Economics of Canal Lining for Trapezoidal Section

Komal B. Gujarati[1] Dr. R. B. Khasiya[2] Dr. J. N. Patel[3] Prof. B. J. Batliwala[4]
[1]M. E.(4th Sem. Water Resource Management) [2, 4]Associate Professor [3]Professor
[1, 2, 3, 4]Civil Engineering Department
[1]Dr. S & S. S Ghandhy, GEC Surat, Gujarat, India [2]GEC Surat, Gujarat, India
[3, 4]SVNIT, Surat, Gujarat, India

Abstract--- In today's world, water scarcity is a prime issue as the whole world is facing the problem for availability of water canal lining is one of the method to improve the efficiency of canal. By canal lining we can control the wastage of water. In this report, I have tried to explain the advantages and disadvantages of the various canal lining system.The factors affecting the decision for selection of the canal lining material is also discussed in this report. The Kakrapar Right Bank Main Canal (K.R.B.M.C) is choosen as the study area.The main objective is to find out the most economical method of canal lining based on the cost criteria in relation to the wastages etc.

Keywords: Canal lining, K.R.B.M.C, Cement Concrete, Brick etc.

I. INTRODUCTION

Lining of irrigation canal offers one of the best opportunities to extend available water for maximum command area. Lining is not only effective in controlling seepage losses, but it provides insurance against breaks, reduce maintenance costs ,and constitutes a good weed control measure. The lining material shall be so selected that it should meet most of the requirements for the specific site. Many materials have been successfully used for lining.

On Ukai-kakrapar projects comes under Surat canal division. Kakrapar Right Bank Main Canal is one of the important irrigation canal in Gujarat. Ukai- Kakarapar project was constructed in two stages on River Tapi. In first Stage Kakarapar weir was constructed between 1949-1954 at Village Kakarapar; Vyara Taluka of Surat District, about 85 Km upstream of Tapi's confluence with the Arabian Sea. In the final developing stage, the canal discharge is 2480 cusec In the second stage, Ukai Dam was constructed in 1975 on River Tapi near village Ukai in Songadh Taluka of Surat District, about 110 km upstream of Tapi's confluence with Arabian Sea. The dam was planned to impound 6614 MCM as water of live storage and thereby confirming up of existing area of 204080 Ha area and brought additional 127477 Ha area under irrigation served through Ukai Right Bank Canal and Ukai Left Bank Canal. Thus total command area of Ukai – Kakarapar project is 331557 Ha spread over in 5 Districts taking into consideration additional Area brought under command due to Ukai scheme through two canals i.e. U.R.B.M.C with 61,309 Ha and U.L.B.M.C with 66,168 Ha..

II. STUDY AREA

A part of kakrapar Right Bank Main Canal in 0 to 200RD is selected for study purpose. Fig (1) shows the Index map of Command area under Ukai & Kakrapar and Table (1) shows the dimensions and characteristics of different sections. The study area, K.R.B.M.C. is totally rural area in south zone of Gujarat, At present cropping pattern has to be changed so more water required for irrigation purpose but due to unlined canal wastage through seepage is more than for present and future demand of water for irrigation purpose. The total length of canal is 60KM.

