

**Uttar Pradesh Water Sector Restructuring Project
Department of Irrigation, U.P.**



**Manual for Construction
and
Maintenance of Minors**

January, 2008

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PREFACE

India is potentially one of the richest agricultural countries in the world. The proportion of arable land to total geographical area is the highest in India (about 45%). Irrigation is the most essential single input for agriculture on which depends the economy and well being of the rural masses. The state of Uttar Pradesh is the most populous state in India and more than 70% population is engaged in Agriculture. The farm outputs have shown a decline due to loss of irrigation and land degradation.

Minor is a vital element of any irrigation system which carries irrigation supplies to the fields through guls. Inadequate financial resources have adversely affected the upkeep of the system, particularly the minors. Although, all physical systems deteriorate with use and age, their life can be prolonged with proper maintenance. Irrigation performance and agricultural sustainability are intimately linked. An organic linkage between the agencies involved in the provision of water and other agricultural inputs is necessary for irrigation performance improvement. Farmers normally have no control on- the amount of water they receive, when they receive it and even whether they will receive it at all. This leads to farmers' dissatisfaction with the Irrigation system. Under these conditions, water rate revisions are politically resisted and water payments are delayed leading to low cost recovery.

The Government of Uttar Pradesh, in its state water policy, declared in 1999, has resolved to adopt integrated water resources management through participatory approach. Forming the WUAs (Water User Associations) and handing over the conveyance system (minors) to them after rehabilitation and modernization, would allow decision making in water / canal management at the lowest level and by the main stake holders- the water users themselves. To bring qualitative improvement in water resources management, which should include users participation and decentralization of authority, has been included in the state water policy. Some provisions of the State Water Policy are given below:

- पुनर्स्थापना कार्यों के पश्चात माइनर के हस्तांतरण से पूर्व सिंचाई विभाग उत्तर प्रदेश के संबंधित अधिशासी अभियन्ता, जल उपभोक्ता संगठन के साथ सहमति पत्र (मैमोरैण्डम आफ अंडरस्टैंडिंग) हस्ताक्षर करेंगे।
 - नहर प्रणाली तथा उसके समस्त पक्के कार्य / संरचनायें राज्य सरकार के स्वामित्व में रहेंगे, जल वितरण, परिचालन एवं रख- रखाव, उपभोक्ताओं का प्रतिनिधित्व तथा दक्ष एवं इष्टतम उपयोग से संबंधित अन्य समस्त कार्य जो सहमति पत्र के अनुरूप हों, का उत्तरदायित्व जल उपभोक्ता संगठन का होगा। शासन पूर्व
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की भांति सुनिश्चित सिंचाई हेतु, आवश्यक निर्माण कार्यों, नहर के पुनरोद्धार एवं आधुनिकीकरण हेतु तकनीकी एवं वित्तीय सहायता प्रदान करने हेतु उत्तरदायी होगा।

- जल उपभोक्ता संगठन, माइनर के उपरोक्त कार्यों हेतु हस्तांतरण के पश्चात, शासन द्वारा निर्धारित विनियमों के प्राविधानों को क्रियान्वित करेंगे। जल उपभोक्ता संगठन एवं उनके सदस्य इन विनियमों के प्राविधानों के अन्तर्गत प्रदत्त अधिकार, उत्तरदायित्व एवं कर्तव्यों का निर्वहन करेंगे। जल उपभोक्ता संगठनों से अपेक्षा की जायेगी कि वे जल के अल्प व्ययी प्रयोग हेतु समुचित प्रबंधन करें जिनमें ड्रिप व स्प्रिंकलर जैसे जल बचत करने वाले संयंत्रों की स्थापना तथा कम जल उपयोग वाली फसलों की किस्मों का प्रयोग भी शामिल है।

Since maintenance works on the minors are to be carried out by Water Users' Associations, the water supply for irrigation is expected to improve through participatory approach. This manual has been prepared specially to be used by WUA. The manual provides for their duties, responsibilities, functions, authorities etc.

The manual also covers the construction of minors which will continue to be the responsibility of Irrigation Department.

As experience is gained on working of Water Users' Associations, the manual may need periodic updating.

Some useful information for farmers such as Draft U.P. Environmental Policy 2005, Conjunctive use of Water, Chemical and Salts in Soils and mitigation measures for environmental imbalances etc. have been added at the end of the manual as Annexure-J.

(K.D. Shukla)
Chief Engineer
PACT

COMMON CONVERSION FACTORS¹

LENGTH:

1 <i>Ghatta</i>	=	2.24 m.
1 <i>Jareeb</i>	=	50.3 m.
1 Link	=	20.12cms (7.92 Inches)
1 Rod / pole	=	25 Links
1 Rod /pole	=	5.03 m. (5.5 Yards)
1 Chain (Engineer's)	=	30.48 m. (100 feet)
1 Chain (Gunter's)	=	100 Links
1 Chain (Gunter's)	=	20.12m (66 Feet)
10 Chains (Gunter's)	=	1 Furlong
1 Hand	=	10.16 cm. (4 Inches)
1 Mile	=	1.609 km
1 Canal Mile	=	1.525 km. (5000 feet)
1 Yard	=	0.914 m.
1 Foot	=	0.305 m.
1 Inch	=	2.54 cm.
1 Mega-meter	=	10 ⁶ m.
1 Kilo-meter	=	10 ³ m.
1 Hecto-meter	=	10 ² m.
1 Deca-meter	=	10 m.
1 Meter	=	100 cm.
1 Deci-meter	=	10 cm.
1 Centi-meter	=	10 mm.
1 Micron	=	0.001 mm.

AREA:

1 Sq. <i>Ghatta</i>	=	1 <i>Biswansi</i>
1 Sq. <i>Ghatta</i>	=	6.33Sq.m (68.06 Sq. ft.)
1 <i>Ghatta x 1 Jareeb</i>	=	20 <i>Biswansi</i> or 1 <i>Biswa</i>
1 <i>Biswa</i>	=	126.6 Sq.m (1361.25 Sq.ft.)
1 Sq. <i>Jareeb</i>	=	20 <i>Biswa</i> or 1 <i>Beegha</i>
1 <i>Bigha</i>	=	2531.93 Sq.m (27225 Sq.ft)
1 Acre	=	32 <i>Biswa</i>
1 Acre	=	0.4047 Hectare (43560 Sq. ft.)
10 Sq. Chains (Gunter's)	=	1 Acre
1 Sq. Mile	=	259 Hectare (2.59 Sq. Km.)
1 Hectare	=	10 ⁴ Sq. m.
1 Sq. ft.	=	0.093 Sq. m

VOLUME:

1 Acre ft.	=	1233.5 cum.
1 Cu. ft.	=	0.0283 cum.
1 Cusec day	=	83386 cu. ft.
1 Cu. ft.	=	6.24 Gallons (UK)
1 Gallon	=	4.546 Liters
1 Liter	=	1000 Cu. cm.
1000 Liter	=	1 Cu. m.

WEIGHT:

1 Tonne	=	0.9842 Ton
1 Tonne	=	1000 Kg (26.79 Maunds)
1 Maund	=	37.324 kg
1 Seer	=	0.933 kg
1 Liter (water)	=	1.08 Seer
1 Ton	=	984.20 Kg.
1 Kg.	=	2.205 Pounds

FORCE:

1 Ft. pound	=	0.1383 Kg. m.
1 Kg. f.	=	10 N (Newton)
1 Kg. f. / cm ²	=	0.10 N / mm ²
1 HP (metric)	=	0.9863 HP (UK)
1HP (metric)	=	735.5 Watts (75 kg-m/sec)
1HP-hour	=	0.7355 Kw-hour

TEMPERATURE:

⁰ C	=	5/9 (⁰ F- 32)
(C is centigrade)		(F is Fahrenheit)

OTHERS

12 Nos	=	1 Dozen
12 Dozen	=	1 Gross
20 Nos	=	1 Score
25 Sheets (paper)	=	1 Quire (paper)
20 Quires	=	1 Reem (paper)

PAPER SIZES

A0	=	841 x 1189 mm ²
A1	=	594 x 841 mm ²
A2	=	420 x 594 mm ²
A3	=	297 x 420 mm ²
A4	=	210 x 297 mm ²

Reference

- सींच प्रदर्शिका - S.P. Mathur, E-in-C, UPID (Retired)
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MANUAL AT A GLANCE

Participatory Irrigation Management & Water User Associations

The UP State water policy resolved to adopt integrated Water Resources Management through participatory approach. Farmers normally have no control on the amount of water they receive, when they receive it and even whether they will receive it at all. Consequently formation of Water Users Associations (WUAs) to manage Irrigation water distribution system at minor level was stipulated. As the channels are under performing, it was considered appropriate to restore the channels to their original design characteristics before the maintenance and management of minors is transferred to WUAs. To make the use of irrigation water economical / efficient, volumetric system of water flow has been introduced. Forming the WUAs and turning over the minors to them would allow decision making at lowest level and by main stake holders- the water users themselves. They will take better care of the minors than a distant bureaucracy. Cost recovery is normally synonymous with improved O&M.

The main objective of PIM is to secure the participation of farmers in equitable distribution of water among themselves, ensuring efficient use of canal water for agriculture intensification, operation and maintenance of given minors, drainage of waste / surplus water and other aspects of irrigation management as assigned to them. The ability of WUAs to perform as an effective IMT organization depends on their economic features and legal status. From financial angle WUAs should have their own funds, adequate to generate interest income, which are enough to carry out their O&M functions. Involvement of farmers in operation and maintenance will create a feeling of ownership.

The UP State Government issued instructions on 18 Jan, 2001 for formation of WUAs. Detailed instructions regarding functions of WUAs were notified vide GO NO. 2188/27-4-67W/96 Dated 01-05-2006. The minors shall be transferred to WUAs in phases.

- In the first phase joint management of minor shall be done by UPID and WUAs.
- In the second phase the operation and maintenance works of a minor shall be completely handed over to WUAs. State Government shall give grant-in-aid for maintenance of minors.

The following benefits are expected to accrue with the transfer.

- The maintenance cost will reduce.
- Works will be executed expeditiously.
- Irrigation intensity will increase due to equitable water distribution.
- Discrimination between head and tail farmers will reduce.
- Silt clearance will be done in each minor.

Detail instructions have also been notified by UP State Government regarding members of working committee of WUAs that:

- President of all outlets committees of minor;
- President of water management committees of all village panchayats in command area of the minor;
- Two progressive farmers in the command area of minor – to be nominated by District Magistrate ;
- If the schedule caste / schedule tribe woman and marginal farmers do not get representation, nomination of one representative of each of the unrepresented class will be done with mutual agreement / election.
- The president of the outlet committee of the tail outlet of minor shall be the president of WUA and its working committee.
- The president of the outlet committee at the head of minor shall be the vice president of WUA and its working committee.
- The irrigation department shall be represented by a departmental official / officer who will be the secretary of WUAs.
- One farmer secretary and one Treasurer shall be selected by the working committee by mutual agreement / election.
- Till the formation of new working committee of WUA, members of old working committee will remain in their office.

Functions of WUAs have been specified by UP Government in their notification dated 01-05-2006. These are as under:

- To receive water from parent canal and to distribute is equitably throughout the command area under WUA.
- Maintenance works of the distribution network of the water available in the minor.
- Maintenance of minor including its pucca works
- Technical and physical improvements to increase Agriculture productivity in the command area
- To generate financial resources
- To collect information from the department, regarding availability of water, to get operation plan prepared for minor and to monitor / evaluate the execution of this plan.
- To prevent wastage of water and to ensure its optimum utilization.
- To arrange for drainage of surplus / waste water in the command area.
- To arrange for auxiliary services – education and training of farmers and inputs for better productivity.
- Supply of irrigation materials through irrigation cooperative society and / or by establishing Krishak Sewa Kendras.

The WUAs shall maintain the following documents for better control on works and accounts.

- Index map of the canal system & Map of command area of the minor

- Approved L-section / X-sections of the minor
- Details of the land owners in the command area.
- Roaster of fasal wise water distribution of the minor
- Land plan & Land acquisition records of the minor
- Schedule of current irrigation rates.
- Specifications issued by UPID.
- Details of sanctioned outlets and details of warabandi
- Environment / social safeguards to be adopted during execution
- Details of temporary outlets
- Details of procedure for charging punitive irrigation rates.

Disputes cannot be completely avoided in any organization / association. The settlement of disputes regarding maintenance and operation of irrigation system, constitution, management, powers and functions of WUAs arising between members of WUA or between different WUAs has been proposed as under;

- Any dispute or difference touching the constitution, management, powers or functions of WUA arising between members shall be resolved by the working committee of the WUA.
- Any dispute/ difference arising between the members and working committee of the WUA or between two or more WUAs shall be resolved by the working committee of the concerned Distributory Committee / competent canal officer.
- A party to dispute / difference aggrieved by any decision of working committee of WUA may appeal to the working committee of the concerned Distributory Committee or competent canal officer.
- The appeal shall be preferred within 30 days of communication of decision to the person aggrieved. The appeal shall be disposed off within 30 days.
- The party aggrieved by decision / order of Distributory Committee or competent canal officer may appeal to appellate officer within 30 days. The decision taken by the appellate authority shall be final and binding.

Construction

The construction of Minor shall continue to be the responsibility of the UPID. All works shall be carried out in accordance with approved drawings and prescribed specifications. Activities like setting out works and site clearance shall be completed before actual execution. Initial X-sections in full design width will be taken @ 50m c/c in straight reaches and at 25m interval in curved reaches. The bed of minor will have longitudinal slope as specified in L-section and will be kept level transversely. Any excavation done below bed level shall not be paid for. All clods of earth shall be broken before placing in embankment. If foundation for any structure is excavated deeper than shown in drawing, it will be filled with 1:3:6 concrete by the contractor at his cost. The locations / suitability of borrow areas shall be identified by the contractor jointly with Engineer-in-charge before start of work.

Borrow areas in Usar land shall be avoided. Borrow areas shall not be more than 1 m in depth & 25 m in length. The borrow areas in private land shall not be dug without consent of the owners and shall be rehabilitated after completion of work.

The embankment shall be built to height, levels and slopes as shown in the drawings. The surface should be scarified and embankment shall be built in layers of 25 cm thick (loose) and compacted to specified densities at OMC. The height of embankment shall be kept 5% higher if compaction is done by machine and 10% higher than design if compaction is done manually for settlement. There shall be no unwanted disposal in work area. The tests for compaction shall be done as per desired frequency.

The pucca structures shall be constructed in the minor as per approved drawings and as per location on the approved L-section. All construction materials shall conform to specifications. Use of cement from mini cement plants should be avoided. Re-rolled steel should not be incorporated in any part of the structure. Curing of masonry works for 10 days and concrete for 14 days should be ensured.

Maintenance

Maintenance is necessary to keep the facilities in good condition and in efficient service. All physical systems deteriorate with use and age. Proper and timely maintenance will prolong their life and the channels will be able to accomplish their purpose of systematic and equitable distribution of available water. The minor should be inspected during closure and during running. The office bearers of WUAs will conduct joint walk through with PIM team to identify the nature and location of various deficiencies and plan the necessary remedial measures. The bed bars should be intact and clearly visible and should be repaired wherever needed and replaced in case of excessive damage. The estimation of silt may be done from the depth of silt on bed bars. The silt should be removed only from the designed internal section and silt clearance should be done from d/s to u/s starting from tail or from fall on the channel and should be finished before start of rabi sowing. Coarse and medium silt should not be spread on service road. Usable silt will normally be utilized for repair of banks, daula and outer slopes. In any case silt should not be heaped above bank level. Minors off-taking from branch canals, carry coarse silts. It should be disposed off at identified locations. The existing outlets should not be blocked.

The banks should generally be 30 cms above country levels. No tubewell should be allowed within 25 m on either side of minor.

Regular inspection, maintenance and repair of all pucca works on minors are necessary. The canal gauges should be cleared periodically. Displaced boundary pillars should be re-fixed. The repair work in masonry should be kept wet for 10 days. The damage to deck slab can be in form of

- Damage to concrete surface
- Cracks in concrete
- Corrosion of steel reinforcement

Detailed procedures for repair have been included in manual.

All gates shall be kept painted with specified anti corrosion enamel paints to prevent rusting. Rust should be carefully removed. The outlets should be inspected for any chocking or tampering. Guls should not be allowed along channel banks or inside canal land. In case of inadequate funds, the priorities for repair works shall be fixed by president of WUA.

Environmental & Social Aspects

The WUAs should be aware of problems that threaten the health of soils and crop. Any neglect will lead to environment degradation / deterioration in social values. Over irrigation and water stagnation shall be avoided. The industrial waste and untreated effluents of sugar mills, tanneries etc should not be allowed to be released in minors / drains. The borrow areas should be suitably rehabilitated. The water bodies shall be conserved. The occurrence of water borne disease should be minimized.

Inequitable water distribution, waterborne land degradation, reduced agricultural production and loss of earnings of the farmers are directly associated with irrigation infrastructure. The WUA should check the misuse of water, and land encroachment through social pressure.

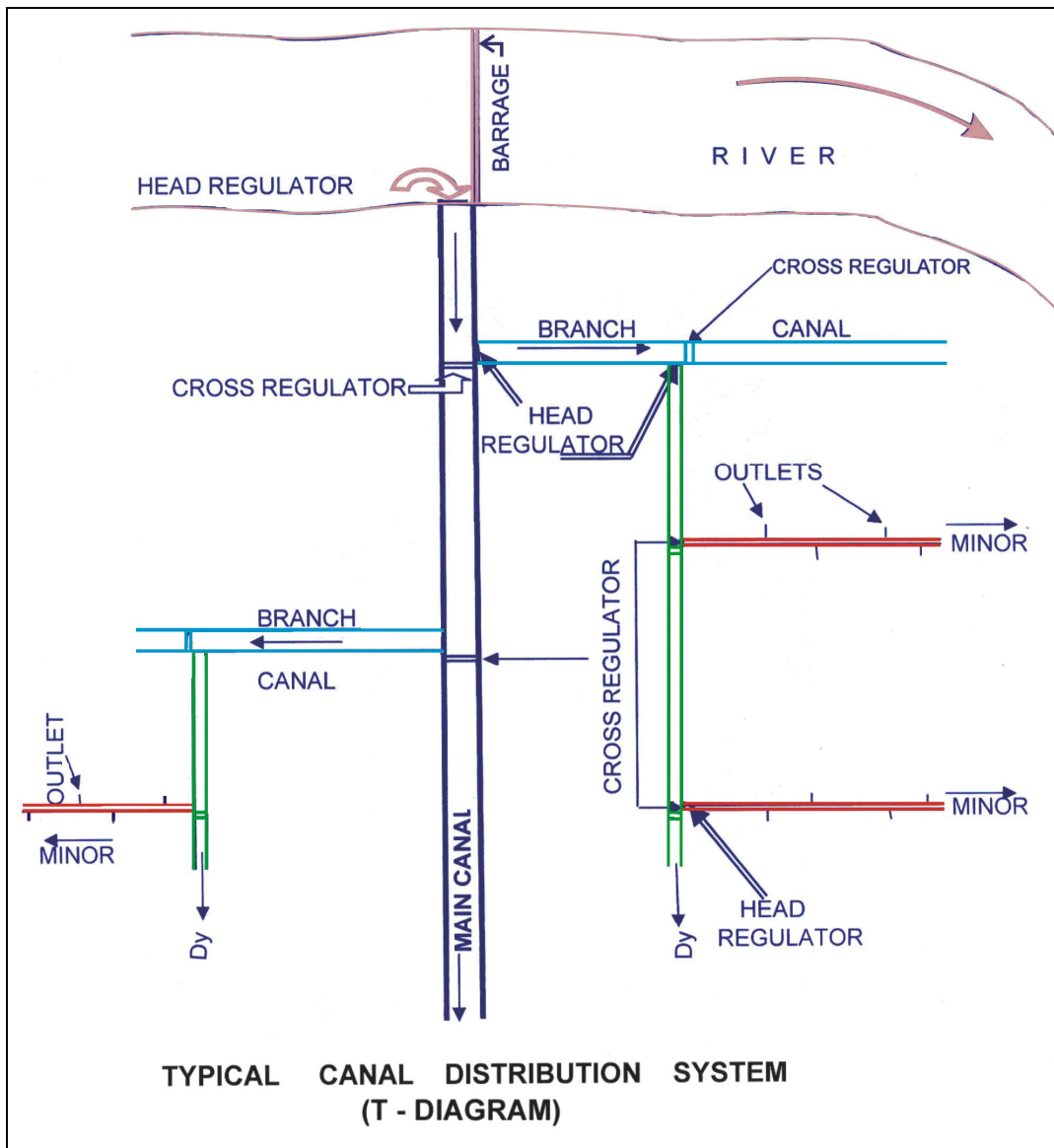
CHAPTER -1

CANAL DISTRIBUTION SYSTEM AND STRUCTURES ON MINOR

1.0 Canal Distribution System

To provide Irrigation in an area, a wide network of canals is constructed so as to carry water from a natural source such as River, Lake, and Ponds etc. and to distribute it in a fairly uniform and equitable pattern in the entire command area. This network is called the distribution system.

A typical irrigation canal distribution system is shown below.



