** **IS 1786** **IS 1732**
1.5	**Structural Steel**	: Steel for general and Structural Purpose	**IS 2062**
1.6	**Prestressing strand**	: Uncoated stress relieved low relaxation strand of 7ply & nominal diameter 12.7mm class 1 type UTS = 16.33 t class II type UTS =18.737 t. Size : T 13 Modulus of Elasticity : 196 GPa	**IS 14268**
1.8	**Concrete for Deck**	: M45 grade Modulus of Elasticity Ec = 18000 $\sqrt{f_c}$ kg/cm^2 Modulus of Rupture = 2.25 $\sqrt{f_c}$ Where f_c is in kg/cm^2	**cl 6.4.2.1** **cl. 6.9.2.4**
1.9	**Steel for Reinforced Concrete**	UTS : 415 Mpa[1] Modulus of Elasticity : 200 Gpa	
1.11	**Sheathing :**		**Cl. 3.6 of IRC 18**

System	**Thick-ness**	**Dia**	**Ultimate load**
12T13	4 mm	72 mm	196/223 t for class I & II
19T13	5 mm	90 mm	353 t

(Equivalent wire system also permissible subject to satisfaction of Engineer Re. Spec. adopted)

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1.11	**Anchorage**	: As per stressing system adopted.	
2.0	**<u>Losses in Prestressed Concrete members</u>**		
2.1	**Elastic shortening**	: During stage prestressing as applicable.	
2.2	**Creep of concrete**	: 0.043% per 100 kg/sq.cm.stress at Centroid of prestressing steel.	**cl. 6.7.2**
2.3	**Creep of Steel**	: <u>Low relaxation steel</u> to be used and losses assessed as under 1.8% after 100 hrs, 2.5% after 1000 hrs. & 2.5 x 2.5 = 6.25% long term at 70% UTS & Zero at 50% UTS **In the absence of verifiable data shall be taken as 8% @70% UTS & Zero at 50% UTS**	**cl.6.4** **IS14268** **cl. 6.7.3 and** **A/c slip 20**
2.4	**Shrinkage**	: Residual shrinkage strain At 28 days : .019%. 14 days : .025% 10 days : .030% Differential shrinkage stresses shall be accounted for, if deck is cast in stages. Reinforcement shall be > 20mm for Tor steel	**cl. 6.7.4 and** **IRC 18 cl. 11.3**
2.5	**Friction**	: $P_x = P_o(1 - \alpha\mu - K_f\alpha)$ P_o = Stress at jacking end α = Change of angle in radians. μ :Co.oeft. of friction. = 0.3 for steel moving on steel K_f : wobble coeft = .00328/m of cable length	**cl. 6.7.5**
2.6	**Slip at anchorage**	: Will depend on system used; shall be taken as 0.6	

		mm for grip type anchorages and the wedge settles following stressing. (Freyssinet type).	
3.0	Service Loads		
3.1	Permanent Loads	: Self Weight for Concrete deck = 2.5 T/m^3 Superimposed Dead Load : Ballast = $5.5^t/m$ Track = $0.67^t/m$ Cable & Pipe lines : 150 Kg/m on either side	
3.2	Live Loads	: As per the Addendum and Corrigendum Slip No.16 dated 14.1.88	**Br. cl. 2.3.1**
3.3	For Simply Supported Spans :	: Total load for Bending Moment, shear and Coefficient of dynamic augment(CDA) for various bridge spans shall be used as specified in Appendix II for Modified BG loading - 1987.	**Ref. Br. Rules App. II**
3.4	For continuous Spans	: The bending moments and shear forces for design purposes at various sections shall be computed for loading spectrum shown in Appendix I for Modified BG Loading - 1987	**Ref. Br. Rules cl. 2.3.1 App. I**
3.5	Dynamic effect	: Shall be as per IRS clause 2.4.1.1 for countinous decks and Appendix II A/C slip no. 16 dated 14.1.1988 for simply supported spans. No dynamic effect shall be taken on footpath loads or longitudinal forces.	**Br. App II of A/c slip no. 16** **BR. cl. 2.8.1.1**
3.6	Longitudinal Forces	: Tractive effort : 50ts per loco & for spans more than 29m = 100ts Braking effect : 25% of Loco axle loads	A/c slip 21 **Br.App.I &**

		13.4% of Train load on the loaded length Gradient effect : Shall be statiscally determined but shall not exceed the limits specified above The forces to be reduced by 25% for dispersion due to welded rails with rail free fastenings, approach anchorage etc., subject to a minimum of 16T and an additional 40% if span is supported on elastromeric bearings (not integrated with pier)	**A/c slip 16** **A/c slip 21** **BR cl. 2.8.2.3**
3.7	**Forces due to track eccentricity**	: Load eccentricity of 100 mm to be considered even on straight tracks	**A/c slip 19** **BR cl. 2.5.1**
3.8	**Raking forces**	: 600 kg/m length of deck .	**Br. cl. 2.9**
3.9	**Derailment loads**	: Shall satisfy for deck with guard rails for Serviceability, Ultimate and Stability conditions only.	**Br. A/c slip 18 & App. IX**
3.10	**Live Load On Footpath**	: Live load on footpath shall be taken as 490 kg/m^2 for slab design, and for deck girders system as per IRS clause 2.3.2.2. Approximately 30 m spans = 300 kg /m2 100m spans = 200 kg/m2	**BR. 2.3.2.1&** **BR. cl. 2.3.2.2**
3.11	**Forces on Parapets**	: Height of parapet above the foot path level = 1.0m A horizontal force of 150 Kg/m and a vertical force of 150 Kg/m applied simultaneously at the top of parapet.	**BR cl. 2.10**
3.12	**Kerbs**	: Kerbs shall have a width of less than 600mm	**BR cl. 2.3.2.4**

3.13	Temperature Effect	: Coefficient of expansion for Concrete =11.7×10^{-6} per ^{0}C. Global Temperature variation = $\pm$ 25° C. During Construction Temperature Temperature gradient for PSC box girder Temperature Movement of deck due to Temp. shall be independent of ballast.	**BR. cl. 2.6** **Clause 5.4 of BS 5400 Part 2**
3.14	Ventilation	: Provide Ventilation in the box girder with spans 45m and above to reduce creep & shrinkage strain and also to minimise temperature gradient through box.	
4.0	Distribution, Temperature and Shrinkage Reinforcement	: Distribution reinforcement shall be 20% of the main reinforcement or 0.2% of the concrete area whichever is higher. Quantum can be reduced by 25% where HYSD bars are used. This steel to be placed 2/3 over the main reinforcement and 1/3 in the same direction below the surface far away from the main reinforcement and an equal amount perpendicular to it. This provision may be ignored if this min. steel is available from other design requirements.	**A/c slip no. 15 and cl. 6.19.3.1**
5.0	Seismic Force	: Applicable zone : IV & V : coefficent α_0 = 0.05 & 0.08 respectively Importance factor I = 1.5 Soil factor β = 1.0	**Br. cl. 2.12**

		Horizontal seismic coefficent X = $\beta I \alpha_0$ Vertical seismic coefficent will be half of the horizontal seismic co-efficient	
		Effect on Live load shall be ignored along bridge only.	
		The governing seismic values for the seismic stage shall be as per seismic co-efficient method	**Roorkee Report**
		The response spectrum for the DBE cases of Roorkee report shall be evaluated, and checked if the result exceeds the results of the seismic co-efficient method	
		The ultimate capacity of the bridge shall be checked for the Response Spectrum for the MCE case. Failure mode shall be high steel elongation followed by concrete crushing. The characteristic value of the concrete and steel shall be taken when evaluating the structural capacity. While evaluating the above the scour level shall be taken for the Average Annual flood level. The stability of all sections especially at bearing footing & foundation levels shall be checked for a factor of safely of 1.5	**Cl. 6.1**
6.0	Wind **Pressure** Effect :	Basio Wind Pressure as per IS 875 @ 30 m above Mean retarding surface. Mean retarding surface : K = $\frac{\text{Cross Section area of bed between abutments Below abutment bed.}}{\text{Bed width between abutments}}$ Ht. for wind pressure evaluation = K + Height from	**Br. Cl. 2.11.3 and its sub paras**

		bed to deck level at abutment. Height of Rolling stock = 3.54 m2/m C.G. of Rolling stock = 2.37m Exposed area of Box girders to be calculated by considering total depth of deck and the box girder.	
7.0	**Construction Load** :	To be evaluated on the basis of equipment to be used as per superstructure design. For cantilevered construction the actual load during construction shall be validated to comply with the assumption made; this factor is also relevant for camber prediction during cantilevered construction. Live load may be assumed 50 kg/m^2 on deck. **During handling :** Compressive stress Tensile stress to an extent of 5% of the permissible compressive stress may be permitted.	Cl. 6.6.4.4
8.0	**Differential Settlement** :	To be evaluated from soil data and accommodated in the design process. No settlement shall be taken for Pier and live loads. The foundations shall be so designed so that long term settlement does not exceed 25 mm.	
9.0	**Coefficient of Friction at Bearings : μ** :	Elastomeric/POT/POT + PTFE Bearing well lubricated and dust protected shall be used. Coefficient of Friction shall be taken as under in the absence of data supplied by the manufacturers.	

Bearing Stress N/mm2	μ
5	8%
10	6%
20	4%
30+	3%

B.S. 5400
Part 9 clause 5.14.2.4 Table 3

LIVE LOADS AND LOAD COMBINATION TO BE CONSIDERED FOR STRAIGHT BRIDGES

Load Cases (LC)

1. DL1: Ist Self Load + Constn. Load, if any.
2. DL2: 2nd stage: Ballast retainer + Kerb + Railing + Footpath
3. DL3: Ballast + sleeper + Track + Pipes & Cables.
4. LL: Live load + Footpath live load (FPL)
5. Temp. effect(TE)
6. Longitudinal Force (LF)
7. Raking force (RF)
8. Wind effect (WE)
9. Seismic effect (SE)
10. Prestressing Effect (First stage = PE1, second stage PE=2)
11. Differential Settlements (DS)
12. Derailment Effect (DE)
13. Prestressing effect after losses (First stage KPE1, second stage KPE2)
14. Loads due to Bearing Friction (FB)

S.N.	Load Combination	Reference of draft IRS code
	Pre-Service stage.	
1	DLI + PE 1	Not mentioned in the draft code.
2	LC 1 + TE	-Do-
3	LC1 + SE	-Do-
4	LC1 + WE	-Do-
5	DL1+DL2+KPE1+PE2	-Do-
6	DL1+DL2+KPE1+KPE2	-Do-
7	LC6+DL 3	-Do-
8	LC 7 + DS	-Do-
9	LC 8 + TE	-Do-
10	LC9 + WE	-Do-
11.	LC8 + SE	-Do-
	Service Stage	
12.	LC7+LL+LF+TR	Combination 1
13.	LC 12 + DS	
14.	LC13+TE	Combination 3
15.	LC 13+SE	Combination 2
16.	LC13+WE	Combination 2
17.	LC8+DE	Combination 5
18.	LC8+FB	Combination 4

