RESTORATION WORKS FOR THE COLLAPSED PORTION OF CIRCULATORY WATER CHANNEL AT NTPC/TSTPS

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ABSTRACT

Talcher Super Thermal Power Station (TSTPS), located in the state of Odisha, commissioned the first unit in the year by NTPC during the year 1995. It is one of the highest power generating coal stations in India with installed capacity of 3000 MW (500 MW x 6).

As thermal plant requires enormous quantity of water for condensation of steam, this plant is accordingly designed to minimize the water requirement by the way of condensation of steam by cooling towers and circulating water channels, by which the same water can be used multiple times with minimum intake of water from the nearest reservoir.

The topic of paper presentation is about the construction of wall for circulating water channel (CW channel) in the Civil engineering point of view. In detail, recently in 2016, the wall of the CW channel was collapsed in some portion of the stretch of CW channel. As the water in the CW channel flowing with much velocity and there has no scope for the diversion of water for the re-construction of wall at the collapsed region, it makes tough challenge for the civil engineering aspect. It is required to takeup the restoration activity of the CW channel in the flowing water having velocity of nearly 6 m/s and average water depth of about 6 mts. Within the constrained region of space available on the bank of the channel.

Hence, as it involves skillful engineering application, this concept is chosen for the technical paper presentation. In this paper, much emphasis has been given on the constraints while making restoration work, study of rock strata, analysis of loads acting on the structures and methodology of the execution along with photographs of collapsed portion of the wall and some diagrams. This has happened first time in NTPC. This study report will be a reference to any such CW channel failure in future.

SYNOPISIS

In the civil engineering point of view, restoration work for the CW channel poses a great challenge and seeks better professionalism. The only reason is that taking up of construction activity, without water being diverted and working across the torrents of flowing water at higher velocity with variable depths, is of prime concern. Moreover, the working space available is also minimal with the situation of pump houses on the right bank side and other civil structures on the left bank side.

If there is no flowing water in the CW channel, this construction activity can be easily taken up. But, stopping of flowing water which will be possible by only shutting down the running units is a great loss to NTPC, which is not at all possible in the power generation point of view.

As the RCC wall of the CW channel carrying the cable trays and power cables was collapsed during the year 2016, in order to meet the exigency condition, temporarily minor civil works on the bank of CW channel were taken up along with the re-rerouting of power cables.

And simultaneously , it is learnt that the erosion and scouring had taken place on the banks of the CW channel, thereby, making the banks of CW channel much unsafer and causing impact on the functioning of pumps and turbines due to siltation of channel. After considering all the exigent conditions, it has been decided to take up this work by consulting with M/s L&T. Accordingly, this contract is awarded to M/s L&T to complete the task of restoration works of CW channel.

After the award, the agency, M/s L&T had carried out the some of the preliminary investigations by the way of under water survey, boreheole drilling,topographical survey etc.,to assess the exact condition of the collapsed wall before the start of the actual work. In this technical paper, some emphasis has been given regarding the aspects of construction sequence with detailed drawings and as well as with the photographs of the collapsed portion of the wall.

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1. INTRODUCTION

Talcher Kaniha, the NTPC thermal power plant at Talcher in Angul District of Orissa, is one of the largest power plants in India with a rated capacity of 6x500 MW that caters power to the Eastern and Southern states of India. This coal based power plant is functional since three decades.

This channel is for the Stage I & II. The restoration of this damaged portion and additional support system for the remaining portion A small portion of the circulatory water channel side support failed in the month of October 2016. of the channel are proposed for the smooth functioning of the circulatory water channel.

2. PURPOSE & SCOPE

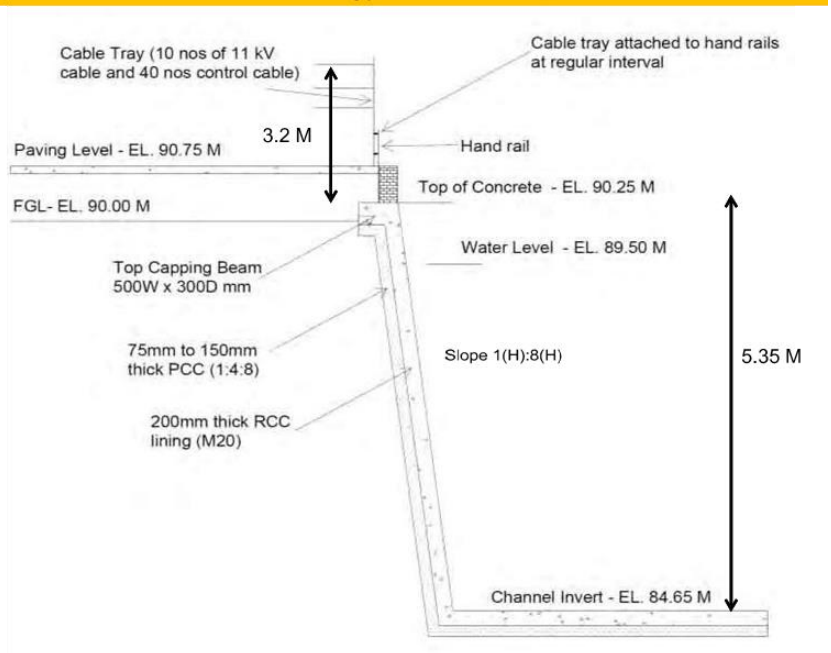
The purpose of this document is to describe about the proposed restoration system and the provisional construction sequence.

