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Review and Measures for Rehabilitation of Zaingeer Canal and its Head Works

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Abstract

The paper reviews Zaingeer canal with an objective to make the famous canal to function more efficiently as it was observed that the said canal has undergone various deformities during passage of time as the canal has been constructed some 600 years ago. The main objective of the present study is to have an overview of the present condition of the canal, to study various causes of its deformation and ineffectiveness and then suggesting the remedial measures for its rehabilitation.

Keywords: Zaingeer canal; review; rehabilitation; improvements; head works

Introduction

Water is one of the important natural resources present on the Earth, which makes it habitable. Earth has a total water volume of about 1.4 billion cubic kilometer, out of which only 35 million cubic kilometer is freshwater which is just about 2.5% of the total volume of water on earth. Also, out of this freshwater only about 30% comprises of lakes and groundwater together, which can be utilized by humans for different uses such as drinking, irrigation, etc. The irrigation sector accounts for about 70% of all freshwater worldwide (WWDR by World Water Assessment Programme). Molden (2007) based on a study stated that in the near future; less water will be available for agricultural production due to competition with other sectors. Also, as per FAO (2013), food production will have to be increased to feed the growing world population. Rosegrant et al. (2002) estimated that by 2025 the world population will increase by 1.5 to 2 billion. The water use is increasing more than twice the increase in the population rate (Cruz et al. 2007); by 2025 more than two thirds of the world population will be under stress. The decrease in the availability of water for irrigation coupled with the increasing population will lead to a drastically reduced food and water for the population as a whole (FAO 2011). The diminishing water availability for various critical uses such as irrigation focuses on this grave problem. It demands the optimization of the available water resources utilization. This can be achieved through several strategies that include; sustainable river catchment management, proper design of water canals, hydraulic structures and proper scheduling for release to farmers, operation and maintenance of the systems (Maghsoud et al. 2013). Restoration and rehabilitation of the already constructed canal networks for irrigation is a very prospective area for a sustainable development. The present work aimed at reviewing and proposing the rehabilitation of one of the most famous canal system in Jammu and Kashmir-Zaingeer Canal.

Zaingeer belt comprises of a large fertile alluvial area of district Baramulla and Bandipore in Kashmir valley. The canal was constructed some 600 years ago and was named as Zaingeer canal in the memory of King Zainul Aabdien. The off-take of the canal is located on the right bank of the Madhumati Nallah at Sunarwani Bandipora. It extends between 34-27 N and 74-38 (E). The Nallah Madhumati runs along the foot of mountains dividing Gurez valley from Kashmir valley. The Nallah originates from upper mountainous region of Gangabal glaciers having sufficient discharge**.** The canal is spread over a length of 34 kms with distributary system of 41 kms having a gross command area of 6480 hectares along with cultivable command of 5100 hectares.

The canal was designed for the discharge of 10 cumecs in its head reaches and 7.07 cumecs in tail reaches at the time of commissioning of canal about 50 years back, with bed width of canal in the head reaches 7.6 meters and 5.50 meters in tail reaches and full supply depth of 1.37 meters. The bed level of the canal at the head works was 1634.20 meters with a total available fall of 40.20 meters throughout its length. The supplies into the canal were diverted through a head work consisting of 4 bays.

1. Present status of the Zaingeer canal system

Zaingeer canal runs along hill toes for most of its alignment and is subjected to heavy damages due to rains and cloud bursts which occur quite frequently in the area during summer. The canal has shown signs of deterioration at various places and sloughening on right embankment which brings huge debris and mulba during torrential rains. The canal structures like cross drainage works, escapes, falls, head regulators etc. have rendered their services and are in damaged position. The wooden outlets have got deteriorated and are chocked. At present the canal has developed a maximum number of leaking spots and continuous seepage and percolation has reduced the performance of the canal. Catch water drains along the canal have become defunct with the result huge debris from uphill side find its way in the canal resulting in huge deposition on bed and blocking of canal section.

1.1 Canal

The length of the main canal is 34 Km and that of distributaries is 41 Kms. The canal has accumulated heavy silt which has badly affected running of assured irrigation water to the command. While reviewing the canal, it was noticed that up to RD 650 Mtr., boulders of different size also get entry with water.