11.0	**Permissible Stresses in Prestressed Concrete** :		
11.1	**Concrete** :	Exposure status : Normal	
11.2	**At Transfer** :	Allowable Compressive stress 0.4 x Cube strength at time of stressing. or 1.2 x permissible Comp. stress at working whichever is less. Tensile Stress : Under partial DL : 1/20 of permissible compressive stress Under full DL : Nil.	**cl. 6.6.4.2**
11.3	**At Working** :	Compressive Stress For cube strength of 28 days of 350 kg/cm^2 = 112 kg/cm^2 For cube strength of 28 days of 530 kg/cm^2 = 140 kg/cm^2 For intermediate values of cube strength, interpolated value may be taken. Allowable tensile stress in the concrete during service conditions with and without seismic loading.	**cl. 6.6.4.5** **A/c slip 24**
11.4	**Prestressing Steel** :	At the time of initial tensioning, the maximum tensile stress in the steel at the jack end shall not exceed 80% of GUTS and after anchoring 70% of GUTS. Including the effects of Creep, Shrinkage, friction,	**A/c slip 20** **Clause** ***6.6.2.1*** ***Cl.6.6.2.2***

		wobble and relaxation of steel, the maximum tensile stress at the **point of maximum bending moment** shall not exceed (a) 0.8 of proof stress or (b) 0.6 of the ultimate strength whichever is lower.	
12.0	**Dispersion of Railway Live load through sleepers and ballast**		**Br. Cl 2.3.4.2**
	Dispersion through ballast : 2 Vertical x 1 Horizontal		
	RCC Slab spanning transverly:	Longitudinal Dispersion : ¼ span on each side of loaded area ¼ of loaded length on each side of loaded area for cantilever slabs	
13.0	**Minimum Dimensions of deck members** :	Deck slab not less than 200 mm. Tip of cantilever not less than 150 mm. Bottom slab of box girders not less than 150 mm Web thickness : Single duct and double duct	**Cl. 6.12.A of A/c slip 20** **A/c slip 23**
14.0	**Spacing of Diaphrams** :	For box girders : at least two end diaphragms with proper openings for access.	**cl. 6.16.3 of A/c slip 20**
15.1	**Concrete Cover over Reinforcement**	For P.S.C. sections: Reinforcement other than pre-stressing steel 40mm minimum For sheaths : 75 mm minimum	**cl. 6.20 A/c slip 20**
15.2	**Cover & spacing of curved tendons** :		**cl. 6.22 of A/c slip 20**
15.3	**Anchorage spacing** :	Spacing shall comply provisions of edge distance and	

		reinforcement as per system used for pre-stressing	
16.0	Section Properties :	In post tensioned members while calculating area, centroid and moment of inertia of cross sections deduction shall be made for cable ducts.	Cl. 6.3.2.2
17.0	RESERVE CABLES		
17.1	Emergency Cable : :	This shall be capable of generating 4% of total design force in the structure.	cl. 6.22 of A/c slip 20
17.2	Future Cable :	This shall cater for 15% of the total designed pre-stressing force. Provision shall be made for easy installation when required.	Cl. 6.22.9 A/c slip no. 20
18.0	Shear Provision in Prestressed Beams :	This shall be carried out for ultimate load condition only. Shear stress shall not exceed provision of cl.6.17.2.3. Min. shear steel shall always be provided as per cl. 6.17.2.5 Shear steel shall be provided in accordance with cl. 6.17.2.1, 6.17.2.4 & 6.17.2.6	Cl. 6.17.2 A/c slip 19
19.0	POST WORKING CONDITIONS		
19.1	Load Condition At First Crack :	1.1 DL + 1.25 LL	Cl. 6.9.2.4
19.2	Load Conditions At Failure :	1.4 DL + 2.0 (Super imposed DL) + 2.0LL	A/c slip 22

Ultimate Load Design Shall comply cl. 6.10

20.0 **Miscellaneous Provisions** : Deck to be cast horizontally for simply supported spans
Drainage provisions @ 6m c/cs.
Deck surface protection : 50 MM if Mastic asphalt is used.

PART 2 : SUBSTRUCTURE : PIERS & FOUNDATIONS OF PIERS

All the clauses referred to in Part 2 pertain to the sub structure code unless otherwise specified

			Reference of Relevant Code / Clause
1.0	Standards :	Generally the substructure shall be in RCC and shall conform to the provisions of the codes already referred to under **Standards** (page 4) particularly the **Code of practice for the Design of Substructure and foundations of bridges (Revised 1985)**	
2.0	Materials :		
2.1	Cement Reinforcement and other provisions	as per clause 1.0 in Part 1	
2.2	Concrete :	Concrete grade used in the substructure shall be as under for durability and service conditions.	

Pier : M30 grade
Pier footing : M30 grade

Mass Concrete : 1:3:6 c.c.

3.0	**Loads & Load Combination & Stresses**		
3.1	The loads on the substructure shall be those transmitted from the deck besides forces due to wind/seismic effects, and water current over the submerged portion.		
3.2	Since the entire project lies in seismic zone 4 and 5, the stresses during erection shall not exceed beyond 1.4 times of the permissible stresses when wind or seismic effects are also accounted for		Clause 5.13, 5.14 & 5.15.
4.0	**Force on Pier**		
4.1	Force due to Water Current	Forces on the pier. Pressure shall be evaluated by the formula P = K AV2 K = Constant for shape of cut water.	Clause 5.9
4.1.1	Force due to current flowing at an angle to the pier.		Clause 5.9.2.3
4.1.2	Point of application of the water current		Clause 5.9.2.6
5.0	Buoyancy	Buoyancy on submerged portion of piers & foundations shall be taken as 100% if the same is founded on coarse sand or shingle & 50% for other strata. For rocky strata the effect of buoyancy will be as per the discretion of the designer.	Clause 5.10.1.1
6.0	**Seismic effect**	• Modal Analysis as per the Roorkee Report shall be carried out where the piers are higher than 30 m.	Cl.5.12.1.2
		• While evaluating the seismic forces on the	Cl. 5.12.5 and 5.12.2

substructure, besides the force generated by its own dead weight, Hydrodynamic forces shall be accounted for

7.0 Foundation design.

7.1 Save Bearing Capacity on the founding strata shall be evaluated and size defined with due care taking into account the maximum settlement. The settlement shall not exceed 25 mm. — Cl. 6.4.1

7.2 In the case of open foundations the transferred moments & vertical forces, after accounting for buoyancy, active and passive pressure from the embedded soil where applicable, shall cause the resultant to fall within the middle third of the base if founded on soil and within the middle half if founded on rock. Embedment in soil shall not be less than 1.25 m — Clause 6.5 and 6.8

7.3 Stability factors in foundations — Clause 6.11

7.4 The depth of foundations below the water level for the design discharge for foundations shall not be less than 1.33 times of the maximum depth of scour. — Clause 6.10.1

7.5 Over turning of the well foundation. — Clause 6.10.3

PART 3 : EARTH PRESSURE ON ABUTMENTS AND FOUNDATIONS IN CONCRETE

1.0 **Standards :** Generally the substructure shall be in RCC and shall conform to the provisions of the codes already referred to under **Standards** (page 4) particularly the **Code of practice for the Design of Substructure and foundations of bridges**
(Revised 1985)

1.1	For calculation of earth pressure Coulomb's theory will be used.	**Cl. 5.7.1 and its sub paras**
1.2	Where the abutment is founded on compressible clay the active earth pressure shall be increased by 50% except for very soft, soft clay organic silts.	**Cl.5.7.3**
1.3	Earth pressure due to surcharge behind ballast wall.	**Cl. 5.8**
1.4	Active and passive earth pressure under seismic conditions.	**Cl. 5.12.6**
	Active and passive surcharge.	**Cl.15.12.6.3 and 15.12.6.4**
1.5	For submerged earth fill the saturated unit weight of the soil shall be taken while working out the forces and their C.G.	**Cl.5.12.7.1**
	Dynamic increment of submerged earthfill.	**Cl. 5.12.7.2**
2.1	Permissible stresses in concrete.	**Cl. 5.15.1**
	Permissible increase in allowable bearing pressure on soil	**Cl.6.9**
	Stability provisions	**Cl.6.11**

TEMPERATURE STRESSES

The I.R.S. Code for temperature stresses is insufficient. The existing clause of the I.R.S. Code speaks of a linear temperature
radiant of 5 degree centigrade to 10 degree centigrade between the top and bottom fibres. The provision of this clause for deep P.S.C.
girders was considered to be on a lower side. Following this clause could have therefore paved way for increase in the actual stresses
beyond the permissible stresses. For deep P.S.C. girders the contribution of the temperature stresses may go upto 20 % of the
maximum permissible stresses in the girder. As such these stresses assume a considerable importance. B.S. code 5400 gives greater
details about the variation of temperature across the depth of the girder. For designing the P.S.C. girders the temperature distribution
across the depth of the girder has been assumed as per clause 5.4.5 of B.S. Code 5400.

CONCRETE MIX FOR THE SUPER STRUCTURE

The design of the super structure has been made with M 45/M 40 grade of concrete. The trial mixes for M 40 have been
successful with 43 grade cement. For girders required to be cast with M 45, 53 grade cement will be used. The actual design of the
mix will be done with the I.S.I. method. The use of admixtures (super plasticiser) for casting of long span P.S.C. girders has been
envisaged. To restrict the shrinkage stresses, the girders are proposed to be cast with only two construction joints. Two construction
joints will also help in overcoming the problem of segregation of concrete during casting of the thin webs of deep girders.

DIFFERENTIAL SETTLEMENT

Differential settlement which is not an issue for simply supported P.S.C. girders assumes a considerable importance while
designing a continuous P.S.C. girders. Both the I.R.S. and I.R.C. codes do not stipulate any maximum value for the same. A value of
25 mm has been adopted which is in conformity with the practice being followed for M.O.S.T. design for continuous super structures.

CALCULATION OF EARTH QUAKE FORCES

A sizeable number of major bridges are high bridges. Their height from the bottom of foundation to the top of pier cap is more
than 30 meters. As per the stipulation of the present I.S.I. 1893, for such bridges the dynamic analysis for calculation of earthquake
forces is mandatory. For such bridges the earthquake forces are to be calculated based on static co-efficient method and dynamic
analysis. The higher of the two forces are to be considered for the design. Accordingly, for all major bridges having a height of more
than 30 meters, dynamic analysis as per the Roorkee University Report has been done.

DETAILS OF HYDRAULIC SLIP FORM SHUTTERING

The slip form system or construction of hollow/solid piers is characterised by 1m high shuttering for the entire cross section of the structure jointed together as the singie unit which is lifted at specified rate uniformly as the process of concreting progresses. The entire system is supported hydraulically through jacks. The main components of the system are described below:-

1.0 SLIP FORM COMPONENETS

(i) Shuttering :- The shuttering consist of 4 to 5 mm thick steel plates supported with angle framing on the out side to enable the shutter plates to take the proper shape of the structure.

(ii) Steel Waler :- Generally two steel walers of ISMC-100 are used . These walers run along the periphery of the structure and support the shuttering plates all around the periphery .

(iii) Yokes :- This is the main part of the slip form shuttering as the entire load of the shuttering plates through waler is supported on the vertical legs of the yokes. Depending upon the size and shape of the structure the spacing of the yokes is normally kept as 1 to 1.5 m c/c . The yoke legs are connected horizontally with yoke beams which are supported on jacks through jack rod.

(iv) Jack Rod :- The entire load of the slip form arrangement is transferred through jack rod to the concrete surface already cast. The jack rod is normally of 25 mm dia and is retrievable.

(v) Hydraulic Jacks :- The hydraulic jacks are operated through power pack and are fixed with the jack rods. Generally these jacks are of 3 tonne capacity. One jack is provided at every yoke. The entire load of shuttering working plate form etc. is transferred through these jack to jack rod to the bottom concrete. The jacks are double acting type which facilitate sliding of jack over the jack rod upward along with the entire slipform assembly.