3. INVESTIGATIONS CARRIED OUT

A detailed survey of the affected area is carried out in form of total seven (7 nos) of boreholes. Underwater survey / photography are also proposed to study the extent of damages below water along the damaged extent.

a. ORIGINAL DESIGN SECTIONS OF CW CHANNEL

CW Channel –Typical sectional details



b. Damages caused by erosion of the CW channel bank

c. Preliminary details of topographical survey

It represents preliminary details of the topographical survey carried out close to the damaged portion of the channel. Based on survey observations, the total length of damaged portion is approximately 55m . The damage along the vertical direction of the channel section is not fully visible presently hence not clear at this point of time. Based on the initial assessments, it is assumed that a part of the RCC side wall is damaged and there are remnants of the damaged portion still held by the reinforcements which are presently under water. Present topographic survey is prepared based on the temporary bench mark created near to the channel.

d. Bore hole data

This illustrates the borehole data from two boreholes BH/7 drilled near the damaged portion towards downstream. Weathered jointed rock is observed to be present from the surface. The first 3.0 m from the existing ground level is having significant jointing and partial weathering. The jointing & weathering reduce towards depth as indicated by the total rock core recovery and the RQD. The rock is having uniaxial compressive strength ranging from 14MPa to 20 MPa, which may be classified as medium rock.

RESTORATION OF C.W. CHANNEL WALL AT TALCHER S.T.P.S.

BH-7

Sl. No	DEPT IN MTR	Drill Run (m)	Symbol	Rock Description	Percent Recovery (%)	Size of Hole	Rock Quality designation (RQD)	Specific gravity	Water absorption (%)	Un confined Compressive strength (Kg/Sq.Cm)
1	0.5MT			Medium weathered Rock with light grey colur	82	NX	-	2.87		
2	1.0MT	0.5			98	NX	-	2.90		
3	2.0MT	1			47	NX	-	2.87		
4	3.0MT	1			99	NX	20	2.89	0.27	147.71
5	4.0MT	1			49	NX	29.5	2.89	0.22	198.04
6	5.0MT	1			34	NX	16.8	2.90	0.16	170.04
7	6.0MT	1			40	NX	55	2.88	0.30	156.29

e. OBJECTIVE AND BASIS OF THIS RESTORATION SCHEME

The major objectives of the proposed restoration scheme are listed below.

1. Provide a stable side wall in the damaged sections of the cooling water channel
2. Restore the available width of the walk way and bank along the damaged extent

<u>Important considerations for proposed restoration system are listed below.</u>

1. The initial damage assessment by site visits and topographic survey mostly based on visual inspections
2. The tentative conclusion that the bed of the channel is not damaged
3. The side wall that was constructed against the rock / weathered / jointed rock face is not damaged from certain depth or collapsed up to channel bed only without damaging the channel base
4. Some damaged portion may be clinging to the undamaged portion of the RC skin wall at discrete locations
5. The access into the flowing water of the channel is almost nil for taking up the restoration work
6. The undamaged portion of the side skin walls is protected by suitable scaffolding / strut system on the either side of the damaged wall during restoration works to avoid any progressive damage to the intact section of the channel.
7. The mass strength of the jointed rock is considered to be adequate to support the system

