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Case Study Of "Neera Devdhar" Canal Seepage Losses and Canal Lining

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Abstract: ***In india canal irrigation is a major source of artificial irrigation. Many canals are unlined and due to that major seepage is found in unlined canal.50 to 60 % seepage is found in unlined canal. Concrete, shortcrete, stones are the general materials used for lining of canal. Concrete can reduce seepage losses upto 70 % as well as shortcrete is efficiently reduce losses upto 90 %.these materials also required a maintenance due to expansion and contraction cracks. Hdpe sheets is the best solution to reduce the seepage losses from concrete lining cracks. Indian government also provides a subsidy for using this sheets as a lining material. Concrete and shortcrete can be used as covering and protection material to hdpe from external agencies like damage from stone and crawling animals. Kolhapur's dudhganga canal is best example of (hdpe + concrete) lining canal. We can save 100 % water by using this materials combination and more area will be comes under irrigation.***

We can also provide a sensor system on canal to find out canal discharge and water level in canal at different sections in canal. Radar, bubbler are the best sensor system to find out the discharge at different sections of canal. So we can easily locate seepage at any section.

With the help of hdpe sheets and sensor system we can reduce the seepage losses in canal upto 100% and achieves more benefits by reducing water losses and more cultivation of crops

I. INTRODUCTION

Effective management of water in an irrigation system requires knowledge of the quantity of water flowing in the canal in order to send the right quantity of water to every user at the right time, avoid unnecessary losses, and avoid physical and environmental damages. Seepage and evaporation are the most serious forms of water loss in an irrigation canal network. Seepage loss depends on the channel geometry, while evaporation loss is proportional to the area of free surface Excessive seepage losses can cause water logging and soil salinity necessitating the installation of elaborate and costly drainage systems. Furthermore the cultivable area is reduced, resulting in a loss of potential crop production. . canal seepage loss is unavoidable unless the canal is lined. An irrigation canal is said to be lined when the bed and the sides of the canal cross- section are protected with impervious or fairly impervious material of sufficient strength.

Thus main aim of lining the irrigation canals with impermeable material is to stop seepage, thereby saving valuable irrigation water. When canal is lined considerable additional area can be commanded with the help of the saving resulted from lining the canals

II. OBJECTIVES OF PROJECT

A. The purpose of this Project is to present the main considerations regarding the issue of whether to line or not, the following irrigation canals
B. To estimate seepage losses canals followed by a description of the most commonly used lining methods.
C. To estimate the expected cost of implementing the recommended types of lining according to some alternative schemes,
D. To evaluate the benefits produced by the lining and calculate the corresponding benefit/cost ratio.
E. To study the principal reasons for considering the lining

III. LITERATURE REVIEW

Magdy H. Mowafyevaluated seepage losses at different critical sections of Ismailia Canal which transports fresh water from River Nile at north of Cairo to Ismailia, Port Said and Suez cities with discharge of 433.56m^3/sec using different empirical, analytical and field measured results

Z. Iqbal, R.T. MacLean, B.D. Taylor, F.J. Hecker and D.R. Bennett studied seepage losses from unlined irrigation canals in the 13 irrigation districts in southern Alberta. The ponding method for measuring the rate of seepage from canals was used to determine seepage losses at 29 sites in the irrigation districts in soils of different textures. Seepage rates were determined for three soil textural

groups: fine-, medium-, and coarse-textured soils.

Shiv Kumar Sharma and U. Tikekar presented a case study of lining of two parallel canals, Rajasthan Feeder (capacity 18500 cusecs) and Sirhind Feeder (capacity 5272 cusecs), off taking from Harike Headworks (Pb) and discussed various issues involved in the lining of such important canals carrying considerable discharge. Main issues involved herein revolve around very short time available for repairs and introduction of Geo-synthetic material for lining.