(v) Working Platforms:- The working platform made up of wooden planks are also fixed with the slipform assembly i.e one at the top level which is used for fixing the reinforcement , pouring of concrete and operation of the power pack. Another working platform is provided about 1 m below the bottom of the slipform assembly, so that the surface of green concrete can be attended by Masons.

2.0 SLIPFORM OPERATION

Slipform operation shall generally be executed in a continuous, round the clock manner resulting in monolithic structure without horizontal joints. However, should there be stoppage of slipping operation due to any reason the construction joint so created shall be treated in a manner similar to those for fixed form joints. The cycle of operation commencing form the stage when the forms are filled with concrete after erection of the slipform in proper position and proper manner, is to raise the form with the help of jacks until the entire form work has been evenly raised to about 250 mm or so. The horizontal reinforcement for this height shall be placed in position and concrete deposited and vibrated almost to the top of the formwork. The hydraulic jacking system shall provide for the simultaneous movement of all the jacks in small pre-calculated increments of 25 mm in 10 to 15 minutes giving a sliding rate of 100 to 150 mm per hour average of continuous slipforming. Concrete shall generally be placed in equal horizontal bonds of not more than 250 mm and not less than 100mm in depth. The slides operations in no case shall be so fast as to cause 'blowouts' of soft concrete falling out from under the form nor so slow as to cause lifting of concrete or concrete sticking to forms. The sliding operation will have to be carried out under careful experienced supervision.

ANNEXURE-VI/VI

CHECK REQUEST FOR FOUNDATION
(LEAN CONCRETE)

BRIDGE NO :-

PART – A   FOUNDATION LOCATION:-

1. Soil starta at founding level - ....
2. Soft Pocket if any - ....
3. R.L. of Pit (Four corners and Centre)

UDM/Left   UDM/Right   Katra/Left   Katra Right   Centre

....

4. Sulphate content of soil & ground water ....
5. Orientation of Pit -..

	UDM end		KTR end	
i) w.r.t. Centre Line	c	d	a	b
	.....	.....	.....	.....
ii) w.r.t. Prep. to centre line	3	4	1	2
	.....	.....	.....	.....

6. Pit Dimensions   UDM side ....   KTR side ....   Left ......   Right ......

Part (B) **Arrangement of Material etc.**

	Cement	Sand	Crusher dust	C.A.	Water	Others
Qty Rqd.	....	......	....	.....	....	.....
available at site.	....	......	....	.....	....	.....

7. Total shifts required ....
8. labour/shift ....
9. Availability of T&P   Mixer   Vibrator   DG set

Date______   Time______   Signature of contractor______________

INSPECTION BY Inspector incharge of site

The above listed items have been checked and are within permissible limits. Concreting may be allowed.

Date______   Time______   Signature of JE INCHARGE______________

Date______   Time______   Signature of AEN/SEN______________

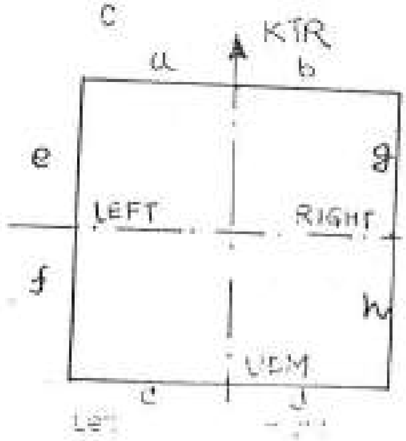
Check Request for RCC in foundation

Bridge Location Size Qty.

A **Layout**

A-1 **R.L. On Top of L.C.**

KR UR UL KL C



A-2 **Orientation of foundation**

a b c d

e f g h

A-3 **Dimension of foundation inside shuttering**

Sides UDM KTR Left

B **Shuttering**

B-4 **Condition of shuttering**

Alignment Cleanliness Use of lubricant

B-5 **Condition of joints**

Tighness Type of packing

C **Steel reinforcement**

C-1 **Detailing of reinforcement**

Location	Size	Nos.	Spacing	Laps/no	
Mesh(B)					
Mesh(T)					
Verticals					
Loops					

C-3 Whether steel has been recorded in MB and signed - yes/No

C-4. **Cover to reinforcement**

Location	1	2	3	4	5
Bottom					
UDM side					
KTR side					
Left side					
Right side					
Top					

C-5 Whether joint sampling of steel required - Yes/No

D **Details of concrete mix to be used**

D-1 **Grade of concrete** **Slump**

D-2 **Proportion of ingredients per bag of cement (Kgs.)**

CA10mm	CA20mm	Sand	Stone dust	Water

D-3 Nominal weight of cement bag (by sampling) =

E **Material availability at site(rquired/available)**

Cement	CA10mm	CA20mm	Stone dust	Sand	Water

F **Machinery availability at site**

Mixers	Weigh batchers	Vibrators	Moulds	DG Set

G **Details of personnel to be deployed**

Shifts required = Hours/Shift =

Category of Staff	Shift-1	Shift-2	Shift-3	Shift-4	Shift-5
Engineer					
Supervisor					
Mason					
Operator					
Labour					

Category of Staff	Shift-6	Shift-7	Shift-8	Shift-9	Shift-10
Engineer					
Supervisor					
Mason					
Operator					
Labour					

Date&Time of submitting check request: **Signature of Contractor**

The above details have been checked by me and found correct. Variations in parameters are within permissible limits. Permission for concreting may be granted.

Date   **Time**   **Signature of Inspector-In-Charge**

Date   **Time**   **Signature of SEN/AEN**

DETAILS OF MINOR BRIDGES BETWEEN UDHAMPUR - QAZIGUND

S. NO.	BRIDGE NO.	LOCATION KM.	BED SLOPE (METER PER KM)	CATCHMENT AREA (SQ. KM.)	BED LEVEL	HT. OF FLOOD LEVEL ABOVE BL (M)	FORMATION LEVEL	RECOMMENDED SPAN (M)
1	2	3	4	5	6	7	8	9
1	4	9.050	68.00	1.0	695	0.70	709.85	1x3R.C.C. Box 3
2	5	9.437	74.00	0.3	693	0.50	710.81	1x3R.C.C. Box 3
3	6	9.760	83.30	0.1	705	0.30	711.62	1x3 R.C.C. Box 3
4	7	10.050	155.63	2.8	702	1.00	712.72	1x5 R.C.C. Box 5
5	9	10.975	-	-	725	-	721.97	Irrigation syphon
6	10	11.500	63.00	0.87	727	0.60	727.22	1x2 R.C.C. Box 2
7	12	12.150	-	-	748	-	733.72	Acquaduct
8	14	16.375	58.50	3.75	766	1.00	775.88	1x4 R.C.C. Box 4
9	14A							1x4m RCC Box 4

1	2	3	4	5	6	7	8	9	24
10	15	16.820	94.86	0.90	774	0.60	780.33	1x3 R.C.C. Box	3
11	16	18.090	93.14	0.81	787	0.60	792.44	1x3 R.C.C. Box	3
12	17							1x3 R.C.C. Box	3
13	18							1x3 R.C.C. Box	3
14	19							1x3 RCC Box	3
15	21	20.525	77.50	0.38	778	0.50	785.16	1x3 RCC Box	3
16	22	20.650	112.00	0.28	774	0.40	785.64	1x3 R.C.C. Box	3
17	23	21.125	-	-	798	-	787.46	1x3 R.C.C. Box	3
18	25	21.950	114.55	0.25	777	0.30	793.42	1x2 R.C.C. Box	2
19	26A							1x3 R.C.C. Box	3
20	27A							1x3 RCC Box	3
21	28	24.420	56.00	0.45	798	0.50	812.04	1x3 RCC Box	3
22	28A	25.200	65.00	0.25	808	0.30	811.20	1x3 R.C.C. Box	3
								1x3 R.C.C. Box	3
									62

1	2	3	4	5	6	7	8	9	
23	30	26.400	68.00	0.32	805	0.30	810.50	1x10 P.S.C. Girder	10
24	33	26.960	482	0.21	745	0.20	761.00	1x10 P.S.C. Girder	10
25.	36	36.951	516	0.20	740	0.50	754.00	1X3 R.C.C. BOX	3.
26.	38	38.593	818	0.12	741	0.30	769.79	-do-	3
27.	39	39.312	740	0.05	752	0.20	776.01	-do-	3
28.	41	40.146	428	0.25	758	0.30	778.13	-do-	3
29.	43	41.055	550	0.30	755	0.40	780.38	-do-	3
30.	44	47.515	523	0.12	817	0.20	840.10	-do-	3
31.	55	62.105	115.5	0.50	919	0.15	951.33	1x6.0 R.C.C. Box	6
32	56	62.600	590	0.20	927	0.15	952.63	1x6.0 R.C.C. Box	6
33	62	73.837	1071	0.75	1050	0.20	1057.34	1x3.0 R.C.C. Box	3
34.	67	79.400	153	0.20	1093	0.15	1102.41	1x3 R.C.C. Box	3
35.	71	82.000	200	0.25	1100	0.20	1121.36	1x3 R.C.C. Box	3
36.	72	82.270	200	0.25	1100	0.20	1121.36	1x3 R.C.C. Box	3

T = 4

1	2	3	4	5	6	7	8	9	124
37.	73	82.700	442	0.50	1090	0.20	1121.36	2x 6.0R.C.C. Box	12
38.	77	87.150	550	0.50	1160	0.15	1164.75	1x3.0R.C.C. Box	3
39.	79	88.900	350	0.50	1163	0.20	1179.65	1x6.0R.C.C. Box	6
40	81	91.200	-	-	1218	-	1201.82	1x10 PSC	10
41.	82	91.500	553	0.75	1185	0.20	1204.75	1x6.0R.C.C.Box	6
42.	83	91.570	-	-	1198	-	1205.45	1x10 PSC	10
43.	84	92.225	-	-	1202	-	1212.00	1x10 PSC	10
44.	85	92.425	550	0.2	1200	0.15	1214.00	1x3.0R.C.C. Box	3
45.	86	93.200	243	0.75	1197	0.70	1221.01	1x6.0R.C.C.Box	6
46.	87	94.600	285	0.2	1230	0.15	1230.60	1x1.2R.C.C.Pipe	1.2
47.	88	95.100	318	2.87	1204	0.75	1231.85	2x6.0R.C.C. Box	12
48.	95	105.350	485	0.500	1303	0.20	1325.49	1x6.0 R.C.C. Box	6
49	96	105.630	379	3.250	1315	1.00	1326.19	1x6.0 R.C.C. Box	6
50	98	106.583	704	0.200	1322	0.20	1329.20	1x3.0 R.C.C. Box	3
									218.2