1.1 Elements of Canal System

The Canal distribution system generally comprises of

a. Barrage

A barrage is constructed across a river from which a canal is proposed to be taken-off. Barrage is a barrier across the river and is necessary to divert the river water to the proposed canal. The upstream water level in the river is controlled by lowering or lifting the gates at the barrage.

b. Main Canal

A head regulator is constructed on the river in the upstream of barrage and at the location proposed for the canal to take-off. The designed discharge is released in the main canal through the head regulator. The discharge in canal is controlled by lowering or lifting the gates of the head regulator. Normally main canal has no direct outlets and minors taking off from it.

c. Branch Canal

One or more branch canals may take off from a main canal, depending upon the requirements of water in the command area of these branch canals. Normally no direct outlets are provided on branch canals.

d. Distributory (Dy.)

One or more Dys may take off from a branch canal, depending upon the requirements of water in the command area of these Dys. Some direct outlets are provided in Dys.

e. Minors

One or more minors may take off from a Dy, depending upon the requirement of water in the command area of these minors. In exceptional circumstances, minors may take off directly from branch canal. A minor has several outlets which pass the water from minor to the fields through the guls constructed at the exit of the outlets. The number of outlets on a minor depends upon capacity of an outlet and the command area of the minor proposed to be irrigated.

f. Escape

An escape on the canal takes off at the U/s of a cross regulator across the canal. In case of emergencies in the D/S of cross regulator due to breaches in canal or encroachment on free board of canal due to sudden drop in water demand in its command area, the desired discharge from canal is passed into nearby river / drain

through escape. This reduces the canal discharge to facilitate closure of breaches. The discharge in escape is regulated through its gated head regulator.

g. Cross Regulator and Head Regulator

A cross regulator, at the location proposed for taking off a canal is constructed across the parent canal as below:

- Across the main canal for taking off a branch canal.
- Across the branch canal for taking off a Dy.
- Across the Dy for taking off a minor, where necessary

Construction of Cross Regulators across the canal should be avoided unless absolutely necessary.

A head regulator is constructed on the bank of parent canal in the upstream of the cross regulator to pass and regulate the designed discharge in the off- taking canal. The discharge is controlled by lowering or lifting the gates of the head regulator.

2.0 Capacity of main canal

The capacity of main canal depends upon the total water requirement in its command area proposed to be irrigated, water losses during the flow of water through all the off-taking canals and availability of water in the river.

2.1 Discharging capacities¹

Sl. No.	Type of canal	Capacity in cumec
1	Branch	> 14 (500 cusecs)
2	Distributory	> 0.6 (20 cusecs) & <14 (500 cusecs)
3	Large Minor	> 0.3 (10 cusecs) & <0.6 (20 cusecs)
4	Small Minor	<0.3 (10 cusecs)

3.0 Structures on a minor

Normally following type of pucca structures are constructed on a minor.

a. Head Regulator

This is constructed on the bank of a Dy or branch canal (in case of direct off-taking minors) to pass the designed discharge in a minor at its head. The discharge is controlled by lowering or lifting the gates of head regulator.

b. Water Measuring Structures (Orifice Module)²

Orifice Modules measure the volume of water passing through them in litre per second. These modules are used as direct intake for minors and may be installed on the bank of parent canal to function as head regulator, only when fluctuations in water level of parent canal are small and within specified limits of 0-11 cm. These modules can be single orifice for a fluctuation upto 8 cm. and double orifice for a fluctuation of 8-11 cm in water level. Desired discharge is passed in d/s by lifting appropriate number of gates of the module.

In case, the water level in parent canal fluctuates beyond the specified tolerance limits, a head regulator with constant D/s level gate (head gate) may be installed in the U/s of orifice module.

c. Gauge Well

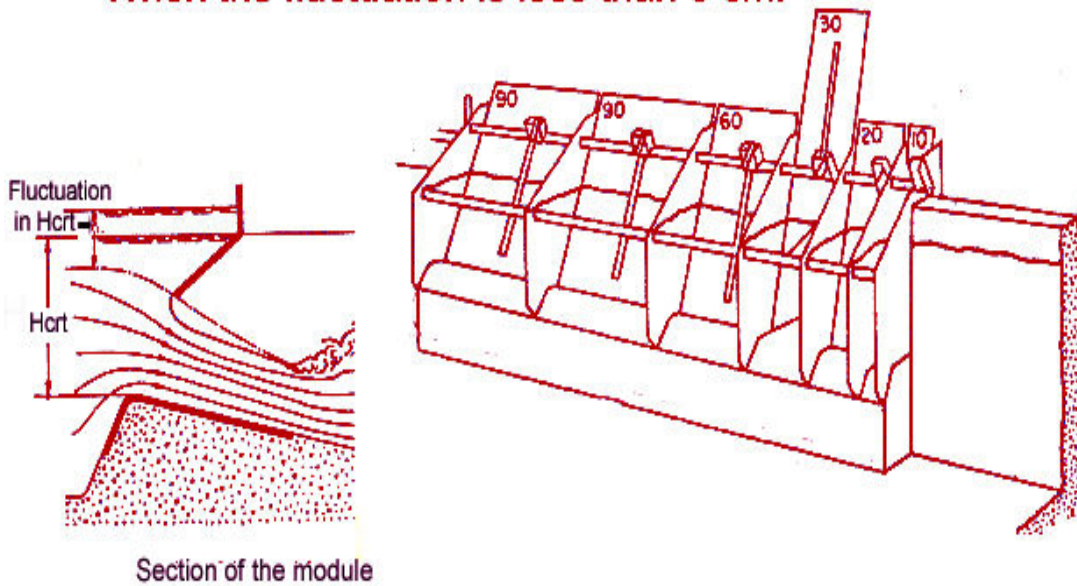
It is constructed on the bank in down stream of the Orifice Module (head regulator where Orifice Module is not provided) at a short distance where flow in the minor becomes smooth. This consists of a pucca well with its bottom at the bed level of minor and connected at its bottom to the minor through a pipe. Water level in the well is same as in minor and is measured on a scale painted on a wall of the well.

d. VRB / DRB³

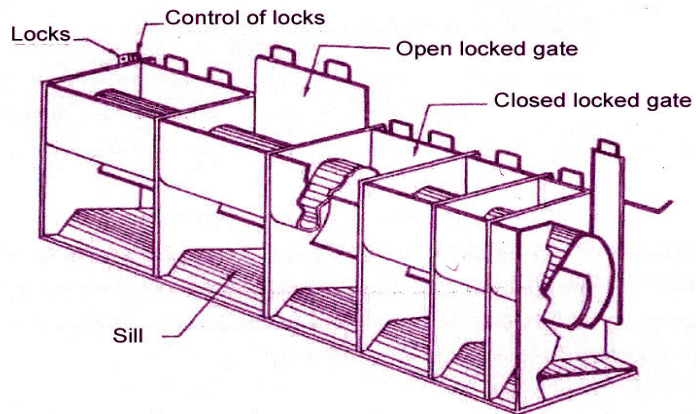
When a road crosses a minor, a pucca bridge VRB / DRB, is constructed across the minor.



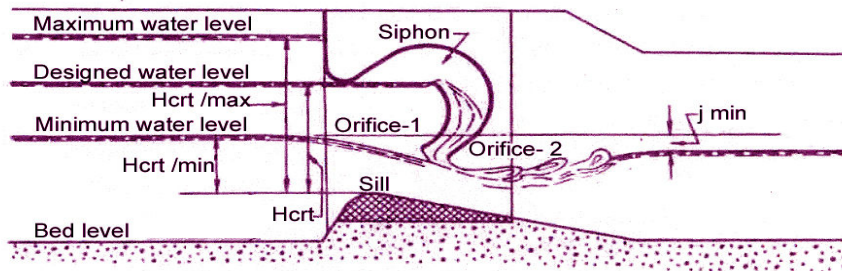
When the fluctuation is less than 8 cm.



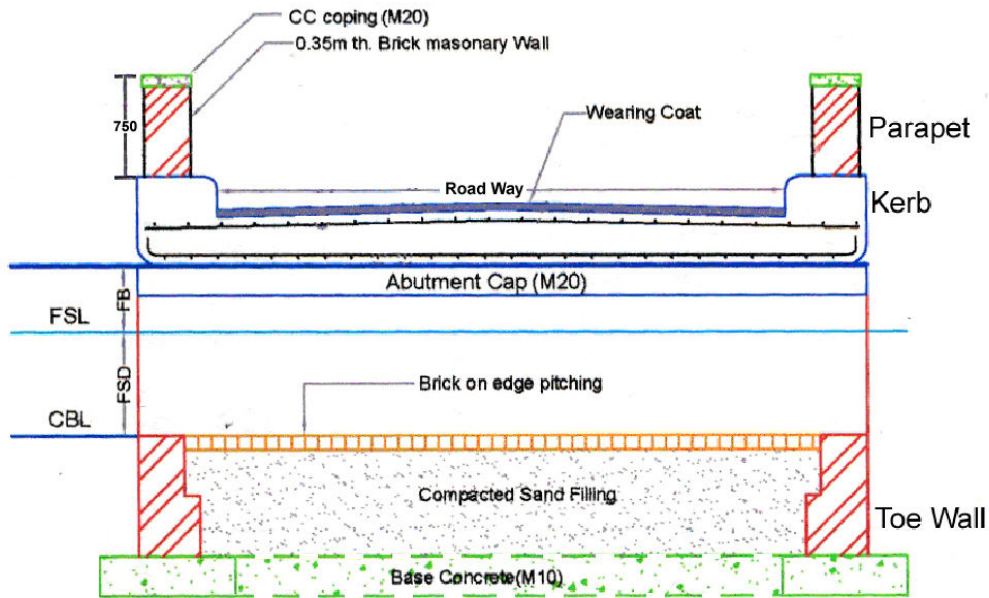
Single Orifice Module



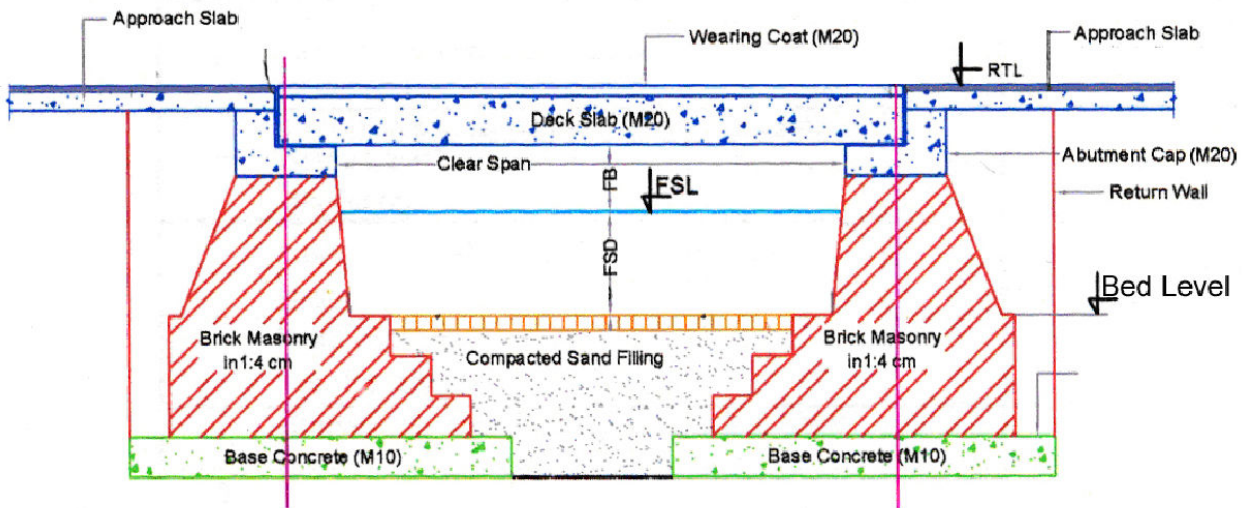
When the fluctuation is between 8 to 11 cm.



Double Orifice Module



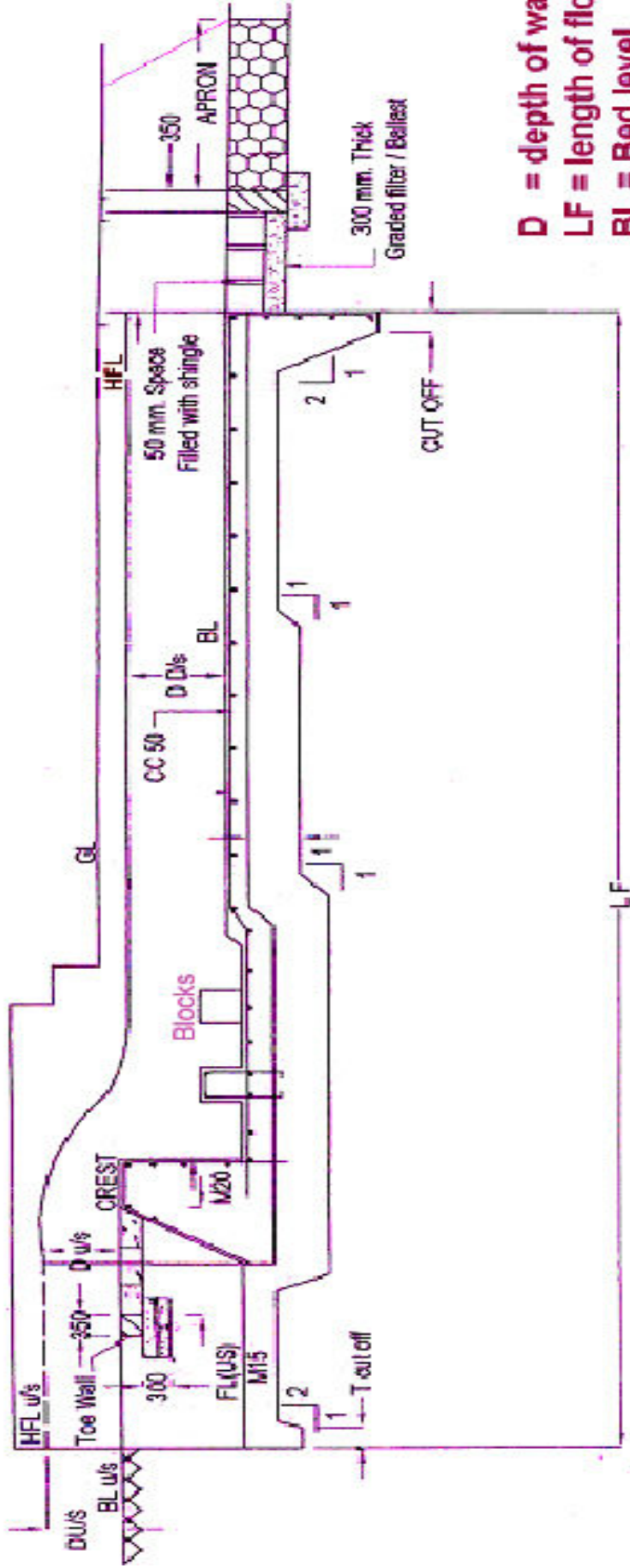
SECTION ALONG FLOW



SECTION ACROSS FLOW

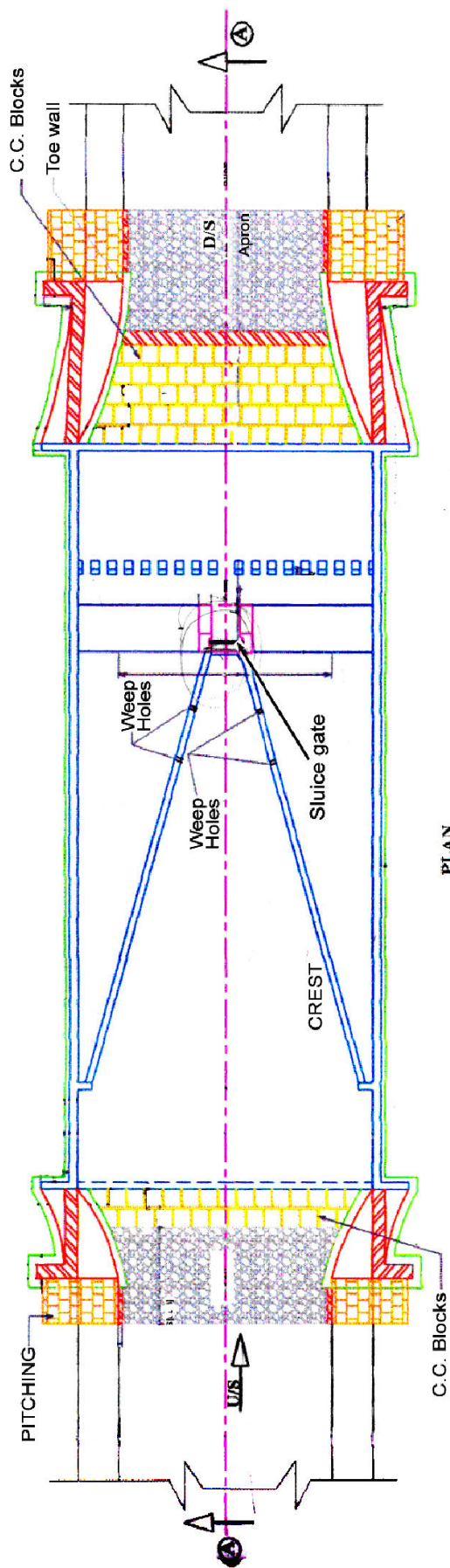
TWA - Top Width of Abutment
 FSD - Full Supply Depth
 FB - Free Board
 RTL - Road Top Level

VRB ON A CANAL

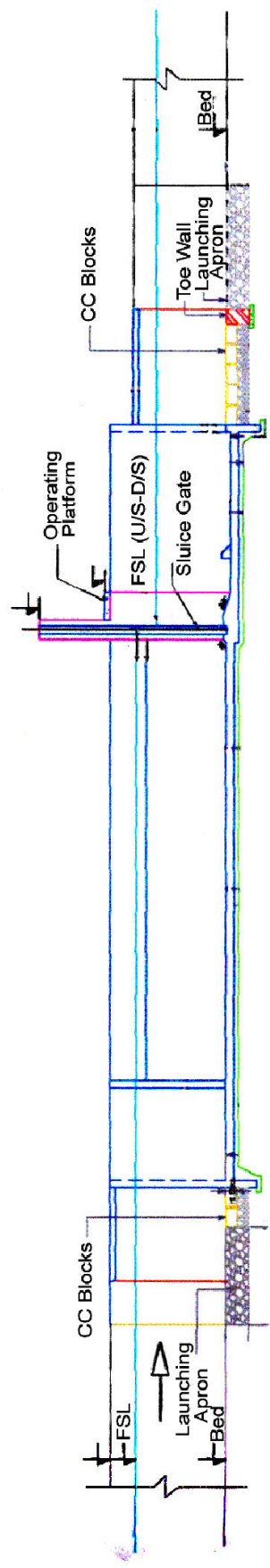


D = depth of water
LF = length of floor
BL = Bed level

Section of Fall

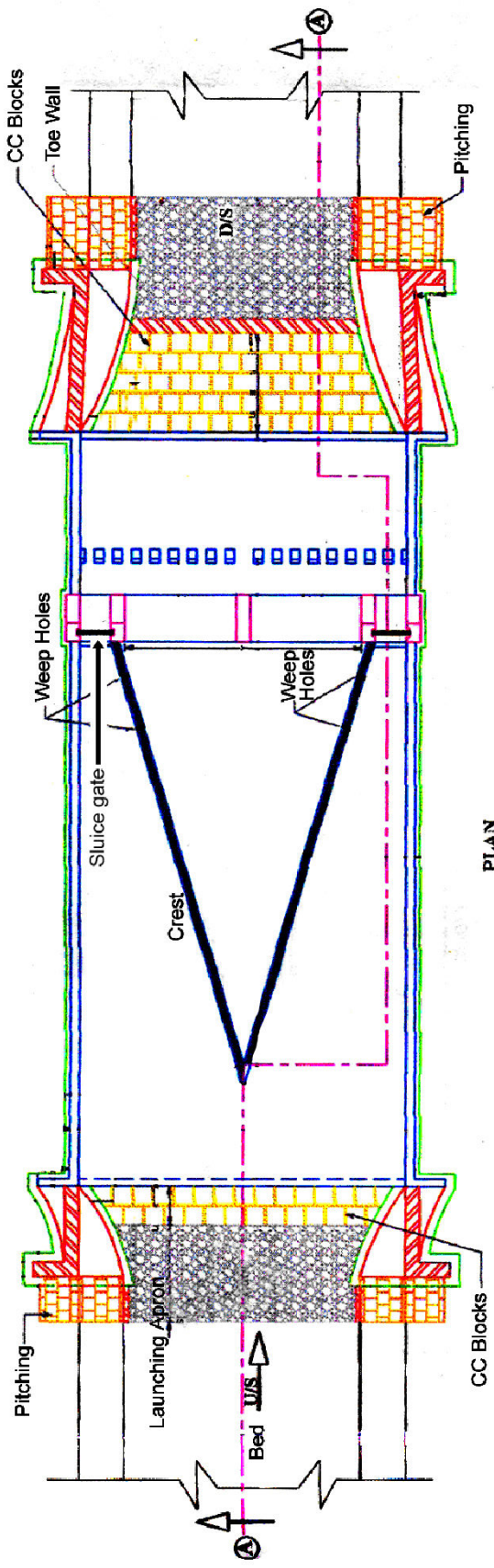


PLAN

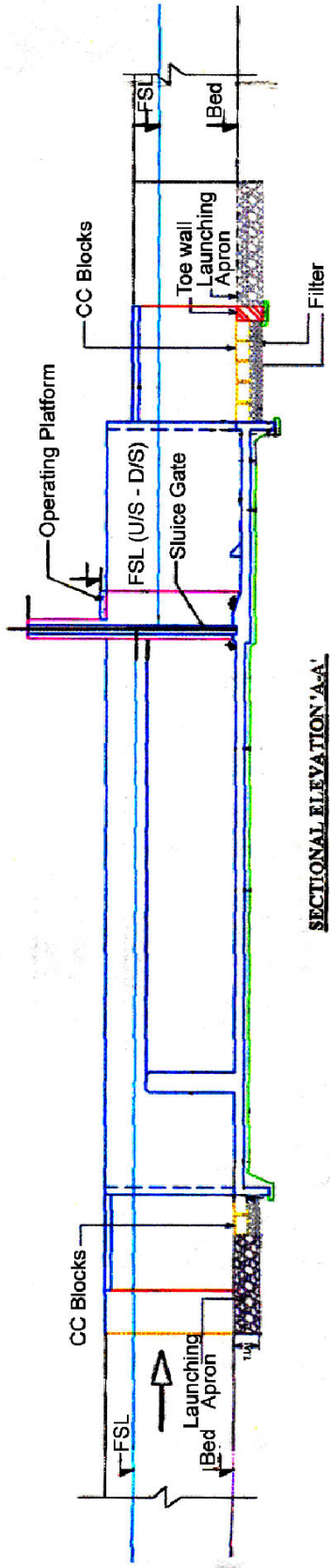


SECTIONAL ELEVATION 'A-A'

V - TYPE SINGLE GATE DUCKBILL WEIR



PLAN



SECTIONAL ELEVATION 'A-A'
Y-TYPE DOUBLE GATE DUCKBILL WEIR

e. **Fall⁴**

This is constructed across the minor, at the location where topography of the area along the minor so requires. The crest wall of the fall ensures that the designed gradients of the U/S and D/S canal bed are suitably negotiated. This, in turn, ensures the proper feeding of U/S outlets / off taking channels.

f. **Duckbill weir⁵**

This is constructed across the minor to control and maintain the water level in upstream at a specific minimum elevation, even when discharge in the channel is lower (within designed limits) than its full supply discharge. This weir helps in feeding the U/S off-taking channels / outlets. Fifty percent discharge passes through the sluice gate(s) of weir and remaining 50% passes over the crest of the weir. When full discharge is available, the gate is kept opened. When discharge falls within designed limits, adjustment for down stream discharge in the channel is made by regulating or closing the sluice gate of weir so as to maintain specific minimum U/S & d/s water elevation in channel.