Filipe Morgado, Grandão J. Lopes, J. De Brito, And J. Feiteira surveyed canals in Portugal, found that in most situations, the following technologies are used: concrete cast on site, precast concrete slabs, and prefabricated membranes (polymer bitumen or synthetic). These linings may manifest various pathologies with significant consequences on the amount of water lost as a result of lack of water tightness. These defects are classified by lining solution, and their main causes identified. Finally, an exhaustive set of recommendations and rehabilitation techniques are described to minimize water leakage from the canals

Jay Swihart and Jack Hayneshas constructed 27 alternative canal-lining test sections to assess durability and effectiveness (seepage reduction) over severe rocky subgrades using lining materials of different combinations of geosynthetics, shotcrete, roller compacted concrete, grout-filled mattresses, soil, elastomeric coatings, and sprayed-in-place foam. Preliminary benefit/cost (B/C) ratios have been based on initial construction costs, durability (service life), maintenance costs, and effectiveness.

ErhanAkkuzustudied the usefulness of the equations of Moritz and Davis-Wilson in estimating the seepage losses of concrete lined canals. Seepage losses of the concrete-lined trapezoid canals of the Menemen irrigation system at the end of the Gediz basin were measured by the inflow-outflow method and the results were compared with the estimates of seepage losses given by the use of these two equations and found that seepage loss values calculated by means of the Moritz and Davis-Wilson equations from the hydraulic parameters of the canal at the time of measurement were well below measured values and concluded that these empirical equations are not suitable for use in estimating seepage losses for concrete-lined canals in which adequate repair and maintenance could not be carried out.

IV. MATERIALS

A. *Concrete*

Excellent durability, but only 70 percent long-term effectiveness. Irrigation districts are familiar with concrete and can easily perform required maintenance. Its B/C ratio is 2.5 to 3

B. *Shortcrete*

As a shortcrete can be advantageously used as a lining material for canal lining Effective reduction in losses up to 85 %. Its B/C ratio is 3.5 to 3.7

C. *Exposed HDPE*

Excellent effectiveness (90 percent), but susceptable to mechanical damage from animal traffic, construction equipment and vandalism. Its B/C ratio is 3.5 to 4

D. *Iitd Sheet*

IIT Delhi also compare there IITD sheets with High densile polyethylene sheet and found some positive points as compare with (HDPE).

V. METHODOLOGY

A. *Site selection*

For this project neeradewdhar projects right bank canal is selected for measuring discharge and find out the seepage losses; because some section of canal is unlined and some section is lined(with cement concrete).we can find out seepage in lined section and unlined section and find out remedies for reducing the seepage.

B. *Data collection*

Data is collected by two methods

1) *Direct measurement (Inflow-outflow method):* This method gives direct measurement of flow rate in to reach and out of reach of canal; so flow of rate which goes into the soil can be easily find out.

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S = Qi + R – Qo – D + I – E
S = seepage through canal
Qi = upstream inflow
R = Rainfall
Qo = Downstream outflow
I = inflow along the reach
D = evaporation loss
E = outflow along the reach

2) Direct measurement

a) As the discharge on 0 chainage m is 4.23(m^3/s) and at 7000 m chainage is 2.77 (m^3/s),so the difference in discharge is 1.46(m^3/s) (1)

b) There were 9 distributaries located in 7 km sector of channel

c) 50 liter/sec is discharge of each distributary

d) Total discharge of distributaries = 9*50 =450liter/sec(0.45m^3/sec)

e) Total reduction discharge= 1.46-0.45= 1.01 m^3/s (2)

f) Its found that in canal losses main loss is "seepage loss"(98 to 99%) and evaporation loss is minor loss (0.5 to 1%).so by considering this

g) Seepage loss = loss in discharge - evaporation loss

h) = 1.01(m^3/s)- 0.0101(m^3/s) (3)

i) = 0.9999 (m^3/s) in 7000 meters

j) 999 liter/sec water can be saved in 7000 meter run by applying HDPE sheets(high densilepolytherin sheets) and providing cement concrete cover to protect HDPE sheets from any action or attack.