1	2	3	4	5	6	7	8	9	[illegible]
51.	101	110.865	698	0.500	1351	0.20	1369.14	1x6.0 R.C.C. Box	6
52	103	112.573	640	0.500	1380	0.20	1385.04	1x3.0 R.C.C. Box	3
53	110	120.325	756	0.250	1421	0.20	1447.20	1x3.0 R.C.C. Box	3
54.	117	130.500	740	0.375	1530	0.20	1543.54	1x3.0 R.C.C. Box	3
55	119	131.198	628	0.050	1530	0.20	1550.54	1x3.0 R.C.C. Box	3
56.	122	133.340	600	1.000	1550	0.50	1561.74	1x6.0 R.C.C. Box	6
57.	125	137.680	828	1.000	1566	0.30	1602.48	1x3.0 R.C.C. Box	3
58.	126	138.010	444	1.000	1582	0.30	1604.66	1x3.0 R.C.C. Box	3
59.	127	138.160	710	0.500	1581	0.20	1605.34	1x3.0 R.C.C. Box	3
60.	128	139.037	1036	0.375	1573	0.20	1607.23	1x6.0 R.C.C. Box	6
61.	129	140.343	571	0.300	1600	0.20	1618.49	1x3.0 R.C.C. Box	3
62.	136	144.440	508	0.350	1630	0.20	1656.97	1x3.0 R.C.C. Box	3
63.	139	146.820	562	0.300	1663	0.20	1680.59	1x3.0 R.C.C. Box	3
64.	140	147.650	275	3.500	1664	1.00	1683.20	1x6.0 R.C.C. Box	6
									272.20

1	2	3	4	5	6	7	8	9	
65.	141	148.133	664	0.500	1668	0.30	1684.66	1x3.0 R.C.C. Box	3
66.	142	149.170	349	3.750	1683	1.00	1694.77	1x6.0 R.C.C. Box	6
67	142A	149.375	-	-	1712	-	1696.82	1x1.2 R.C.C. Pipe	1.2
68.	143	150.200	-	-	1714	-	1704.33	1x10.0 PSC	10
69.	144	150.462	-	-	1698	-	1706.66	1x3.0 R.C.C. Box	3
70.	147	164.480	-	-	1746	-	1740.45	1x10.0 P.S.C.	10
71	148	165.067	-	-	1747	-	1738.98	1x10.0 P.S.C.	10
72.	149	165.955	124	2.100	1727	0.75	1736.76	1x6.0 R.C.C. Box	6
73.	150	166.067	109	2.150	1727	0.75	1736.48	1x6.0 R.C.C. Box	6
74.	152	166.666	32	2.100	1726	0.75	1734.98	1x3.0 R.C.C. Box	3
75.	153	167.033	46	2.150	1727	0.75	1734.06	1x3.0 R.C.C. Box	3
76.	154	167.650	34	2.120	1728	0.75	1732.52	1x3.0 R.C.C. Box	3
									336.40

LIST OF MINOR BRIDGES (QAZIGUND - BARAMULLA)

S. NO	BRIDGE NO.	LOCATION KM.	BED SLOPE (METER PER KM.)	CATCHMENT AREA (SQ. KM.)	BED LEVEL	H.F.L. / F.S.L.	FORMATION LEVEL	RECOMMENDED SPAN	REMARKS
1	2	3	4	5	6	7	8	9	10
1.	1.	0.725	21.33	0.20	1724.00	0.20	1731.40	1x1.2 R.C.C. Pipe	Nalah
2.	2	1.550	35.76	0.46	1717.00	0.30	1723.23	1x3.0 R.C. Box	Nalah
3.	4	2.850	12.02	0.48	1700.00	0.30	1711.32	1x1.2 R.C.C. Pipe	Nalah
4.	5	3.100	-	-	1711.00	-	1708.96	1x10 P.S.C. Girder	N. Highway
5.	6	4.075	13.33	0.30	1689.00	0.30	1699.94	1x1.2 R.C.C. Pipe	Nalah
6.	7	5.000	20.05	0.30	1691.00	0.30	1690.70	1x3.0 R.C.C. Box	Nalah
7.	8	6.770	23	2.30	1660.00	0.30	1673.42	1x3.0 R.C.C. Box	Nalah
8.	9	7.400	10.02	0.30	1660.00	0.23	1667.12	1x3.0 R.C.C. Box	Nalah
9.	10	7.800	10.50	0.20	1659.00	0.15	1663.12	1x1.2 R.C.C. Pipe	Nalah

1	2	3	4	5	6	7	8	9	10
10.	11	8.600	10.00	0.20	1648.00	0.30	1655.12	1x1.2 R.C.C. Pipe	Nalah
11.	12	9.125	13.35	0.10	1640.00	0.15	1649.87	1x1.2 R.C.C. Pipe	Nalah
12.	14	12.400	10.06	1.39	1611.00	0.45	1629.91	1x3.0 R.C.C. Box	Nalah
13.	151	13.175	33.75	1.05	1608.50	0.30	1622.80	1x1.2 R.C.C. Pipe	Nalah
14.	16	13.250	33.75		1607.00	0.30	1622.11	1x1.2 R.C.C. Pipe	Nalah
15.	18	16.440	12.5	0.56	1598.00	0.23	1604.90	1x1.2 R.C.C. Pipe	Nalah
16.	19	17.240	3.0	0.39	1595.00	0.23	1604.26	1x1.2 R.C.C. Pipe	Nalah
17.	20	17.800	-	-	1598.00	-	1603.55	1x10 P.S.C. Girder	N. Highway
18.	21	20.040	5.0	1.20	1593.00	0.23	1599.84	1x1.2 R..C.C. Pipe	Nalah
19.	22	22.224	13.3	0.50	1590.00	1.46	1598.38	1x3.0 R.C.C. Box	Nalah
20.	23	23.175	2.30	0.40	1589.00	0.30	1597.75	1x3.0 R.C.C. Box	Canal
21.	24	23.450	2.00	0.40	1589.00	0.30	1597.57	1x3.0 R.C.C. Box	Nalah
22.	25	24.570	-	-	1590.50	-	1596.83	1x3.0 R.C.C. Box	Kacha Road

1	2	3	4	5	6	7	8	9	10
23.	26	25.900	-	-	1590.00	-	1595.98	1x3.0 R.C.C. Box	Canal
24.	28	26.835	-	-	1592.00	-	1595.82	1x3.0 R.C.C. Box	Canal
25.	29	26.890	5.45	0.28	1589.00	0.45	1595.87	1x3.0 R.C.C. Box	Nalah
26.	30	27.175	9.00	0.38	1588.50	0.15	1595.76	1x1.2 R.C.C. Pipe	Nalah
27.	31	28.075	13.24	0.68	1588.50	0.15	1595.62	1x1.2 R.C.C. Pipe	Nalah
28.	33	28.400	5.45	0.50	1589.00	0.23	1595.56	1x3.0 R.C.C. Box	Kacha Road
29.	34	28.470	-	-	1591.00	0.30	1595.31	1x1.2 R.C.C. Pipe	Canal
30.	35	29.950	2.51	0.30	1589.00	0.30	1595.30	1x1.2 R.C.C. Pipe	Nalah
31.	36	30.835	2.50	0.10	1589.50	0.23	1595.10	1x1.2 R.C.C. Pipe	Nalah
32.	38	31.700	-	-	1592.00	0.30	1595.00	1x1.2 R.C.C. Pipe	Canal
33.	39	33.225	3.75	0.75	1589.50	0.30	1594.00	1x1.2 R.C.C. Pipe	Nalah
34.	40	34.550	4.66	0.63	1589.50	0.30	1594.00	1x1.2 R.C.C. Pipe	Nalah
35.	41	35.200	1.67	0.66	1589.40	0.30	1594.00	1x1.2 R.C.C. Pipe	Nalah

1	2	3	4	5	6	7	8	9	10
36.	42	35.340	1.67	0.66	1589.50	0.23	1594.00	1x1.2 R.C.C. Pipe	Canal
37.	43	35.500	-	-	1589.00	0.23	1594.00	1x1.2 R.C.C. Pipe	Canal
38.	44	36.600	-	-	1589.00	0.23	1594.00	1x1.2 R.C.C. Pipe	Canal
39.	45	37.300	1.50	0.40	1590.00	0.30	1594.00	1x3.0 R.c.C. Box	Path
40.	46	39.850	-	-	1590.00	-	1594.00	1x10 P.S.C. Girder	Nalah Road
41.	47	42.890	-	0.20	1589.00	-	1590.00	2x0.90 R.C.C. Pipe	Nalah
42.	48	44.315	-	0.30	1584.00	-	1588.63	2x1.2 R.C.C. Pipe	Nalah
43.	49	44.520	-	0.30	1586.00	-	1589.04	1x1.2 R.C.C. Pipe	Nalah
44	50	44.820	-	0.40	1585.00	-	1589.64	2x1.2 P.S.C. Pipe	Nalah
45	51	45.750	-	0.40	1587.00	-	1590.00	2x1.2 R.C.C. Pipe	Nalah
46	52	45.965	-	0.30	1587.00	-	1590.00	1x1.2 R.C.C. Pipe	Nalah
47	54	47.250	-	0.40	1589.40	-	1590.50	4x1.2 R.C.C. Pipe	Nalah
48	55	48.663	-	0.60	1890.50	-	1593.32	1x3.0 R.C.C. Box	Kakapor Nalah

368

1	2	3	4	5	6	7	8	9	10	
49	56	50.695	-	0.30	1586.70	-	1591.39	1x1.2 R.C.C. Pipe	-do-	1.2
50.	57	50.965	-	0.30	1587.00	-	1591.93	1x1.2 R.C.C. Pipe	-do-	1.2
51.	58	50.985	-	-	1587.00	-	1591.97	1x6.0 R.C.C. Box	R.U.B.	6
52.	59	51.108	-	-	1586.70	-	1592.22	1x1.2 R.C.C. Box	Irr. Channel. Dhamal Kol Nala	1.2
53.	60	51.410	-	-	1586.70	-	1592.82	1x1.2 R.C.C. P:ipe	-do-	1.2
54.	61	52.185	-	-	1587.80	-	1594.00	1x1.2 R.C.C. Pipe	-do-	1.2
55.	62	52.410	-	-	-1588.00	-	1594.00	1x6.0 R.C.C. Box	R.U.B.	6
56.	63	52.742	-	-	1584.00	-	1594.00	1x3.0 R.C.C. Box	Canal under const.	3
57.	64	53.875	-	-	1587.50	-	1594.00	1x3.0 R.S.C. Box	Irr.Channel. Talbren Kol.	3
58.	65	54.450	-	-	1586.00	-	1594.00	1x3.0 R.C.C. Box	-do-	3
59.	66	54.623	-	-	-1586.00	-	1594.00	1x3.0 R.C.C. Box	Irr. Ch.	3
60.	67	54.652	-	-	1588.00	-	1594.00	1x3.0 R.C.C. Box	R.UB.	3

1	2	3	4	5	6	7	8	9	10
61.	68	55.225	-	0.30	1587.50	-	1594.00	1x1.2 R.C.C. Pipe	Irr. Ch.
62.	69	56.000	-	-	1586.00	-	1594.00	1x3.0 R.C.C. Box	Irr. Ch. Talbrem Kol
63.	70	56.500	-	1.00	1587.00	-	1594.00	1x6.0 R.C.C. Box	Hood opening
64.	71	56.900	-	1.00	1586.50	-	1594.00	1x6.0 R.C.C. Box	-do-
65.	72	57.500	-	1.00	1588.00	-	1594.00	1x6.0 R.C.C Box	Hood opening
66.	73	58.125	-	-	1586.00	-	1594.00	1x3.0 R.C.C. Box	Irr. Ch.
									Tulbran canal
67.	74	58.900	-	1.00	1586.80	-	1594.00	1x6.0 R.C.C. Box	Hood opening
68.	75	59.000	-	1.00	1586.50	-	1594.00	1x6.0 R.C.C. Box	-do-
69.	79	61.318	-	1.00	1586.50	-	1594.00	1x6.0 R.C.C. Box	Nalah
70.	80	61.600	-	1.00	1587.00	-	1594.00	1x6.0 R.C.C. Box	Flood opening
71.	82	62.200	-	-	1586.50	-	1594.00	1x6.0 R.C.C. Box	R.U.B
72.	85	63.013	-	1.00	1587.50	-	1594.00	1x6.0 R.C.C. Box	Nalah