Water logging problem has become eminent in some areas of the canal due to considerable seepage and percolation losses. The canal is open to vagaries of nature viz heavy rains, floods, thus causing heavy slips and breaches effecting badly proper irrigation facilities.

1.2 Canal Embankment

The main canal passes along hill toe in most of its alignments while as left embankments being in filling from head to tail have undergone tremendous sloughing, thus rendering the canal weak and unsafe. Heavy damages are caused during the torrential rains and cloud bursts, resulting in accumulation of debris in the canal. Besides the canal embankments on the left side are weak and have a small top width, are liable to damages, especially when floods and rains put forth extra burden on canal section.

1.3 Regulators

A head regulator cum escape structure at off take point on Madhumati Nallah diverts water from the Nallah into the canal. The supplies are controlled at the head works and regulated by gated system installed on the head regulator and escape channel. The gated system does not work properly. It does not control the entry of silt into the off taking channel .The flow at the entry of Head regulator is turbulent which is not desirable as it allows silt entry into the canal.

The canal has efficient distribution system in the tail reaches comprising of distributaries and minors. The water is regulated from the main canal into distributaries and minors through gated controlled system at distributaries heads. The regulatory heads are in delipitated condition and need immediate attention.

1.4 Canal Structures

The Zaingeer canal consists of the Canal structures as given in Table 1.

Table 1 Various canal structures of the Zaingeer Canal System

S. No.	Canal Structure	Number
1	Aqueducts	10
2	Canal Siphons	11
3	Super Passages	10
4	Escapes	5
5	Falls	18
6	Outlets	73
7	Head regulators	48

Supplies into canal are drawn through head regulators constructed on right bank of Nallah Madhumati near village Sunnar Wani Bandipore. The distribution of water up to RD 27440 meters is done by the main canal through the outlets constructed and embedded within the canal banks. The canal beyond RD 27440 meters has a well net distribution system, consisting of distributaries and minor where outlets have been fixed as per check bandi to ascertain location and size, with net irrigated area. The water from the outlets is led into the fields by means of field channels and water courses which are constructed and maintained by farmers. All the minors/ distributaries are operated by gate controlled, to regulate supplies where as outlets are ungated. At the time of shortage during peak irrigation season, warbhandi at outlets is resorted in order to distribute water in tail reaches.

The required discharge is 10 cumecs during Kharief irrigation season but at present the required discharge is not available. During passage of time and continuous damage caused by heavy siltation, breaches, slips and tremendous leakages, the canal has undergone heavy deterioration. The present positions of Canal structures are as follows.

1.4.1 Falls

The main canal has a series of falls to maintain water floor. These falls constructed in stone/brick masonary earlier have rendered their life and need early attention. It has been witnessed that erosion of bed and banks on both sides of canal and in some reaches, some falls have disappeared with silt.

1.4.2 Escapes

The canal being hilly passes through hill toe and has to accommodate run off from the hill sides during precipitation in the right side of catchment. To spill over excess water during heavy rains or closure of canal, four numbers of escapes exist on the main canal. These escape channels constructed earlier to discharge excess water during emergencies have got chocked and damaged resulting in undulation of adjacent land and property during operation and have become great threat to the stability of canal, need immediate attention.

1.4.3 Cross Drainage Works

The canal being hilly is intercepted by rivers and Nallah which become quite active and ferrous during rains and cloud bursts. The cross drainage such as aqueducts, and siphons have been constructed at the confluence of canal with the intervening Nallah, and rivers to pass safely water from the hill catchment. These structures are constructed decades back in arch brick masonary. The drainage water way of these structures have witnessed overtopping at the time HFL condition. The vital structures have served their life and need early attention.

1.4.4 Outlets

There are no proper outlets on canal and its distribution system. The old wooden outlets have become defunct and need immediate attention, so as to ensure immediate water distribution to the command.

1.4.5 Silt Ejector

There is no silt ejector at present on the canal which further adds to the deposition of silt in the canal, thereby, restricting the flow of water in the canal. Further measures are required for preventing the silting of the canal, as the canal runs for a good length along the hill toes.

