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CONSTRUCTION ASPECTS OF BALLOKI-SULEIMANKI LINK

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By

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Sutlej Valley canals have been experiencing serious shortage of river supplies in Kharif sowing and maturing period, ever since their construction. During the periods of acute shortage i.e. April to June and September, surplus water is available in the river Chenab. The Anderson Committee in 1935 therefore recommended transfer of surplus Chenab waters to Sutlej river through feeder canals linking the Chenab with the Ravi and then the Ravi with the Sutlej.

Various alignments for link canal from the Ravi to the Sutlej were examined, and finally Balloki Suleimanki Link alignment was selected keeping in view the following factors:

a) shortest possible route

b) Alignment of the canal through Crown-waste land to avoid acquisition of fertile private cultivated areas.

c) To minimize the reaches in which the water table is high

d) To dig the canal through low-lying country to reduce water-logging.

e) To reduce the number of crossings for the existing channels and roads.

f) To avoid grave-yards and religious buildings.

keeping in view the above factors some curves had to be introduced n the alignment of the link canal. The canal is in heavy cutting upto RD 106,200. In the head reach upto RD 68,000, subsoil water level was above the designed bed level. The link consists of both unlined and lined parts. Unlined portion upto RD 0-73250 was designed as per Lacey theory. For a discharge of 15000 cusecs, section adopted consisted of bed width of 300' and depth of 13'. Side slopes above subsoil water level were kept 1,1 and below it 3 : 1. Longitudinal slope was kept as 1:10,000 with Lacey's silt factor 1.0. Lined section has bed width of 115.8' and depth of 18', bed slope of 1:8000 and side slopes as 2.1. It can be seen that there is an increase of 5' in depth and reduction of 184.2' in bed width at the junction of unlined and lined reaches. It meant an abrupt drop of 5' and instead of giving a fall, the bed width was reduced and the depth increased in stages in the transition reach from RD 73250 to 78,500. This was achieved in three cascades.

The Link has unprecedented features such as that the depth of cutting at places exceeds 40' and that the bed line in the head reach requires digging below sub-soil waterlevel to a maximum of 8.27'. It was decided that the dry earthwork should be done by donkey labour and the wet and slush earthwork by machines. Donkey labour was to do excavation upto 2' to 3' above water level from where machinery was to take over. The wet and slush earthwork as per original estimate was 18 crore Cft, but the excavation program aimed at reducing it to the very minimum. To achieve this a cunette 50' wide and 2' deep below design bed was dug by machines near the centre line of the canal, after the dry earth was removed from the top by donkey labour. This method proved effective and the sub-soil water level was considerably lowered. About 4.5 crore Cft of earthwork, originally considered to be wet was dug out by donkey labour without paying wetness allowance. Thus out of a total estimated quantity of earthwork of about 87 crore Cft 71 crore cft was done by the donkey labour. Earth-moving equipment worth Rs. 1 crore cft was imported from abroad but the total work done by these machines was only 10% of the work done by the donkeys during the same period. Comparison of cost between machinery and donkey labour shows that work done by the former is cheaper.

Major masonary works to be constructed were 14. These included 3 acqueducts for distributeries, 5 V.R. Bridges, 2 DR Bridges, and 2 AR

Bridges and a railway bridge. Generally structure crossings were made at right angles to the centre line of the Link, but AR bridges were sometimes skewed to avoid bends in important highways. However in the case of Railway bridge an "S" curve was introduced in the Link to make a right-angled crossing for the railway line over the canal.

Selection and timely arrangement of materials is a pre-requiste for every large project. Cement was arranged from Wah works. Sand samples were collected from various places and their fineness module and cost was worked out. Kalabagh sand was used only on a few important works. Wazirabad sand was used for all concrete works whereas Ravi or Beas bed and pit sand was used for all masonary works. Reinforcement steel weighing 677 tons was arranged from local market. To ensure quality control, sample of bars were got tested from Punjab Engineering college Laboratory at Moghalpura. Results revealed that steel was of good quality. Brick requirement was met by operating departmental kilns. For shuttering, centering, etc 7855 cft of timber was used. To meet the requirement of water 7 tubewells were sunk but sweet water could not be found even upto a depth of 250'. Canal and tubewell water was therefore mixed for use on masonary works and lining.

Dewatering of the foundations was carried out according to the following methods as per site requirements.

a) Pumping units worked by electric motors and diesel engines.

b) Hand Pumps or contractors Pumps for small sites

c) Bailing out water with hand

Major dewatering problem was encountered at the Head Regulator which had to be built on the bank of the river by the side of a running main canal (LBDC). An area of 450' x 450' had to be dewatered with a head across of 21' from the river pond level. Pumping sets were of 2 cusecs capacity.

At various sites wells were sunk to provide stable foundations for structures. Various methods employed for well sinking were Jham

Grab worked by bullocks by using excavator, open excavating, by steam winches and by water jets as the site conditions warranted. Various difficulties were met during well sinking. First was maintaining the verticality of the wells. This was ensured by sinking alternate wells by halves, standing wells giving an indication of verticality. Second difficulty was that the wells got stuck up when they were being sunk though clay strata and any further loading seemed ineffective. In such cases resort was made to method of well sinking by open excavation. Another source of trouble was that the false work collapsed and fell into the well and filled it up with water and slush from outside. It was thought better to have thicker falsework, and 1:8 cement sand mortar instead of mud mortar.

Wooden scaffoldings were used in the case of the Railway bridge. Angle iron cribs served as scaffoldings at all such works where centerings were made of angle iron cribs. Where earth centering was used, scaffloing was also afforded by filling earth side by side with the construction of piers. Pipe scaffolding was used for tall structures. For many works, formwork and shuttering were required. M.S. sheet formwork is the best but non-availability in such large quantities prevented its use. Deodar wood formwork lined with GI sheet was used on head regulator. Forwork consisting of brick work in mud mortar lined with impervious coat of cement mortar and properly white washed was also used. At places combination of wooden formwork and brickwork were used.

Placing of reinforcement in deep and narrow beams was tackled by placing it in steps. Similarly proper care was employed in preparing mix design and then its placing, compaction and curing. Centrifugal concrete mixer of the tilting type was used for mixing concrete and vibrators worked by air compressors were used for its compaction. Constructions, expansion and contraction joints were provided at suitable places.

Note :-

Paper No. 307 appears in the proceedings of Engineering Congress 1954, Volume 38 at pages 166 to 222. It has 18 photographs and 13 plates.