V-shaped double or single gated Duckbill weirs are constructed as per discharge of the minor. If 50% discharge cannot pass through single gate of 1.2m width, a double gated weir is adopted with combined width of two gates higher than 1.2m.

g. **Drainage Crossing⁶**

Where a drain intersects a channel, a suitable drainage crossing is constructed in the form of a siphon or aqueduct.

h. **Drainage Inlet⁴**

These are provided on the banks of a channel to allow the drainage of rain water collected in nearby fields into the channel. Normally such inlets are not provided on the minors as a discharge with heavy silt load into a minor may create problems. These inlets can only be provided when FSL of minor is lower than ground level.

For field drainage, an inlet chamber of suitable size is constructed at the left or right bank of minors in the D/s of crest walls on minors. Drainage, across the bank is provided through RCC pipes of adequate diameter with its one end embedded in the wall of the chamber and second end in the D/s wing wall of the crest wall and at the level of FSL of the minor.

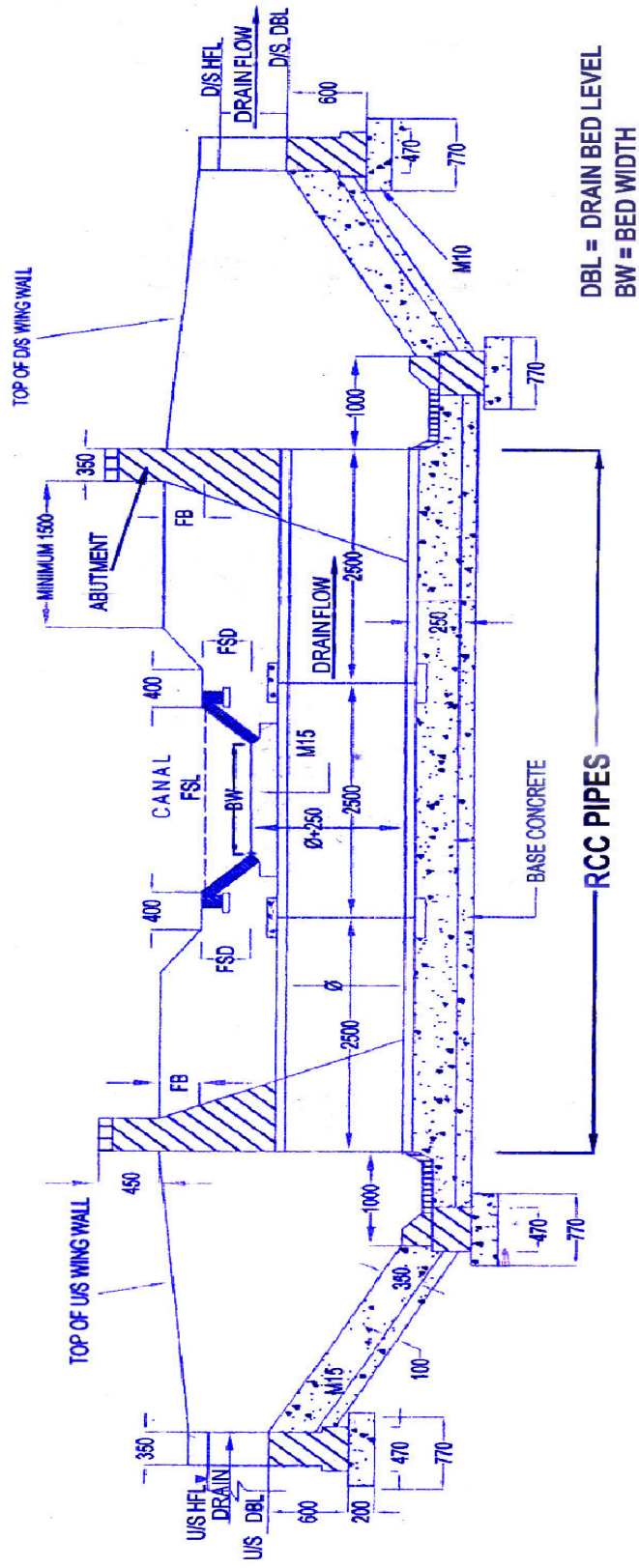
i. **Tail Wall⁷**

This is constructed at the tail of the minor in its bed and upto FSL in height to maintain the designed supply level in the minor so that the outlets in the channel are fed properly.

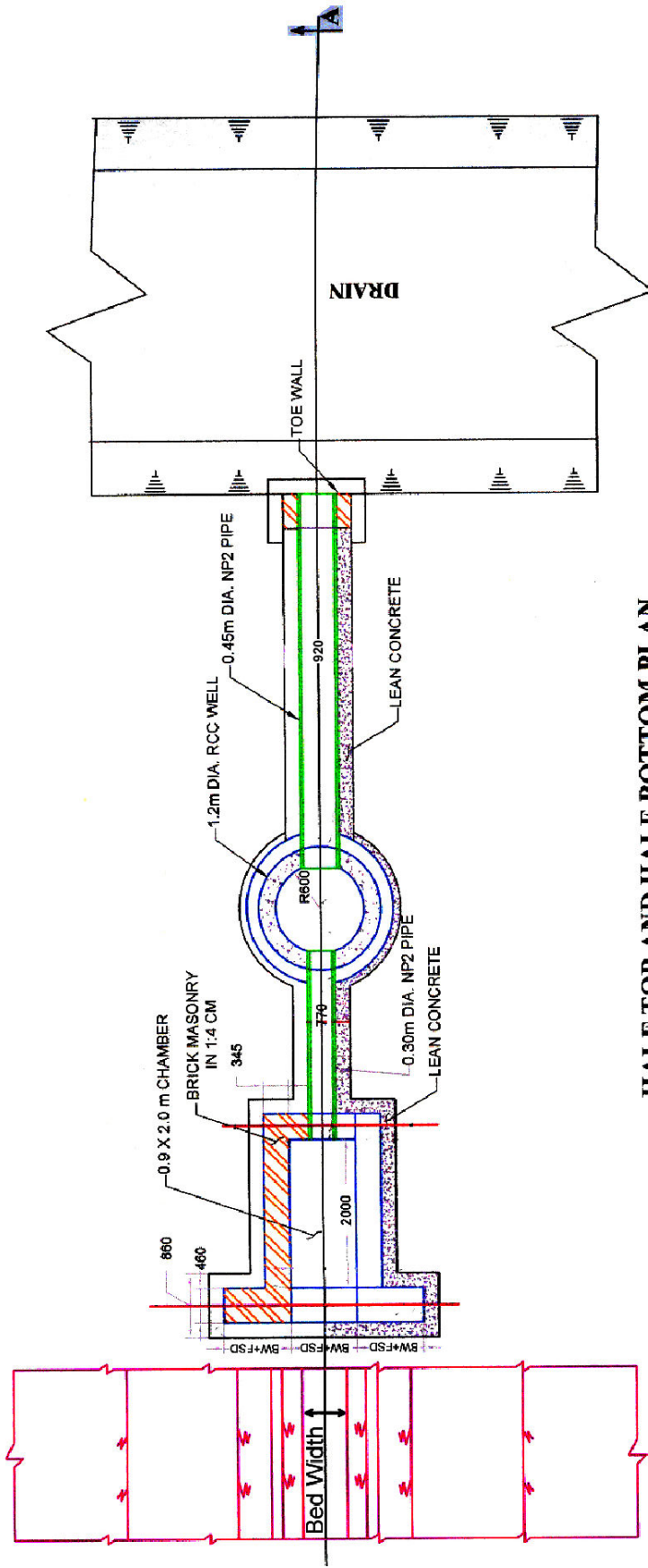
j. Tail Well

This is constructed at the tail of the minor when there is a steep gradient in the ground levels near its tail. At up-stream, bed of minor is kept at the designed gradient upto the well. At down stream, a pipe is provided in the well at the ground level which is very low as compared to the up-stream bed of minor.

Where water in a minor at its tail is directly discharged through tail well in a nearby drain, provision of recharge well may be considered.



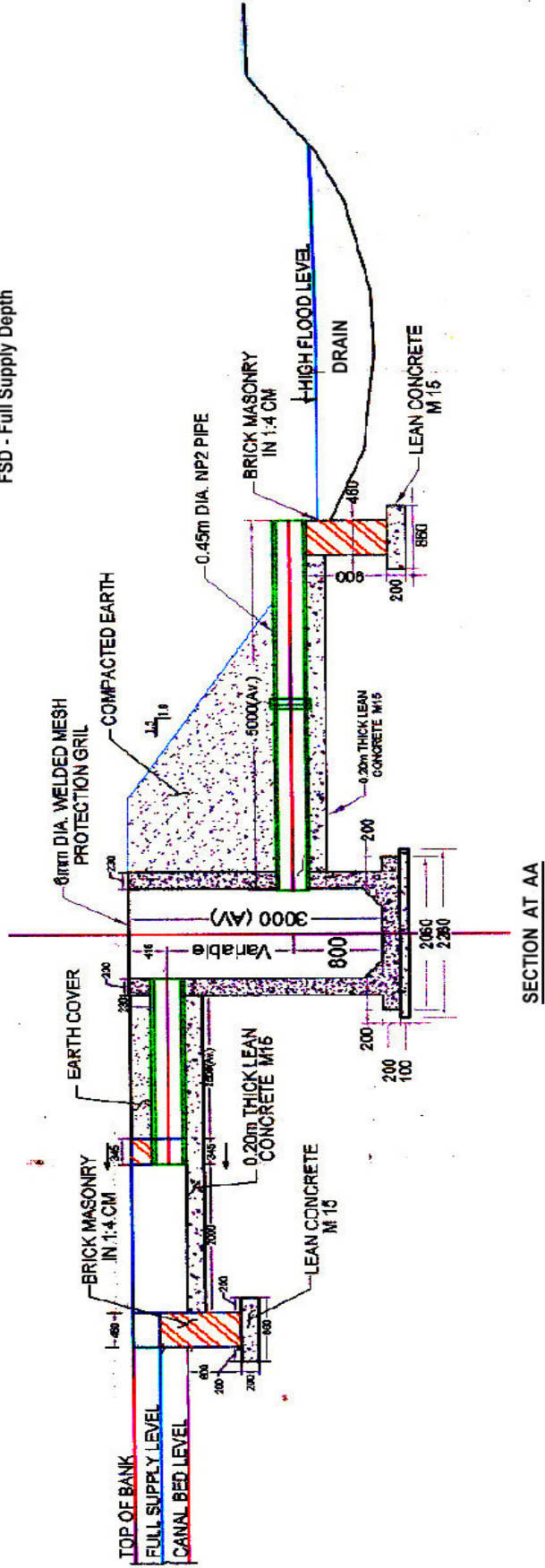
SECTION OF DRAINAGE CROSSING



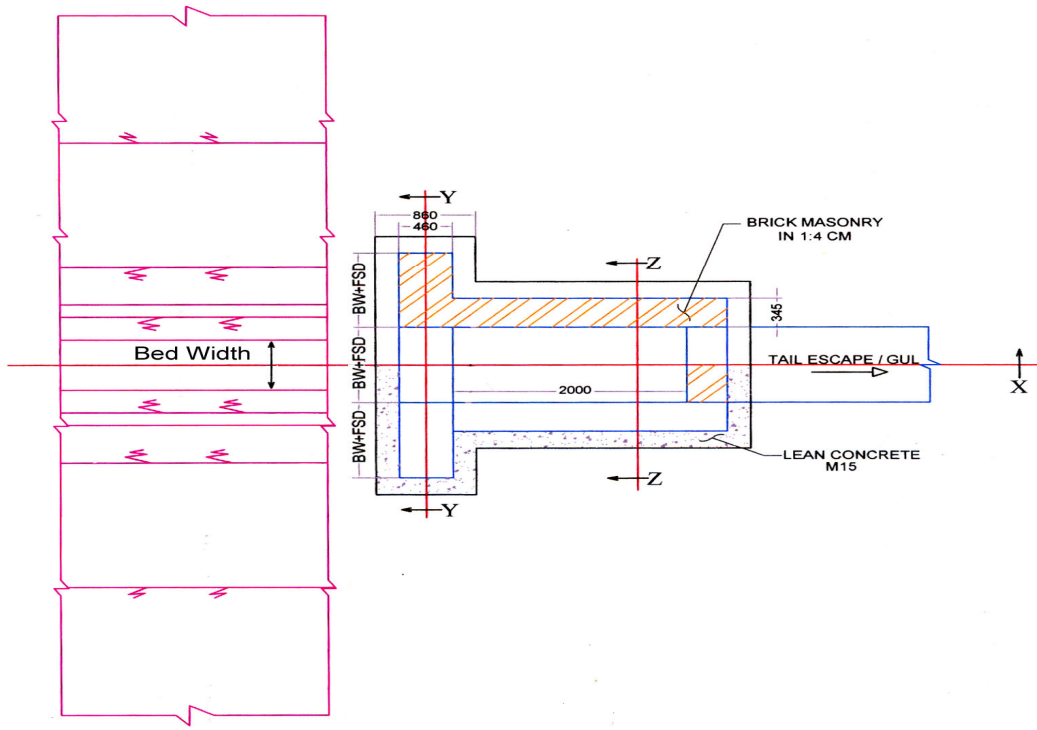
HALF TOP AND HALF BOTTOM PLAN

Details of Tail Well

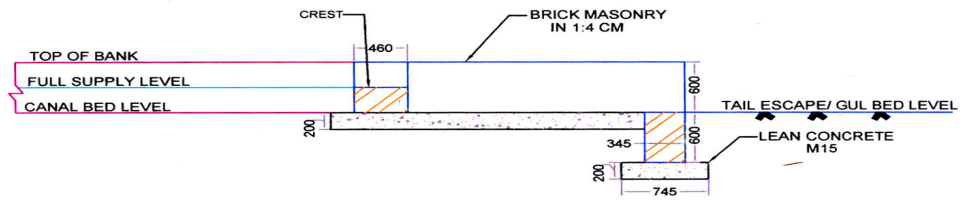
BW - Bed Width
 FSD - Full Supply Depth



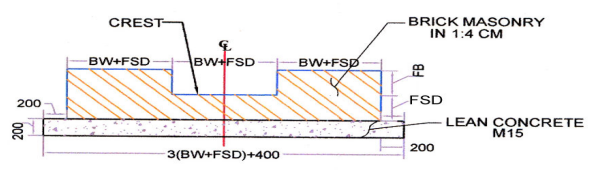
Details of Tail Well



HALF TOP AND HALF BOTTOM PLAN

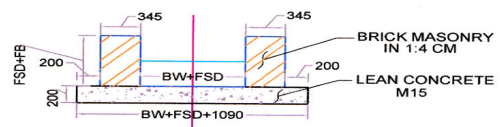


SECTIONAL AT XX



SECTION AT YY

FSD - Full Supply Depth
 FB - Free Board
 BW - Bed Width



SECTION AT ZZ

Details of Tail Wall

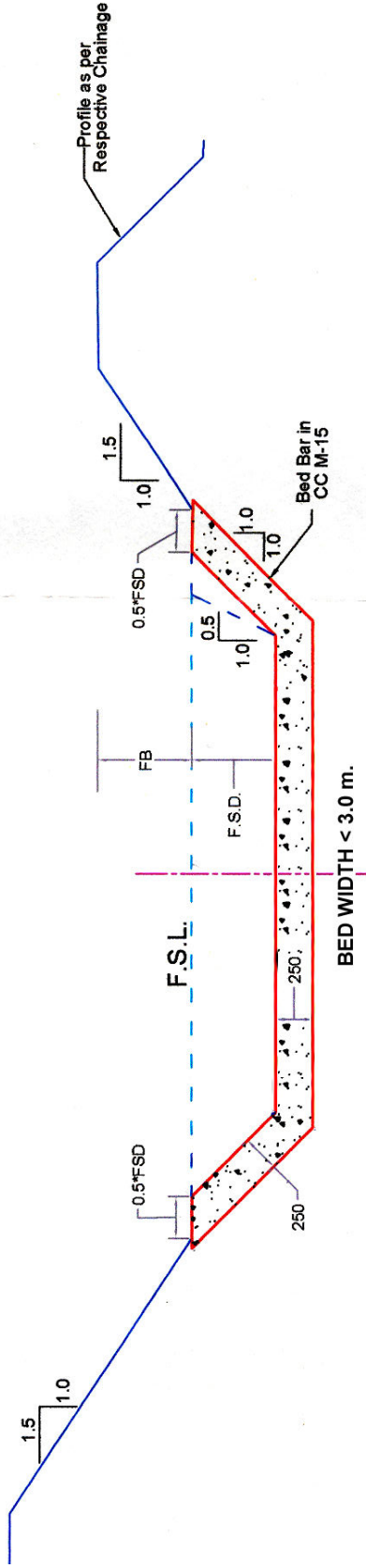
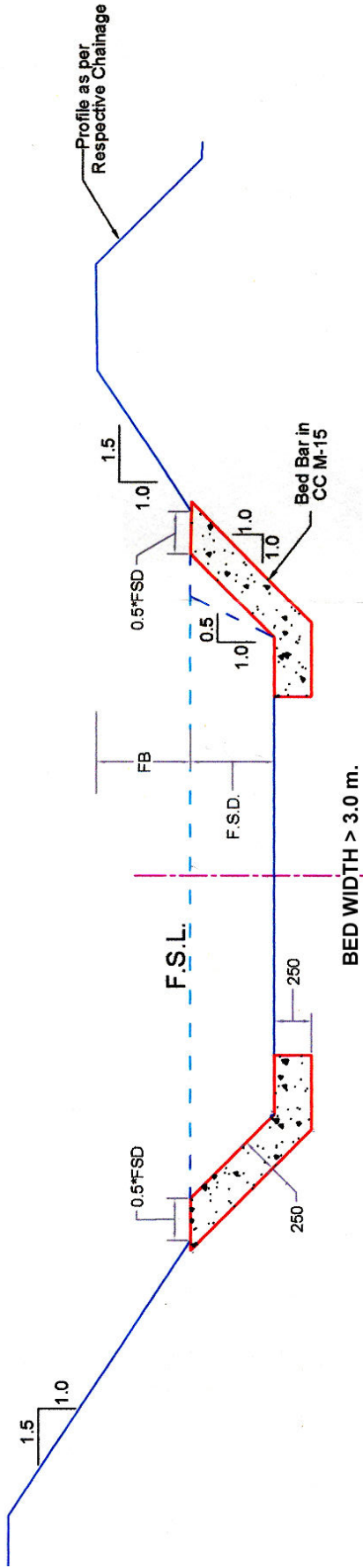
k. **Semi Module Outlets**⁸