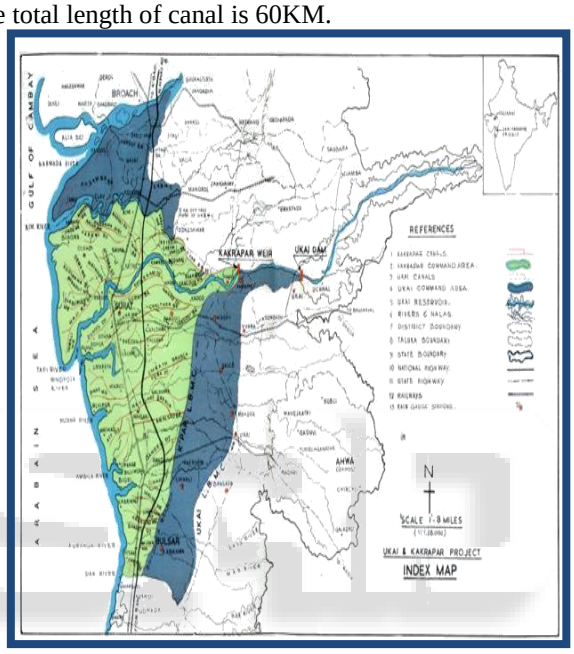

Fig. 1: Index map of Command area under Ukai & Kakrapar

From KM	TO KM	L(KM)	Q(m3/sec)	B(m)	H.G=i	D(m)	P(m)	A(m2)	V(m/s)
0	16357	16.357	61.397	27.44	0.0001	2.9	37.896	92.191	1.087
16357	25201	25.201	63.509	22.56	0.000167	2.84	32.8	76.169	1.073
25201	28040	28.04	61.733	24.09	0.000152	2.77	34.077	78.239	1.056
28040	42988	42.988	60.676	23.78	0.00015	2.77	33.767	77.38	1.056
42988	46795	46.795	60.253	22.56	0.00015	2.84	32.8	76.169	1.073
46795	52280	52.28	54.911	21.1	0.0003	2.28	29.321	55.906	0.932
52280	56093	56.093	53.262	19.5	0.0003	2.34	27.937	53.843	0.942
56093	57813	57.813	54.046	16.3	0.00025	2.74	26.179	55.923	1.048
57813	59293	59.293	52.227	15.7	0.00025	2.74	25.579	54.279	1.048
59293	60980	60.98	51.6	17.5	0.0002	2.74	27.379	59.211	1.048

Table. 1:

I. BACKGROUND AND METHODOLOGY

A. Define canal lining :

Impervious layer is provided to bed of the canal and side slope of the canal it's called canal lining. Should a canal be lined? This question is often asked by farmers or those engaged in the operation of irrigation schemes.

Before the decision is made to line a canal, the costs and benefits of lining have to be compared. By lining

the canal, the velocity of the flow can increase because of the smooth canal surface

For example, with the same canal bed slope and with the same canal size, the flow velocity in a lined canal can be 1.5 to 2 times that in an unlined canal, which means that the canal cross section in the lined canal can be smaller to deliver the same discharge.

Possible benefits of lining a canal include:

1) Water conservation;
2) No seepage of water into adjacent land or roads;
3) Reduced canal dimensions; and
4) Reduced maintenance.

B. Objective of research

As observed in the crop pattern for last ten years, it is clear that the increased crop of sugarcane has led the demand of the irrigation waters. Especially in the summer season, with available water resources and limited carrying capacity of the existing canal system, it becomes difficult situation to cater the needs at field as per demands received. Further, with unlined section of the canals, desired volume of water at designed velocity does not reach hence there has always been a roar from the cultivators of the tail end area demanding water for irrigation.

C. Need of the canal lining

1) During course of irrigation, farmers switched over to cash crops viz Sugarcane, Hot Paddy etc.
2) Sugarcane jumped to 35 % against 8% as designed. Hot Paddy which was not included in designed cropping pattern was introduced by 7.2 %
3) Deviation from designed cropping pattern resulted in higher discharge requirements for which canals were not designed
4) Higher discharge requirements compelled operation of main canals almost uninterruptedly to fulfill irrigation demands leaving meager time for routine maintenance. Lack of routine maintenance has resulted in deterioration of canal section and structures.
5) In order to fulfill the higher demands and sufficient time for routine maintenance, it is planned to increase canal discharge of K R B M C from 2480 cusecs to 3000 cusecs.

D. Optimal Section shape

Vertical side walls require large thickness to resist the earth pressure. Trapezoidal section is better for such cases since sloping side walls require less thickness.