k) Cement Concrete lining cost for "NEERA DEWDHAR" canal project is 1.5 crore/kilometer

l) For example: we considered 7 km channel section

m) Approximate cost of cement concrete lining is=

n) 1.5crore/km * 7 KM=10.50 crore (4)

o) HDPE sheets lining cost is 185 RS/square meter

p) For canal bed width 7 meter and top width 18 meter and channel lenth 7000 meter (7 km)

q) Total cost of lining HDPE sheets =

r) For HDPE =185 * **189840 = 35,120,400/-…** **(5)**

Total cost of lining = 10,50,00,000 + 35,120,400 = 140,120,400/-

Total cost of lining HDPE sheets (with geotextile cover)

For Geotextile = 185*189840 *2 = 70,240,800/-

s) Total cost of lining (HDPE + cement concrete) = 10,50,00,000 + 3,51,20,400 + 70,240,800/-= 210361200/- (6)

t) By using HDPE sheets we can save 999 liter/sec water

u) By assuming 0.999 m^3/s as a discharge which can save in seepage losses

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v) For bottom width side area is = (7+2)*7000 = 63000 sq meter

w) For side channel area is = (7.06 + 2)*7000 = 63420 sq meter

x) For side channel area is = (7.06 + 2)*7000=63420 sq meter

y) Total area is = 63000 + 63420 +63420 =189840 sq meter (7)

z) Volume of water saved per kilometer=999/7 = 142.71 litre/sec/km

aa) = 0.142 m^3/sec/km

bb) For 7 km we saved 0.999 m^3/sec

cc) Consider this as a discharge and Rice as a crop

dd) Base period = 100 days

ee) Delta = 120 cm

ff) Duty = (864*100)/(120) = 720 ha/cumec

gg) Discharge = area/duty

hh) 0.999 = area /720 = 719.28 hactare

ii) 4 ton rice can be produce in 1 hectare base period 100 days

jj) Extra rice can be produce = 719.28*4000 = 2877120 kg Rice

kk) Approxholsale rate or price at farmers stage = 25 Rs/ kg

ll) Total earning = 25 * 2877120 = 71928000 RS

Now for wheat base period is 100 days

Duty = (864*100/50)= 1728 ha/cumec

Discharge = area/duty

0.999 =area/ 1728= 1726.272 hectare 3 tons /hectare

3000*1726.272 = 5178816kg wheat

Approx wheat cost will be 20 Rs at farmers end= 20*5178816=103576320 Rs

Benefits due to lining= 71928000+ 103576320 = 175504320 Rs

C. BY EMPIRICAL FORMULA

1) By Empirical Formula

Formulas	Mortiz Formula	Moles worth & Yemidunia	Indian Formula	Pakistanian Formula	Hungarian Formula
SEEPAGE	0.2657 M^3/S/KM	0.1832 M^3/S	0.01395 M^3/S/KM	0.157 M^3/S/KM	0.3935 M^3/S/KM

VI. COMPARISON

As a With knowing cost of lining material normal concrete, shortcrete, HDPE, IITD we can compare the following combination of lining As we have taken 7 km section of canal as study

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Table 7.1 HDPE + Concrete

Sr no	HDPE	CONCRETE	Cost	Total cost(for 7 km)
1	35120400	15000000*7	35120400+105000000	140120400

Table 7.2 HDPE+SHORTCRETE

Sr no	HDPE	SHORTCRETE	Cost	Total cost(for 7 km)
1	35120400	1100*150000	165000000+35120400	200120400

Table 7.3 IITD+CONCRETE

Sr no	IITD	CONCRETE	COST	TOTAL COST(FOR 7 KM)
1	47460000	15000000*7	47460000+105000000	152460000

Table 7.4 IITD+SHORTCRETE

Sr no	IITD	SHORTCRETE	COST	TOTAL COST(FOR 7 KM)
1	47460000	1100*150000	47460000+165000000	212460000

By considering 10 % maintenance cost of original cost and 50 years of project life We have 4 different combination of lining materials and comparison as well B/C ratio will be given as follows