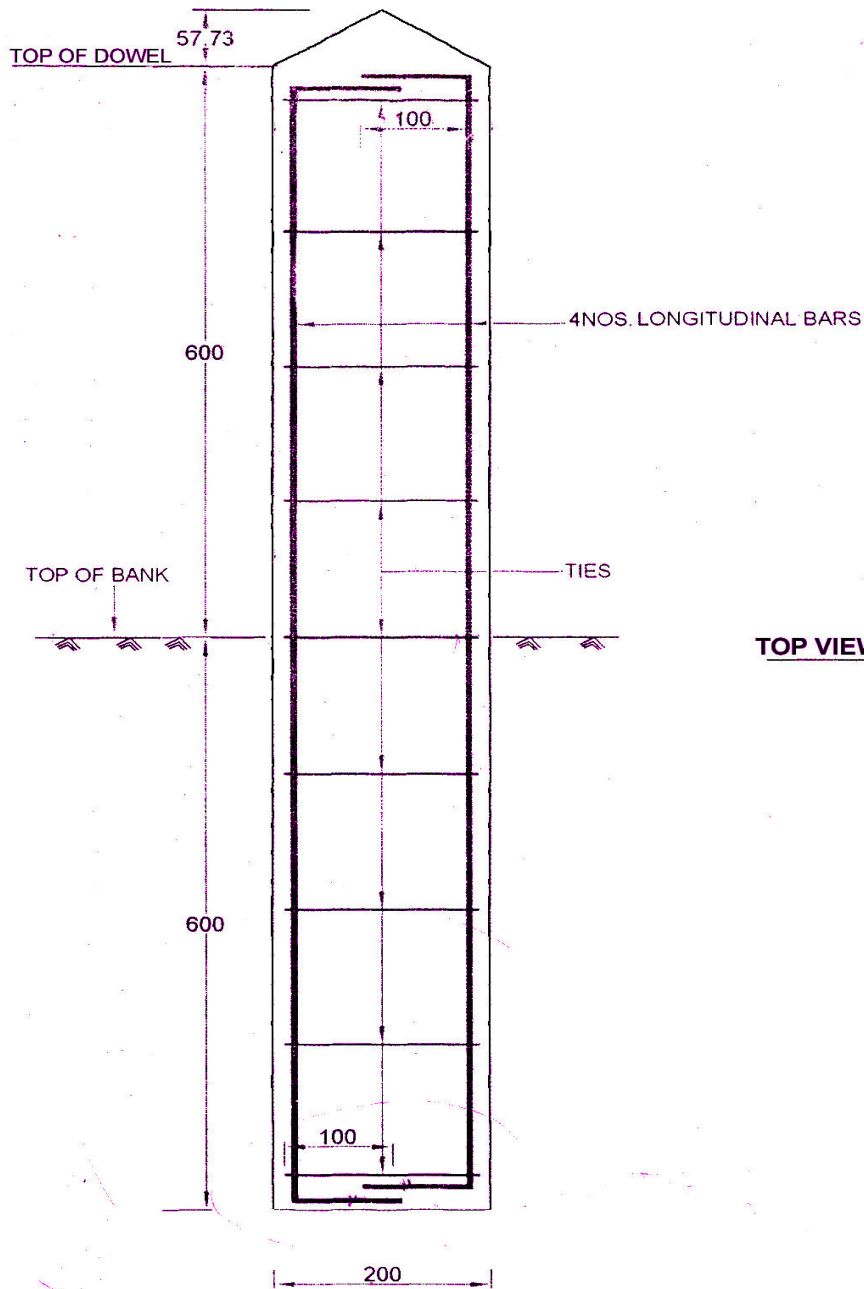
These are constructed at the designed locations in the banks of the minor to supply water to the fields to be irrigated. The outlet pipe is fixed in masonry pedestal wall at its mouth in the minor. This pipe ends in a masonry well, constructed at the toe of outer bank of minor. A pucca flume takes off from this well with a concrete throat block fixed at its mouth which passes and carries a predetermined discharge into the *gul*. This type of outlet is practically not liable to be tampered with for altering the designed flow through outlet.

Pipe outlets are also provided on the minor. In this type, concrete throat block is not provided.

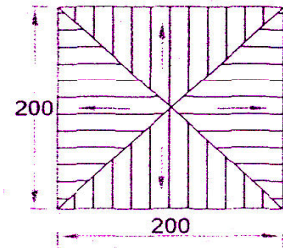
l. **Bed Bar and reference pillars**⁹

The bed bars are constructed in the bed of a minor at a spacing of 200 metre C/C. The bed bars define the designed bed width, bed level and side slope of the minor. In case of any silt deposition in minors, silt is cleared upto the section defined by bed bars. Reference pillars are constructed on left bank of minor and at the chainage of bed bars.

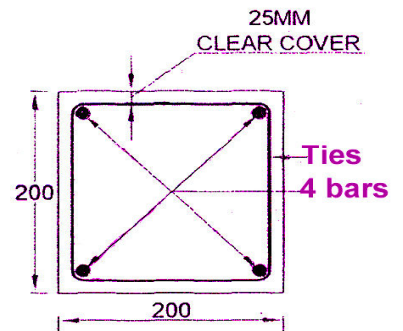




LONGITUDINAL SECTION

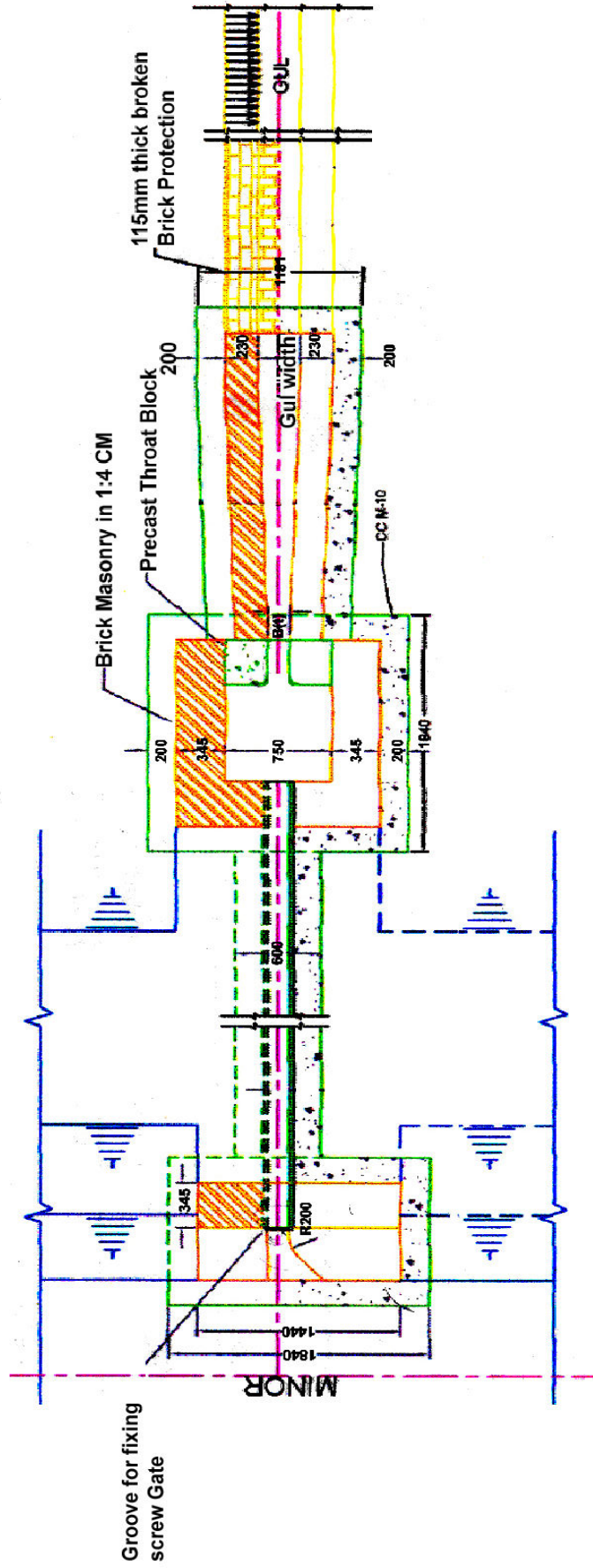


TOP VIEW OF REFERENCE PILLAR



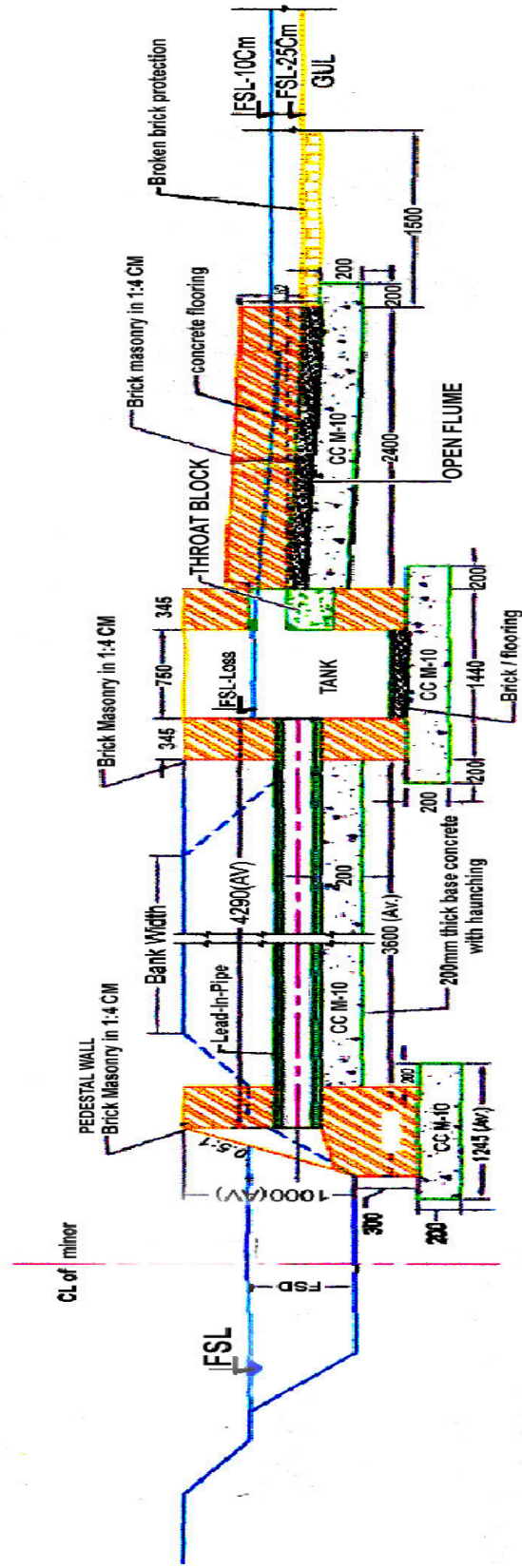
CROSS- SECTION

Details of Reference Pillars



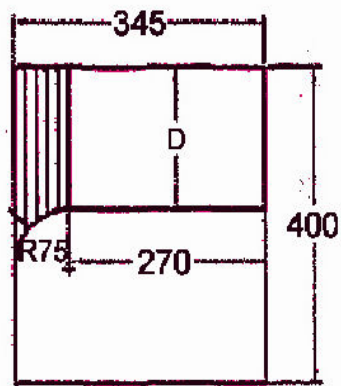
HALF TOP AND HALF BOTTOM PLAN

Pipe Semi-Module (6 to 36 l/sec capacity)

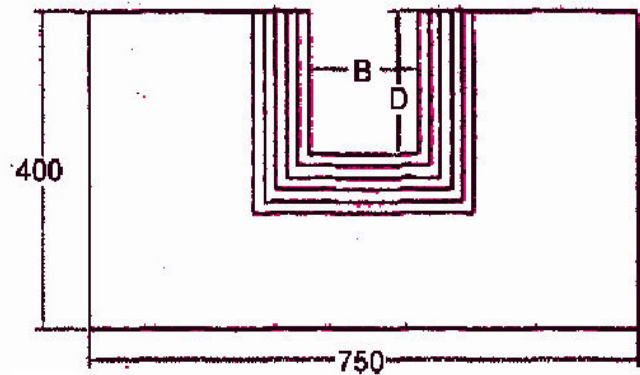


SECTIONAL ELEVATION

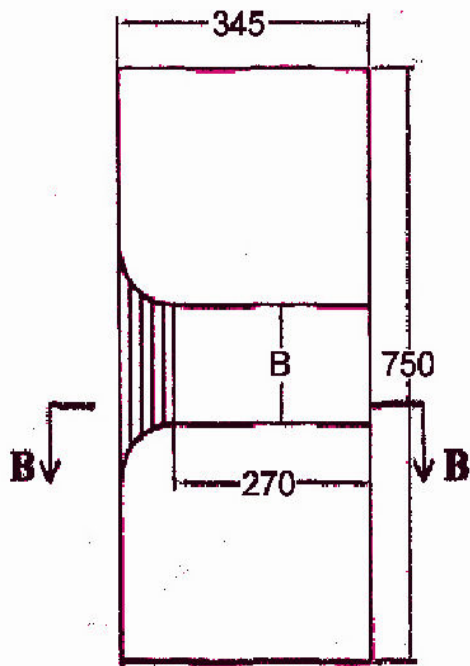
Pipe Semi Module



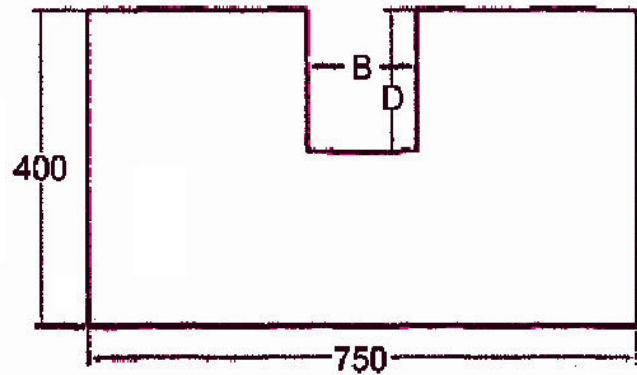
SECTION 'B-B'



FRONT VIEW

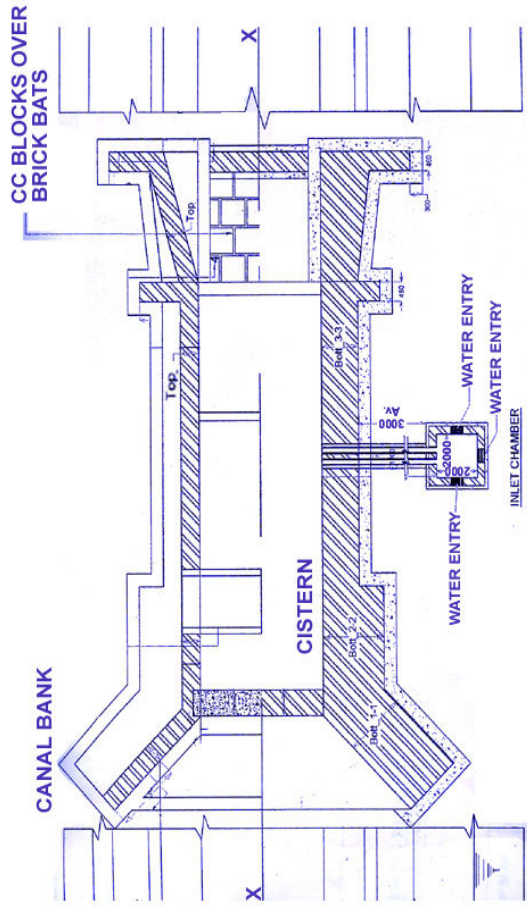


TOP VIEW

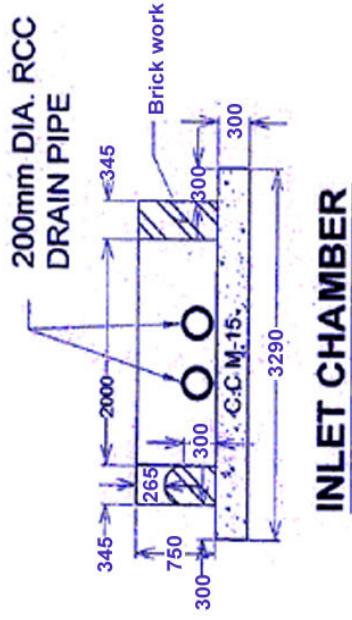


REAR VIEW

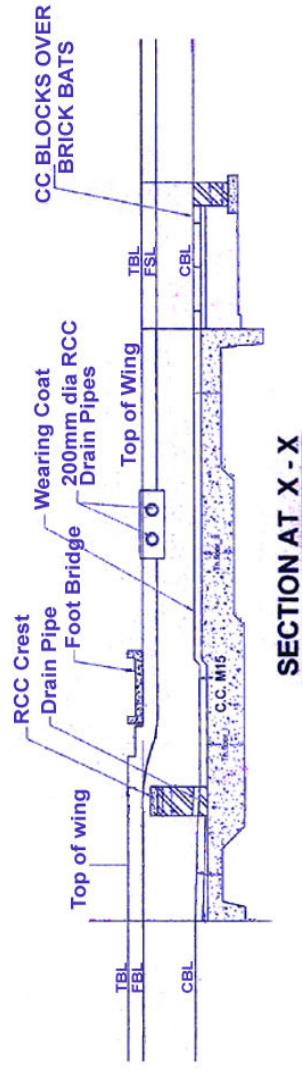
DETAILS OF THROAT BLOCK



HALF TOP AND HALF BOTTOM PLAN (CREST WALL)



INLET CHAMBER



SECTION AT X - X

DETAILS OF DRAINAGE INLET

References

1. सींच प्रदर्शिका – S.P. Mathur, E-in-C (Retd.) UPID
2. TAHAL Document (UPWSRP) – Metering System at the Head of Minor
3. TAHAL Drawing no. – TAHAL/UPWSRP/Dy & Minor/General VRB
4. TAHAL Drawing no. – TAHAL/UPWSRP/General/Check Drop
5. TAHAL Drawing no. – TAHAL/UPWSRP/DBW/General Duck Bill Weir
6. TAHAL Drawing no. – TAHAL/UPWSRP/JB/Dy & Minor/Siphon
7. TAHAL Drawing no. – TAHAL/UPWSRP/Typical/Tail Wall
8. TAHAL Drawing no. – TAHAL/UPWSRP/Minors/Semi Module
 - (i) TAHAL Drawing no. – TAHAL/UPWSRP/Dy. & Minor/Bed Bars
 - (ii) TAHAL Drawing no. – TAHAL/UPWSRP/Dy. & Minor/Reference Pillars

CHAPTER – 2

PARTICIPATORY IRRIGATION MANAGEMENT & WATER USER ASSOCIATIONS

1.0 Participatory Irrigation Management (PIM)

The state of U.P. is essentially an agricultural state aiming at an efficient supply and equitable distribution of water for irrigation by farmers. The government of U.P. in its State Water Policy, 1999 has resolved to adopt integrated water resources management through participatory approach.

The main objective of [PIM](#)¹ is to secure the participation of farmers in equitable distribution of water among themselves, ensuring efficient and conjunctive use of canal water and available ground water for agriculture intensification, operation and maintenance of given irrigation system, drainage of waste or surplus water from their fields to the nearest drain and other aspects of irrigation system management as assigned to them. This will create awareness amongst farmers about the irrigation system and make them responsible about the value of irrigation water. The farmers will become aware of the need for proper maintenance of their canal system to optimize agricultural production by which they can earn more and change their social and economical status.

Once farmers are involved in the operation and maintenance process, this will create a feeling that the irrigation system is made for them, and, if properly used and maintained, they will reap the benefits.

In view of this, the state government has taken the decision to form Water User Associations (WUAs) and transfer the management of irrigation systems at minor level to these Water User Associations.

2.0 [Irrigation Management Transfer \(IMT\)](#)²

- a. The term Irrigation Management Transfer means the relocation of responsibilities and authority for irrigation management from the Government agencies (Irrigation Department) to Water Users Associations (WUAs). Previously the State Government was responsible for all components in the operation and maintenance of irrigation canals i.e.
 - i. Running and maintenance of Main Canals, Distributaries and minors up to outlet head.
 - ii. Utilization of Budget provided for maintenance and fixing priorities of repairs.
 - iii. Preparing the water budget.

- iv. Distribution of water to all beneficiaries.
 - v. Assessment of irrigation area.
 - vi. Preparation and submission of Jamabandis containing statements of Irrigation water charges to concerned District Magistrate Office for recovery from farmers.
- b. With the proposed establishment of Water Users Association and overall change in responsibilities, all above items will need a strategic change process. The changed management after transfer should be such so as to show improvement on the present management system. If there is no improvement, the very propose of management transfer would fail. The changed management system should move with following objectives.
- i. To minimize recurring Irrigation Department expenditure for operation and maintenance of irrigation systems, which are transferred to Water User Associations.
 - ii. To provide transparency in management and accountability of services provided to water users and its social audit.
 - iii. To raise additional resources, if required, for improvements to the system.
 - iv. To maintain accounts and other records in such manner as may be prescribed.
 - v. To get annual audit of its accounts.

2.1. Transfer of Management of Minors to WUAs

- a. For constituting WUAs, U.P. Government Order No. 207/2001-27-Sinchai-04-67W/96 Dated 18-01-2001 was issued. Detail instructions regarding formation and functions of WUAs were issued vide Government Order No. 2188/27-4-67W/96, dated 01-05-2006. As per this G.O, management of Minors shall be transferred to WUAs, in the following manner-
- i. In the first phase, joint management of the minor shall be done by UPID and WUAs. But, prior to this, it will be ensured that UPID shall make the minors capable of running with their designed discharge after rehabilitating them to the minimum extent.
 - ii. In the second phase, the operation & maintenance works of a minor shall be completely handed over to WUAs. State Government shall give grant-in-aid for the maintenance of the minors for only a prescribed duration.
- The ownership of the irrigation system whose management is to be transferred to WUAs shall remain with the government as stipulated in State Water Policy.