1	2	3	4	5	6	7	8	9	10
73.	86	63.910	-	-	1590.00	-	1594.00	1x6.0 R.C.C. Box	R.U.B
74.	88	63.600	-	1.00	1592.00	-	1594.00	1x6.0 R.C.C. Box	Flood opening
75.	89	64.100	-	1.00	1593.00	-	1594.40	1x6.0 R.C.C. box	-do-
76.	90	64.600	-	1.00	1593.00	-	1596.00	1x6.0 R.C.C. Box	-do-
77.	91	64.925	-	-	1594.50	-	1597.70	1x6.0 R.C.C. Box	RU.B.
78.	93	65.345	-	0.30	1590.00	-	1596.62	1x1.2 R.C.C. Pipe	Nalah
79.	94	65.443	-	0.30	1589.00	-	1596.23	1x1.2 R.C.C. Pipe	Nalah
80.	95	65.992	-	-	1590.00	-	1594.03	1x6.0 R.C.C. Box	R.U.B.
81.	96	66.661	-	1.00	1588.00	-	1591.36	1x6.0 R.C.C. Box	Dran to be made square
82.	97	67.478	-	0.30	1587.50	-	1590.00	1x1.2 R.C.C. Pipe	Nalah
83.	98	68.880	-	0.40	1587.50	-	1590.00	2x1.2 R.C.C. Pipe	-do-
84.	99	70.200	-	0.30	1588.50	-	1591.40	1x1.2 R.C.C. Pipe	-do-

1	2	3	4	5	6	7	8	9	10	
85.	100	70.915	-	-	1588.80	-	1592.00	1x1.2 R.C.C. Pipe	Irr. Ch.	1.2
86.	101	71.594	-	-	1588.00	-	1592.00	1x1.2 R.C.C. Pipe	Irr. Ch.	1.2
87.	102	72.054	-	-	1587.70	-	1592.00	2x1.2R..C.C. Pipe	-do-	2.4
88.	103	72.650	-	-	1587.80	-	1592.00	1x1.2 R.C.C. Pipe	-do-	1.2
89.	104	73.040	-	-	1588.00	-	1592.24	1x1.2 R.C.C. Pipe	-do-	1.2
90.	105	73.675	-	-	1589.00	-	1595.38	1x1.2 R.C.C. Pipe	Irr. Ch.	1.2
91.	106	74.300	-	0.40	1590.50	-	1598.50	2x1.2 R.C.C. Pipe	Nala	2.4
92.	107	74.540	-	0.40	1590.50	-	1599.65	2x1.2 R.C.C. Pipe	-do-	2.4
93.	108	75.000	-	0.40	1598.00	-	1599.50	2x1.83 R.C.C. Slab	Irr. Ch.	3.66
94.	109	75.780	-	0.40	1596.50	-	1598.52	2x1.83 R.C.C. slab	Nalah	3.66
95.	110	77.625	-	-	1589.70	-	1592.00	1x1.2 R.C.C. Pipe	Irr. Ch.	2.4
96.	111	78.025	-	-	1589.50	-	1592.00	2x1.2 R.C.C. Pipe	-do-	2.4
97.	112	78.300	-	-	1589.50	-	1592.00	1x1.2 R.C.C. Pipe	-do-	1.2

1	2	3	4	5	6	7	8	9	10
98.	113	78.520	-	-	1590.50	-	1592.00	1x1.2 R.C.C. Pipe	-do-
99.	114	79.130	-		1590.50	-	1593.74	1x1.2 R.C.C. Pipe	-do-
100	115	79.870	-	-	1590.00	-	1596.71	1x1.2 R.C.C. Pipe	-do-
101	116	80.080	-	0.50	1594.50	-	1596.48	2x3.0 P.S.C. Slab	Princh Ara Nala
102	116	80.080			-	1594.50	1596.88	1x1.2 R.C.C Pipe	Irr. Channel
103	117	80.140			-	1594.00	1595.21	1x1.2 R.C.C Pipe	-do-
104	118	80.185			-	1594.50	1596.06	1x6 R.C.C. Box	R.U.B.
105	119	80.700			-	1592.00	1594.00	1x1.2 R.C.C Pipe	Irr. Channel
106	120	81.775			5.75	1589.50	1592.00	2x1.2 R.C.C Pipe	Nalah
107	121	82.625			-	1590.50	1592.00	1x3 R.C.C. slab	R.U.B.
108	123	85.475			1.94	1589.00	1591.03	1x1.2 R.C.C Pipe	Nalah
109	124	86.165			-	1588.00	1590.00	1x1.2 R.C.C Pipe	Irr. Channal

1	2	3	4	5	6	7	8	9	10
110	125	86.750			-	1588.00	1589.75	1x1.2 R.C.C Pipe	-do-
111	126	87.135			-	1588.00	1589.37	1x1.2 R.C.C Pipe	-do-
112	127	87.430			-	1587.00	1589.07	1x1.2 R.C.C Pipe	Nalah
113	128	87.775			0.65	1587.00	1589.28	1x1.2 R.C.C Pipe	-do-
114	129	87.970			-	1587.40	1589.47	1x1.2 R.C.C Pipe	Irr. Channel
115	130	88.750			-	1586.60	1590.25	1x1.2 R.C.C Pipe	-do-
116	132	89.900			-	1586.00	1588.70	1x1.2 R.C.C Pipe	-do-
117	133	90.150			-	1586.00	1588.20	1x1.2 R.C.C Pipe	-do-
118	134	90.430			-	1586.00	1587.64	2x1.2 R.C.C Pipe	-do-
119	135	91.400			0.58	1586.00	1587.30	1x1.2 R.C.C Pipe	Nalah
120	137	91.525			0.38	1585.80	1587.55	1x1.2 R.C.C Pipe	-do-
121	138	92.220			-	1586.70	1588.94	2x1.2 R.C.C Pipe	Irr. Channel
122	140	93.175			-	1589.50	1589.80	1x1.2 R.C.C Pipe	-do-

1	2	3	4	5	6	7	8	9	10
123	141	94.135			-	Road	-	1x6.0 R.C.C. Box	R.U.B.
124	142	94.465			-	1585.00	1587.50	1x1.2 R.C.C Pipe	Irr. Channel
125	143	95.180			-	1580.50	1585.80	1x3.0 R.C.C Pipe	-do-
126	144	95.915			-	1580.50	1583.96	1x1.2 R.C.C Pipe	Irr. Channel
127	146	98.460			-	1587.00	1589.50	1x6.0 R.C.C. Box	-do-
128	151	102.275			-	1583.00	1590.15	1x6.0 R.C.C. Box	Bolagan Nadi
129	153	104.010			-	1583.00	1587.91	1x1.2 R.C.C Pipe	Canal
130	154	104.600			-	1586.00	1588.25	1x3.0 R.C.C. Box	Canal
131	155	104.840			-	1588.00	1588.54	1x3.0 R.C.C. Box	Canal
132	158	107.330			-	1589.50	1590.50	1x3.0 R.C.C. Box	Channel
133	159	108.590			-	1589.50	1590.50	2x3.0 R.C.C. slab	Canal
134	160	108.980			-	1588.00	1590.50	2x1.2 R.C.C Pipe	Channel
135	161	109.760			-	1587.50	1590.50	1x1.2 R.C.C Pipe	Irr. channel

1	2	3	4	5	6	7	8	9	10	
136	162	111.100			-	1589.00	1590.50	1x3.0 R.C.C. Box	Channel	3
137	163	112.130			-	1588.00	1589.71	1x1.2 R.C.C Pipe	Irr. Channel	1.2
138	164	112.600			-	1587.50	1589.13	1x1.2 R.C.C Pipe	-do-	1.2
139	165	112.775			-	1587.00	1588.91	1x1.2 R.C.C Pipe	Channel	1.2
140	166	113.275			-	1586.00	1588.28	1x1.2 R.C.C Pipe	-do-	1.2
141	167	113.550			-	1586.50	1587.99	1x1.2 R.C.C Pipe	-do-	1.2
142	168	114.230			-	1585.00	1586.54	1x1.2 R.C.C Pipe	-do-	1.2
143	169	114.570			-	1584.00	1585.86	2x1.2 R.C.C Pipe	-do-	2.4
144	170	114.807			-	1583.50	1585.00	1x6.0 R.C.C. Box	-do-	6
145	171	115.100			-	1583.00	1584.80-	1x3.0 R.C.C. Box	-do-	3
146	172	115.50			-	1582.00	1584.00	1x3.0 R.C.C. Box	-do-	3
147	173	116.440			-	1580.00	1583.00	1x6.0 R.C.C. Box	-do-	6
148	174	116.850			-	1580.00	1582.35	1x3.0 R.C.C. Box	-do-	5

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1	2	3	4	5	6	7	8	9	10	
149	175	116.907			-	1580.50	1582.50	1x1.2 R.C.C Pipe	-do-	1.2
150	176	117.050			-	1580.50	1582.55	1x1.2 R.C.C Pipe	-do-	1.2
151	177	117.150			-	1580.50	1582.65	1x1.2 R.C.C Pipe	-do-	1.2
152	178	117.280			-	1580.50	1582.80	1x1.2 R.C.C Pipe	-do-	1.2
153	179	117.400			-	1581.00	1582.90	1x1.2 R.C.C Pipe	-do-	1.2
154	180	117.530			-	1581.00	1583.00	1x1.2 R.C.C Pipe	-do-	1.2
155	181	118.420			-	1580.00	1583.00	1x6.0 R.C.C. Box	-do-	6

ANNEXURE - VI | IX

SALIENT FEATURES OF TUNNEL BETWEEN UDHAMPUR - BARAMULLA

S.No	TUNNEL NO.	ENTRY KM	EXIT KM	LENGTH KM	TYPE OF SUPPORT	ALIGN-MENT OF TUNNEL	REMARKS
1	2	3	4	5	6	7	8
1.	1	2.180	5.392	3.212	Heavy lining	Partly in curve	
2.	2	6.725	8.020	1.295	-do-	-do-	
3.	3	12.228	14.802	2.574	-do-	-do-	
4.	4	14.961	16.300	1.339	-do-	Straight	
5.	5	16.925	17.791	0.866	-do-	Partly in curve	
6.	6	19.683	19.936	0.253	-do-	Straight	
7.	7	23.257	23.689	0.432	-do-	Partly in curve	
8.	8	25.758	26.321	0.563	-do-	-do-	
9.	9	27.181	27.658	0.477	-do-	Straight	

1	2	3	4	5	6	7	8
10.	10	28.137	30.879	2.742	-do-	-do-	
11.	11	31.248	36.339	5.091	-do-	-do--	Ventilation required
12.	12	37.026	37.541	0.515	-do-	Curve	-
13.	13	37.631	38.371	0.740	-do-	Partly in curve	-
14.	14	35.818	39.235	0.417	-do-	Curve	-
15.	15	41.129	47.185	6.056	-do-	Partly in curve	As the alignment crosses thrust zone, full and heavy lining with ventilation arrangements are required.
16.	16	50.186	52.002	1.816	Heavy lining	Partly in curve	
17.	17	52.262	53.178	0.916	-do-	-do-	