1.5 Catch Water Drains

Zaingeer canal is almost hilly along hill toes. During heavy precipitation in the catchment, the runoff is intercepted by the presence of catch water drains along the right side of canal. At present the catch water drains are almost vanished. These catch water drains are life line for the stability of the canal and need early attention.

1.6 Watlab lift scheme

Zaingeer canal in the reach of RD 19812 to RD 24384 meters is hilly and aligned along hill toes in periphery of famous Wular Lake. As the flow in the perennial source of Zaingeer canal decreases in the month of late August and September during drought years, the canal cannot meet the requirement of water for irrigation resulting in shortage of water in tail portion. A lift scheme had already been constructed at RD 24384 m of Zaingeer canal on Wular Lake which was supposed to cater the water requirement of the tail portion. The lift station comprises of four pumping units having capacity of 1.98 cumecs but presently the said lift scheme has become defunct due to occupation of the area by Indian Navy who has utilized the building of lift scheme for human use.

2. Problems Identified in Zaingeer Canal System

The assessment of the existing Zaingeer Canal and the whole system helps in concluding the main problems that exist in the canal network. The most serious issues found include as follows:

(a) Illegal encroachment of canals structures
(b) Siltation
(c) Plant growth
(d) Water losses
(e) Frequent overtopping
(f) Low water levels due to canal erosion
(g) Weak canal embankments
(h) Defunct Head Regulator
(i) Defunct Canal Works
(j) Defunct Watlab lift scheme
(k) Absence of silt ejector

Considering these main issues with the whole canal network system, various rehabilitation measures have been proposed over the whole system at the suitable junctions; these are discussed in the following section.

3. Measures for rehabilitation and improvement of Zaingeer canal system

Zaingeer canal system has almost reached a stage of its collapse. Right from head works to the tail end it requires immediate attention and action in respect of various measures for its rehabilitation and improvement.

3.1 Head works improvement

The head works which is so important for a canal system, has almost become defunct and is just acting as a cut in the embankment of the Nallah allowing water into the canal without any proper regulation and restriction to the silt entry. So a need arises to renovate and improve the head works of the canal system. For this purpose it's proposed to design the head regulator afresh at the off take and also renovate the other components of head works like guide banks and river training works for the upstream and downstream of Madhumati Nallah near off take site.

3.1.1 Design of Head Regulator for Zaingeer Canal at Sunnerwani Bandipore

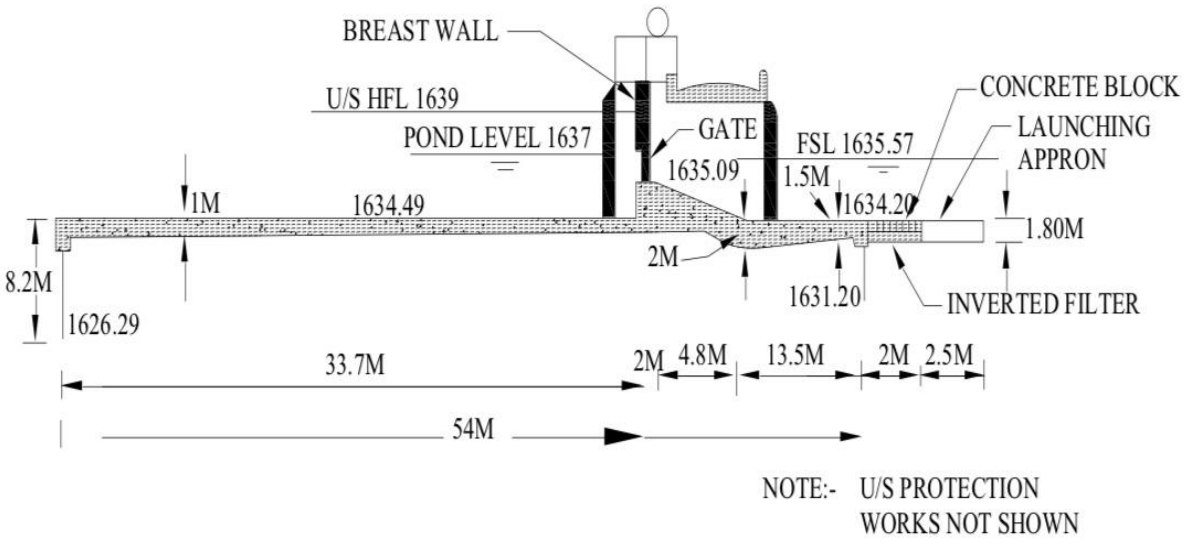

Figure 4.1 Longitudinal Section of Head regulator

3.2 Canal improvements

Canal improvements include mainly the removal of silt and debris from the canal and seepage control.

