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Hydraulic Design and Estimation of Kundu - Penna Flood Flow Canal

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ABSTRACT:

One of the difficulties with irrigation canals is providing a reliable flow of water. When the canal is directly connected to a water source like a lake or a river, the water supply is fairly reliable, but care must be exercised to avoid using so much water that other areas suffer. When an irrigation canal traverses a great distance or must navigate changes in elevation, other strategies must be employed. It's common, for example, to build a reservoir to store water for irrigation and to fill irrigation canals with systems of dams and locks. Another method is to dig canals alongside water supply sources and build dams or locks separating the two, opening them when water is needed in the irrigation canal and closing them afterward. Present our project kundu-penna is proposed to construct from Rajoi anicut to Proddutur town for supply of drinking water from Kundu River during flood flow. WE need to design and estimate for 400 cusecs water supply so we are going to study about project requirements what are the structures required to supplying water from source to destination without any disturbances,in this project we will survey,design and estimate canal near proddutur town

1. INTRODUCTION

WHAT IS IRRIGATION?

Irrigation is the artificial application of water for the cultivation of crops, trees, grasses and so on. For a typical Indian farmer, looking up to the skies to see whether the rain gods will favour him this time, irrigation means a wide range of interventions at the farm level, ranging from a couple of support watering(s) (or 'life saving' watering) during the kharif (monsoon) season from a small check dam/pond/ tank/dry well to assured year-round water supply from canals or tube wells to farmers cultivating three crops a year. The method of application has also evolved, from traditional gravity flow and farm flooding to micro-irrigation where water is applied close to the root zone of the plant. Indian farmers gain access to irrigation from two sources—surface water (that is, water from surface flows or water storage reservoirs) and groundwater (that is, water extracted by pumps from the groundwater aquifers through wells, tube wells and so on). Surface irrigation is largely provided through large and small dams and canal networks, run-off from river lift irrigation schemes and small tanks and ponds. Canal networks are largely gravity-fed while lift irrigation schemes require electrical power. Groundwater irrigation is accessed by dug wells, bore wells,tube wells and is powered by electric pumps or diesel engines. To meet the growing needs of irrigation, the government and farmers have largely focused on a supply side approach rather than improve the efficiency of existing irrigation systems.

1.1 IRRIGATION SECTOR TERMINOLOGY:

The terms used by the Ministry of Water Resources (MoWR), Ministry of Rural Development (MoRD), and the Ministry of Agriculture (MoA), the three ministries within the government responsible for irrigation are as follows:

1. Major irrigation (cultivable command area above 10,000 ha).
2. Medium irrigation (cultivable command area between 2000 ha to 10,000 ha).
3. Minor irrigation (cultivable command area less than (2000 ha)

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1.2 SIGNIFICANCE OF CANAL:

The efficient and economical use of water in irrigation is a major concern. While 40 percent of all food produced worldwide comes from irrigated land, the irrigation itself consumes 80 percent of the freshwater supply, representing a very inefficient use of the water. In some cases, an excessive amount of water is simply absorbed into the ground; in others, it runs off the land to be irrigated. Modern irrigation canals are built and managed according to ever more sophisticated models of water management and conservation. Present our project kundu-penna is proposed to construct from Rajoi anicut to Proddutur town for supply of drinking water from Kundu River during flood flow. WE need to design and estimate for 400 cusecs water supply so we are going to study about project requirements what are the structures required to supplying water from source to destination without any disturbances,in this project we will survey,design and estimate alternate canal for 5 kilometers near proddutur town.

1.3 NEED OF PROJECTS:

Irrigation means artificial storage and discharge of water to agricultural fields. Generally the water is carries to agricultural fields through canals either from the river or from a tank or reservoir.

Less Rainfall:

When the total rainfall in a particular area is less than needed for the crop, artificial supply is necessary.