f. THE PROPOSED RESTORATION SCHEME

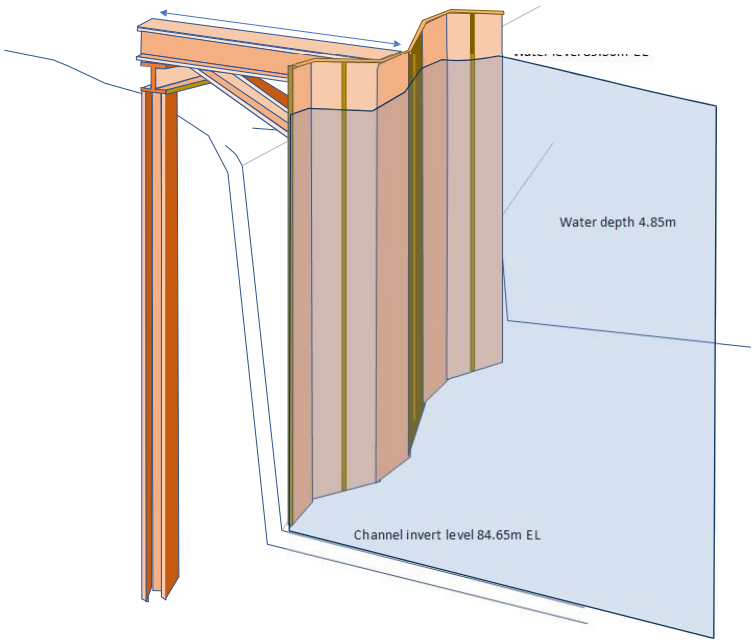
After reviewing all possible options for the restoration, a scheme with vertical sheet pile wall held by horizontal and inclined tension members connected to steel piles penetrated sufficiently into the rock is being proposed.

500mm wide U-hat sheet pile sections of required length and structural steel members like ISMB 250 for the steel pile and horizontal beam, ISHB 200 section as horizontal strut and ISMC 200 as the inclined strut are used in the design. This vertical sheet pile wall will be part of permanent system and remain in place for its entire service life.

The backside of this sheet pile wall will be filled with concrete to make it a permanent structure. Adequate steel bars and nominal reinforcement may be used to make this concrete stable and holding to the sheet pile wall. Reinforcement details will be further elaborated based on the approval of the present scheme.

The design loads on the individual members are arrived at by analysis using standard finite element software. Since the major load on the system is from the fresh concrete that is to be filled behind the sheet pile wall and this fill is not a regular fill, geotechnical software is being used for the analysis. The detail design calculations will be shared based on the approval expressed for the proposed scheme.

<u>Tentative view of the proposed scheme</u>



g. SEQUENCE OF CONSTRUCTION

1. Fixing the alignment of steel piles strictly with respect to the possible alignment of the sheet pile wall. This requires an initial survey for the entire damaged section and clearing of the debris), remove the soil / loose rock to a level of about EL 90.00m EL along this alignment and adequately strengthen the area for envisaged construction activities.
2. Install all the grouted H piles in prebored holes.
3. Fix the connecting beam and complete the welding of sections with main longitudinal beam.
4. Clear the portion between the pile and the water front for a length of 5.0m
5. Place the first sheet pile section fitted with the bracket and loosely place the bracket over the pile connecting beam. The bracket may be held using U clamps or suitable system. Check the correctness of the position and verticality and more importantly the alignment.
6. Place the second sheet pile section fitted with bracket
7. Lower the intermediate pile sections
8. Finish the welding of this first stretch of 1.50m length of the wall
9. Place the third bracketed sheet pile section at 1.50m away from the second one.
10. Place the two intermediate sheet pile sections
11. Repeat the procedure to complete the wall for a length of 5.0m
12. Clear the next 5m portion and repeat the procedure
13. Close the gap between the wall and the intact portion of the undamaged wall at the starting point using steel plate from inside (may be cut to width).
14. The placement of plastic concrete for the bottom 1.0m height. Care shall be taken not to place / flow the concrete into the length where the wall is not erected.
15. Concreting to a level of 88.50m may be completed for a 10.0m portion once 20m long wall is erected
16. The remaining concreting may be placed with nominal reinforcement cage in L shape between the brackets.
17. Complete the construction and finishing.

h. CONCLUSION

As it is difficult to manage the works from the water side, it is required to execute this from the bank side.

The proposed scheme comprises sheet pile wall system resting over the channel bed and held in position connecting it to a bracket system that is corrected to steel piles at every 2.0m spacing. The sections are designed for the expected loads during the restoration work. Since the banks are having jointed rock, the major loads on the wall is only during the placement of fresh concrete which may be considered as temporary.

Four to five meters length of the undamaged portion of the skin wall in the upstream and downstream portion shall be supported by proper strut system.

The restoration work shall progress in a sequence. Changes may be required depending on the site conditions. The proposed system has the flexibility to adopt such changes.

All safety drills and precautions shall be taken during the entire restoration work activities.