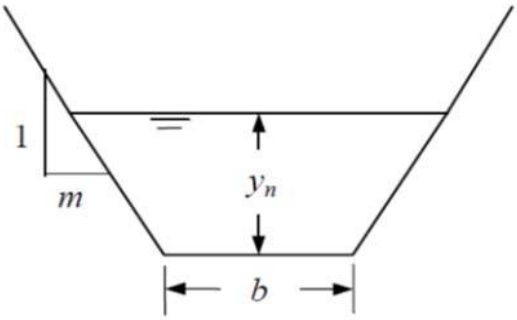

Fig. 1:

Section Shape	Flow Perimeter P	Area of Flow A
Trapezoidal	$b + 2y_n\sqrt{1+m^2}$	$(b + my_n)y_n$

Table. 2: Geometrical Properties of Canal Section

Chainage	Length	Area	Perimeter	Discharge	Area of lining
0 to 16357	16357	92.191	41.1411	92.095	672944.89
16357 to 25201	8844	76.169	36.0448	95.264	318779.87
25201 to 28040.	2839	78.239	37.3224	92.599	105958022
28040 to 42988	14948	77.38	37.0124	91.014	553260.95
42988 to 46795	3807	76.169	36.0448	90.386	137222.41
46795 to 52280	5485	55.906	32.5657	82.367	178622.61
52280 to 56093	3813	53.843	31.182	79.893	118896.91
56093 to 57813	1720	55.923	29.4242	81.068	50609.64
57813 to 59293	1480	54.279	28.8242	78.34	42659.83
59293 to 60980	1687	59.211	30.6242	77.399	51663.04
Total	60980			TOTAL	2230618.36

Table. 3: Details of calculation showing he total area of lining

E. Benefit Cost Ratio of PCC and BRICK Canal Lining

1) PCC Canal Lining

Preliminary survey and investigation of canals has been carried out. It is proposed to line the main canals with concrete lining in M : 15 grade between Ch 0 to 60980 M on Kakarapar Right Bank Main Canal.

As per the calculation, for PCC the possible Cost is Rs. 2470.435 lacs for the project.

As per the calculation, for PCC the possible benefit is Rs. 5916.86 lacs for the project.

Thus Benefit cost ratio carried out 2.39

2) Brick Canal Lining

Preliminary survey and investigation of canals has been carried out. It is proposed to line the main canals with Brick lining in 1:6 mortar between Ch 0 to 60980 M on Kakarapar Right Bank Main Canal.

As per the calculation, for PCC the possible Cost is Rs. 2388.385 lacs for the project.

It is to be noted that in real life problem the brick lining canal is having approximately 6% extra water loss compare to that of PCC lining.

Hence, the benefit for brick lining canal can be considered as Rs. 5561.85 lacs.

Thus Benefit cost ratio carried out 2.32

III. CONCLUSIONS

1) The rugosity co efficient is improved and velocity can be increased. This will increase the discharge carrying capacity of the existing canals.
2) Reduction in seepages due to lining would save precious water which can be used to cover additional area.
3) 2000 Ha of tail end area would get timely and sufficient water
4) By providing lining, not only seepage can be reduced, but it will also minimize the problem of water logging. Whatever quantity of water saved can be used for improvement of crop pattern.
5) The lining is provided to increase discharge carrying capacity of the canal and it also reduces the seepage loss. Fertile land, good rainfall, large storage at Ukai, good marketing facilities, rapid development of agro-industries, and progressive nature of farming community

in the command area have provided the necessary climate for accelerating the pace of agriculture development still further.

6) Inadequate conveyance capacities of canal cannot meet future irrigation demand due to increased irrigation intensity and increasing in coverage of cash crops such as sugarcane and other perennial crops. Also inadequate drainage provisions and their consequent effects on cropping pattern. These along with fewer control structures and constraints in ensuring efficient water management have imposed severe limitations in the planned development of the area. These can be taken care of with regarded as tangible benefits.
7) Increase in income from crop production would help farmers in making higher investment in crop production and subsidiary farm activities which would have a multiplier effects. It may be added that the Project will help in making a large numbers of small marginal holdings economically viable than overall development of rural area and also upgrade standard of living of rural area. These can be regarded as intangible benefits.

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