- b. [WUAs can get the works executed by following means³](#)
- i. Through members of WUA
 - ii. Through deploying local muster roll labor.
 - iii. Through a contractor, who can complete the work expeditiously as sufficient skilled staff and machinery is available with him.
 - iv. WUA's can also place a requisition with U.P. Irrigation Department for executing works on behalf of WUA for which the necessary funds would be made available by WUA. UPID may execute the works as a Deposit work through the contractors after calling tenders, approval of estimates / rates with detailed justification.
- c. [Effects of transferring the management of minors to WUAs³](#)
- i. The maintenance cost of minors can be reduced by involving WUAs through utilization of indigenous know-how and local wisdom. There shall be no overhead charges incase the maintenance works are done through members of WUA.
 - ii. Works can be done expeditiously as they are not to wait for the administrative approval or technical sanction from the Government. WUA can pass a resolution in their committee to make arrangements of the funds for the works.
 - iii. The execution of works will be methodical because the members of WUA can keep vigil over the works.
 - iv. Discrimination between irrigated areas in head and tail reaches of a minor often results in reduced irrigated area and violation of principal of equitable distribution. With the President of tail outlet committee of a minor being also President of WUA of the same minor and through participatory approach, this discrimination is likely to be reduced.
 - v. Involvement of WUAs in silt clearance of the minors will result in clearance of each minor. This shall result in an increase in the irrigated area of the minor through equitable water supply upto tail reach of the minor.

3.0 Members of Working Committee of Water User Associations

The Minor level WUA shall have the following members as per government order no. 2188/27-4-67w/96 dated May 01, 2006.

- a. WUA will be constituted for every minor by the Irrigation Department. All farmers in the command area of a Minor shall be members of the WUA. The concerned Executive Engineer will constitute the Working Committee of WUA in the following manner.

- i. Presidents of all Outlet Committees of the Minor.
 - ii. Presidents of Water Management Committees of all Village Panchayats in the command area of the Minor.
 - iii. Two progressive farmers in the command area of the Minor, nominated by the District Magistrate.
- b. If under para-3 (a), the scheduled caste/ scheduled tribe woman and marginal farmer do not get representation in the WUA, then nomination of one representative for each of the unrepresented class will be done by the members of the Working Committee of the WUA with mutual agreement or election. Only a person who is a member of an outlet committee shall be nominated in this manner.
- c. The President of the Outlet Committee at the tail of the minor shall be the president of WUA & its Working Committee. The President of the Outlet Committee at head of the minor shall be the Vice President of WUA & its Working Committee. The Irrigation Department shall be represented by a departmental officer / official, who will be the Secretary of the WUA and nominated by Executive Engineer.
- d. One farmer Secretary and one treasurer shall be selected by the members of the Working Committee by mutual agreement or election. This shall be the responsibility of the secretary of WUA representing Irrigation Department that in one year he shall fully train the farmer secretary to carry out all the responsibilities of the secretary of WUA.
- e. The official notification for the formation of the Working Committee of WUA with the names & designations of Working Committee members and date of formation shall be issued by the concerned Executive Engineer.
- f. Till the formation of new Working Committee of WUA, members of old Working Committee will remain in charge of their offices.
- g. Registration of all Water User Associations shall be got done under Society Registration Act and concerned Executive Engineers shall transfer the management of Minors to concerned WUAs after Memorandum of Understanding in prescribed format is signed as per procedure laid down in Government Order no. 2652/03-27-Irrig-4-67 W/96 dated 04-09-03.

4.0 Functions of WUA

The functions to be performed by the WUA as per Government Order No. 2188/27-4-67W/ 96, dated 01-05-2006 are as below.

- a. To receive water from parent canal and to distribute it equitably throughout the command area under WUA.

- b. Maintenance works of the distribution net-work of the water available in the minor.
- c. Maintenance of the minor including all its pucca works and its documentation etc.
- d. Technical and physical improvements in micro-level system / to provide agricultural techniques to increase agricultural productivity in the command area of the minor.
- e. To generate financial resources to cater-for the current expenditure of the WUA.
- f. Keeping in view the availability of water in the command area of WUA, to take-up timely procurement of land from state government for digging of irrigation or other works such as, channel, pond, nalla, reservoir, dams, tube wells etc.
- g. To collect information from the department, regarding availability of water, to get operation-plan prepared for minor and to monitor & evaluate the execution of this plan.
- h. To prevent wastage of water and to ensure its optimum utilization.
- i. To arrange for drainage of water in the command area of the minor.
- j. For better productivity and connected development works, to arrange for auxiliary services, education & training for farmers and inputs for pre and post irrigation periods along with agriculture extension service & marketing.
- k. Supply of agricultural materials through Irrigation Cooperative Society and by establishing Krishak Seva Kendras to enable farmers to get optimum produce using irrigated farming.
- l. To execute any work which is essential, helpful or casual for achieving any one or all of the above objectives.

5.0 Meetings of WUA⁴

Annual general meeting or other special meetings of the members of WUA and meetings of working committee of WUA shall be called, whenever required, by Secretary, WUA with the permission of President, WUA. Minutes of and decisions taken in, each meeting shall be recorded in the prescribed meeting register by Secretary WUA & got approved by President WUA.

6.0 Water Management Committee & WUA

Under Command Area Development Act 1976, a provision for formation of *Chak* Committees to plan, execute and maintain all the works in command of outlets was made. With *Chak* committees becoming non functional, in the year 1990-1991, Water Management Committees (WMC) were constituted under Panchayati Raj Act for construction & maintenance works in the command area

of outlets. Permission of WMC is necessary before taking up execution and maintenance of such command development works. Scarcity of funds after completion of command development works rendered WMCs practically inactive. For effective coordination between WMC & WUA, President of WMCs of all the villages in the command area of a minor have been made members of the WUA of the minor vide G.O. no. 2188/27-4-67W/ 96, dated 01-05-2006.

7.0 Documents with WUA⁵

6.1 The following documents shall be maintained by WUA

- a. Index map of the canal system.
- b. Map of command area of the minor.
- c. Base data of the command area.
- d. Approved L-sections / cross sections of the minor.
- e. Approved design data of minor.
- f. Details of land-owners in the command area of the minor.
- g. Roaster of fasal-wise water distribution for the minor.
- h. Orders regarding PIM.
- i. Land-Plan of the minor.
- j. Land acquisition records of minor.
- k. Schedule of current irrigation rates.
- l. Specifications issued by UPID.
- m. Details of sanctioned outlets.
- n. Details of war-bandi.
- o. Environmental / Social safeguards to be adopted in execution of works on minor.
- p. Details of temporary outlets.
- q. Details of procedure for charging punitive irrigation rates.
- r. Documents concerning audit and enquiry reports.
- s. Other documents which are prescribed.

6.2 The following Documents shall be recorded by WUA regularly for audit

- a. Plantation register of the minor
- b. Details of irrigation – Zinswar, village-wise, outlet-wise.
- c. Account-book containing details of receipts and payments. UPID shall examine this book.
- d. Register of minutes of meetings held by WUA.
- e. Register of details of sales.
- f. Register showing details of MBs, Level Books and Work Order book.
- g. Details of property and dues to be paid.
- h. Register of expenses incurred on maintenance of minor.

The documents shall be kept safely at prescribed place by secretary of WUA. The audit of accounts of WUA shall be done every year by an auditor authorized by UPID and expenses incurred on auditing shall be borne by WUA.

8.0 Disputes & Settlement¹

Settlement of any dispute regarding the maintenance and operation of irrigation system, distribution of water and constitution, management, powers or functions of WUAs arising between members of WUA or between different WUAs is proposed as under:

- a. Any dispute or difference touching the constitution, management, powers or functions of a WUA arising between members shall be resolved by the working committee of the WUA.
- b. Any dispute or difference arising between a member and the Working Committee of a WUA or between two or more WUA shall be resolved by the Working Committee of the concerned Distributory Committee (Rajwaha Samiti) or competent canal officer if Rajwaha Samiti does not exist.
- c. Every such dispute or difference shall be disposed off within 30 days from the date of reference of the dispute or difference.
- d. A party to a dispute or difference aggrieved by any decision made or order passed by the working committee of a WUA may appeal to the working committee of the concerned Rajwaha Samiti or competent canal officer if Rajwaha Samiti does not exist.
- e. Any appeal shall be preferred within 30 days of communication of the decision or the order to the person aggrieved. Every appeal shall be disposed off within 30 days from the date of filing the appeal.
- f. Any party aggrieved by decision of the Rajwaha Samiti / competent Canal Officer may appeal to Appellate Officer within 30 days of communication of such decision. The decision taken by the appellate authority shall be final and binding.

Do's and Don'ts

Do's

1. Registration of WUA should be got done under Society Registration Act.
2. Executive Engineer will transfer O&M of minor to WUA after signing a prescribed MoU with WUA as per G.O. no. 2652/03-27-Irrig-4-67W/96 dated 04.09.2003.
3. The meetings of the WUAs should be held as per schedule and minutes should be recorded.
4. All documents of WUA should be maintained properly by the secretary (WUA).
5. Record of total expenditure of WUA should be maintained in a transparent manner.
6. Annual audit of WUA should be got done of the total income & expenditures.

Don'ts

1. The expenditure of WUA should not be allowed to exceed the income.
2. Members of existing working committee of WUA will not resign until new working committee is formed and take charge.

References

1. Draft U.P. PIM Act (Under Finalization), UPWSRP
2. Rajghat Canal Irrigation Project (M.P.) – Operation & Maintenance, Final Report, October 2003, Para 7.4.2 - Policy of State Government towards WUA.
3. Rajghat Canal Irrigation Project (M.P.) – Operation & Maintenance, Final Report, October 2003, Para 7.4.6 – Resources of Farmers Organization.
4. सहभागी सिंचाई प्रबंधन हस्त पुस्तिका – (UPWSRP)INDIA-N-PIM, New Delhi, August 2005 , Chapter-3- Working System of WUA.
5. सहभागी सिंचाई प्रबंधन हस्त पुस्तिका – (UPWSRP) INDIA-N-PIM, New Delhi, August 2005, Chapter-4, Enclosure-4, para 5, Supplementary Encl: 2.1 & 2.2 under Transfer of Minor Management & Supplementary Encl: 2.3 & 2.4 under Operation of Minors

CHAPTER – 3

GUIDELINES FOR CONSTRUCTION OF MINORS

A. EARTHWORK FOR MINOR

All works shall be carried out in accordance with the drawings approved by the competent authority and in accordance with IS: 4701 & UPID specifications.

1.0 Setting – out

Before start of work, centre line of the minor shall be marked by suitable firm pegs each at about 30 m interval in straight reaches. In the curved reaches of the minor, the centre line of the curve, top and bottom edges of excavation and toe of embankment shall be peg marked at an interval of 5 m to ensure smooth curve profile during excavation / [filling](#)¹.

All levels of canal profiles shall be referred to an established firm bench mark not subject to subsidence / disturbance or interference. Temporary bench mark pillars shall be constructed at suitable locations for reference of levels during construction.

Profiles (*Kaccha Namunas*) of designed minor section in fill and cut reaches may be marked at intervals of 25m at curves and 50 m in the straight reaches or as directed by Engineer-in-Charge before start of earth work in the [reach](#).¹

For the embankment construction the toe of the slope on each side of the bank shall be Dag-Belled and marked by pegs firmly driven in the ground at intervals of 20 m. Profiles made by bamboos, earth and strings shall be setup for the guidance of workmen at 50 m interval in straight reaches and 25 m interval in curved reaches. A suitable allowance for settlement, as described under Para 6 “Embankment Construction”, shall be made in setting up the profile for an [embankment](#).²

2.0 Site Clearance

The land over which embankments are to be formed and other excavation is to be carried out shall be cleared off all trees, bushes, rubbish, ant hills and other objectionable matter. The cleared material shall be suitably disposed off as directed by Engineer-in-Charge.

In filling reaches, all holes and hollows whether originally existing or produced by digging up roots shall be filled with suitable earth, well rammed and leveled off.

Boulders if found at site which may interfere with the work, should be removed after breaking them down, if required. The land so cleared shall be maintained free from any growth and vegetation during progress of construction.

It is desirable to protect the trees out side the outer edge of the canal embankments.

3.0 Excavation

a. For Minor

- i. Before starting excavation, initial cross sections shall be measured as specified in [para 14.0.](#)³
- ii. Excavation may be carried out by manual labor or by excavating machines. The choice of the type of machine will depend on nature and quantity of material to be excavated and also on the leads and lifts involved.
- iii. Before commencement of the excavation in any reach, the contractor shall obtain in writing from the Engineer-in-Charge instructions and schedule of quantities in regard to the disposal and utilization of the excavated materials.
- iv. Dagbel should be laid down on the ground indicating the bed, berms and banks of the canal.
- v. Canal section shall be excavated as shown on the drawings or as directed by the engineer in-charge. Both edges of the bank specially the inner one shall be neatly aligned symmetrically to the centre line of the minor.
- vi. The contractor shall excavate whatever material may be encountered up to the depth of excavation shown on the Cross-section of the channels. Extra payment shall however be admissible for rock and block Kankar excavation, if any and found in excess of [5%.](#)⁴
- vii. All material thus excavated shall be the property of the Government.
- viii. The bed of the minor will have a longitudinal gradient as given in L-section and will be kept level transversely.
- ix. The side slopes and sections of canal shall also conform to those given in the drawings and shall be neatly finished.
- x. Any excavation done below the prescribed bed level shall not be paid for.
- xi. All clods of earth shall be broken thoroughly before placing in embankment.

b. For foundations

- i. Foundation trenches for all structures such as head regulator, VRB, fall etc. shall be dug to the exact length & width of the foundation concrete. The sides shall be left plumb where the nature of the soil admits of it, but the sides must be sloped back or shored up carefully when the soil appears likely to slip. No excavated material shall be placed within 1 metre from the edge of any

trench. The disposal of excavated material shall be as per direction of Engineer-in-charge.

- ii. The bottom of the foundation trenches must be perfectly level both longitudinally and transversely. The bottom of the trench shall be slightly watered and well rammed. If boulders are found in bed of the trench they shall be removed. Roots of all trees and plants if found in the bed of the trench shall be removed completely or they shall be cut to a depth of 30 cm. on sides and bottom of the trench and shall then be smeared with boiling coal-tar. Any soft, spongy or other unsuitable soil found in the bottom of the trench, shall be removed to such depth, width & length as directed by Engineer-in-charge. All the depressions and holes caused by removing the boulders, roots or soft material from the bed, shall be filled with lean concrete [\(1:3:6\)](#)⁵
- iii. If excavation is done deeper than shown in the drawing, the contractor shall fill it at his own expense, the extra depth with lean concrete (1:3:6).
- iv. Before laying foundation concrete in the trench, a 2 cm. thick layer of 1:4 cement sand mortar may be laid over the earth at the bottom of the trench to prevent absorption of concrete moisture by earth. Alternately, a polythene sheet of adequate thickness, in place of cement mortar, may be spread over the earth in the bottom.

4.0 Drainage of work area

- a. Suitable arrangements for drainage shall be provided to take surface water clear of the excavation site during the progress of work. Sumps may be constructed at suitable places and water collected may be pumped out. When cutting on cross sloping ground, it is advisable to cut a catch water drain on the higher side to prevent water from flowing down the cutting slope.
- b. Wherever ground water is met during excavation adequate measures shall be taken to dewater the excavated sections. The choice of method to be employed and type of equipment to be used would depend on the nature of ground and the volume of water to be dealt with.
- c. All operations for proper drainage and to make the work area suitable for excavation shall be carried out by the contractor at his own cost. In foundation trenches, water shall on no account be allowed to rise above the lowest level of the concrete in foundation.

5.0 Selection of borrow area

- a. Suitable material available from excavation of canal, foundation for structures, and any other associated excavations & within economic leads shall be used for the embankment.
- b. Where canal excavation does not furnish sufficient suitable material for embankment, additional material required shall be procured from the borrow pits. The location of the borrow area shall be identified by the contractor with the approval of Engineer-in-Charge before commencement of work and clearly demarcated on shazara sheet of the area with khasra nos of the fields identified.
- c. Borrow area having expansive and dispersive clay shall be avoided. If the expansive and dispersive clay is there in a thin layer or in small pockets it shall be excavated and removed.
- d. Suitability of earthwork material for use in construction of embankment shall be determined by the engineer on the basis of specified laboratory test results for engineering properties of the soil. These tests shall be carried out to ensure that the soil proposed to be used does not contain soluble lime content or cohesionless fines in quantities harmful to the embankments.
- e. The soil shall also be free from any organic material. This shall be ensured by removing top vegetative layer of soil upto a depth of 15 cm. at the site of borrow area before digging the earth.
- f. Borrow area in 'Usar' land or having salts on the surface shall be avoided.
- g. All the borrow areas shall be cleared in the same manner as prescribed in the Para 2.0 above.
- h. No borrow pit shall be dug within 5 m of the toe of the embankment, if their depth is less than 0.5 m, and 10 m if their depth is more than 0.5 m; or within such a distance from toe of bank where a 4 (horizontal) :1 (vertical) hydraulic gradient line cuts the ground surface whichever is [more⁶](#).
- i. Borrow pits shall not be more than 1 m in depth and 25 m in length. A clear distance of 1 m shall be left between the pits. The bed of borrow pits shall be left reasonably smooth and [even⁶](#).
- j. Borrow pits shall be drained to avoid stagnation of water. The bottom level of borrow pits should be fixed with reference to the prevailing ground slope towards the nearest natural drainage course. The pits shall be connected together by a drain about 0.5 m wide. The bottom level of connecting drain should suit the bed level of the pits it [connects⁷](#).
- k. Borrow pits shall not be dug by contractor without consent of farmers and shall be rehabilitated after completion of works. This shall include leveling of the borrow area & bottom of borrow pits after spreading evenly any unused loose [earth⁸](#).

6.0 Embankment construction

- a. Embankment shall be built to the height and slope as shown on the drawings. All the edges of the embankment shall be neatly aligned symmetrical to the centre line of the channel. They shall be absolutely straight and smoothly curved at bends.
- b. Before beginning the laying of embankment, the surface area of ground to be occupied shall be stripped or excavated to such depth so as to remove all roots and vegetative matter of any kind or unsuitable top soil as directed by the Engineer-in-charge. The depth of stripping, as a guide, shall be 5.00 to 7.50cm for soil containing light grass cover and 15 to 22.5 cm for soil containing thick vegetation or [agricultural land](#)⁹.
- c. The ground surface under all canal embankments (except rock surfaces) where it is below the maximum water level in the canal, shall be scarified making open furrows not less than 20 cm. deep below natural ground surface at intervals of not more than 1 m. However where the ground surface is below the bed level of canal, the entire surface of the foundation for embankments shall be stripped to a [depth of not less than 20 cm](#)¹⁰.
- d. Embankment shall be built in layers of thickness generally not exceeding 25 cm loose. Each layer will be laid in 30 cm more than full width of the section on its both ends and the banks and berms shall then be dressed after compaction in full width and to the required slope. The top of embankment shall be leveled and finished so as to be suitable for roadway and given a cross slope of 1.25% outwards to drain away [rain waters](#)¹¹.
- e. The height of the earth-fill placement on banks and berms shall be kept 10% higher than the designed section for settlement in case of manual compaction and 5% higher if the compaction is done by heavy [mechanical equipment](#).¹²
- f. Contactor shall be responsible that no unwanted disposal is being made in the work area. Any such disposal shall be removed by him at his own cost to the satisfaction of Engineer-in-Charge.
- g. Where the embankment is constructed by taking material from borrow pits care shall be exercised that all large clods are broken and no clod bigger than human fist (say 8 to 10 cm), roots, grass and other rubbish are buried in the banks. Before procuring materials from borrow pits, all organic / unsuitable materials shall be stripped off from the top surface as specified in Para 5.0. All materials shall be spread in embankments so that clods upto 8 to 10 cm present in borrowed earth are well distributed through other material and not concentrated in any position within or under the embankment.
- h. In areas where gravel and stone is mixed with earth, these should be removed as far as possible. But the areas where all gravel material cannot be economically

removed, cobbles, stones of size greater than 40 mm should be removed to ensure proper compaction. The existence of nest of cobbles may result in more seepage and piping. In view of this, measure to remove cobbles of larger size should be taken at the borrow area [itself](#).¹³

7.0 Compaction

Embankments shall be compacted as detailed under:

a. [Embankments without Controlled Compaction](#)¹⁴

- i. Where the natural ground surface is above the maximum water level in the minor but below the top of the embankment and bank is not likely to be used for vehicular traffic, the embankment shall be built in layers not exceeding 25 cm loose in thickness and in excess by 30 cm. to the full width on the both ends of the embankment. The extra width of 30 cm. shall be removed by lip cutting while finally dressing the surface.
- ii. Placement of each layer shall be commenced from the edge farthest from the excavation site. Top of each layer shall be kept slightly depressed in the centre.
- iii. The travel of excavating and hauling equipment or labor shall be well planned so as to take maximum advantage in evenly distributing the material and compacting effort over whole surface.

b. [Embankments with Controlled Compaction](#)¹⁴

- i. Where the natural ground is below the maximum water level in the minor, or incase the embankment is to carry vehicular traffic, it shall be constructed as “embankment with controlled compaction”. The embankment shall be built in layers similar as in the case of embankment without controlled compaction.
- ii. The placement of each layer, movement of labor or machinery / equipment over each layer for compaction shall be done similar as in case of embankments with compaction without control.
- iii. Prior to and during compaction operations the embankment shall have optimum moisture content (OMC) required for the purpose of compaction and this moisture content shall be fairly uniform throughout the layer. OMC is the moisture content that corresponds to the maximum dry density determined in laboratory in accordance with IS 2720 (Pt-VII) 1980. So far as practicable, the moistening of the material shall be performed at the site of excavation but such moistening shall be supplemented as required by sprinkling water at the site of compaction, if necessary.
- iv. If the moisture content is higher than optimum for compaction, the compaction operation shall be delayed until such time as the material has dried to the

OMC. The moisture content of the soil shall be determined in accordance with IS 2720 (Pt-II) 1973.