3.2.1 Eradicating silt from Zaingeer canal

During the visit to the Zaingeer canal, it was noticed that silt as well as debris had been accumulated in the whole canal. The silt and debris accumulated has raised the bed level which needs to be removed by way of deepening the canal up to the originally designed bed level. By ensuring deepening of canal, the designed depth of canal shall be restored for smooth functioning of the canal. By evolving the methods of deepening the canal for removal of silt from the canal, the efficiency of the canal is likely to be improved to a large extent and discharge of the canal shall also get increased considerably resulting in efficiency of discharge. To prevent apprehension of further silt in the canal, silt ejector has been proposed at just d/s of head regulator.

3.2.2 Control of seepage losses in Zaingeer canal

Some reaches where excessive seepage losses have been detected need to be controlled by way of lining of canal viz RD 2050 to RD 2850, RD 3450 to 4250, RD 6167 to RD 9700, RD 10250 to RD 16700, RD 18745 to RD 23385, RD 23625 to Rd 23965, Rd 24550 to RD 26280, RD 27990 to RD 31615, RD 31650 to Rd 31890, RD 32400 to RD 32650. By lining of canal, water logging in adjacent areas shall also be controlled to great extent. The best alternative to make the bottom of the Zaingeer canal at above discussed reaches impermeable is to install a buried geo-membrane. Besides being the most economic type of bottom lining considered impermeable, other lining methods require a careful preparation of the sub-grade -especially compaction- which, considering the conditions probably to be met in the field, will be quite difficult to perform.

The one based on a synthetic geo-membrane seems to be the fastest to implement, which is an important consideration in the light of the limited lapse of time that can be devoted for the performance of the lining works each year. The seepage losses which were detected in the canal where treated by recommendation of lining of the canal which shall control loss of water and shall prevent water logging in the adjacent areas which in turn will also increase the efficiency of the canal.

3.2.3 Strengthening the embankments of canal

It is proposed to raise the canal embankments in earth filling, strengthening these by construction of outer walls, retaining walls and toe walls. The location of weak canal embankments are RD 1700-2000, RD 3050-3450, RD 4500-6100, RD 9700-11000, RD 11080-14480, RD 17050-20030, RD 20670-23280, RD 25480-26395, RD 27500-50775, RD 32700-33761.

3.2.4 Reduction in the growth of weeds in the canal

The channel should be run full for the required period and then the supply should be stopped for some time so that the channel becomes dry. This method helps in controlling the weed growth in two ways:

(a) During full supply, the velocity is high which retards the weed growth. Moreover the depth of water is large, which cuts off the sun rays and prevents the weed growth

(b) During the closure of the channel, the scorching rays of the sun destroy the weed

3.3 Canal works improvements

Canal works improvements include mainly the design of canal syphons, aqueducts, falls, outlets, and construction of catch water drains

3.3.1 Cross Drainage works

To prevent the canal from runoff/natural Nallah's from hilly areas, faulty canal siphons and aqueducts have been redesigned which are presently not functioning properly and catch water drains are to be constructed viz RD 335 to RD 1707, RD 3445 to RD 4176, RD 6400 to RD 88100, RD 15090 to RD 15900, RD 16850 to RD 17300, RD 19817 to RD 21345, RD 23018 to RD 23295, RD 25080 to RD 26830, RD 28090 to RD 29070, RD 29618 to RD 30137. The design of canal siphon at RD-17664 m and aqueduct at RD-4085 m are presented below.

