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AMB RIVER DIVERSION FOR EXTRACTING THE COAL IN UMRER AREA, NAGPUR DISTRICT - A CASE STUDY

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ABSTRACT

In the present situation, coal is an important raw material used for various industrial purposes. Generally, coal exists under the ground which can be extracted by removing the top soil. If the same coal exists below the river bed, the river has to be diverted in order to extract the coal. The primary survey was done in the area through which the Amb river water is being passed out. The levels were taken at regular intervals by using total station and the reduced levels were calculated. The volume of earth in cutting and filling were evaluated for forming a levelled river bed. The river plugs were designed to stop the flow of water before diverting the river flow into the designed river bed. The nallas which are the junction points were also designed which are provided along the river bed wherever the bed width changes.

INTRODUCTION

Umrer Area, a unit of Western Coalfields Limited (WCL) falls in the Nagpur district of Maharashtra state. It is located at a distance of 45 kilometres from Nagpur city. The nearest town is Umrer which is 6 kilometres away from the Area office. This area is approachable by Nagpur-Umrer State Highway No. 9. Kanwah village is situated on Umrer-Butibori road. Five major nallas passing in this area have been discharging water into Amb river. The average level of the area surrounding the village is 273.02 m and 275.02 m above the sea level. During heavy rains, there is backlash of water from the Amb river as it is not able to cope up with flash flood due to narrow width and inundates the agricultural fields. Kanwah village eventually becomes island during heavy rains. Such a situation had arisen in the year 2000 due to heavy downpour from 17th July to 19th July 2000. In this connection, in the year 2001, State Govt. authority requested WCL, Umrer to formulate a scheme to control flood in the years to come. The mine is encircled by a seasonal river named as “Amb nadi” from three sides i.e., eastern, western and southern side. The Amb river has its main source called Shripat nalla near Kanwah Village, Nagpur District, which meets the River Vainganga. The drainage of the area is controlled by Amb river with a network of small tributaries. The Amb river can be termed as a seasonal stream as it becomes almost dry during summer months. However, during monsoon (July to September) heavy rainfall often causes flooding in the river as well as the adjoining areas (surroundings of Kanwah village). The high flood level (HFL) of Amb river was recorded to be 274.68 m above the MSL. The mine water which is discharged at the surface is given to the farmers for irrigation purpose. The river channel is not so wide and varied between 40 and 50 meters of average width. As it is a seasonal stream it becomes almost dry during summer, heavy rainfall during monsoon often causes flooding of the river and the low lying areas surrounding Kanwah village.

STATEMENT OF THE PROBLEM

The drainage of the area is controlled by Amb river with a network of small tributaries. The river can be termed as a seasonal stream as it becomes almost dry during the summer months. However, during monsoon (mid June mid September) heavy rainfall often causes flooding in the river as well as the adjoining areas. The HFL of Amb river was recorded to be 274.68 m above the MSL. The climate of the area is tropical. In summer the temperature rises to as high as 47°C and relative humidity goes down to as low as 18%. The average annual rainfall is 1200mm. As the mine water is given to the farmers for irrigation purpose, not only the Umrer area or Western Coalfields Ltd. but also the entire coal industry of the country is committed to the development and economical growth of the rural areas apart from its contribution to the growth of national economy.

BENEFITS OF RIVER DIVERSION

The river diversion is having the following advantages.

1. Flood protection: It may save the surrounding lower level villages from inundation

2. Extension of life of mine: The life of mine may be extended by more than 13 years, otherwise the mine will be closed after two years. All the men and machinery would become idle and useless. This would affect the livelihood of more than 5000 people who indirectly depend upon the WCL, Umrer mine.

3. Increase in revenue: After diversion of the river, WCL would be able to extract 25.55 MT of coal blocked under the river. The State Govt. would be losing Rs.200 crores in the form of royalty and other taxes, if diversion is not done. Thus, Umrer region would be deprived of nearly Rs. 40 crores which would have been used for development work by the State Govt. authority.