- v. The dry bulk density of the soil in compacted embankment shall not be less than 95% of the maximum dry bulk density at OMC as per IS 2720 (Pt-VII) 1980.

8.0 Compaction Method

- a. Each and every layer of earth shall be compacted by appropriate number of passes of 8-10 T plain drum / vibratory / pneumatic tyred power rollers and for slopes, by mechanical compactors (fuel or pneumatic operated) depending upon the extent of space available. Where space is not sufficient for the deployment of 8-10 T power rollers, the earthwork shall be compacted by deploying appropriate smaller capacity compaction equipments of the same [compacting effort](#).¹⁵
- b. Density of soil after compaction of each layer shall be determined in accordance with IS: 2720 (Part XXVIII)-1974 “Determination of dry density of soils in place, by the sand replacement method” or IS: 2720 (Part XXIX) - 1975 “Determination of dry density of soils in place, by the core cutter method”.
- c. Density tests at desired frequency, shall be made after rolling of every layer.

9.0 Rehabilitation of Existing Canal Embankments

- a. Site shall be cleared as specified in Para 2.
- b. The base of the extension portion of the embankment shall be treated as specified in para 6, before starting the earthwork.
- c. Benching of slopes of the existing embankments of canal shall be done with a slope not steeper than 2H:1V so as to give a proper bond to the freshly laid embankment soil with the existing soil. The benches shall be 0.3m (V) x 0.6m (H) or as directed by [Engineer-in-charge](#).¹⁶
- d. The contractor shall ensure that there is no blockage of existing outlets of the minor due to disposal of the excavated surplus material. If anything found contrary, the contractor shall arrange to rectify at his own cost.
- e. Earthwork shall be done in layers and with settlements allowance as specified in Para 6. The clods of the earth shall be broken before laying in embankments.
- f. Under no circumstances, the embankment shall be widened by material dumped from the top of the existing embankment.
- g. Adequate quantity of moistening / watering shall be done at the junction of the freshly laid soil with the old embankment for proper bonding.
- h. If initial moisture content in the soil is less than the optimum moisture content (OMC) water shall be sprinkled over the freshly laid layer before compaction. A tolerance of $\pm 1\%$ of OMC for field moisture [content may be allowed](#).¹⁵

- i. Compaction of embankments by machines shall be done as specified in Para 7 & 8. In case of compaction of non-cohesive soils (sandy / gravely), soil placement shall be done in layers not exceeding 20-25 cm loose and shall be properly leveled / spread by dozers / graders, saturated with water and thereafter compacted with 8-10 tonne vibratory power rollers to achieve specified relative density at field .
- j. Manual compaction by durmuts may be allowed where machines cannot be used for compaction.
- k. In case of cohesive soils controlled by proctor test, acceptable density shall be 95% of proctor density. In case of cohesion less soils controlled by relative density test, acceptable relative density shall not be less than 65%.¹⁵

10.0 Disposal of Materials

Where the canal is aligned on sloping ground, excavated material not required for the construction of embankment on the higher side shall be deposited on the lower side. Where canal is on nearly level ground, the excess of material from excavation shall be deposited outside the embankments on either side of the canal in the form of spoil banks leaving a suitable berm and cross drains or at sites directed by Engineer. A gap of 3 m. width at the toe may be left in spoil banks at 150m intervals for the purpose of drainage.

In no case, the surplus earth be loaded on the designed section of embankments.

11.0 Leveling and Dressing

- a. After section of embankments is completed, it shall be leveled and dressed to the lines and slopes in accordance with the drawings.
- b. On completion of construction, all rubbish arising from the works and superfluous earth not required shall be removed and disposed of as directed by Engineer.

12.0 Turfing

For stabilization of slopes and prevention of soil erosion due to winds and rains, turfing is done in following order

- a. **Top Soiling:** Before turfing, laying of 20 cm good quality earth overlying the sub soil (where required) shall be done on outer slopes. The surface is prepared by uniformly grading the area, clearing all debris, removing pebbles (if any) and clods and applying suitable fertilizer. During periods of high temperature, soil of the surface will be lightly moistened.
- b. **Sodding:** The sods to be used shall be cut in rectangle shape 8 to 10 cm thick and laid so that their edges are close in contact and then welded by

being gently rammed to form a level and compact mat. When old surfaces are to be turfed, they shall be picked upto a depth of 4 cm to give a hold to the sods.

- c. **Turfing:** For sodding suitable type of grass forming a thick short turf shall be used. For selecting type of grass it is desirable to consult Agricultural Department. Local farmers may also make available the suitable sods of grass for turfing.
- d. As turfing is completed in an area, the entire area is lightly rolled or temped to ensure adequate contact of grass roots with the soil below. After rolling, turf is immediately watered until the underside of the new turf and base soil are thoroughly wet.

13.0 Tests and their frequency for embankment construction

For each borrow area material, Standard Proctor density and Atterberg limits tests shall be carried out. For field compaction, at-least one set of field density test (comprising 5-6 no of tests) using core cutter or sand replacement method and corresponding moisture content tests shall be conducted for every 1500 cubic metre or 2000 sqm or each layer of compacted earth fill. In case the tests show that the field densities are below 95% of Proctor density, suitable remedial action shall be taken either by moisture correction or by additional compaction, so as to obtain the specified density. The test locations for a set of tests should be so chosen as to represent the whole layer under test. Each layer should be tested for proper compaction before a fresh layer is allowed over it.

Tests and their frequencies for embankment construction

Location	Test	Frequency of test	Purpose	References
Borrow area	Atterberg limits (Liquid Limit & Plastic Limit)	One test for each borrow area or 3000 cum of earthwork	Classification of soil to be placed in the embankment.	IS : 2720-V-1985
Borrow area/Excavated silt	Standard Proctor density test	-----do-----	MDD and OMC of the soil and to compare the results with field density and moisture content	IS : 2720-VII-1980

Location	Test	Frequency of test	Purpose	References
Embankment	Field Density & Moisture content (Cohesive Soils) & Relative density for cohesion less soils	One set of tests for every 1500 m ³ or 2000 m ² of earth work or each layer laid on embankment.	Placement density and moisture content	IS:2720-XXVIII-1974 IS:2720-XXIX-1975 IS:2720-XXXIII-1971
	Natural moisture content	----- do-----	To assess the requirement of wetting the earth	

Note: If moisture content of this soil in the layer is higher by more than 2 to 3% than OMC, harrowing of the earth layer should be done to achieve OMC and only then compaction should be done.

14.0 Measurements

Before start of the earthwork, initial cross sections, covering full designed width of minor including its banks, as per drawing, will be measured jointly by contractor and Engineer-in-Charge @ 50m. c / c in straight reaches of minor and 25m. c / c in its curved [reaches](#).³

After completion of construction, final cross sections of the minor will be jointly measured in the same way and at the same locations as for initial cross sections. All the measurements will be entered in the measurement book (MB) by JE, UPID. The contractor will have to record acceptance of measurements under his signatures in M.B.

Measurements of other items of work shall be done as under.

Sl. No	Item of Work	Dimensions to be measured	Unit of Quantity
1.	Earthwork	As described above	Cum
2.	Concrete / Brick Work	Length, Width & Height of section	Cum
2.	Excavation for foundation of structures	Length & Width of the lowest footing of concrete foundation and depth of lowest level of concrete foundation as per drawing below bed of minor	Cum

Sl. No	Item of Work	Dimensions to be measured	Unit of Quantity
3.	Cement Plaster (with specified thickness)	Length & Width (or Height) of plastered area	Sqm
4.	Cement Pointing	Length & Height of pointing area	Sqm
5.	Dry Brick Pitching (with specified thickness)	Length & Height of pitching	Sqm

B. PUCCA WORKS FOR MINOR

1.0 Materials for Construction

1.1 Cement

- a. Cement to be used in the works shall be ordinary Portland cement, 43 grade conforming to IS 8112:1989.
- b. The average compressive strength per source of cement shall be tested on at least three mortar cubes 7.06x7.06x7.06 cm (area of face 50 cm²) composed of one part of cement, three parts of standard sand (conforming to IS 650:1966) by mass and water as (P/4 + 3.0) % of combined mass of cement & sand, where P is standard consistency of cement in %age.
- c. Consistency of cement is determined as quantity of water (in %age w.r.t. quantity of cement) to be added to 500 gms of dry cement to form a wet mass which is workable and penetration of Vicat plunger through it is up to 5 to 7 mm from bottom when tested as per IS: 4031
- d. Cubes are prepared and tested in the manner described in IS 4031(Part 6).The Compressive Strength shall be as under:

72 ± 1 hour (3 days)	not less than	23 MPa (230 kg / cm ²)
168 ± 2 hours (7 days)	not less than	33 MPa (330 kg / cm ²)
672 ± 4 hours (28 days)	not less than	43 MPa (430 kg / cm ²)
- e. Weight: The average net mass of cement per bag shall be 50 kg. Unit weight will be taken as 1.44 tonne / cum.
- f. Cement shall be dry and shall not contain cakes of dampened cement.
- g. Cement shall not be more than 90 days old.
- h. Cement will not be procured from a mini plant to ensure uniform quality.

1.2 Sand (Fine aggregate)

- a. Sand shall conform to IS 383. Sand shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust, lumps, soft or

flaky particles, mica, silt or other deleterious substances. Fine aggregates with a history of having positive reaction with alkali of cement shall not be used. The unit weight of sand (dry) will be 1.6 tonne /cum.

- b. Sand shall be washed off all the mixed earth before use.
- c. The sand shall be well graded and shall have the following gradation for concrete, masonry and plaster works as per IS: 383.

IS Sieve Size	%age passing by weight			
	Zone 1	Zone 2	Zone 3	Zone 4
10 mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.38mm	60-95	75-100	85-100	95-100
1.18mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

Note: Fine Aggregates conforming to zone IV should not be used for reinforced concrete works.

1.3 Coarse aggregate

- a. Coarse aggregate shall confirm to IS: 383 and tests for conformity shall be carried out as per IS: 2386 Part-I and VIII.
- b. Coarse aggregate shall consist of clean hard, strong, dense, non-porous and durable pieces of crushed stone, crushed gravel, natural gravel or a combination thereof or other approved inert material. The aggregate shall not consist of pieces of disintegrated stones, soft, flaky, elongated particles, alkali, vegetative matter or other deleterious material.
- c. Coarse aggregate for use in concrete shall be well graded and shall conform to IS 383:1970 requirements given below:

IS Sieve Size	Percentage passing by weight for graded aggregate of nominal size	
	40 mm	20 mm
80 mm	100	-
63 mm	-	-
40mm	95 – 100	100
20mm	30 – 70	95-100
10mm	10 – 35	25-55
4.75mm	0 – 5	0-10

- d. The unit weight of coarse aggregate (dry) will be 1.6 tonne /cum.
- e. Coarse aggregate shall be washed off all the mixed earth before use.

1.4 Water

Water used for mixing and curing shall be clean and free from injurious amount of oils, acids, alkies, salt, sugar, organic materials. pH value of water shall not be less than 6.0 and shall be within the range of 6.0 to 8.0. Potable water is generally considered satisfactory for mixing concrete. Water found satisfactory for mixing is also suitable for curing concrete. However water used for curing should not produce any objectionable stain or unsightly deposit on concrete surface. The presence of tannic acid or iron compounds is objectionable.

1.5 Steel Reinforcement

- a. For RCC, the reinforcement steel shall be of the grade given below
- b. Grade : Fe - 415
- c. Type : High strength deformed steel bars conforming to IS:1786
- d. Characteristic Strength : 415 N / mm² (Fy)
- e. All reinforcement shall be procured from genuine manufacturers. All reinforcement shall be clean, free from loose mill scales, dust, loose rust and coats of paints, oil or other coatings which may destroy or reduce bond with concrete.
- f. Re-rolled steel shall not be used.
- g. The mass per metre run in Kg of reinforcement steel bars is [tabulated below](#)¹⁷

Sl.No.	Nominal Size of bar (mm)	Cross sectional area (mm ²)	Mass per metre (kg)
1.	6	28.3	0.222
2.	7	38.5	0.302
3.	8	50.3	0.395
4.	10	78.6	0.617
5.	12	113.1	0.888
6.	16	201.2	1.58
7.	18	254.7	2.00
8.	20	314.3	2.47
9.	22	380.3	2.98
10.	25	491.1	3.85

1.6 Bricks

a. General

- i. Bricks shall be made from good earth and shall be table / hand moulded. The earth shall be free from all traces of gravel, kankar or ash or other alkaline

deposits. Bricks shall have a uniform deep cherry red or copper colour and regular in shape, shall be thoroughly burnt but not over burnt. Their edges shall be straight & square and the bricks must emit a clear ringing sound on being struck. They must be free from cracks, chips, flaws and stones or lumps of any kind.

- ii. Before the carriage of bricks to site, they shall be got approved at the kiln site by the Engineer-in-charge of the work. Any sub standard brick carried to site shall be rejected and the contractor shall have to remove the rejected bricks at his own cost within 24 hours of their rejection.
- iii. The following Indian Standard Codes shall be followed:
 - IS 1077:1992 – Common burnt clay building bricks specifications
 - IS 3495:1973 (Part I to IV) – Methods of test of burnt clay building bricks.

b. Size of brick

Brick used shall be of the specified class and size. The standard size of common building bricks shall be as follows (IS 1077: 1977).

Type of bricks	Actual size (in cm)
Non modular size	23 x 11 x 7
Frog in the brick	10 x 4 x 1
	10 x 4 x 2

c. Classification & compressive strength

- i. The common burnt clay bricks shall be classified on the basis of average compressive strength as per IS 1077:1992 as given below:

Class designation	Average compressive strength	
	N / mm²	Kgf / cm² (approximate)
15	15.0	150

- ii. Five whole bricks shall be taken at random from a lot. The dimension shall be measured correct to 1 mm. Testing shall be carried out as per IS 3495 (Part 1): 1992. Minimum average compressive strength shall be as given above.

d. Dimensional Tolerance

- i. All blisters, loose particles of clay and small projections shall be removed. 20 bricks shall be then arranged upon a level surface successively in contact with each other and in a straight line. The overall length of assembled bricks shall be measured with a steel tape or suitable inextensible measuring device sufficiently long to measure the whole row at one stretch. If for any reason it is found impracticable to measure bricks in one row the same may be divided in

two rows of 10 bricks which shall be measured separately to the nearest millimeter. These dimensions shall be added together.

- ii. As per IS 1077:1992, the dimensions of 20 bricks when tested as described shall be within the following limits:

Length	4600mm ± 80mm
Width	2200mm ± 40mm
Height	1400mm ± 40mm

e. Water absorption

The bricks shall be tested in accordance with the procedure laid down in IS 3495 (Part 2): 1992 after immersion in cold water for 24 hours. The average water absorption shall not be more than 15 percent by weight, as per IS 1077: 1992.

f. Efflorescence

The bricks when tested in accordance with the procedure laid down in IS 3495 (Part 3): 1992, the rating of effloresces shall not be more than 'slight'

2.0 Storage of materials

- a. The cement shall be stored in such a manner so as to prevent deterioration due to dampness / water. If the cement is stored for more than 3 months, it should again be tested for its properties before [use](#).¹⁸
- b. The heaps of fine and coarse aggregates shall be kept separate. When different sizes of coarse aggregates are procured separately they shall be stored in separate stock piles sufficiently away from each other to prevent the mixing of materials at the edges of the piles.
- c. Reinforcement shall be stored in such a way so as to prevent rusting and corrosion.
- d. All materials shall be stored so as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-Charge shall not be used for the construction works.
- e. Bricks shall not be dumped. They shall be staked in regular piers even as they are unloaded, to minimize breakage and defacement of bricks. Bricks selected for different situations of use in the work shall [be staked separately](#).¹⁹

3.0 Brick Work

The work shall be carried out as per IS 2212: 1991, U.P.I.D. Specifications and UPPWD Specifications.

3.1. Proportioning and Mixing of Mortar

- a. Cement mortar for ordinary brick masonry shall conform, generally to IS 2250:1981. For preparation of mortar, cement and sand shall be mixed in proportion of 1:4 by volume, taking the unit weight of cement as 1.44 tonne per cubic metre. The volume of sand shall be increased equal to percentage bulking to account for bulking of sand.
- b. Bulking of sand shall be estimated as follows:
 - i. Sample of sand is filled in a measuring cylinder and after gentle tapping, volume of sand is noted.
 - ii. Water is added, to saturate the sand, upto top level of jar and gentle tapping is done so that sand is settled in the bottom of jar, volume of sand is again noted.
 - iii. Percentage increase in volume of sand shall be percentage bulking of sand.
- c. The mortar shall be mixed in a concrete mixer. No hand mixing shall be allowed unless otherwise permitted by the Engineer-in-charge. Sand & cement in the required proportion shall be added in the drum of mixer and drum shall be rotated to mix them uniformly. Lastly water shall be added and mixing will be continued for 2 minutes until all particles of sand are uniformly coated with cement paste. The mortar so prepared shall be consumed within 30 minutes. In case the initial setting has begun, partially set or lumpy mortar shall not be allowed to be used. It shall be rejected and removed from the site by the contractor at his own cost.
- d. Mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with maximum density of mortar. Control shall be exercised on water content and it shall be kept between 0.4 - 0.6²⁰ .
- e. For brick work in piers of VRB, mortar shall be prepared by mixing cement and sand in proportion of 1:3 and for pointing work over brick masonry, in a proportion of 1:2 by volume.
- f. Sampling of fresh mortar shall be done by casting at-least 3 number of 5x5x5 cm cubes for testing compressive strength at 28 days' which shall not be less than 7.5 N / mm² when tested as per IS 2250.

3.2. Laying

- a. All bricks shall be soaked in clean water in tanks for a period of at least 12 hours before use and the contractor shall provide tanks of sufficient capacity to admit simultaneous immersion of bricks for two days use. At the time of laying, the bricks shall be skin dry.
- b. All brickwork shall be laid in an English bond or as directed by Engineer-in-charge. The bricks used at the face and also at all angles forming junction of any

two walls shall be selected whole bricks of uniform size, with true and rectangular faces.

- c.** As per IS 2212: 1991, Cl. 11.1.2, bricks with 20 mm deep frog shall be used frog down on a full bed of mortar. Bricks with 10 mm deep frog shall be used either frog up or frog down. Each brick shall be properly bedded and set in position by slightly pressing while laying so that the mortar gets into all their surface pores to ensure proper adhesion.
- d.** All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on the brick to be placed so that no hollow spaces are left. All joints shall be properly flushed. No bats or cut bricks shall be used except to obtain dimensions of the different course for specified bonds or wherever a desired shape so requires. Closers shall be clean cut to size as indicated in English bond and shall be situated near, but not at, the ends of walls. Thickness of bed and side joints shall not exceed 10 mm. Brick work shall be done in horizontal courses, care being taken that the joints are straight. Mason cord shall always be spread while laying masonry in horizontal courses. Wooden templates shall be used to check the straightness of the masonry faces. Nothing extra shall be paid to the contractor for corners, splays, cut water etc.
- e.** The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over another. The thickness of brick courses shall be kept uniform. Both the faces of the walls with thickness of more than one brick shall be kept in proper plane. All the brick work shall be carried up nearly at one level. No portion of a wall during its construction shall rise more than 1 m above the general construction level, to avoid unequal settlement and also improper jointing. Where this is not possible the work shall be raked back suitably at an angle not exceeding 45° and properly toothed.
- f.** At all angles forming the junctions of walls, the bricks of each wall shall, in alternate courses, be carried into the other wall so as to thoroughly unite the work. When a brick is omitted to allow for support of a scaffold pole, such brick shall always be a header and not more than one header for each hole shall be omitted.
- g.** All brick work shall be strictly in accordance with detailed drawing supplied to the contractor, true to dimensions and in proper bond. If the brick work does not conform to the prescribed size, shape and quality, the contractor shall dismantle it at his own cost. The faces of brick work shall be cleaned with wire brush so as to remove any splashes of mortar during the course of raising the brick work.

- h. When single scaffolding is used, efforts will be made to support poles of scaffolding upon only one of the headers in masonry. Scaffolding should be strong enough to withstand all the loads expected to come on them.
- i. For pointing over the brick work, the joints shall be squarely raked out to a depth of 15 mm while the mortar is still green and the raked joints shall be well brushed to remove dust and loose particles. Surface of masonry will be kept well wetted for at least 2 days and shall be later completely refilled with 1:2 cement mortar to give the required finish. Some such finishes are 'flush', 'weathered', 'tucked', ['ruled' etc²¹](#).