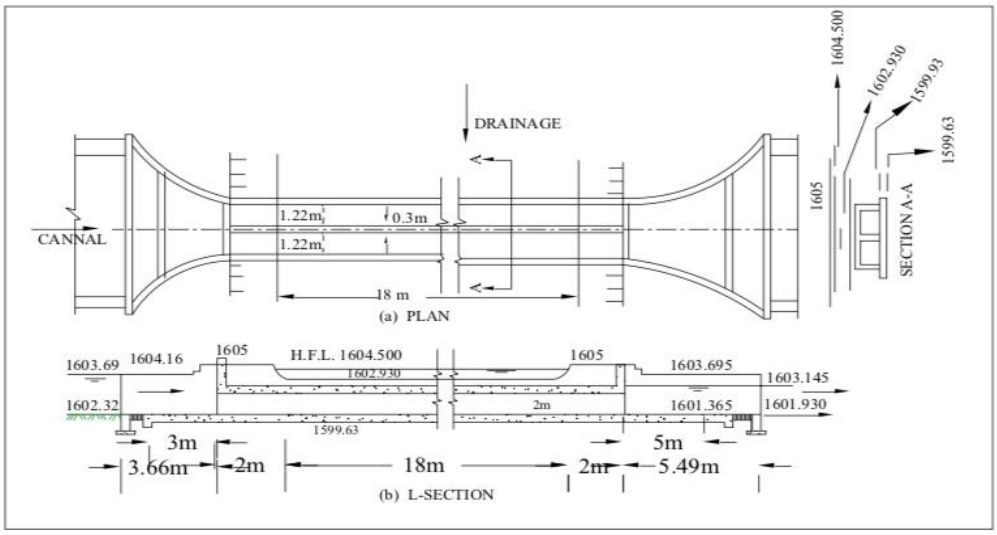

Figure 4.2 Plan and L-section of canal siphon at RD-17664 m

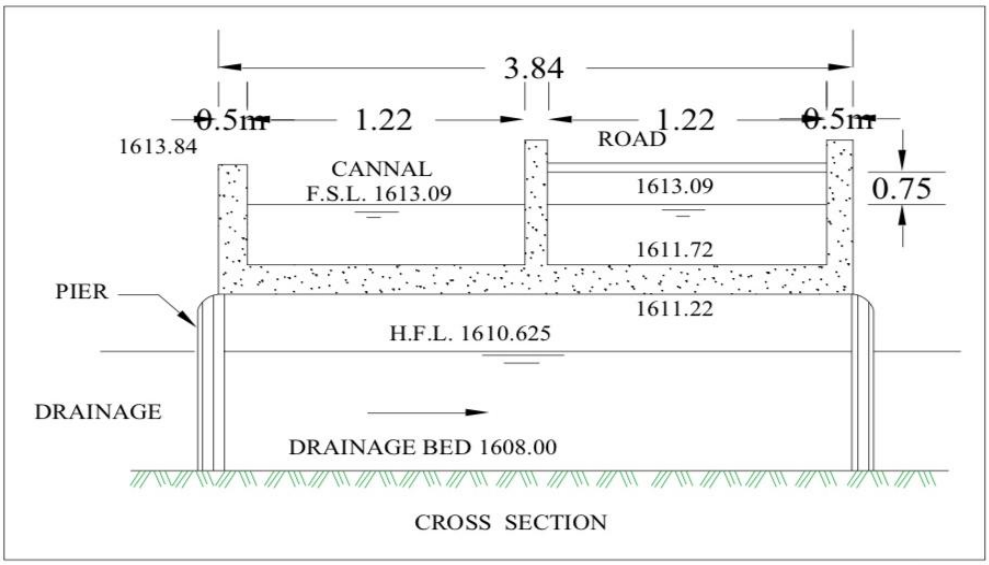

Figure 4.3 Cross section of Aqueduct at RD 4985 m

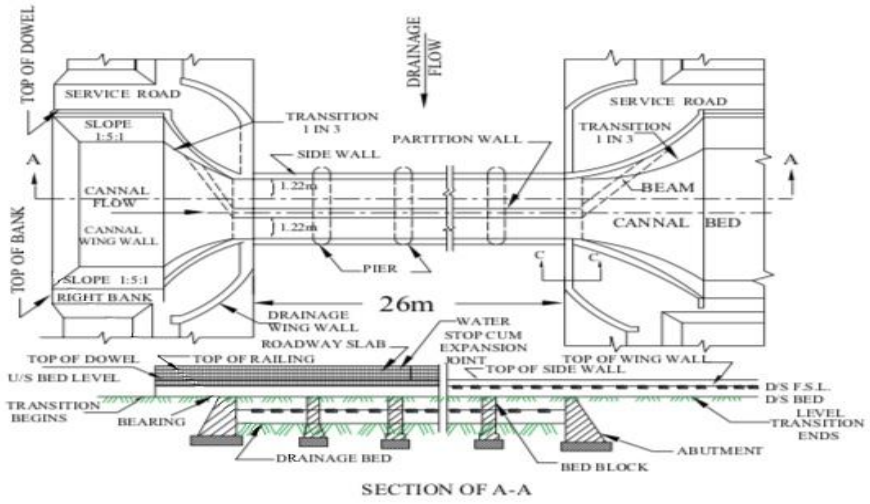

Figure 4.4 Section of Aqueduct

3.3.2 Falls

The location of faulty Falls are RD 400m, RD500m, RD 564m, RD 612m, RD 648m, RD 700m, RD 796m, RD 884m, RD 952m, RD1050m, RD1300m, Rd 1378, Rd 1420m, RD 1492m, RD 1612m, RD 1872m, RD 3900m, Rd 26860m. The design of fall at RD-400m is presented below.