4. Benefit to the nation: By diverting the river, the WCL would be able to produce coal of the value of Rs. 2400 crores. It would be a great loss to the nation, if diversion is not done.

MAJOR ACTIVITIES OF THE SCHEME

The major activities of the diversion work are 1. acquisition of 30 ha of land, 2. re-handling of OB, 3. earth cutting of river channel and making embankments, 4. diversion of 1.6 km PWD road, 5. diversion of 1.6 km MIDC pipeline, 6. diversion of MSEB line and 7. diversion of P&T line.

AMB RIVER DIVERSION PHASE I AND II

To extract the blocked coal under Amb river, WCL in consultation with CMPDIL diverted the river into two phases in the past (Figs 1, 2, 3, 4). Table 1 gives a brief idea of different phases.

RIVER DIVERSION PLUG

It is proposed to plug the river at two locations for the diversion. Once plug shall be located at the off take point of the diversion and the other one on upstream side of the confluence of diversion with river i.e., at the exit point of the diversion. The river plugs shall be constructed in the form of an earthen dam embankment.

FIELD DATA

As the work is going to be executed in the area where Phase II work was executed and during design of Phase II work sufficient soil test data were made available, hence the design parameters have been finalized by considering the soil test data considered during Phase II design.

DIMENSIONS AND ZONING OF THE SECTION

During visit to the site it was found that sufficient quantities of casing and hearting soils are available in the vicinity of the site. It is, therefore, proposed to provide a zone embankment section comprising of a core of impervious soils and shell of pervious soils.

Casing zone: The outer casing zone comprises of pervious soil available from the soil banks of mines in operation at present. The present section of the embankment of river plug is of the category of a M.L. tank for which usually a top width of 4.5m is provided as per standard practice, with side slopes of 2H : 1V in accordance with standard practice to provide 30 m top width for the embankment of river plug for diversion channel on mine side. The H.F.L. of the river for plug No. 1 is at R.L. of 273.775 m. Hence, the T.B.L. of the embankment is proposed at 276.775 m i.e., with the free board of 3.0 m above the H.F.L. Similarly, the H.F.L. of the river plug No. 2 is at R.L. 271.375 m. Hence, the T.B.L. of river plug No. 2 is proposed at R.L. 274.375 m. The embankment slopes are provided as per requirements of stability (Sharma & Sharma 1998).

Impervious core: The hearting material is available from the diversion channel in ample quantities. With a view to utilize this material from the compulsory excavation, it is proposed to provide a thick impervious core with its top width of 15 m. The top of the hearting is kept 1.50 m above H.F.L. The side slopes of hearting on U/s and D/s shall be 1H : 1V.

Internal drainage arrangement: Since this is a low height bund, the inclined sand filter is not provided. However, to take seepage water out of the embankment, longitudinal and cross drains at 30.0 m interval are proposed. The L-drain shall be provided at the downstream toe of hearting zone with cross drains at 30 m interval at angle of 45° to the alignment of the plug, leading to the toe drain located at a distance of 8 m from the downstream toe of the plug. The toe drain will lead to the natural depression. The seepage water collected through toe drains in river gorge shall suitably be disposed off.

Rock toe: It is general practice that the height of rock toe shall be maximum of following values:
1. One meter above the peak T.W.L. or 15% of hydraulic head.
2. Half a meter above horizontal filter mat.
3. The height of rock toe as worked out above will be subject to minimum and maximum limit of 1 m and 4 m respectively.

Hand packed rock toe of height specified as above may be provided. The height of the rock toe may be increased, if sufficient quantity of rock spoil is available from the compulsory excavation, to make its use economically. On the upstream face of rock toe 150 mm thick sand layer, 250 mm thick graded gravel, 250 mm thick quarry spauls, and remaining portion 76 to 150 mm thick rubble should be provided.

Slope protection: The upstream slope of the dam is proposed to be protected against eroding action of waves by hand placed stone pitching 450 mm thick laid over 300 mm thick quarry spauls. The provision of pitching is as per I.S. 8237-1976 (Garg 2001). The average weight of those stones used in pitching shall be over 50 kg. The downstream slope may, however, be protected by grass turfing in order to prevent soil erosion and gully formations (Modi 2000).