A. Results

Table 7.5 Result

MATERIALS	HDPE + CONCRETE	HDPE + SHORTCRETE	IITD + CONCRETE	IITD + SHORTCRETE
B/C RATIO	10.43	7.33	9.59	6.833

MATERIALS	HDPE(with geotextile cover) + concrete	HDPE (with geotextile cover) + shortcrete
B/C RATIO	6.95	5.409

As per results shown in table B/C ratio of all the lining materials which are shown above
Are more than 1.so all the materials can be used for canal lining and gives benefits. HDPE sheet is a best solution to minimize the losses of unlined canal as well as concrete lined canal

VII. MEASURING DISCHARGE AND SEEPAGE EVALUATION

A. Radar, Shaft Encoder, Bubbler System To Find Out Discharge

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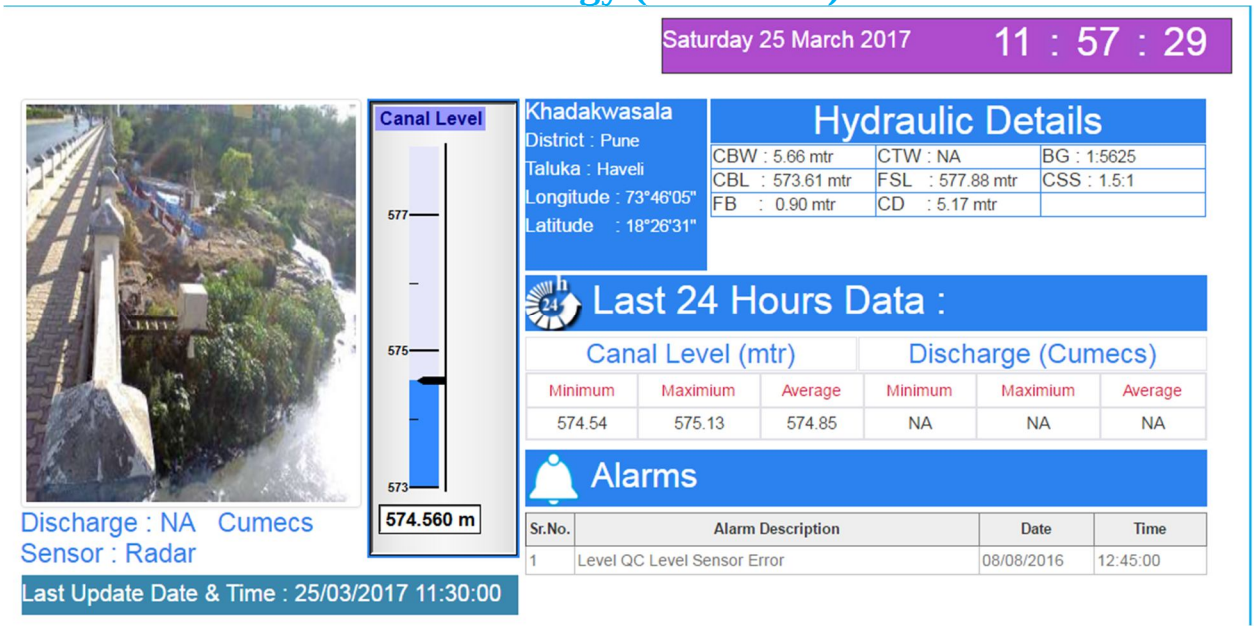

fig 8.1 discharge measurement using radar sensor

fig 8.2 model making (1 unlined canal,2 concrete canal, 3HDPE +concrete canal)

VIII. CONCLUSION

As the benefit cost ratio is greater than 1 .this method of HDPE sheets lining justifying its application, further we can lined different irrigation channel using this lining material and reduces the seepage loss .It will help in increasing production and overall benefit HDPE sheets are advantageously used for canal lining and also useful for reducing the losses in unlined as well lined canal also.HDPE sheets reduces the losses upto 99% if fixed and maintained properly .material quality of lining which affect less due to different actions