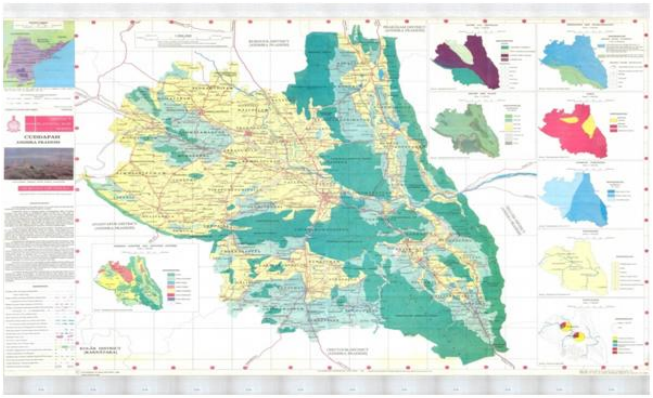
Non-Uniform Rainfall:

When the rainfall in a particular area may not be uniform over the crop period, artificial supply is necessary.

Seasonal Variance:

In rainy season (i.e. kharif) the water is supplied to plants through rains. But in rabi season we don‘t have rains. In this situation, artificial supply is necessary. In order to get the maximum yield, it is essential to supply the optimum quantity of water, and to maintain correct timing of water.

This is possible only through a systematic irrigation system by collecting water during the periods of excess rainfall and releasing it to the crop as and when it is needed.



KADAPA DISTRICT IRRIGATION MAP

1.3.1 General Information:

The District is situated with in the Geographical Co-ordination of 13o43’ and 15o14’ of Northern latitude and 77o55’ and 79o29’ of the Earthen longitude. The entire District lies in Pennar river Basin with 118.89 Lakhs Acres of Area covered. The Major amount of rain falls due to South-West Monsoon. The District is classified as drought Prone area due to Scanty and erratic rain fall. The normal rainfall is 700 mm. The Statistical data of the district Kadapa is as follows.

RAINFALL:

Normal annual rainfall: 696.2 mm
South west monsoon: 388.7 mm
North east monsoon: 231.3 mm
Cumulative departure from normal
Rainfall (for the last five years) : - 27%

1.4 DETAILS OF KUNDU PENNA PROJECT:

DETAILS OF PROJECT:

Formation of Rajoli reservoir in view of the time required to complete the Rajoli reservoir and severe Drinking water problem in Proddatur & Yerraguntla Municipalities and surrounding 17 villages. it was also informed to propose concrete trough in the reach between km 30.000 to km 33 km so as to minimize the

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LA, as the said area is surrounding to Proddatur Municipality and urbanized.In this project we are changing the alignment because of the the land aquision near the proddutur town.

- The work of "Investigation, design and construction of canal from chainage 30km to 35 km (Penna river) near Proddatur (M) including construction of CM & CD works and in Penna river to supply drinking water to Proddatur town and water problem in Yerraguntla Municipalities and surrounding 17 villages
- " with the intension of solving drinking water problem to Proddatur Municipality and its surrounding mandals covering population of 4,50,000 in addition to benefit nearly 20,000 Acres of indirect ayacut.

SCOPE OF WORK:

- In this project we are going to study about the construction of canal project from RAJOLI village to PRODDUTUR ,considering from land acquisition, surveying construction and estimation, design of canal structures for proposed 35 km length of canal, study and investigate about hydraulic particulars, CD works.
- Construction of pick-up anicut across Kundu river(200m width) near Nagarajupalli (v) and Head regulator.
- Excavation of flood flow canal to a length of 33 km with a carrying capacity of 400 cusecs
- Due to land acquisition problem and legal complication in land acquisition of about 9 no's of various cases are since pending finalization in reach from km 27.400 to km 33.907. So aignments needs to be modified below above said Railway line of Yerraguntla to Nandyal.
- Considering their representation the official of this department have inspected the site of the proposed new alignment of the canal several times and the following report is submitted:
- The modified canal joins at km 32.200 already excavated diversion of flood protection arrangement by diverting Madur chanal at Kothapet village which posses below railway station at Proddatur and ends at Pennar River for a length of about km 2.000. This proposals avoids complications of the land acquisition problems from km is 32.200 to km 34.200. Where land acquisition already acquired and railway bridge proposal can also be avoided.
- The proposals below Railway Bridge and around Proddatur town where costly filter points about 800 meters. The new subsurface dam costs about 2.8 lacks is required below proposed alternate alignment. Hence I request that the above proposals may please be examined in detail by higher authorities and necessary instructions be issued at the earliest.