DESIGN OF CHANNEL SECTION

The channel section is designed to pass the designed discharge safety by working out the velocity by

Manning's formula. The design discharge has been increased by 10% and then the cross section has been finalized.

Free board: According to the standard practice of design of channel section, 1.00 m free board above full supply depth is provided on opposite to mine side. Free board of 3.00 m is adopted on mine side for safety requirements. For the protection bunds of nallas, 1.0 m free board above full supply depth is provided.

River training and regradation: The diversion channel joins the main river course at R.D. 4720 m. The existing river section at the confluence is small as compared to the diversion channel. Adequate length of at least 100 m of the river beyond the confluence point should be cleared off with all undulations to give a safe passage to river flow. Proper care shall be taken to avoid heading up in diversion channel due to obstructions, if any, in the reach of river immediately downstream of diversion junction.

Under seepage control measures: Augur bores are driven along diversion channel at different locations. The locations of these points are given in the Table 2. The strata classification of the above bore holes indicates that the foundation grade rock is not met with at reasonable depths. As the river is diverted to make the space available for coal mining, and hence water tight construction is most essential. As deep quarries are going to operate on mine side, water tight C.O.T. at least on mine side is essential but as per the bore data, hard rock is not available at reasonable depth, and hence there is no option but to provide partial C.O.T.

As far as possible we are going to provide partial C.O.T. on at least mine side below the bed level of diversion channel. If good rock is available in certain reaches above the diversion bed channel level, the C.O.T. should be keyed at least 1.0 m in good rock. If good rock is not available at reasonable depth, the C.O.T. on mine side should be provided at least 0.5 H below diversion channel bed level and 0.5 H from existing ground level on opposite side. The bottom widths proposed are 5.0 m and 2.50 m on mine side and opposite side respectively. The C.O.T. should be located in such a way that its centre line should meet at the point where a line meets the ground with 0.25:1 slope starting from top of centre of hearting. The slopes of excavation shall be adopted as prescribed in I.S. 8826 -1978.

Fig. 1: Works carried out at the WCL site.

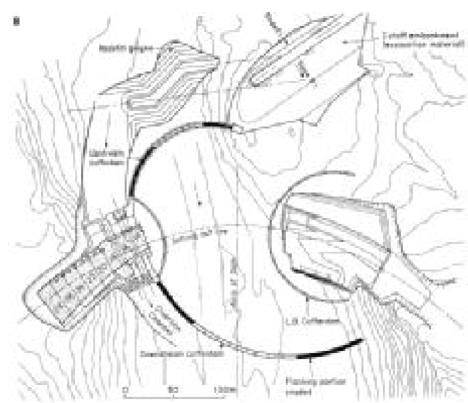

Fig. 2: Diversion of the river at first stage.

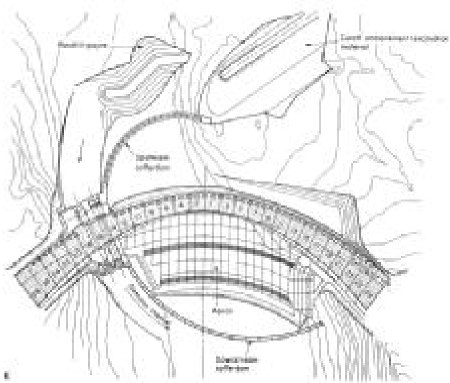

Fig. 3 Diversion of the river at last stage.

Fig. 4: Layout of the Amb river.