1	2	3	4	5	6	7	8
18.	18	53.421	54.096	0.675	-do-	Curve	
19.	19	54.340	54.798	0.458	-do-	Straight	
20.	20	55.322	55.708	0.386	-do-	Curve	
21.	21	56.266	58.438	2.172	-do-	Partly in curve	Ventilation is required
22.	22	58.883	61.376	2.492	-do-	-do-	-do-
23.	23	63.018	63.396	0.378	-do-	Curve	
24.	24	64.247	64.382	0.136	-do-	-do-	
25.	25	64.464	66.133	1.669	-do-	Straight	
26.	26	66.309	68.154	1.845	-do-	-do-	
27.	27	68.594	70.788	2.194	-do-	Partly in curve	Ventilation is required
28.	28	71.355	71.546	0.191	-do-	-do-	
29.	29	71.722	71.993	0.271	-do-	-do-	
30.	30	72.260	73.675	1.414	-do-	-do-	

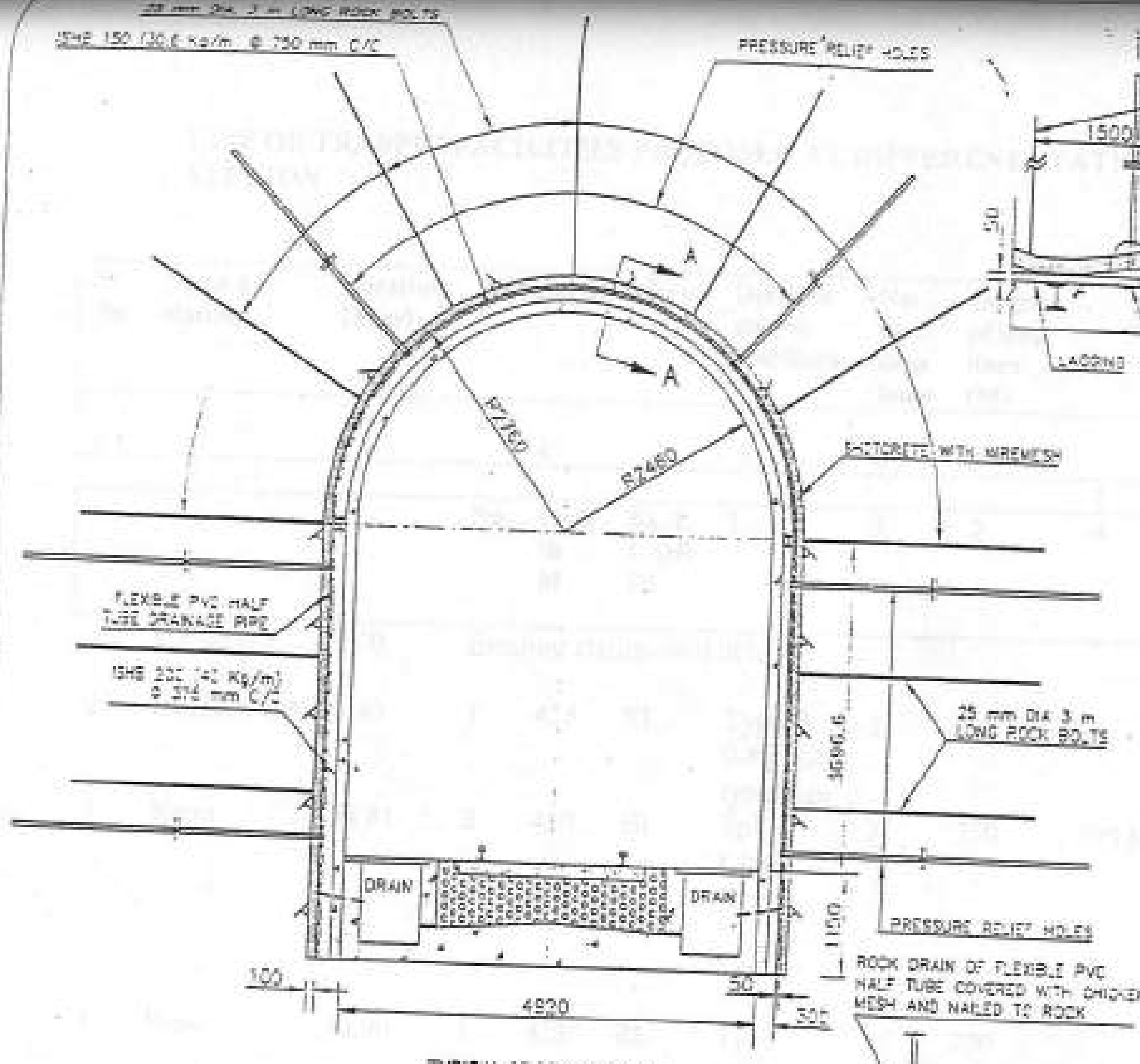
1	2	3	4	5	6	7	8
31.	31	73.898	74.144	0.246	-do-	-do-	
32.	32	74.759	77.763	3.004	-do-	-do-	Ventilation is required
33.	33	78.018	78.714	0.696	-do-	Curve	
34.	34	79.430	79.887	0.457	-do-	Partly in curve	
35.	35	80.462	80.859	0.397	-do-	Straight	
36.	36	83.840	84.478	0.638	-do-	-do-	
37.	37	84.819	85.710	0.891	-do-	Partly in curve	
38.	38	86.054	86.833	0.779	-do-	Straight	
39.	39	87.426	88.223	0.797	-do-	Curve	
40.	40.	89.088	89.843	0.755	-do-	Partly in curve	
41.	41	90.306	91.191	0.885	-do-	-do-	
42.	42	91.343	91.417	0.074	-do-	Straight	
43.	43	91.858	92.141	0.283	-do-	-do-	

1	2	3	4	5	6	7	8
44.	44	92.571	92.877	0.306	-do-	Curve	
45.	45	93.323	93.994	0.671	-do-	Partly in curve	
46.	46	95.447	96.983	1.536	-do-	-do-	
47.	47	97.292	99.613	2.321	-do-	-do-	As the alignemtn is close to the thrust zone, full and heavy lining with ventilation is required.
48.	48	99.765	101.886	2.121	Heavy lining	Partly in curve	Ventilation is required.
49	49	101.953	103.638	1.685	-do--	-do-	
50	50	104.037	104.164	0.127	-do--	Straight	
51	51	104.616	104.893	0.277	-do--	Partly in curve	
52	52	106.643	107.510	0.867	-do--	-do-	
53	53	107.945	108.967	1.022	-do--	-do--	
54	54	109.359	110.690	1.331	-do--	-do--	

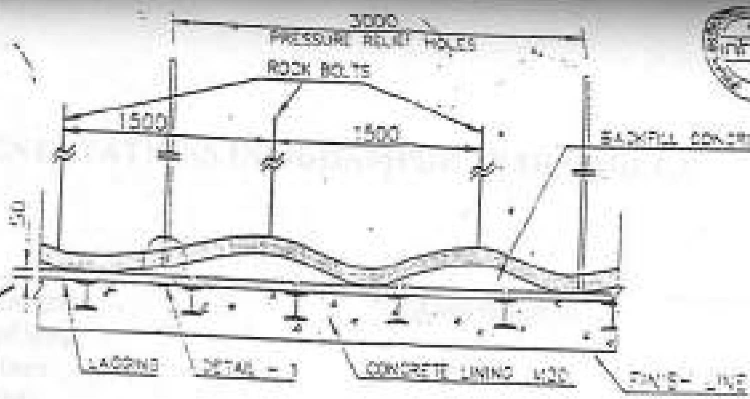
1	2	3	4	5	6	7	8
55	55	110.994	111.466	0.472	-do--	-do--	
56	56	111.875	112.492	0.617	-do--	-do--	
57	57	112.965	113.972	1.007	-do--	-do--	
58	58	114.318	114.765	0.447	-do--	-do--	
59	59	115.080	116.506	1.426	-do--	-do--	
60	60	117.656	118.216	0.560	-do--	-do--	
61	61	119.389	119.910	0.521	-do--	-do--	
62	62	120.443	121.641	1.199	-do--	-do--	
63	63	121.954	123.002	1.047	-do--	-do--	
64	64	123.314	123.646	0.332	-do--	-do--	
65	65	123.929	126.789	2.859	-do--	-do--	Ventilation is required
66	66	127.077	128.389	1.311	-do--	Straight	
67	67	128.609	129.405	0.796	-do--	Partly in curve	

1	2	3	4	5	6	7	8
68	68	129.751	130.209	0.457	-do--	-do--	
69	69	131.251	131.523	0.272	-do--	-do--	
70	70	133.377	133.842	0.465	-do--	Straight	
71	71	133.973	134.688	0.715	-do--	Partly in curve	
72	72	135.024	137.603	2.589	-do--	-do-	Ventilation is required
73	73	139.290	140.206	0.916	-do--	Straight	
74	74	143.824	143.975	0.151	-do--	-do-	
75	75	145.175	145.319	0.144	-do--	Partly in curve	
76	76	145.549	146.615	1.066	-do--	-do-	
77	77	148.213	149.064	0.851	-do--	-do--	
78	78	149.409	150.003	0.594	-do--	-do--	
79	79	151.749	152.023	0.274	-do--	-do--	
80	80	153.756	163.836	10.080	-do--	-do--	Ventilation is required
				96.99			

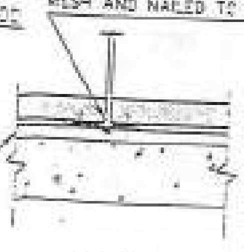
ANNEXURE-1



TYPICAL CROSS-SECTION
POOR ROCK



SECTION A-A



DETAIL - 1

NOTES :-

1. ALL DIMENSIONS ARE IN MILIMETRES.
2. HEADING SHALL BE EXCAVATED AND FULLY SUPPORTED PRIOR TO BENCHING.
3. CONCRETE LINING SHALL BE PLACED AFTER FULL SECTION IS SUPPORTED.
4. 5 m DEEP PRESSURE RELIEF HOLES @ 3 m C/C LONGITUDINALY WITH SLOTED PVC LINER SHALL BE PROVIDED.
5. PREGROUTING AND/OR CONSOLIDATION GROUTING MAY BE REQUIRED IN SOME STRETCHES BY ENGINEER-INCHARGE.
6. REQUIREMENT OF FOREPOLING DURING EXCAVATION SHALL BE INDICATED BY ENGINEER-INCHARGE DEPENDING UPON THE TUNNELING CONDITION.
7. UPTO 25 m DEEP PROBE HOLES MAY NEED TO BE PROVIDED FROM THE FACE IN SOME STRETCHES AS REQUIRED BY ENGINEER-INCHARGE.
8. IMMEDIATE PLACEMENT OF 50 mm THICK SHOTCRETE PRIOR TO MUCKING FOLLOWED BY INSTALLATION OF WIREMESH, SECOND LAYER OF 50 mm THICK SHOTCRETE AND INSTALLATION OF FULLY GROUTED ROCK BOLTS AFTER MUCKING SHALL BE DONE IMMEDIATLY AFTER BLAST IN EVERY ROUND ADJASCENT TO THE FACE.
9. EACH ROUND OF EXCAVTION SHALL BE FULLY SUPPORTED PRIOR TO EXCAVATION OF NEXT ROUND.
10. STRUCTURAL STEEL OF RIBS SHALL HAVE A MINIMUM YIELD STRENGTH OF 240 MPa.

