Notes by-

Pravin S Kolhe,

BE(Civil), Gold Medal, MTech (IIT-K)

Assistant Executive Engineer,

Water Resources Department,

www.pravinkolhe.com

Er. Pravin Kolhe
(B.E Civil)

ROLL NO. 22
B.E. CIVIL

LINING OF CANAL

ADVANTAGE OF LINING OF IRRIGATION CANALS :-

1. Prevention of water-logging and no seepage
2. Reduction of cross-section
3. Stability to sides
4. Reduction of operation and maintenance cost.
5. High velocity : great side slopes & Logitudinal slope
6. More command area.
7. Water free from salts
8. Hydel power generation
9. High velocity of flow reduces evaporation losses
10. Lining provieds stable channel sechon which is easier to operate

DISADVANTAGE OF LINING OF CANAL:

1. High intial investment
2. It is difficult to repair damaged lining.
3. Difficult to shift owlet posiion.

TYPES OF CANAL LINING:

A) Exposed & hard surface lining.

I. Cement concrete lining :- The cement concrete lining consist of layer of cement concrete of required strength laid on a well prepared and compacted subgrade in the bed and side of the canal. Cement concrete lining is preferable to any other lining to carry high velocity flow because of its great resistance to erosion. Velocity upto 2.5 m/sec or heigher than 5m/sec may be bare been permitted. It prevent growth of weed & improves flow characteristics and also obstract the burrowing animal to enter in bed. It also reduces maintenance charge.

REQUI

① Concr
cost of c

② Structur
strong
& walls
behind

③ Durabil
effect of
& thawin
chemical

④ Repairs
economi

⑤ Imperm
seepage

⑥ Hydrauli
of rugos
capacity
efficient

⑦ Resistanc
able to a
transported
channel

The main disadvantage of cement concrete lin
is lack of extensibility results in frequent cracks due
to contraction taking place from temprature change
drying & shrinkage and settlement of subgrade
& Also likely to damaged due to alkaline water.

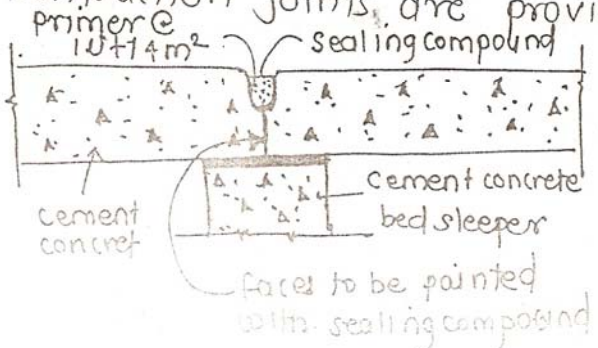
The thikness of the lining is fixed on the
nature of channel requirement, full supply depth
and channel capacity

Capacity of canal (cumec)	Depth of water (m)	Thickness mm
0-5	0-1	50-60
5-50	1-2.5	60-75
50-200	2.5-4.5	75-100
200-300	4.5-6.5	90-100
300-700	6.5-9.0	120-150

Deep channels are great thiker than shallow chan

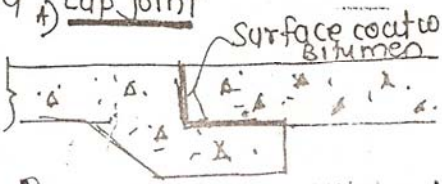
Reinforcement: Normally reinforcement is not provid
in cement concrete lining. But however if it is provided
up to 0.25 to 0.3% is provided. It helps to reduce
the coldth of shrinkage cracks & thus minimise seep

JOINTS: Due to temprature variation shrinkage
cracks developed in concrete lining result in appre
-able leakage from canal. to minimise this effect
contraction joints are provided

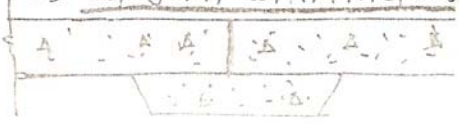


Details of construction joint when
lining cast in panels.

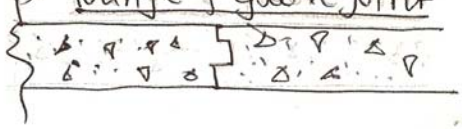
4) Lap joint



5) Lap joint with fillet sealing



6) Tounge & groove joint



concrete: for lining generally concrete grade M10 or M15 are used. special cases where canal subjected to high velocity M20 also used.

Laying of concrete: Before laying all surfaces of subgrade is saturated up to depth of 300mm.