Over burden	1.0 H : 1.0 V
Soft rock	0.5 H : 1.0 V
Hard rock	0.25 H : 1.0 V

Nalla training and regradation: The nallas meeting the natural river course within this reach is Nalla Nos. 3, 4 and 5. They meet the natural river course at R.D. 2360 m, 3570 m and 4250 m respectively. Field officers have taken the detail surveyed 'L' sections of each nalla, and from the 'L' section it is seen that excavated soils are dumped randomly in the nalla course, and hence uniform gradient to the existing nallas does not appear. The river course is diverted from its existing river course from R.D. 2280 m and the diverted channel meets the original river course at R.D. 4720 m. The nalla Nos. 4 and 5 meet the diverted channel at a distance of 630 m and 600 m respectively from their original confluence point. For design purpose the natural bed gradient has been worked out by taking level difference from their original confluence point and the farthest location made available by the field officers. The natural bed gradient works out to be 1 in 600, 1 in 930 and 1 in 400 for nalla Nos. 3, 4 and 5 respectively. The cross sections of nallas have been designed for the floods of that nalla with 10% additional floods. The existing nalla section is very small and hence resectioning and regradation of nalla sections have to be done up to the point where H.F.L. of the main river meets the nalla banks.

Flood protection banks: Flood banks up to 1.0 m height above H.F.L. of nalla have also been proposed to avoid overtopping. The flood protection banks comprising of hearting core and casing cover have been proposed. The top width of hearting is proposed as 3.0 m whereas top width of casing is proposed as 5.0 m. The top level of hearting is proposed at H.F.L. whereas top level of casing is proposed at H.F.L.+1.0 m. For under seepage control measures a C.O.T. of 2.00 m for keying purpose has been proposed on both the flanks. The protection bund on both the flanks should be constructed up the level of the bank meets the H.F.L. on the river so that flood water will not enter the adjoining fields.

Nalla confluence: For the junction of nalla and the diverted channel, bell mouth entry type arrangement is proposed. The flood protection banks of the nalla on both the flanks will smoothly joins the protection bund of the diversion channel. The top level of protection bunds of diversion channel and protection bunds of the nallas are the same. 450 mm thick stone pitching on 300 mm thick quarry

Table 1: Yearwise extraction of coal from Amb river.

Phase of diversion	Coal released (Million tones)	Year of completion
Phase-I	8.4	1991
Phase-II	6.13	1997
Phase-III	25.55	In progress

Table 2: Locations of the Augur bores along the river.

Sr. No.	R.D. in m.	Bore hole No.
1.	2560	BH 01 (AB 01)
2.	3510	BH 03 (AB 03)
3.	4000	BH 02 (AB 02)

spauls along with the toe walls is also proposed to avoid erosion of nalla at confluence. Initially this will extend on upstream and downstream side for 15 m length. The same will be extended if found necessary after observation. As the nalla bed level and diversion channel bed levels are nearly same for nalla Nos. 3 and 4, no separate energy dissipation arrangements are proposed but for nalla No. 5, there is a level difference of 1.755 m, and hence protection walls at 30.0 m from right side face of the diversion channels is proposed. For energy dissipation arrangement, R.C.C. slab of 300 mm thick on rubble soil is proposed, as the river water will be always available as a water cushion, this arrangement will be sufficient (Sharma 1998). A stone pitching of 450 mm thick with 300 mm quarry spauls have been proposed on the front side of nalla confluence for a length of nalla bottom width + 15 m on either side.

Inlet of diversion: At off take point of diversion, the river shall be diverted into channel by providing river plug No. 1 from left end where T.B.L. 276.775 meets the ground level to R.D. 2300 m.

Guide Bund: At the location of exit of diversion channel, it is proposed to provide river plug No.2 from R.D. 4720 m to the end point where T.B.L. 274.375 m meets the ground level so as to stop the flood water from entering into mine area. Guide bunds on both the banks of river shall be provided for 100 m length form river plug No. 2 to let flood water from diversion channel into the existing river smoothly.

CONCLUSIONS

The coal which is available under the bed of Amb river is excavated by diverting the river successfully in three phases at different locations. Three nallas are provided at three different places along the river. The discharge of the river increases in flow direction by increasing the bed width. The Nallas can be designed by calculating the flood discharge. The bed slope is considered as 1 in 1000 based on the study of original river. Out of two river plugs, one is placed at the off take point of the diversion and the other one is on the up stream side of diversion.

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