LIST OF TRAFFIC FACILITIES PROPOSED AT DIFFERENT STATIONS IN UDHAMPUR - BARAMULLA SECTION

S. No	Name of stations	Location (Kms)	Passenger platform			Detail of station buildings	No. of loop lines	Length of loop lines (M)	Goods facilities					
1	2	3	4			5	6	7	8					
			No.	Length M	RL/LL OR HL	1	2	3	I 4	ii 5	iii 6	iv 7	v 8	vi Length of sidings (M)
1.	Udhampur	0.00	Existing station in JURL											
2.	Chakarwaha	9.40	1	425	RL	Type B 0-85 NR type plan	2	720	-	-	-	-	-	-
3.	Katra	24.81	2	419	HL	Spl. Class	3	750	1=110	2=716		1	2	140
			1	150	HL					1=125			1	230
													1	414
													1	190
													1	150
4.	Riasi	39.90	1	425	RL	Type 0-83	2	720						

1	2	3		4		5	6	7			8		
5.	Salal Road	47.90	1	425	RL	Type B 0-85	2	716				1	230
6.	Surukot	62.40	1	425	RL	Type B 0-85	2	716				1	100
7.	Barala	82.20	1	425	RL	Type B 0-85	2	716				1	100
8.	Sangaldan	94.70	1	425	RL	Type B 0-85	2	716					
9.	Kohli	105.70	1	425	RL	Type B 0-85	2	716					100
10.	Laole	118.80	1	425	RL	Type B 0-85	2	716				1	230
11.	Nachlana	132.70	1	425	RL	Type B 0-85	2	716					
12.	Arpinchla	138.60	1	425	RL	Type B 0-85	2	716					100
13.	Banihal	147.55	2	425	HL	Type C 0-83	3	716	1=110	1=125		1	230
14.	Charil	152.70	1	425	RL	Type B 0-85	2	716					
15.	Qazigund	167.30	2	425	HL	Type D 0-86	4	716	1=110	1=125	1=75	2	716
												2	230
16.	Sadura	178.20	1	425	RL	Type B 0-85	2	716					

1	2	3		4		5	6	7			8		
17.	Anantnag	186.40	2	425	HL	Type D 0-86	3	716	1=110	1=125	1=75	2	716
												1	230
18.	Panjgam	199.70	1	425	RL	Type B 0-85	2	716					
19.	Awantipura	206.30	2	425	RL	Type C 0-83	3	716				1	230
20.	Kakapore	216.90	1	425	RL	Type B 0-85	2	716					
21.	Pampore	222.10	1	425	RL	Type B 0-85	2	716					
22.	Srinagar	228.40	2	550	HL	Spl. Class	6	716 to	1=150	1=200	75	1	230
			1	400	HL			790		ART		2	716
												2	300
												1	130
23.	Badgam	239.25	1	425	RL	Type B 0-85	2	716					
24.	Rajwiansher	250.60	1	425	RL	Type B 0-85	2	716					
25.	Pattan	262.70	2	425	HL	Type C 0-83	3	716	1=110	1=125	75	2	716
26.	Hamre	268.90	1	425	RL	Type B 0-85	2	716					

1	2	3		4		5	6	7			8		
27.	Sopore	277.70	2	425	HL	Type C 0-83	3	716	1=150	1=200	75	1	716
												1	230
28.	Baramulla	287.00	2	425	HL	Type D 0-86	3	716	1=150	1=200	75	2	716
												1	230

NOTE:

1. Panel room and other S&T structures shall be constructed separately.
2. Sand humps shall be constructed on all crossing stations.

REQUIREMENT OF QUARTERS AT DIFFERENT STATIONS BETWEEN UDHAMPUR – BARAMULLA

S.No	Name of stations	Locations (Kms)	No. of quarters proposed to be constructed			
			Type-IV	Type-III	Type-II	Type-I
1.	Udhampur	0.00	4	12	33	62
2.	Chakarwaha	9.40			2	48
3.	Katra	24.81	2	10	35	76
4.	Riasi	39.90		1	3	17
5.	Salal Road	47.90		4	16	64
6.	Surukot	62.40		1	3	17
7.	Barala	82.20		1	3	17
8.	Sangaldan	94.70		6	9	30
9.	Kohli	105.70		1	3	17
10.	Laole	118.80		4	9	30
12.	Arpinchla	138.60		1	3	17
13.	Banihal	147.55		4	9	30
14.	Charil	152.70		1	3	17
15.	Qazigund	167.30	5	7	9	30

S.No	Name of stations	Locations (Kms)	No. of quarters proposed to be constructed			
			Type-IV	Type-III	Type-II	Type-I
16.	Sadura	178.20		1	3	17
17.	Anantnag	186.40		1	3	17
18.	Panjgam	199.70		1	3	17
19.	Awantipura	206.30		1	3	17
20.	Kakapore	216.90		1	3	17
21.	Pampore	222.10		1	3	17
22.	Srinagar	228.40	26	18	13	42
23.	Badgam	239.25		1	3	17
24.	Rajwiansher	250.60		1	3	17
25.	Pattan	262.70		1	3	17
26.	Hamre	268.90		1	3	17
27.	Sopore	277.70		1	3	17
28.	Baramulla	287.00	5	6	9	30
	Total		42	89	198	748

Annexure- IX / I

Table depicting number of Yatries visiting Vaishno Devi Temple and Amarnath Holy Cave from 1985 to 1996 and growth thereof
(Source:- Digest of Statistics of J&K Govt. for 1995-96)

(Figures in lakhs)

S.No	Year	Amarnath Holy Cave	Variation year to year	Vaishno Devi temple	Variation year to year
1.	1985	0.42	Base	14.85	Base
2.	1986	0.51	+0.09	13.97	-0.88
3.	1987	0.52	+0.01	18.58	+4.61
4.	1988	0.96	+0.44	19.93	+1.35
5.	1989	0.95	-0.01	23.12	+3.19
6.	1990	0.05	-0.90	21.69	-1.43
7.	1991	0.16	+0.11	31.51	+9.82
8.	1992	0.55	+0.39	35.27	+3.76
9.	1993	0.56	+0.01	33.69	-1.58
10.	1994	0.37	-0.19	37.06	+3.37
11.	1995	0.60	+0.23	40.12	+3.06
12.	1996	1.20	+0.60	43.36	+3.24
13.	Total growth during 11 years		+0.78		+28.51
14.	Growth per annum		$\frac{0.78}{0.42 \times 11} \times 100 = 16.9\%$		$\frac{28.51}{14.85 \times 11} \times 100 = 17.5\%$

Table depicting road traffic between Jammu-Srinagar (Kashmir Valley) growth rate and projection of passenger traffic. (Source:- J&K State Road Transport Corporation, Regional Headquarter, Jammu).

S. No	Year	No. of buses operated Avg. per day		No. of pass. carried per annum	Each way
1.	1993-94	240 per day		5936000	2968000
2.	1994-95	231 per day		6107000	3053500
3.	1995-96	280 per day		6657000	3328500
4.	1996-97	294 per day		7005000	3502500
5.	Year to year variation	1993-94 Base	1994-95 +171000	1995-96 +550000	1996-97 +348000
6.	Percentage variation year to year		+2.80%	+8.26%	+4.96%
7.	Total variation in three years and growth per annum both ways	$\frac{1069000\times100}{5936000} = \frac{18}{3} = +6\%$			

8. Projection of the passenger for the year 2001-02, 2007-08, 2012-13 and 2017-18 by assuming growth rate @6% upto 2002-03 and 3% thereafter. Base year 1996-97.

2002-03		2007-08		2012-13		2017-18	
Addl.	Total	Addl.	Total	Addl.	Total	Addl.	Total
2101500	9106500	1639170	10745670	3005145	12111645	4371120	13477620
Each way							
1050750	4553250	819585	5372835	1502573	6055823	2185560	6738810

Diversion to rail @ 50%

P.D	12475	P.D.	14720	P.D.	16591	P.D.	18462
50%	6238	50%	7360(*)	50%	8296	50%	9231

(*)Interchange 5940 and on the basis of 19.3% of the total traffic as per the criteria
Local 1420 adopted by RITES in their report.

329 Amarnath pilgrim traffic will get diverted from Qazigund. Therefore, balance pass. traffic between Kazigund to Srinagar-Baramula would be =7360 – 329= 7031
(Interchange=5675 per day Local=1356 per day)

All the projected traffic between Kazigund-Srinagar would not move beyond Srinagar. Therefore, only 30% of this traffic is reckoned to move beyond Srinagar i.e. 2109 per day (local as well interchange).

Table showing booking of upper class and 2nd class passengers during the year 1991-92 to 1995-96 at rail head section Jammu Tawi.

Station	Year	Upper Class	Second Class	MST	Total second	%age of UP class pass. to total pass.
Jammu Tawi	1991-92	155125	2622615	7800	3012615	4.90
	1992-93	180713	2700971	9000	3150971	5.42
	1993-94	170979	2377656	10200	2887656	5.60
	1994-95	185656	2647814	16150	3455314	5.10
	1995-96	193224	2829111	17050	3681611	4.98

(a.) Projected number of wagons per annum commodity wise for valley during 2007-08, 2012-13, 2017-18 [Taking 50% of above for Jammu and 50% for valley]

Year	POL	Coal	Food grain	Military store	Cement	Misc.	Total
2007-08	13160	4312	5855	4200	2464	14672	44663
2012-13	15216	4986	6500	4856	2849	16964	51373
2017-18	17272	5659	7146	5512	3234	19257	109455

(b) Projected Number of wagons per day commodity wise for valley

2007-08	36	12	16	12	7	40	123
2012-13	42	14	18	13	8	46	141
2017-18	47	16	20	15	9	53	160

ANNEXURE - IX/V

SUMMARY OF COST UDHAMPUR-BARAMULLA

Description	Cost in Rs.
P-1100 - New Line Constructions	30772376441
P-1110 - Preliminary Expenses	6832678
P-1120 - Land	4098130942
P-1130 - Structural Engg. Works	
P-1131 - Earthwork	2885996401
P-1132 - Tunnel (Civil Engg.)	11205364947
P-1140 - Str.Engineering Works. P.Way	
P-1141 - Rail & Fastening	907114224
P-1142 - Sleepers & Fastening	802595475
P-1143 - Points & Xings	92803615
P-1144 - Ballast	368872200
P-1145 - Fencing	6358253
P-1146 - Road & Xings	15629548
P-1147 - Misc.	605570
P-1150 - Bridge	
P-1152 - Major Bridge	4686900662
P-1155 - Minor Bridges	330409030
P-1160-Station Buildings	
P-1161 - Offices (Civil)	46265682
P-1162 - Stations (Civil)	257796657
P-1163 - Power & Sub-station (Civil)	18562144
P-1165 - Residential Building (Civil)	229439670
P-1166 - Building in c/w with staff welfare (Ci	9678652
P-1167 - Station Machinery (Civil)	164371685
P-1170 - Equipment Plant & Machinery	
P-1174 - Plants (Civil) Engg.	11231402
P-1178 - Misc. (Civil)	8652670
P-1180 - General Charges Establishment	
P-1181 - Direction & General (Civil)	185849514
P-1182 - Audit & Accounts (Civil)	176082649
P-1183 - Civil Engg.	1023682088
P-1186 - Operating Department	63403520
P-1188 - Store (Civil + P.Way)	81081437
P-1189 - Medical (Civil)	22772194
P-1189 - Vigilance (Civil)	11786037
P-1190 - Genl charges other than establishment (Civil)	
P-1191 - Plant Construction (Civil)	76705324
P-1192 - Instruments (Civil)	10476377
P-1193 - Office Expenses (Civil)	66433891
P-1194-Temp. Residential Qts. & Accommoc	160819055
P-1196 - Loss of Cash & Store	2297248
- Security Charges	187500000
Total Cost (Civil)	28222501441
Total Cost (Elect.)	749875000
Total Cost (S&T)	1800000000
Total Gross Cost	30772376441

ANNEXURE - IX/V

UDHAMPUR- BARAMULLA

SUMMARY OF COST OF THE PROJECT

(Fig. in Lacs of Rs.)