1) spread 1:3 cement sand slurry on subgrade
2) spread oil paper on subgrade
3) spread crude oil on subgrade

The laying of concrete is done by hand or specially designed machine

II) PRECAST CONCRETE LINING ⊳

The precast concrete lining consist of precast concrete slab of 1:3:6 concrete of size 500mm x 250mm x 50mm set in 1:6 cement mortar. The slabs having a 10mm wide and 16mm deep rebate on all four side so that when laid side by side 20mm wide & 16mm deep open joint are formed around each slab. the open joints are sealed with 1:3 cement mortar of a dry consistency & properly packed to eliminate shrinkage. 5% crude oil is added as admixture Expansion joints, are provided at an interval of 3.5m to 5m. which is grouted with suitable bituminous mastic.

Advantage of precast concrete lining over in situ concrete lining. ①

① It is manufactured under controlled condition & it provides better, more impervious & durable lining than insitu concrete lining.

② Thinner in section & strong and can be manufactured in mass scale.
③ less site operation & take much shorter time to lay than in situ cement concrete lining
④ these can be made during non-working season and can be placed all along canal for curing purpose thus reduces cost of curing
⑤ these are of small size so risk of cracking due to shrinkage is eliminated.
⑥ In case of damage to the lining due to settlement of subgrade, it is easier & cheaper to repair such damage.

VIII) SHOTCRETE LINING OR GUNITED LINING:

In this type of lining 1:4 cement mortar is applied pneumatically (i.e. by compressed air) through a nozzle on subgrade in the bed and side of channel. The pneumatically applied mortar is known as Shotcrete. The instrument required is pneumatic gun & the process is known as gunning so the lining is also known as gunning lining.

The pneumatic application is made by ① Dry mix process ② wet mix process.

In dry mix process cement & sand having moisture content in betn 4% to 8% are thoughly mixed & delivered through equipment & carried in suspension by compressed air. A water hose is connected to nozzle fitted at end of hose and resulting mortar is is jetted from nozzle and applied on subgrade.

* In wet mix process cement, sand & water is throughly mixed and mortar is prepared and mixe is applied with the help of nozzle on the subgrade.

The sand used should be well graded & max size 4.75 mm. The usual thikness of lining is 40mm but very from 25 to 65mm. Further mesh of reinforcement is frequently used in shotcrete lining

IV) CEMENT MORTAR LINING: In this type of lining a layer of cement mortar of uniform thickness is laid on compacted subgrade. The thikness is 25mm. The sand used should be such that 85% or more will pass the 6.35 mm sieve and not more than 12% will pass through 0.15 mm sieve. This type of lining is however not common

V) HYDRAULIC LIME CONCRETE LINING:- It consist of concrete from hydraulic lime in suitable proportion. Example of this lining is Ganga canal. 'kankar' is available through length of canal. It was burnt to form lime further it was used as coarse aggregate. Since all material used in derived from 'kankar'.

But investigation proove that compare to cement concrete lining hydraulic lime concrete would make very poor lining material hence it is not commonly adopted.

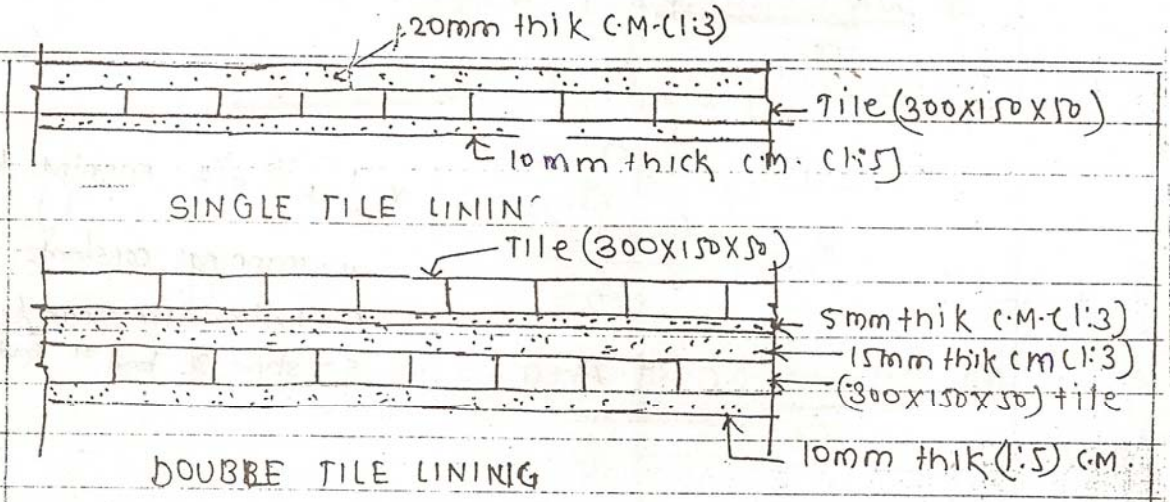
(VI) BRICK TILE LINING OR BURNT CLAY TILE LINING :→

The type of lining consist of single or doubble layer of burnt clay tile. laid in cement mortar The size of brick restricted to 300mm x 150mm x 50mm. for convenience of handling. Before laying subgrade is properly dressed & saturate to a depth of 300mm

In case of single tile lining 10mm thick layer of 1:5 cement mortar is laid on prepared subgrade on this layer of mortar tiles are laid & embedded in it and vertical joints are filled with mortar on top 20mm thick 1:3 cement plaster is applied.