HYDRAULIC PARTICULARS OF EXISTING RAJOLI ANICUT:

- Length of the existing anicut : 294m
- Crest level of the existing anicut : + 158.590
- Total Ayacut stabilization through the anicut : 81,260 Ac.
- Through KC canal : 49,900 Ac.
- Through Chapadu channel : 18,452 Ac.
- Below Adinimmayapalli anicut : 12,908 Ac.

DETAILS OF OLD ALIGNMENT:

The following provisions are made in the present proposal: Strengthening of Rajoli anicut for the last duly raising 30 cm by means of RCC skirting with M25.Construction of Head regulator on right flank of Kundu river on u/s of Rajoli anicut with guide bund to length of 50m from anicut. Link channel of length 1.8 Km with open excavation from Rajoli anicut to km 11.750 of approved alignment with a carrying capacity of 400 cusecs. Excavation of open channel from km 11.750 to km 30.000 with revised hydraulic

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particulars.Canal with Double counter forte retaining walls from km 30.000 to km 33 with necessary CM & CD works from Rajoli anicut to Penna river.

The Hydraulic particulars of the present proposal are as follows:

- Proposed crest level of Rajoli anicut : +158.890
- Driving head proposed : 0.15m
- Canal FSD arrived : 1.25m
- Canal bed width (with 1½:1 slopes) : 13.50m
- Bed fall : 1 in 7500
- Value of "n" : 0.02
- Sill level of Head regulator arrived : (158.890-0.15-1.25) = + 157.490
- which is 1.59 m higher than the sill of K.C. Canal.

Floods:

Kundu Valley's villages and the town of Nandyal are affected by frequent floods, incurring heavy losses to properties and farmlands. The farmers in this belt are not guaranteed crops until the harvest, as no one can predict the precise arrival of floods. From July to December there are several instances of flooding on this river. In 1994 floods incurred around Rs.60 crores of loss. On August 20, 2000, around midnight, the people of Nandyal were inundated with flood water. Almost everyone in the town experienced some loss of property, and 10 people died. In the much-publicised Kurnool floods of 2009, Nandyal was cut off from civilisation for 5 days as the flooded Kundu encircled the entire town.

PENNA

Name of River	Penner River
Location	India (Karnataka, Andhra Pradesh)
Origin	Nandi Hills in Chikballapur District of Karnataka
Length	597 km (371 mi)
Depth	46.30 km

River of Rayalaseema. The Penna is a river in the Andhra Pradesh of India. Its source is in Nandi Hills in the State of Karnataka. It has a few tributaries. But its main tributaries are Papaghni, Chitravathi, Kumadwati (also known as Kundu) and Cheyyeru. Its other tributaries are Boggeru, Beeraperu. It enters the State of Andhra Pradesh in Madakasara Mandal of Anantapur District. It flows through the districts of Anantapur, Kadapa and Nellore. It joins the sea near Vutukuru, Nellore District.

Nearby cities:

Kadapa (Cuddapah), Nandaluru, Rayachoti

Coordinates: 14°29'52"N 78°53'54"E

3. METHODOLOGY:

3.1 MAP STUDY:

If the topographic map of the area is available, it is possible to suggest the likely routes of the canal. In India topographic maps are available from the survey of India, with 15 or 30 meter contour intervals. The main features like rivers, hills valleys etc. are also shown in these maps. By careful study of such maps, it is possible to have an idea of several possible alternate routes so that further details of these may be studied later at the site. The probable alignment can be located on the map from the following details available on the map.

a) Alignment avoiding valleys, ponds or lakes
b) When the road has to cross a row of hills, possibility of crossing through a mountain pass
c) Approximate location of bridge site for crossing rivers, avoiding bend of the river, if any,

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Thus from the map study alternate routes can be suggested. It may also be possible from map study to drop a certain routes in view of any unavoidable obstruction or undesirable ground, enroute. Map study thus gives a rough guidance of the routes to be further surveyed in the field.