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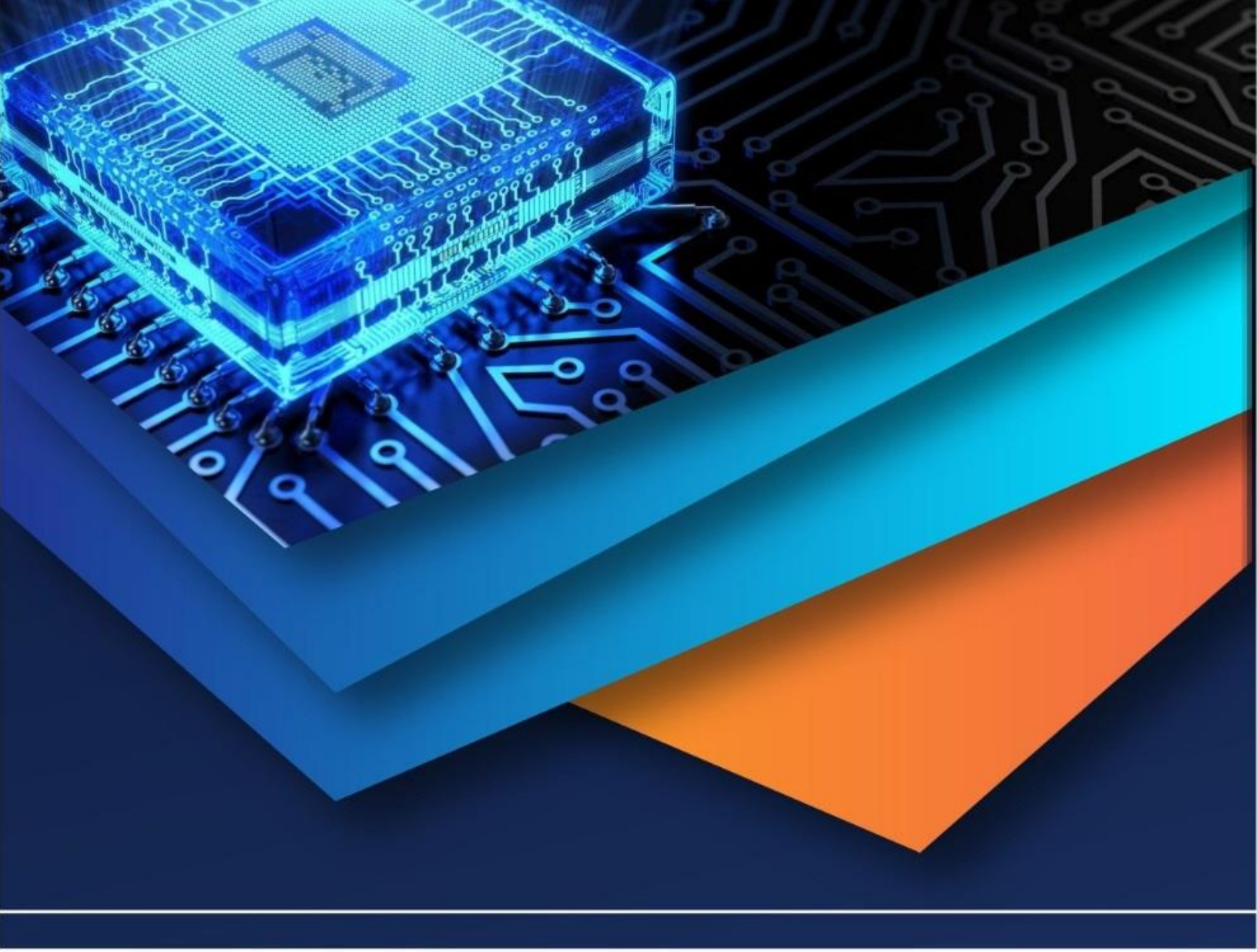

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