In case of doubble lining on the top of single layer tile 15mm thick layer c.m 1:3 is laid after this mortar has set & is made rough on this top tile is laid on 3mm thick layer of 1:3 c.m. The layer of cement mortar betn two tile is known as sandwitch Hence doubble lining is also known as (सैंडविच) cement mortar sandwitch lining

Advantage ① Economical in initial cost
② Skilled labour is not required.
③ No special equipment is needed
④ Rigid control on work is not required.
⑤ Expansion joints are not required as shrinkage is eliminated
⑥ Repair is easy & expeditious.
⑦ Transportation cost is less
⑧ Thickness of lining remain constant



SINGLE TILE LINING

DOUBBE TILE LINING

VII STONE BLOCKS OR UNDRESSED STONE LINING :

It consist of a layer of undressed stones set in 1:6 cement mortar, and laid on a well prepared subgrade in bed and side of canal. As fine dressing of stone is costly, undressed stones are used but this would result in higher resistance to flow. As such to reduce resistance of flow 1:4 to 1:6 cement plaster is provided on the top of stone.

VIII ASPALTIC LINING :-

It consist of layer of asphaltic concrete laid on subgrade in bed & side of the channel. It consist of mixture of asphalt, cement and graded aggregate and hence is known as asphaltic cement concrete. It is mixed and laid under high temprature. The asphaltic concrete is laid either by hand or by subgrade or rail guided slip forms similarly those used for cement concrete lining.

Asphaltic concrete lining has greater ability to withstand change in the subgrade further it is used for repairing cement concrete

PROCEDURE for calculating Canal Dimensions.

① Data Required Q, N, S, Z, V_{min}

1. knowing V, N, S find out R..

manning's eqn

$$R = \frac{(VN)^{3/2}}{S^{1/2}}$$

$V = \frac{1}{N} R^{2/3} S^{1/2}$ mannings formula

N = mannings constants

R = hydraulic mean depth $\frac{A}{P}$

S = slope or Radious

② Calculation of Area.

$$A = \frac{Q}{V}$$

③ Wetted perimetre

$$P = \frac{A}{R}$$

④ calculation of diamension

$$A = BD + D^2(\cot\theta)$$

$$P = B + 2D(\theta + \cot\theta)$$

A, P are known, B & D can be found out

ECONOMICS OF LINING:

The lining of canal economically justified if extra cost of providing lining is less than or equal to value of benifits from it..

Extra cost of lining ≤ Benefit from it.

C - cost of lining Rs/m^2

S - seepage losses in lined canal /m^2

S_s = seepage losses of unlined canal /m^2

P = Wetted perimetre of lined canal

P_s = Wetted perimetre of unlined canal

T = Total perimetre of lining in m

d - No of running days / year
W - value of water saved / m^3
water price
L - Length of channel in m
N - life of lining in years
M - saving of operation and maintenance cost
B - Annual estimated value in Rs of other benifits
i - % rate of interest

value of water lost by seepage (unlined)
$= p L s d W$ Rs

value of water lost by seepage (lined)
$= P L S d W$ Rs

Annual saving by avoiding seepage
$= p L s d W - P L S d W$
$= L d W (ps - PS)$ Rs

Total annual Benifit (a)
$a = L d W (ps - PS) + B + M$.

Expenditure on constn of lined canal
$= TLC$

$$TLC \leq a \left(\frac{(1+i)^N - 1}{i(1+i)^N} \right)$$

present worth of total annual Benifit

for purpose of economic analysis life may be assumed - 60 years

REQUIREMENT OF CANAL LINING:

① Economy – The lining should be economical in intial cost as well as repair & maintance cost

② Structural stability – The lining should be enough strong to withstand different subsoil pressure. & to also withstand effect of local cavity formation behind lining

③ Durability: The lining should able to withstand effect of velocity of water, rain, sunshine, frost & thawing, thermal & moisture changes and chemical action of ~~salts~~ ~~salts~~.

④ Repairability: It can be repaired easily & economically

⑤ Impermeability: The lining should such that seepage losses are reduced considerably extent

⑥ Hydrawlic efficiency: It should be low coefficient of rugosity so that channel has high discharge capacity & section is hydrawlically more efficient

⑦ Resistance to erosion – The lining should be able to withstand abrasion due to sediment transported by the flowing water in the channel