PRELIMINARY SURVEY:

The main objectives of the preliminary survey are:

a) To survey the various alternate alignments proposed after the reconnaissance and to collect all the necessary physical information and details of topography, drainage and soil.
b) To compare the different proposals in view of the requirements of a good alignment.
c) To estimate quantity of earth work materials and other construction aspects and to work out the cost of alternate proposals.
d) To finalize the best alignment from all considerations.

3.2 DIGITAL PLANIMETER:

To measure the area of the plan in the drawing sheet. Level and paste the object on a drawing board placed nearly horizontal. Set the instrument with its roller with and tracer arm placed at right angles to each other and placed the tracer arm on the approximate centre line of area of the object. Push the on/c key.

3.3 CANAL ALIGNMENT:

A canal has to be aligned in such a way that it covers the entire area proposed to be irrigated, with shortest possible length and at the same time its cost including the cost of cross drainage works is a minimum. A shorter length of canal ensures less loss of head due to friction and smaller loss of discharge due to seepage and evaporation, so that additional area can be brought under cultivation.

According to alignment, the canals may be of the following types

1. Ridge canal
2. Contour canal
3. Side slope canal

4. GENERAL CONSIDERATIONS FOR ALIGNMENT:

1.The alignment of the canal should be such as to ensure

- The most economical way of distributing the water to the land.
- As high a command as possible.
- Minimum number of cross drainage works.

2. The alignment of canal on a watershed, being the most economical, is preferred.
3. The length of the main canal from the point where it takes off from a river to a point where it mounts on a watershed should be minimum.
4. The contour alignment should be changed this way or that way in order to reduce the number of cross-drainage works to a minimum.
5. The alignment should avoid villages, roads, cart tracks, cremation places, places of worship and other valuable properties.
6. The alignment should pass through the balanced depth of cutting. If not, it should involve minimum depth of cutting or minimum height of filling.
7. The number of kinks and acute curves should be minimum.

4.1 CANAL DESIGN

General design

A typical canal section is shown below:

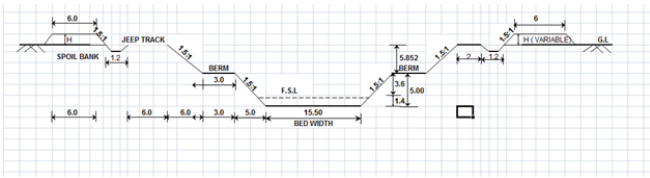

FIG:(3)

Where

b=bed width of canal
d=full supply depth
f. b=free board
z=side slopes

TW1&TW2=top width of banks Discharge of the canal=area of water prism (A)*velocity of flow.

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DISCHARGE OF THE CANAL (Q):

The discharge of the canal at any section includes discharge required for the ayacut below that point for the given duty and losses.

DUTY:

1429 ha/cumec at the farm gate
1144 ha/cumec at the pipe head
1029 ha/cumec at the distributary head

LOSSES:

For the distributory system known below the point where the section is to be calculated the following losses are to be considered.
1)3.048 cumecs/million sq.ms of wetted area of unlined canal.
2)1.828 cumecs/million sq.ms of wetted area of lined canal.

Freeboard:

The free board to be provided over the full supply depth depends upon the discharge as given below:

1. For 0.0283 cumecs …..to 0.710 cumecs the free board is 0.45m.
2. Above 0.711cumecs…to 4.5cumecs the free board is 0.60m.
3. Above 4.5cumecs ….to free board is 0.90m.
   The above free boards are also applicable to lined canals.

Top width of banks:

The following table gives the top width of banks to be provided in both the cases (lined and unlined). The larger width of the bank shall be on ayacut side and the smaller is on other side.