3.3. Curing

Curing should be done as per IS 2212:1991. In the absence of curing, the mortar is likely to dry up before it has attained its final set and may crumble. This shall be prevented by keeping the brick work constantly wet for seven days commencing from 24 hours after the course is laid.

4.0 Plastering

4.1. Proportioning and Mixing of Mortar

This shall be same as given in Para 3.1. The mortar shall be prepared by mixing cement and sand in a proportion of 1:3 by volume.

4.2. Preparation of wall surface and application of plaster

- a. The joints of the brick work shall be raked out to a depth of 10 mm for providing key to plaster and all raked cement mortar or loose material shall be removed. The surface shall then be kept wet for 2 days before plastering. If the surface becomes dry in spots, such areas shall be moistened again to ensure uniform [bond.²²](#)
- b. The plaster over brick work shall be 12mm thick. To ensure fairly even thickness and truly plane surface (Vertical in the case of walls and pillars and horizontal in the case of top of walls) small patches of plaster about 150x150 mm or narrow strip of plaster about 100 mm wide, shall be first applied about 3 metre apart to serve as gauges. The surface of these gauges areas shall be truly in the plane of the finished plaster surface. The plaster shall then be applied and brought to a true smooth surface in the level of gauges by means of proper trowels as approved by Engineer-in-Charge. The plaster shall be floated with wooden / steel templates to produce sandy granular / smooth surface. Corners and junctions must be neat straight lines, horizontal, vertical or [inclined as in plan²³](#).
- c. In suspending work at the end of the day, the plaster shall be left, cut clean to line both vertically and horizontally. When re-commencing the plaster, the edge of the old work shall be scraped, cleaned and wetted with cement slurry, before plaster is applied to the adjacent areas, to enable the two to join together. The

plaster shall not be closed on the bends or cornices. No portion of the surface shall be left out initially to be patched up later on. Any cracks in the plaster or any parts which sound hollow when tapped or are found to be soft or otherwise defective shall be cut out and re plastered at the contractor's expenses.

4.3. Curing²³

Curing shall be started 24 hours after finishing the plaster or as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept continuously wet for a period of at least ten days after application. Fresh plaster shall be protected from sun, rain and frost at the contractor's expenses. Ordinarily to protect the plaster from sun, the whole surface shall be covered with gunny bags.

5.0 Cement Concrete

5.1. General

All works shall be carried out in accordance with IS 456: 2000 "Plain & Reinforced Concrete - Code of Practice", UPID Specifications or as directed by Engineer-in-charge. The works shall be carried out true to the lines, grades and dimensions shown on drawings.

5.2. Composition

Cement concrete shall be composed of cement, fine aggregate, coarse aggregate, an air entraining admixture, if considered necessary by the Engineer-in-Charge and water. The ingredients shall conform to para 1.1, 1.2, 1.3 & 1.4 above. The various ingredients of different nominal concrete mixes for one cement bag of 50 Kg shall be as under (for guidance only).²⁴

Ingredients of Concrete	Quantity of ingredients required for concrete		
	M-10(1:3:6)	M-15(1:2:4)	M-20(1:1.5:3)
Weight of coarse aggregate	320 Kg	220 Kg	165 Kg
Weight of fine aggregate	160 Kg	110 Kg	85 Kg
Quantity of water	34 litre	32 litre	30 litre

Design mix concrete should be preferred to nominal mix. If design mix can not be used or quantity of concrete is small, nominal mix may be used.

5.3. Proportioning of Concrete

- a. The contractor shall provide all necessary equipment and plant to determine and control the actual amount of material entering into each batch.
- b. The coarse & fine aggregates, water and cement shall be batched and measured by weight. Specified air entraining agent / water proofing compound, if any, shall be added separately to the mix, as directed by Engineer-in-Charge.

- c. The weigh batchers should be capable of weighing, controlling and determining accurately the prescribed amount of various materials for each batch of mix. Batching boxes of suitable size shall be used for measuring sand and coarse aggregate. The internal dimensions of the boxes shall be generally 35x25cm with 40 cm depth or as otherwise approved by the Engineer-in-Charge.
- d. One batching box, completely filled with sand or coarse aggregate shall be weighed to determine the number of boxes required to complete the quantity of aggregates in the concrete mix. The unit of measurement for cement shall be a bag of 50 kg.
- e. The contractor shall maintain a record of the number of batches mixed and other details required for checking the correctness of the mix as per directions of the Engineer-in-charge

5.4. Mixing

- a. It shall be done in mechanical mixer. Mixing by hand shall be employed only in special cases with the specific prior permission of the Engineer-in-Charge. Fine & coarse aggregates shall be washed with water to remove dirt, dust or any other foreign materials.
- b. Suitable mixers, preferably tilting type with hopper, should be used to mix uniformly the various ingredients and discharging the prepared mix without segregation. No hand mixing shall be allowed.
- c. The mixer drum shall be flushed clean with water. Measured quantity of dry coarse and fine aggregates shall be placed first in the rotating drum of mixer & mixed thoroughly. This shall be followed by mixing of the measured quantity of cement. The dry materials shall be mixed for at least 4 turns of the drum, after which the measured quantity of water shall be added gradually while the drum is in motion, to ensure even distribution with the dry materials. The total quantity of water to be mixed for achieving the specified water cement ratio shall be introduced before 25% of the mixing time has elapsed. The materials shall be mixed for a period of not less than 2 minutes (normally 25 turns of drum) and until a uniform colour and consistency of concrete are obtained. The time shall be counted from the moment all the materials have been put into the drum.
- d. The complete contents of the mixed concrete shall be emptied before recharging. When the mixer is closed down for the day or for any time interval exceeding 20 minutes, the drum shall be flushed clean.

5.5. Workability

The water-cement ratio in the concrete should be such that the concrete is of adequate workability for the placing conditions of the concrete and can be

compacted with the means available. For workability, minimum slump required for concrete to be compacted by the vibrator shall be 25 to 75 mm²⁵.

5.6. Placing

- a. The concrete shall be mixed & deposited as nearly as practicable to its location of placement to avoid any re-handling. The concrete shall be placed and compacted before initial setting of concrete commences and should not be subsequently disturbed. Methods of placing should be such as to preclude segregation. As a general guidance the maximum permissible freefall of concrete may be restricted to 1.5 m²⁶.
- b. The prepared surface to receive the concrete may be laid with 2 cm thick layer of 1:4 cement mortar or a polythene sheet of adequate thickness to avoid any loss of moisture of concrete by underneath earth bed.
- c. The whole quantity of prepared concrete shall be used within 30 minutes of its mixing.
- d. The entire concrete to be used in the work shall be laid gently (not thrown) in layers not exceeding 30cm in thickness and shall be thoroughly vibrated by means of mechanical vibrators till a dense concrete is obtained. The thickness may vary as per direction of Engineer – in – charge. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. During cold weather, concreting shall not be done when temperature falls below 4.50 C or is above 370 C.
- e. When concreting is to be done in lifts, proper shear keys should be provided in the top surface of previous lift to ensure proper bond with next lift.
- f. Before starting concreting over previously laid concrete, old surface shall be thoroughly cleaned of all the loose material, chips and cement slurry etc. by using a wire brush or air / water jet.
- g. Concreting shall be done continuously in a slab or a footing. In case the concreting is to be discontinued for some time, a construction joint shall be provided as directed by Engineer-in-charge.

5.7. Compaction

- a. Care should be taken, while placing or using vibrator for compaction, to avoid any displacement of reinforcement or movement of form work.
- b. The concrete shall be thoroughly compacted by using mechanical vibrators of appropriate type (plate vibrator for shallow depth of concrete & needle vibrator for depth of concrete greater than 20cm) to avoid formation of honey combing in concrete and shall be fully worked around the reinforcement and embedded fixtures and into the corners of the form work.

- c. Fresh concrete should be thoroughly vibrated near all the construction joints so that mortar of new concrete flows between large aggregates and develop proper bond with old concrete.
- d. Over vibration of concrete shall be avoided.
- e. Care shall be taken that after compaction, vibrator should be withdrawn out of the concrete mass gradually.

5.8. Curing

After 6 hours of laying of concrete, the surface of freshly laid Concrete shall be suitably protected with moist gunny bags or any other methodology approved by Engineer-in-Charge against quick drying for next 24 hours. After that, the surface shall be cured by flooding it with water in a minimum depth of 25 mm. The curing shall be done for a minimum period of 14 days.

5.9. Quality

Regular mandatory tests on consistency & workability of the fresh concrete shall be made by means of slump tests. The sampling of fresh concrete shall be done by casting at least 6 no. of 15X15X15 cm cubes for testing 7 days & 28 days compressive strength of concrete. The frequency of sampling of concrete of each grade shall be as under²⁷.

S No	Quantity of Concrete in the work (cum)	Number of Samples
1	1-5	1
2	6-15	2
3	16-30	3
4	31-50	4
5	51 and above	4+1 additional sample for each additional 50 cum

These tests shall be carried out as per IS 456: 2000 & IS 516, the specified characteristic strength of 150 mm cube at 28 days shall be as under:

S No.	Grade of concrete	Compressive Strength (N / mm ²)
1	M-10	10
2	M-15	15
3	M-20	20

6.0 Formwork

- a. Forms shall be used, wherever necessary, to confine the concrete and to shape it to the required lines. Normally all exposed concrete surfaces having a slope steeper than 2H:1V shall be formed. The form shall be cut to shape and size of concrete profile of the structure.
- b. The form work shall be of steel. Wooden forms shall not be allowed. Supports shall also be of steel. Suitable wedges in pairs should be provided to facilitate adjustment and subsequent releasing of forms. The contractor shall furnish the details of his proposed form work to the Engineer for his approval before erection / fixing.
- c. All rubbish, particularly chippings, shavings, sawdust and grout etc, shall be removed from interior of forms before these are erected. The face of the form work, which is to be in contact with concrete, shall be cleaned and treated with suitable form oil or greasing agent.
- d. The forms shall be of suitable thickness and be made sufficiently rigid by use of ties and bracings to prevent any displacement or sagging. Suitable struts or stiffeners shall be used wherever required. The forms shall be made mortar tight.
- e. The surface of form work shall be treated in such a way so as to produce surface finishes as specified. The joints between the form work and previous lift of concrete shall be mortar tight
- f. The forms required to be used more than once shall be maintained in a good condition and repaired if necessary before reuse.
- g. The forms shall not be removed until the concrete has achieved adequate strength. The striking period of forms, normally, shall be as follows or as directed by Engineer-in-Charge ²⁸.

S.No	Type of form works	Minimum period before striking form work
1.	Vertical form work to columns, walls, beams	16-24 hours
2.	Soffit form work to slabs (props to be re-fixed immediately after removal of form work)	3 days
3.	Soffit form work to beams (props to be re-fixed immediately after removal of form work)	7 days
4.	Props to slabs, spanning upto 4.5m	7 days
5.	Props to beams, spanning upto 6m.	14 days

- h. Forms shall be removed with care so as to avoid any damage to the concrete. Such damages to concrete, if any, shall be promptly repaired by the contractor as directed by engineer in charge.
- i. After removal of shuttering the gap between earth face and concrete shall be tightly backfilled with earth and duly rammed.

7.0 Bending and placing in position of reinforcement

- a. The bars shall be bent cold, correctly and accurately to the size and shape as shown in drawings or as directed by Engineer-In-Charge. At no time the radius of the bars in bending shall be less than 6 bar diameters.
- b. Preferably, bars of full length shall be used. Overlapping of bars, where necessary, shall be done as directed by Engineer-In-Charge. The overlapping bars shall not touch each other and these shall be kept apart by 25 mm or 1.25 times the maximum size of the aggregate whichever is greater. The location and type of welding in reinforcement, if any, shall be as approved by the Engineer-In-Charge.
- c. Reinforcement bars shall be placed in position as shown in drawings. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire of 0.90 to 1.6mm diameter by twisting the strands tight to make the skeleton of the steel bars rigid so that the reinforcement does not get displaced during the deposition of concrete.
- d. The bars shall be kept in position by using pre-cast cement concrete cover blocks, spacer bars, supporting bars and templates as directed by Engineer-In-Charge to provide specified nominal clear cover to the reinforcement.
- e. Lap length for reinforcement bars shall not be less than 30 times bar diameter. All the laps in the bars shall be staggered²⁹.
- f. The actual concrete cover shall not deviate from specified nominal cover by (+) 10mm³⁰.
- g. The contractor shall make his own arrangement to procure high yield strength deformed bars in accordance with IS:1786 as shown in the drawing. Tested quality of steel reinforcement bars shall be used. Requisite IS test certificates from manufacturers are to be provided to the engineer in charge before use of reinforcement on the work.
- h. The radii of the bends in the main reinforcement bars shall not be less than 6 times bar diameter. The radii of the bends of stirrups shall not be less than twice the diameter of the bar.

- i. Unless otherwise specified by engineer in charge, reinforcement shall be placed within the tolerances of ± 10 mm for effective depth of 200 mm or less ³¹.

8.0 Dry Brick Pitching

Dry Brick pitching shall be constructed on the inner side slope of minor to protect them against the scouring action of turbulent flow in d/s of falls / weirs. Pitching is also provided on side slopes in u/s & d/s of VRBs / Pipe culverts and in u/s of falls or weirs. Pitching may be laid by placing bricks on edge or bricks on end.

8.1. Preparation of Sub grade

- a. All work shall be carried out in accordance with the drawing. The work primarily comprises of filling scoured earthen section of canal for laying the pitching and excavation of foundation for toe walls. The surplus earth not required in the section shall be disposed of as per direction of Engineer-in-Charge.
- b. Sample profiles on side slopes true to the designed cross-section of the canal for laying the pitching shall be made at a suitable interval. No extra payment shall be made for this work.
- c. To ensure correct formation of sub grade, a chord shall be stretched across two profiles over a spacer of uniform thickness of 12 mm; a third spacer shall be run under the chord to check the evenness of surface. This process shall be repeated at short intervals, along the slopes till the surface between the two profiles is properly leveled and dressed from top to bottom. Suitable wooden templates shall be used to lay the profile.
- d. Any depressions in the surface of sub grade shall be filled with earth and shall be thoroughly compacted to obtain a dry bulk density of not less than 95% of the density at optimum moisture content, when tested in accordance with IS: 2720 (Part VII)-1980. The surface of finally obtained section should be free from any undulations and perfectly true to lines, grades and levels desired.

8.2. Construction of toe walls

Excavation for toe walls in the bed along side slopes shall be done on the locations and in depth & width as specified in the drawings. The contractor shall excavate all types of soils, wet or dry including slush with block kankar, mixed in any percentage which may be encountered upto the required depth of foundation of toe wall.

The foundations of these walls shall be constructed in concrete and walls shall be constructed in masonry as specified in the drawings. The toe wall is necessary to

prevent any slippage of pitching. The mortar for brick work shall be mixed as per para 3.1 and brick work shall be as per para 3.2 & 3.3.

8.3. Laying of filter

A layer of compacted thickness of 100mm of local sand which is free from any organic matter or gravel etc. shall be laid as filter on prepared sub grade. The compaction shall be done at saturation moisture by vibro - mechanical slope compactors to achieve relative density not less than 65%. The finished surface of compacted base shall be true to line and levels of the channel section as shown in the drawings. The filter layer is essential to prevent any loss of soil from sub grade.

8.4. Bricks for pitching

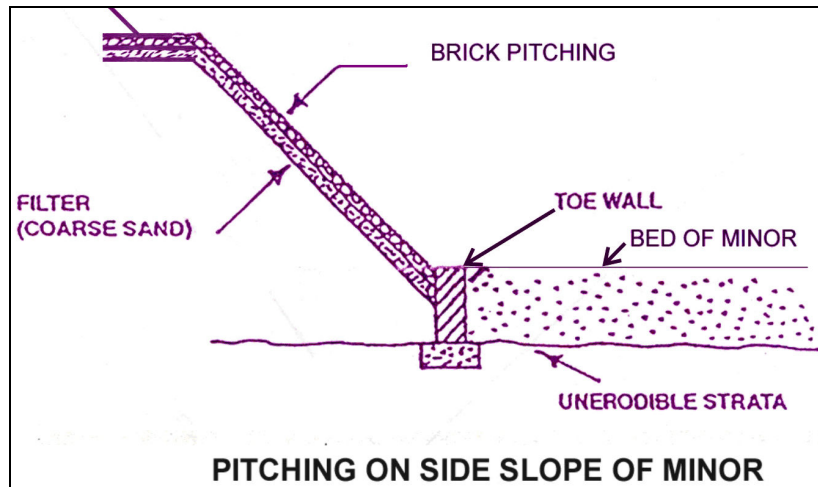
Bricks for pitching shall be in accordance with the specifications laid in para 1.6 (Bricks)

8.5. Laying of pitching

The laying of pitching shall be started only when the sub grade is properly dressed and sand base properly compacted. Sufficient number of bricks for a day's work shall be made available at site before starting the work.

Sleepers having section and spacing as per drawing shall be constructed in brick masonry in 1:3 cement mortar along side slopes for making panels, prior to the start of pitching. After 24 hours of construction of sleepers, bricks on edge / end shall be properly laid in position. All the bricks shall be laid on length normal to the slope of bank beginning at bottom of the slope. Bricks shall be laid compactly to leave minimum joint space.

The pitching should be protected from ingress of rain water behind the pitching by giving outward cross slope of 1 in 80 to top of bank and providing pucca chutes on the outer slopes of bank at suitable interval. The horizontal top portion of the pitching shall be laid in brick masonry as per drawing. The free edge of the pitching top should be well tucked into the canal bank so as to prevent any seepage of water from there. The pitching should be at least upto FSL of minor.



9.0 Railway / Road Bridges on a minor³²

9.1 Railway Bridge

Executive Engineer shall submit necessary data to Railway authorities for preparing design and estimate of the works. The railway authorities will submit this design / estimate to Executive Engineer UPID for approval. Construction will be done by railway authorities.

9.2 Road Bridge

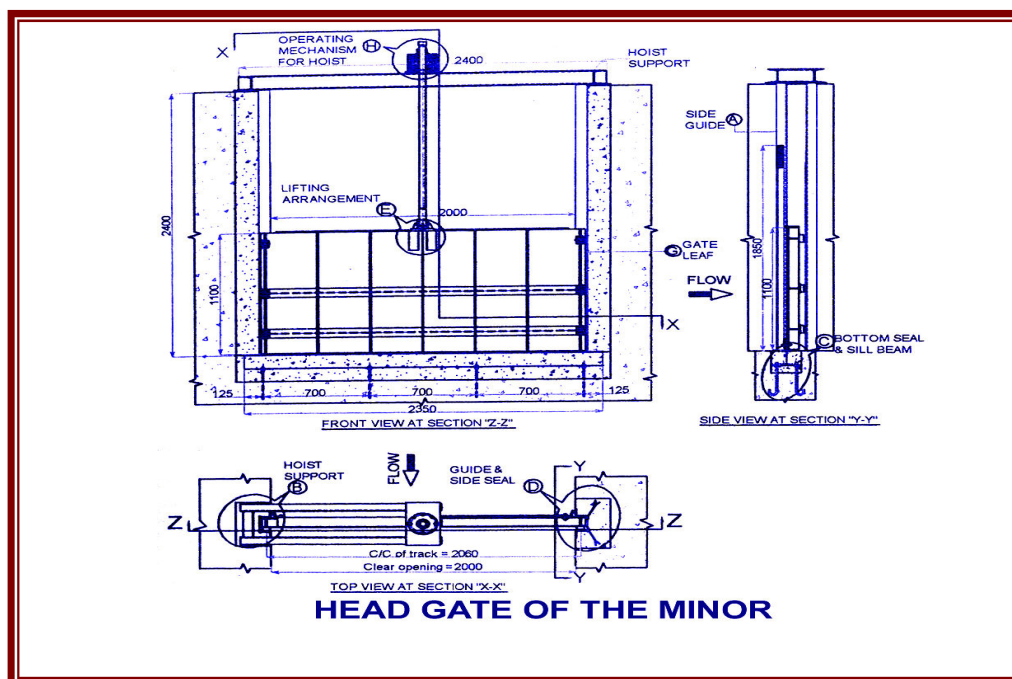
Drawing of the works will be prepared by Executive Engineer UPID and will be submitted to PWD (road maintaining authority) for approval. Drawing / estimates will be sanctioned by UPID and construction works will also be done by UPID.

10.0 Head gate of minor³³

Normally a single leaf vertical lift type steel gate is provided at the head regulator of the minor. While constructing the structure of the head regulator, following block outs are left in the concrete / masonry of civil works as per relevant drawing.

- a. Horizontal block out of specified size is left in the floor / crest of the regulator and between both the abutments. This block out accommodates the embedment / steel sill beam and rubber seal over which gate rests in closed position.
- b. Vertical block outs of specified size are left in both the abutments of regulator and are extended into the left & right concrete / masonry column above the abutments upto top level of gate in raised position. These block outs accommodate the embedment / vertical steel guide beams and rubber seals. The vertical movement of the gate for lifting and lowering is guided by these guides.

The concreting of specified grade is done in the block outs only after the installation of steel embedment / beams / rubber seals is completed.