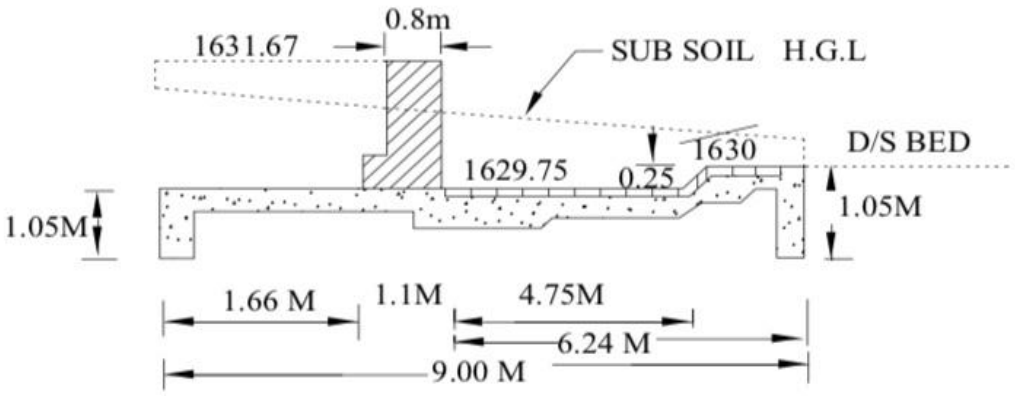

Figure 4.5 Details of the floor

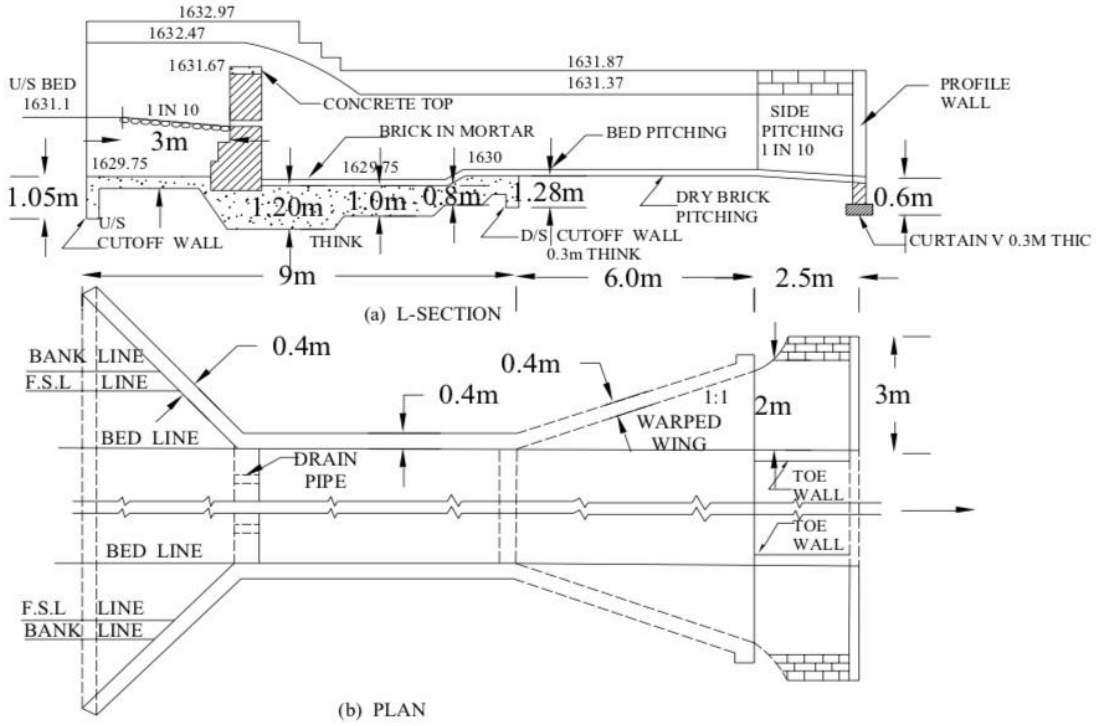

Figure 4.6 L-section and Plan of Sarda Fall

3.3.3 Outlets

All the canal outlets are defunct. The design of outlet at Panzigam Bandipore is presented below.

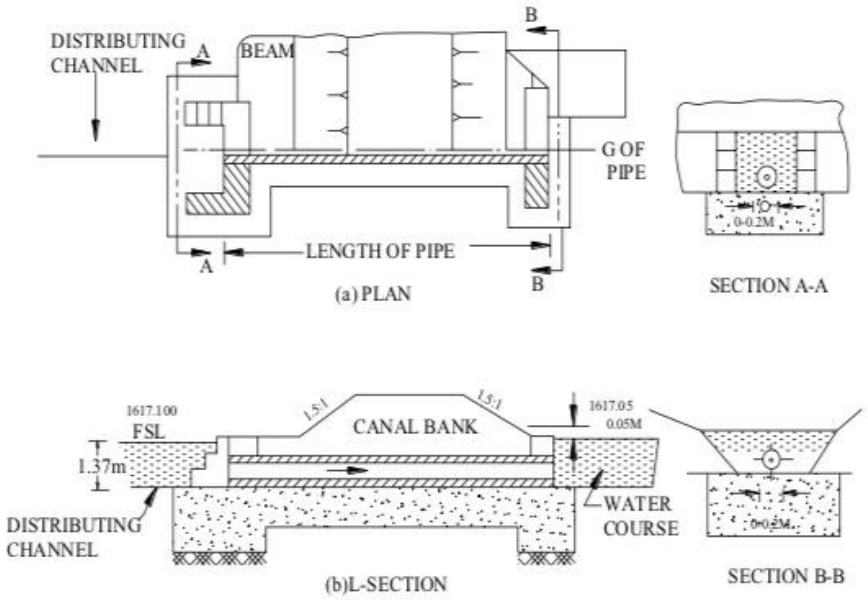

Figure 4.7 Plan and L-section of Outlet

4. Conclusion

The review of Zaingeer canal system has revealed that this is a very old and an important system of irrigation provided to irrigate a very fertile and a vast area in District Baramulla and Bandipore in Kashmir valley. The canal system has reached to its stage of collapse. It is the need of the hour that this system is not only saved /renovated but also improved to cater to the present requirements as well. In the present study certain measures have been suggested which need to be implemented. The study highlights the measures for the rehabilitation/renovation and improvement of the system. Head works improvements of the system include design of head regulator and also renovation of other components of head works is a necessity. Canal improvements which are necessary include eradicating silt from Zaingeer canal, control of seepage losses, strengthening of canal embankments; reduce growth of weeds in the canal. Canal works improvements required include design of faulty canal syphon, aqueduct, fall and outlet. It is very important that after the system is rehabilitated and the improvement works are carried out proper and continuous attention is paid for its maintenance and proper operation.

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