DISCHARGE	WIDTH-TW1/TW2 FOR MAIN CANALS
Over 28.31	4.60m/3.60m
8.5 cumecs to 28.31 cumecs	4.60m/1.80m
2.83cumecs to 8.5m cumecs	3.60m/1.80m
1.416cumecs to 2.83 cumecs	2.7m/1.80m
0.283 cumecs to 1.416 cumecs	1.8m/1.20m
0.283 cumecs and below	0.90m/0.90m

Width of land acquisition clear banks:

I) when the canal depth is more than balance depth of cutting-
Half the depth of the bank subject to a minimum of 1.5m. total width is rounded to nearest multiplies of 3.3 meters.
II) When the canal depth is less than the balance depth of cutting-
Full height of banks +1.5 m or total width rounded to nearest multiple of 3.3 meters.

4.2 DATA REQUIRED FOR CD WORKS:

Before taking up any detailed design for the cross drainage work the required field data is to be collected.

1. An index map to a suitable scale showing the location of the proposed structure, the alternative sites investigated the roads, cart tracks, general topography of the area etc. is to be prepared.
2. A catchment area map of 1:10000 scale with contours at 0.5 m intervals marked therein showing the drain in question from its source together with its distributories is to be prepared.
3. A detailed survey plan of the stream showing important topographical features extending considerable distances downstream and upstream of the proposed site of crossing.
4. A site plan showing the details of site selected extending 300 m on either side of the centre line of the proposed crossing and covering its approaches to sufficient distances of 300 m on upstream and downstream also as to demarcate levels, details of topographical features etc. is to be prepared.

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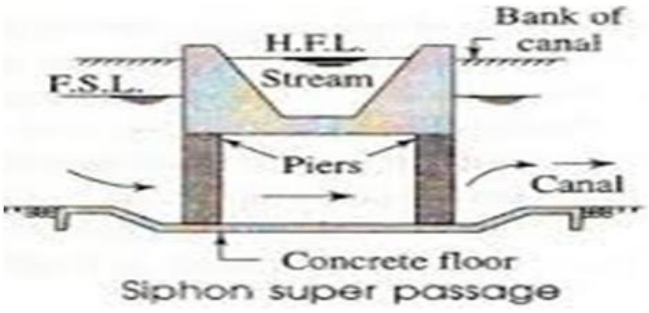
4.3 CROSS DRAINAGE WORKS

AQUEDUCT:

Where the H. F.L. of the stream at the crossing is below the C.B.L with the clear head way an Aqueduct is proposed. In this case the canal is flumed in rectangular shape **RCC** trough with one or more bays. Further it is to be mentioned that the buttress type U.T.



Siphon super passage

4.4 Cross-Section of an irrigation Canal:

A canal is generally taken in such a way that its section is partly in cutting and partly in filling in order to approach close to the balancing depth. Many times, however, the canal has to be carried through deep cutting or filling. A canal section may be either:

1. In cutting
2. In filling
3. In partial cutting and filling

The canal section in these three conditions are shown in the following figures. When the ground level is above the top of the bank, the canal is said to be in cutting. Similarly, when the ground level is below the bed level of canal, it is said to be in filling. A canal is in partial cutting or filling when the ground level is in between bed level and top of bank. A canal can have a dowel section on one side or a bank section on both sides. The section may also be designed to have a bank on one side and dowel section on the other side. Usually the left bank of canal has a dowel section and service road and right bank of the canal has a bank section

Side Slopes:

For the computation of the values of hydraulic mean depth R, the area and wetted perimeter are worked out with ½:1 side slopes for design purpose even through in execution actually flatted slopes depending upon stability and type of soils are adopted. ½:1 side slope is assumed with the presumption that the sides of the channel get silted up to ½:1 slope and channel capacities would be reduced accordingly in due course. However, in case a canal takes off from such storage reservoirs where silt free water is available, the actual slope to be provided during construction is assumed for design purposes. The side slopes depend upon the nature of the soil and the depth of cutting or filling. The minimum slope usually allowed is given in the below table.