	GROSS COST	CREDIT	NET COST
(Engg.	282225.01	0.00	282225.01
r Works	18000.00	0.00	18000.00
rical Works	7498.75	0.00	7498.75
Total=	307723.76	0.00	307723.76

UDM-Bimulia

Life wise Assets of Civil Engg. Works

(fig. in lacs of Rs.)

S.No	Description	Age in Years	Amount (Lacs)
1	Land	Infinity	40901.31
2	Bridge Work (Masonry & Misc.)		
	Important Bridges	100	
	Major Bridges	100	46869.01
	Minor Bridges	100	3304 09
	Tunnels	100	112053.65
3	Bridge Work (Steel)		
	Important Bridges	60	
	Major Bridges	60	0.00
	Minor Bridges	60	
4	Stations and Buildings	65	7261.15
5	(a) Earth Work (Formation)	--	28859.96
	(b) Rails & Fastenings	40	9071.14
	(c) Road crossings including Foot Over/ Under Bridge	60	156.30
	(d) Misc.	60	0.08
6	(a) Sleeper & Fastenings (New) CST-9/BG mono block concrete sleepers inclusive of fittings	40	8025.95
	(b) Points and crossings	20	928.03
7	(a) Rails and Fastenings (2nd hand)	20	0.00
	(b) Preliminary Expenses	30	69.33
	(c) Fencing	30	63.58

S.No	Description	Age in Years	Amount (Lacs)
	(d) Equipment, Plant and Machinery	15	198.83
	(e) General Charges Establishment & other than Establishment	---	189413.85
	(f) Dismantling Charges	---	0.00
8	Sleepers & Fastenings CST-9 (2nd hand)	15	0.00
9	Ballast	10	3688.73
10	Any other charges	--	1875.00
	Gross Cost=		282225.01
	Credit for the released materials= (-)		0.00
	Net Cost=		282225.01

Life of Assets as per vetted S&T Sub estimate

UDM-B/nudle

(fig. in lacs of Rs.)

S.No	Description	Age in Years	Amount
1	Station Machinery and Inter locking other than block working		
2	Train control equipment , block working and Telecommunication system	15	16200.00
3	Underground cables		
4	Pay and Allowances	--	1800.00
5	Other than Pay and Allowances	--	
	Gross cost=		18000.00
	Credit for Released Materials=		0.00
	Net Cost =		18000.00

Life of Assets as per vetted Electrical Sub-Estimate

UDM-B/mulla

(fig. in lacs of Rs.)

S.No	Description	Age in Years	Amount
1	Electrification of Station Buildings	10	5124.77
2	Electrification of uncovered P.F	10	
3	Provision for lighting in circulating area	10	
4	Electrification of service buildings	10	
5	Electrification of Toilets	10	
6	Electrification of S&T cabins	10	
7	Provision of Battery rooms	10	
8	Electrification of P.L. Tower	10	
9	Electrification of Qrs, Gate lodges, level crossings (Type Qrs.)	10	
10	Provision of OH main yard lighting and colony.	10	
11	Provision of OH main to colony lighting and LT supply to Qrs	10	
12	Provision of T&P maintenance	10	

UDM-B/mulla

S.No	Description	Age in Years	Amount
13	DG set with M.P. Panel	10	0.00
14	a) Electrification of cabins with power cables b) Electric sub station Buildings	25	84.49
15	Augumentation of LT supply at stations	25	57.54
16	Purchase of LT supply at stations & S/C charges	25	108.50
17	Modification of O.H. / Charges		
18	OHE traction line excluding wire	40	1389.45
19	Electric contact wire	60	
20	Provision of distilled water plants	40 5	7.87
21	Provision of water coolers	5	11.36
22	Establishment charges, Plant construction, Instruments and other charges		714.77
23	other charges		0.00

Gross cost= 7495.75

Credit for Relesed Materials= 0.00

Net cost = 7495.75

ANNEXURE - IX

HEDULE

UBM-B/ms

0

(fig. in lacs of Rs.)

YEAR	Rolling Stock	TOTAL
1st Year	0.00	7844.00
2nd Year	0.00	7500.00
3rd Year	0.00	10000.00
4th Year	0.00	42282.00
5th year	0.00	44145.00
6th year	0.00	40754.00
7th year	0.00	39690.00
8th year	0.00	40386.00
9th year	0.00	39556.00
10th year	0.00	18950.00
11th year	16692.69	33309.69
	16692.69	324416.69

Life wise cos

Year
5 yrs
10 yrs
15 yrs
20 yrs
25 yrs
35 yrs
40 yrs
60 yrs

Salvage Value (Straight line method)

SV= 48017.83

Maintenance cost @ 3% (works (Total cost-Land-Pay & dismantling-Preliminary Charges) x 0. = 6814.59 Lacs

Maintenance cost @ 5% (Equipments = = 1983.83 "

Ea = 1426.23 "

402

YEAR	CASH OUT FLOW	CASH IN FLOW	P.V Factor @ r1% -14 %	P.V Factor @ (r1+1)% -13 %	PV of out flow -14 %	PV of In flow -14 %	PV of out flow -13 %	PV of In flow -13
(-) 10	7844.00	0.00	0.2573	0.3282	[illegible]	0.00	1948.63	0.00
(-) 9	7500.00	0.00	0.2992	0.3773	14711.08	0.00	19142.43	0.00
(-) 8	10000.00	0.00	0.3479	0.4336	17659.62	0.00	20312.86	0.00
(-) 7	42282.00	0.00	0.4046	0.4984	19171.79	0.00	22738.31	0.00
(-) 6	44145.00	0.00	0.4704	0.5729	21710.75	0.00	26584.30	0.00
(-) 5	40754.00	0.00	0.5470	0.6585	25687.76	0.00	29939.94	0.00
(-) 4	39690.00	0.00	0.6361	0.7569	29255.62	0.00	16488.50	0.00
(-) 3	40386.00	0.00	0.7396	0.8700	16297.00	0.00	33309.69	0.00
(-) 2	39658.00	0.00	0.8600	1.0000	33309.69	0.00	9983.25	1639.34
(-) 1	18950.00	0.00	1.0000	1.1494	9998.17	1658.41	1.14E+04	1884.30
0	22309.68	0.00	1.1626	1.3212	1.16E+04	1.92E+03	1.31E+04	2.17E+03
1	8598.43	1428.23	1.35E+00	1.52E+00	1.35E+04	2.24E+03	1.50E+04	2.49E+03
2	8598.43	1428.23	1.57E+00	1.75E+00	1.57E+04	2.61E+03	1.73E+04	2.86E+03
3	8598.45	1428.23	1.83E+00	2.01E+00	1.83E+04	3.00E+03	1.99E+04	5.32E+03
4	8598.43	1428.23	2.13E+00	2.31E+00	2.13E+04	5.73E+03	2.25E+04	6.12E+03
5	8598.43	1428.23	2.47E+00	2.66E+00	2.47E+04	6.83E+03	2.62E+04	7.03E+03
6	8617.86	2307.08	2.87E+00	3.05E+00	2.87E+04	7.71E+03	3.01E+04	8.08E+03
7	8598.43	2307.08	3.34E+00	3.51E+00	3.34E+04	8.97E+03	3.46E+04	9.29E+03
8	8595.43	2307.08	3.89E+00	4.03E+00	3.89E+04	1.04E+04	6.07E+04	2.09E+04
9	8595.43	2307.08	4.52E+00	4.63E+00	9.16E+04	2.36E+04	4.57E+04	1.85E+04
10	8596.43	2307.28	5.25E+00	5.32E+00	5.26E+04	1.39E+04	5.26E+04	1.89E+04
11	17431.15	4465.43	6.11E+00	6.11E+00	3.11E+04	2.02E+04	6.04E+04	2.17E+04
12	8598.43	5093.67	7.10E+00	7.03E+00	7.10E+04	2.58E+04	6.94E+04	2.50E+04
13	8598.43	5093.67	8.26E+00	8.08E+00	8.26E+04	2.97E+04	2.32E+05	2.87E+04
14	8598.43	5093.67	9.61E+00	9.29E+00	2.79E+05	3.46E+04	9.17E+04	3.30E+04
15	8598.43	5093.67	1.12E+01	1.07E+01	1.12E+05	4.02E+04	1.05E+05	3.79E+04
16	25016.49	5093.67	1.30E+01	1.23E+01	1.30E+05	4.87E+04	1.21E+05	4.36E+04
17	8598.43	5093.67	1.51E+01	1.41E+01	1.51E+05	5.43E+04	1.39E+05	5.01E+04
18	8598.43	5093.67	1.76E+01	1.62E+01	1.76E+05	6.32E+04	3.42E+05	8.86E+04
19	8598.43	5093.67	2.04E+01	1.86E+01	4.06E+05	1.13E+05	1.84E+05	6.62E+04
20	8598.43	5093.67	2.37E+01	2.14E+01	2.37E+05	8.54E+04	2.12E+05	7.61E+04
21	10353.19	4765.44	2.76E+01	2.46E+01	2.76E+05	9.93E+04	2.43E+05	8.75E+04
22	8598.43	5008.67	3.21E+01	2.83E+01	3.21E+05	1.15E+05	2.80E+05	1.01E+05
23	8598.43	5093.67	3.73E+01	3.25E+01	3.73E+05	1.34E+05	3.31E+05	1.16E+05
24	8598.43	5093.67	4.34E+01	3.74E+01	4.12E+05	1.56E+05	3.68E+05	1.33E+05
25	8598.43	5093.67	5.05E+01	4.30E+01	5.05E+05	1.32E+05	4.23E+05	1.53E+05
26	[illegible]	5093.67	5.87E+01	4.94E+01	5.87E+05	2.11E+05	4.86E+05	1.76E+05
27	[illegible]	5093.67	6.82E+01	5.68E+01	6.82E+05	2.45E+05	5.41E+05	3.23E+05
28	8598.43	5093.67	7.93E+01	6.53E+01	[illegible]E+06	4.50E+05		
29	8598.43	10795.67	9.22E+01					
30	8598.43	1.24E+04						
					3.27E+06	3.91E+06	4.80E+06	4.56E+06
						4.84E+04		-2.81E+05
					ROR=	-13.84 %		

Senstivity Analysis

	Trial %	PV out - Flow	PV In- Flow	IF-OF	ROR %
1 ROR (General)	-14	6265237	6313325	48088	-13.844
	-13	4825081	4563959	-261122	
2 ROR with 10% increase in cost	-16	11983620	12301001	317381	-15.447
3 ROR with 10% decrease in earnings	-16	10894200	11070901	176701	-15.640
4 ROR with 10% increase in cost & 10% decrease in Earnings	-18	21621659	22082058	460399	-17.487
5 ROR with 20% increase in cost	-18	23587265	24535620	948356	-17.145
6 ROR with 20% decrease in earnings	-19	26739412	27961637	1222225	-18.022