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Marala Headworks was constructed during 1905-12 on the river Chenab, just below its confluence with Jammu Tawi and Munawar Tawi Nullahs. The Upper Chenab Canal, off taking from this shuttered weir, served the districts of Sialkot, Gujranwala and Sheikhupura and outfalled in the river Ravi at the right flank of Balloki Headworks for augmenting the flow of Lower Bari Doab Canal. It was the first linkage of the waters of two rivers. Marala Headworks was remodeled from time to time and had a length of 4318 feet, and was designed for a flood discharge of 7,30,000 Cusecs. After Independence, as a sequel of Indo-Pakistan water dispute, Upper Chenab Canal was remodeled during 1949-53 to increase its capacity from 11694 cusecs to 16500 cusecs to increase transfers to Balloki. Construction of Balloki-Sulemanki link of 15000 cusec capacity was taken up in 1951. Marala Ravi Link Canal, off-taking above Marala Headworks and outfalling into river Ravi at some distance upstream of Ravi Syphon, was constructed during 1953-56 with a design discharge of 22000 cusecs to meet the requirement of balloki-Sulemanki Link. The regulator of this link was located 300 feet upstream of the U.C.C. regulator. Excessive silt deposition in the Link Canal soon after its commissioning in 1957, necessitated the extension of divide wall of Marala Headworks by 312 feet during 962-63.

Marala Ravi Link, a non-perennial unlined channel had been designed on Lacey's theory for a discharge of 22000 Cs, Lacey's silt factor of 0.98 and silt carrying capacity of 0.7 grams/litre. After two years of its commissioning the channel had heavily silted, its bed width had

increased, the head regulator was rendered non-modular and the discharge capacity was reduced from 22000 Cs to 15000 Cs. The sediment concentration entering the canal frequently exceeded its sediment carrying capacity because disallowing the river waters with excessive sediment would involve repeated closures of the canal. Jammu Tawi joining the river just above the left undersluices of the old weir, was also responsible for inducing higher silt charge into the link. Apart from the extension of the divide wall, shutters of the weir in the first two bays were replaced or modified to raise the pond level, spurs with stone pitched noses were constructed in the canal head reach to restore the design bed width, and training works were constructed along left upper marginal bund to shift the confluence of Jammu Tawi upstream to control silt entry into M.R. Link. All there measures proved futile. The other off-take, the Upper Chenab Canal, however, faced no silt problems.

With the conclusion of Indus Water Treaty between the two countries, India got exclusive right for use of waters of the rivers Ravi, Beas and Sutlej. To feed the canals of these rivers, a net work of Links, some Barrages and two Dams were constructed by Pakistan (Termed as Replacement Plan Works) by securing financial help from the World Bank and the friendly countries. The newly established water rights between Pakistan and India warranted either completed remodeling of exising Marala weir or construction of an entirely new structure. After a detailed examination, it was decided to construct a new barrage 1100 feet downstream of the existing weir. The construction of the barrage was started in 1965 and completed in 1968.

The only way of increasing the silt transport capacity of the Link was to steepen its slope. The crest of the regulating bridge cum fall at RD 237,500 was lowered by 4.34 feet, and it was expected that retrogression smoothly travelling upwards would generate a steeper slope of 1 in 8333. The retrogression, however, travelled only for a lengh of 5 miles due to presence of hard clayey strata.

The barrage has its own share of problems. It has been felt that the pocket is some what wider than required for the length of existing divide wall. River supply turning round the upstream end of the divide wall enters the link canal more or less directly without being sufficiently influenced by the still pond effect of the pocket.

Experience has shown that when the undersluices are operated for flushing, the silt deposited in the paved portion gets washed while that on the Kacha bed takes much longer to get washed. During winter opportunity for flushing is some times provided by a sporadic freshet, otherwise the discharge remains well below that required for effective flushing operation. Provision of skimming platform or silt vanes in front of the regulator can help to exercise some control on the silt entry. Other additional measures like raising crest of the regulator, incorporation of rising cill gates, possible raising of normal pond limit or a combination of these may be helpful in exercising a better control on the silt entry into the link canal. Knocking down of crest of old weir from RL 800 to RL 795 will have healthy effect on silt entry into the pocket.

Due to continuous entry of fine to coarse sand into the link, it has gradually silted upto RD 237,320. Total volume of silt deposit in this reach was estimated as 252 Mcft in 1960 and has now increased to 421.5 Mcft. The link has acquired a steeper slope of 0.17 per 1000 feet. Siltation process combined with running of the link with low discharges has caused widening of the channel and its meandering, resulting in drastic rise in its full supply level. The value of Lacey's silt factor for the existing discharge and existing slope is 1.30 and nearly the same value was obtained when silt factor was determined from mean silt diameter. Silt ejector could not be introduced in the link because of the absence of any old river creek/course on the left downstream.

The Author has proposed some corrective measures for the barrage. The performance of left undersluices can be improved by extension of existing divide wall by 400 feet to eliminate partial pocket effect. Construction of silt vanes to form a silt excluder in the pocket can enable heavy silt charge at the bottom layer of flow in the pocket to pass below the barrage. Compartmentation of pocket into three zones will permit flushing operation at low discharges at more frequent intervals. Pavement of Kacha portion of the pocket will expedite the process of flushing. The old weir crest should be removed because it creates harmful shoaling effect on the upstream side. Modifying the crest level of existing head regulator of the link including raising of crest level with provision of cill gates will reduce silt entry into the

link. The operational pond level can be raised to R.L 813 without endangering the safety of the barrage.

Steps can also be taken to improve condition of M.R. Link. The proposals given by the Author include regrading the bed from head to RD 90190, desilting of the channel, provision of stone pitched profile walls, strengthening of banks particularly the left bank in filling reaches and raising the decks of bridges. The rough cost estimated to implement the above proposals (price level 1985-86) amounts to 194 million rupees.