Side Slopes of Canal:

S.No.	Type of soil	Cuttings	Fillings
1	Hard Rock	1/8:1 to ¼:1	
2	Soft Rock	¼:1 to ½:1	
3	Hard clay or gravel	¾:1 to 1:1	1½:1
4	Soft clay & alluvial soils	1:1	1½:1 to 2:1
5	Sandy soils	1½:1	2:1
6	Light sand	2:1	2:1 to 3:1

SPOIL BANK:

When the quantity of excavated earth is much in excess of the quantity required for filling it has to be deposited in the form of spoil banks. If the quantity of the extra earth available is small, it is used to widen the service road, but the service road can also be widened to a certain limit beyond which its maintenance may be difficult. The height of the spoil bank is not kept large, but on costly land the height of spoil bank is increased to involve minimum width of land. A longitudinal drain is always made between the spoil bank and service road. Cross drains should also be provided at about 100 m interval and the spoil banks should be discontinuous at these points.

Free Board:

Free board is the gap or the margin of height between F.S.L. and top of the bank. It is possible to ensure that water does not overtop the bank.

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Free board in a canal is governed by the consideration of size of canal, its location, water surface fluctuations, rain water inflow etc.

Inspection Path (Roadway):

It is very necessary to have access to all parts of canal system so that proper inspection may be done. It will also increase the efficiency of the maintenance. Main canals and branch canals have roadway on both sides. In case the road can be provided only on one side, it is customary to provide it on left bank of canal. The banks of the canal are classified as left and right by facing the canal along the direction of flow. Usually the road on right serves the purpose of transport of the material. On smaller branches and distributaries the roadway is provided on left side only and it is meant for inspection. Road is not provided along minors. The canal road is usually unmetalled since they are used for limited purpose only. Since the canal divides the area in two parts, sometimes a cart road is provided on both sides. The cart road may be kept 3.0 to 5.0 m wide.

4. RESULTS AND DISCUSSIONS:

4.1 LAND ACQUISITION:

We can estimate the cost of land required for canal construction .We can calculate by knowing the length and width of canal.we can also calculate how much land is required and how much is patta land and how much is government land.. we can come to amount required for land acquition cost by knowing the cost of land At that place from register office .and we will calculate total required for this project

Total land required for the canal:=799 acres

4.2 TOTAL COST OF PROJECT:

We can estimate total project cost by calculating cost required for canal ,canal,,land acquition.180 crores

5 CONCLUSIONS:

We are going to construct this flood flow canal from Rajoli anicut to penna river near proddutur. We had done project for land acquition in different survey numbers where land is required for alignment and required for structures.

We also estimated for earthwork and different structures necessary for construction of canal

We design this canal to supply water of 400 cusec for proddutur city .In that we propose the required canal structures where they necessary. We are going to submit this project to irrigation department for further any necessary data for construction of this canal

6. REFERENCES:

1. IS: 5968-1987 “Guidelines for planning and layout of canal system for irrigation” (Reaffirmed 1992).
2. IS: 7784 “Code of practice for design of cross drainage works.
3. Irrigation and water resources & water power by P.N.Modi
4. Engineering Hydrology by K.Subramanya
5. Design of minor irrigation and canal structures by C.Sathyanarayana Murthy
6. Wang Zhi, Reddy J. M, Feyen J, “Improved 0-1 programming model for optimal flow scheduling in irrigation canals.” Irrigation Drainage Systems 9, 1995,
7. Wardlaw R. B, and Bhaktikul K, “Comparison of a genetic algorithm and Linear Programming Approach for Lateral Canal Scheduling.” Journal of Irrigation and Drainage Engineering ASCE Vol. 130(4), 2004, pp. 311–317. |
8. Anonymous, (1989). Planning for Prosority-Sardar Sarovar Development plan, Narmada Planning Group,SSNL, Gandhinagar.
9. Allen, R.G., Jensen, M.E., Wright, J.L., and Burman, R.D., (1989). Operational estimates of evapotranspiration. Agron. J., 81:650-662.