11.0 Tests on Construction Materials

The Quality tests required to be conducted on construction materials are tabulated below:

Sl. No.	Material	Type of Test	Allowable limits	Test Frequency	Reference
1.	Cement	Consistency	As specified	1 test for each consignment at each worksite	IS:8011 IS: 4031 (IV,V,VII)
		Compressive Strength	---do---		
		Initial setting time:	Not less than 30 minutes		
		Final setting time	Not more than 600 minutes		
2.	Sand	Gradation	As specified	1 test for each consignment at each worksite	IS:383 IS:2386 (I,III,VIII)
		Bulkage	Should be determined		
		Deleterious Materials	< 6%		

Sl. No.	Material	Type of Test	Allowable limits	Test Frequency	Reference
3.	Coarse Aggregate	Gradation	As specified	1 test for each consignment at each worksite	IS:383 IS:2386 (I,III,IV, VIII) IRC:SP-23
		Deleterious material	< 5%		
		Water absorption	< 2%		
		Crushing Value	<45%		
		AIV	<45%		
		Flakiness / elongation index	<25%		
4.	Boulders	Size	As specified	1 test for each consignment at each worksite	
		Weight	----do----		
5.	Reinforcement Steel	Rusting	No rusting is allowed	1 test for each consignment at each worksite	IS:1786
		Weight	As specified		
		Diameter	----do----		
		Bend & Re-bend tests	----do----		
		Ultimate Tensile Strength	----do----		
6.	Concrete (for each grade)	Slump	25-75 mm	1 test per day per work site 1 test per day per work site, 6 cubes for 1-5 cum of concrete	IS:456
		Compressive Strength 7 days	Min. 70 % of 28 days strength		
		Compressive Strength 28 days	As specified		
7.	Mortar (for each grade)	Compressive strength at 28 days	As specified	1 test per day per work site	IS:2250 IS:2386 (VI)
8.	Bricks	Size / Dimension	As specified	1 test per 10000 bricks	IS:1077 IS:3495 (I,II,III)
		Water absorption	< 15%		
		Compressive strength	As specified		
		Efflorescence	Slight		

Note:

1. A certificate from manufacturers of cement & steel and from supplier of coarse and fine aggregates stating that physical & chemical properties conform to relevant IS codes will be obtained at the time of supply.
2. Deleterious materials include coal & lignite, clay lumps, soft fragments and material finer than 75 μ .

12.0 Requirement of materials³⁴

Requirement of materials for different construction works are tabulated below

Sl. No.	Item	Unit	Mix of mortar	Cement bags of 50 Kg. (Nos.)	Sand (cum)	Bricks (Nos.)	Stone (cum)
1.	Brick work	Cum	1:3	2.60	0.275	460	
2.	Brick work	Cum	1:4	2.00	0.275	460	
3.	Cement Plaster (12 mm thick)	Sqm.	1:4	0.168	0.015		
4.	Cement pointing	Sqm.	1:2	0.055	0.0036		
5.	Dry brick pitching Brick on end Brick on edge	Sqm. Sqm.				565 58	

13.0 Norms for construction works

Normally construction works are executed as per following norms:

- a. All hidden works such as concrete / brick work in foundation, placement of reinforcement and concrete in abutment, deck slab of a VRB, fixing of outlet pipes etc. will be done in the presence of Assistant Engineer.
- b. Construction of works will be started from the deepest level.
- c. Works will be executed as per IS / IRC / UPID specifications.
- d. For effective quality control of works, tests on materials shall be done as specified and Quality Assurance plan shall be followed.
- e. Works shall be measured as specified in para 14 section A.
- f. Works shall be checked as per checklist given in Appendix-A.
- g. Earthwork will be done as per following methodology
 - i. Before commencement of earthwork, initial cross sections shall be taken as specified in para 14 Section A.

- ii. The earthwork shall be done by machines and earth shall be carried by tractor-trolleys on the canal banks and shall be spread in layers of specific thickness. Each layer shall be added with water, if necessary, to obtain required moisture and compaction by 8-10T power rollers shall be done so as to achieve 95% of maximum dry density at OMC.
- iii. Where machines can not be used, earthwork and its compaction in embankment shall be carried out manually.
- iv. The embankment shall finally be dressed to the lines and levels shown in the drawings with due allowance for settlement.
- v. The final cross sections shall be taken at the same locations and in the same manner as for initial cross sections as specified in para 14 Section A.

14.0 Quality Assurance Plan

Quality Assurance in construction works relates to proper design, use of adequate and suitable materials, proper workmanship in execution of works.

Quality assurance program of the works comprises of the following activities.

- a. Preparation of work program.
 - b. [Implementation of O.K. card system](#)³⁵.
 - c. Quality checks of works.
 - d. Observations and their compliance.
- a. Contractor shall prepare a work program detailing the dates of starting and completing different work activities along with the details of manpower, materials and machinery required to complete the work as per agreement period. This program shall be made available to UPID so that, after checking its feasibility, schedule for visiting the different major / important construction activities may be planned by them accordingly.
- b. In order to enforce the technical specifications for construction quality, O.K. card system shall be followed. For this, Executive Engineer in-charge him self or his authorized Assistant Engineer / Junior engineer will sign the O.K. cards. The O.K. card will be prepared in four copies. One copy each will remain with contractor, Junior Engineer, Assistant Engineer and Executive Engineer-in-charge of works.

O.K. card gives the preparatory activities which are essential to be completed on site before starting the works. The O.K. card for each activity shall be initiated by contractor when he considers that all the preparations to start a particular activity are complete as per O.K. card. The O.K. card will then be given by the contractor to the concerned J.E., UPID, who will confirm whether all the preparation as per

provisions and specifications are complete. If J.E. UPID finds everything in order, he will, depending upon the competency, get the area / works examined by A.E. / E.E. in-charge and after their approval, sign the O.K. card and handover it immediately to the contractor to commence the activity. If J.E. UPID finds deficiencies in the preparation to start the activity, he will return the O.K. card, at the earliest, to the contractor with his remarks for rectification of the deficiency. The activity shall start only when the deficiencies are removed by the contractor and O.K. card is signed by J.E. UPID.

- c. Contractor shall be responsible for execution of work and conducting 100% quality tests on the construction works as specified in the Technical Specifications enclosed with agreement of works. These tests shall be conducted in presence of the representative of UPID who will certify the results of the tests. UPID shall also conduct quality tests upto the extent considered essential by them for their satisfaction regarding quality of works. UPID shall request for the results of all the quality tests conducted by contractor and it shall be mandatory for contractor to provide these results to UPID on site. On the basis of the results of quality tests conducted by contractor and UPID, the quality of works shall be certified by UPID.
- d. UPID shall visit the construction works and record their observations regarding preventive / corrective measures for the ongoing works in site order book and shall also record whether the compliance of observations has been done / is being done by the contractor. Compliance of observations is a must for quality assurance of works.

All the OK Cards for a work, signed by AE, may be perused at the time of releasing payments to the contractor. Formats of O.K. cards for various activities of construction works for minors are enclosed at Appendix-F.

Do's and Don'ts

Do's

1. The work shall be taken up after sanction of estimate and proper tendering process.
2. The works shall be carried out in accordance with approved construction drawings.
3. Construction materials shall conform to specifications.
4. Adequate compaction / curing of concrete shall be ensured.
5. Concurrence of PWD shall be taken for construction of all road bridges on minor.
6. Borrow areas shall be rehabilitated after execution of works is over.
7. All depressions in bottom of foundation trench caused by removal of roots or unsuitable material shall be filled with lean concrete.
8. The height of finished embankments shall be kept 10% higher than designed section in case of manual compaction and 5% for mechanical compaction.
9. The rejected materials shall be removed from site promptly.
10. The volume of sand shall be increased to account for bulking of sand.
11. All hidden works such as concrete / brickwork in foundation shall be done in presence of Assistant Engineer.
12. The placement of reinforcement & concrete in deck slab of bridges and fixing of outlet pipes shall be done in presence of Assistant Engineer.
13. The construction of works shall be started from the deepest level.

Don'ts

1. Cement from mini cement plant shall not be used in any component of the work.
2. Re-rolled steel shall not be used.
3. The borrow area shall not be selected in *Usar* or *Sodic* lands.
4. Any portion of wall during its construction shall not be raised more than 1m above general construction level.
5. The forms shall not be removed earlier than the specified striking period.
6. Excavation work shall not start until initial cross sections in full width of minor including banks are taken jointly by contractor and J.E. UPID.
7. Any excavation done below the prescribed foundation level shall not be paid for.
8. Filling of over excavation in foundation trench with lean concrete shall not be paid for.
9. The water in foundation trench shall not be allowed to rise above the lowest level of foundation concrete.

References

1. Technical specifications, UPWSRP, UPID, para 1.2
2. IS: 4701, Earthwork on Canals, Cl. 6.1,
3. Technical specifications, UPWSRP, UPID, para 1.13
4. Schedule of rates, UPWSRP, Chapter-5 item 10
5. Technical specifications, UPWSRP, UPID, para 3
6. IS:4701, Earthwork on Canals, Cl. 9.2
7. IS:4701, Earthwork on Canals, Cl. 9.3
8. Technical specifications, UPWSRP, UPID, para 1.8
9. IS:4701, Earthwork on Canals, Cl. 6.5.1
10. IS:4701, Earthwork on Canals, Cl. 6.5.2
11. IS:4839, Maintenance of Canals (Pt.-I)CL 3.5
12. Technical specifications, UPWSRP, UPID, para 1.9
13. IS:4701, Earthwork on Canals, Cl. 6.4.1
14. IS:4701, Earthwork on Canals, Cl. 6.6
15. Technical specifications, UPWSRP, UPID, para 1.11
16. Technical specifications, UPWSRP, UPID, para 1.7
17. IS:1786 Cl. 5.3.1 Table-1
18. IS:8112, 43 Grade OPC – specifications, Cl. 12.2
19. IS:2212, Brick Works Cl. 7.1
20.
 - (i) UPID specifications, Volume -2, Chapter-4, Cl. 4.1.1
 - (ii) IS: 2386 (VI), Measuring mortar making properties of fine aggregate, Cl. 3.1
21. IS:2212, Brick Works, Cl. 6.5.3
22. IS:2212, Brick Works, Cl. 6.5.2
23. UPID specifications, Section 4, plastering & pointing, No. 25
24. IS:456, Plain and Reinforced Concrete, Cl. 9.3 Table-9 – Proportion for nominal mix concrete
25. IS:456, Plain and Reinforced Concrete, Cl. 7.1
26. IS:456, Plain and Reinforced Concrete, Cl. 13.2
27. IS:456, Plain and Reinforced Concrete, Cl. 15.2.2
28. IS:456, Plain and Reinforced Concrete, Cl. 11.3.1
29. IS:456, Plain and Reinforced Concrete, Cl. 26.2.5.1
30. IS:456, Plain and Reinforced Concrete, Cl. 12.3.2
31. IS:456, Plain and Reinforced Concrete, Cl. 12.3.1
32. Irrigation Manual of Orders para 248 (I)
33. TAHAL drawing no. TCE/UPWSRP/JB/MHRG-58
34. Central Design Directorate, UPID, Lucknow drawing no. 14-G-S-S/53 – Schedule for quantities of ingredients required in masonry, pointing and plastering.
35. Technical specifications, UPWSRP, UPID, para 11

CHAPTER –4

GUIDELINES FOR VARIOUS CONSTRUCTION STAGES

A. PRE CONSTRUCTION STAGE

1.0 Preparation of Estimate

A site inspection of work area shall be done by Executive Engineer to identify details of proposed works before preparing the estimate.

Before commencement of earth work, initial cross sections shall be measured as specified in para 14 Chapter 3 Section A. Designed cross sections of minor at the same locations as for initial cross sections shall be prepared and superimposed over initial cross sections to calculate net area and estimate the quantity of earthwork to be done.

The quantities for construction of pucca works shall be prepared on the basis of detailed drawings containing plans & sections of the structure.

The estimate shall include the following.

1.1 Technical Report

In the technical report necessity of construction remodeling / improvement works is described in detail. The priority of taking up the work should also be mentioned. The technical data of existing / proposed work should be given. The cost for proposed work should be mentioned. A site plan on suitable scale giving all the details of proposed works should be provided. The technical report should also contain estimated time of completion of work, basis of rates taken, mention of specifications to be followed, details whether proposed works are covered under any other running scheme or not and proposed environmental & social safeguards while executing the works.

1.2 Bill of Quantities

The details of quantities of different items of work should be prepared in the following format.

Sl. No.	Item	No.	Length	Width	Height	Quantity
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1						
2						
3						

The quantities for earthwork shall be calculated as detailed in para 1.0.

Efforts should be made to include every item of work, which may have to be constructed / provided. The quantities should be worked out precisely.

The lump sum quantities should not be included as far as possible. If lump sum quantities / cost are provided, their due justification should be given.

1.3 Analysis of rates

The rates of items are derived from the schedule of rates of the U.P. Irrigation Department which contains rates of material and labor. If an item is not included in this schedule of rates then schedule of rates of other engineering departments of U.P. may be consulted and an analysis of rates may be prepared accordingly. If an item is not included in the schedule of rates of any department, then cost of item per unit may be prepared by considering the market rates. The certificate for correctness of leads of carriage of various construction materials through shortest practicable route shall be recorded by Executive Engineer.

If the schedule of rates is not based on current rates, then current rates may be worked out by adding specified / prevalent escalation per year. A sum of 2% of total cost for contingencies is added to calculate final cost.

1.4 Abstract of Cost

After preparing the detailed bill of quantities and analysis of rates, abstract of cost shall be prepared in the following format.

Sl. No.	Item	Quantity	Rate	Amount
(1)	(2)	(3)	(4)	(5)
1				
2				

This final cost is the total requirement of funds to be made available for the construction of this particular structure or execution of work.

1.5 Preparation of specifications and construction schedule

The items shown in abstract of cost are for construction / supply of material. The specifications for construction / supply of material should be decided using related Indian Standards / IRC standards or UPID specifications. The specifications should also mention the tests required to be conducted (and their frequency) to determine the quality of construction materials.

The construction schedule containing details of execution of each item of work within the proposed time frame should be prepared depending upon the availability of funds / resources.

1.6 Sanction of estimate

Estimate for construction works prepared as per availability of funds shall be sanctioned by competent authority of UPID, depending upon the cost of estimate, which is currently as under:

S. No.	Amount of Estimate	Sanctioning Authority (UPID)
1.	Upto Rs. 40 Lacs	Executive Engineer
2.	Rs. 41 Lacs to 1 Crore	Superintending Engineer
3.	Above 1 Crore	Chief Engineer

2.0 Tender document and allotment of work

Construction works will be carried out by UPID through contractors under an agreement.

2.1 Preparation of tender document¹

When a work is executed by a contractor under an agreement, tenders for the work are invited. A tender document contains the followings

- a. Bill of quantities of the work.
- b. Technical Specifications
- c. Conditions of the contract
- d. Drawings of the work
- e. Estimated time of completion

The above items of tender document will be prepared as detailed in para1.0 above. For preparing conditions of contract, forms IB111 & IB112 may be consulted.

2.2 Tender notice²

Tender notice in the name of AE / EE, will state the following information

- a. Name, location, nature and execution time of proposed works.
- b. Approximate cost of works
- c. Amount of earnest money to be deposited with sealed tenders
- d. Cost of tender documents
- e. Place of sale of tenders
- f. Place, date and time of deposition & opening of sealed tenders
- g. Category of registration of contractors eligible for purchasing tenders.
- h. A condition that tender accepting authority reserves the right to reject any or all the tenders without assigning the reason there for.

Such tender notice is advertised in leading local news papers at-least 30 days in advance (15 days for short term tender) to sale of tenders, through Director of Publication, Government of U.P. Lucknow.

The tenders are sold to different willing contractors who are registered with the UPID, at a nominal price fixed on the basis of cost of the work, to encourage maximum sale to generate a healthy competition.

2.3 Evaluation of Tenders

After receipt of tenders in sealed covers from various registered contractors / firms, tenders are opened in the presence of tenderers and a comparative statement of all the tenders received, containing names of tendering contractors, earnest money equal to 2% of the estimated cost deposited by them and rates quoted, is prepared and is signed by rates dictating/writing officer as well as all the contractors present.

If any conditions are mentioned by the contractor in his tender or earnest money is not deposited with the tenders, such tenders are rejected. The tenders which are not sealed are also rejected.

The tenders are evaluated on the basis of rates of all the items in bill of quantities submitted in the tender by the contractors. The tender of a contractor, with lowest rates giving the reasonable cost of work is normally accepted with the condition that contractor should have adequate financial capacity

2.4 Contract Negotiations

If the cost of work based upon the rates offered by the lowest tenderer is unreasonably higher than the estimated cost, he will be called by tender accepting authority for negotiations to reduce the rates to give a reasonable cost. If the lowest tenderer does not reduce the rates, he shall be asked to justify the rates. If lowest tenderer neither reduces nor justifies the rates quoted by him, his tender shall be rejected and the process shall be repeated with the second lowest tenderer and so on.

2.5 Work Order

When the cost of the works is quite small, i.e., upto Rs. 20,000/-, works can be got executed through work orders without inviting tenders.

2.6 Allotment of Work³

Letter of acceptance stating the amount of security & its form such as bank guarantee or fixed deposit receipt of bank to be deposited by contractor is signed by tender accepting officer, i.e., Assistant / Executive Engineer / Superintending Engineer depending upon the cost of works and is issued to the contractor

whose tender is accepted. He is required to deposit the prescribed amount of security, usually 10% of cost of agreement and sign along with AE/EE, UPID, the prescribed agreement format consisting of the followings, in token of his acceptance of the terms and conditions of the contract, within specified period:

- a. Form number IB-111 & IB-112
- b. Technical specifications
- c. Conditions of contract
- d. Copy of tender notice
- e. Copy of letter of acceptance
- f. Format of letter of undertaking
- g. Necessary drawings

After signing the agreement, the contractor will be given the date of start of the work by AE / EE, UPID

For a small work with cost upto Rs. 20000, to be executed as per estimate prepared on the basis of Schedule of Rates, work orders shall be issued by Assistant Engineer to contractors registered with the Division.

B. DURING CONSTRUCTION STAGE

1.0 Execution of works

The contractor, to whom the work has been allotted, will meet the engineer-in-charge before executing the work, who will provide necessary drawings and other details to him. The contractor will submit a detailed construction program based upon his assessment of necessary labour, materials and equipments required for the work.

The works shall be executed as per the specifications and drawings.

Before start of work, initial cross sections of minor as mentioned in para 14 Chapter-3 Section A will be measured and entered in MB.

A check list is enclosed at Appendix – A to help the contractor & engineer-in-charge to make suitable arrangements before starting and during construction works. The coarse aggregate, sand, cement, bricks and reinforcement steel should be got tested as tabulated in para-11, Chapter-3 section B. Soil shall be tested as tabulated in para 13 Chapter 3 Section A.. The records of all specified quality tests, done as per prescribed frequency, shall be maintained by contractor and UPID.

For construction works, quality assurance plan as mentioned in para 14.0 Chapter 3 Section B shall be followed by UPID.

2.0 Site management

After allotment of work, the contractor shall visit the work site. He should establish a camp office at site of work. He shall arrange for the labor, materials and equipments necessary for execution of works. He should provide necessary equipment required to check the quality of construction materials and work.

3.0 Requirement of man power & machinery

- a. [The requirement of man power⁴](#) for different construction works on the minor can be estimated on the basis of the working capacity as per norms in UPID, tabulated below.

Sr. No.	Name of work	Man power	Unit	Capacity
1.	Earth work in minors	Beldar / Labor Mate	Cum / day ---do----	3.5 140
2.	Top dressing of Earth work	Beldar / Labor Mate	m-km / day ----do----	0.5 2.5
3.	Leveling / dressing of service road	Beldar / Labor Mate	m-km / day ----do----	0.5 2.5
4.	Silt Clearance	Beldar / Labor Mate	Cum / day ----do----	4 140
5.	Earth work in digging foundation	Beldar / Labor Mate	Cum / day ----do----	2.8 28
6.	Brick work in cement mortar	Mason Beldar / Labor Waterman Mistri	Cum / day ----do---- ----do---- ----do----	1.13 0.70 11.4 11.4
7.	Cement plastering over brick work	Mason Beldar / Labor Waterman	Sq m / day ----do---- ----do----	9.3 4.6 18.5
8.	RCC work excluding reinforcement, shuttering	Mason Beldar / Labor Waterman Mistri	Cum / day ----do---- ----do---- ----do----	1.41 0.35 1.40 1.14

- b. [The requirement of machinery⁵](#) for different construction / rehabilitation works on the minor can be estimated on the basis of the working capacity as per norms of MOSRTH given below.

SNo	Description of		Output of Machine	
	Machine	Activity	Unit	Output
1	2	3	4	5
1	Dozer D-50-A 15	Spreading	Cum / hour	200
		Cutting	Cum / hour	100
		Clearing	Cum / hour	150
3	Motor Grader 3.35 metre blade	Clearing	Cum / hour	200
		Spreading	Cum / hour	200
4	Hydraulic Excavator 1.0 cum bucket	Soil Ordinary	Cum / hour	60
		Soil Marshy	Cum / hour	60
		Soil Unsuitable	Cum / hour	60
	0.3 cum bucket	---- do----	---- do ---	18
5	Front end loader 1 cum bucket capacity.	Soil loading	Cum / hour	60
		Aggregate loading	Cum / hour	25
6	Tipper	Transportation of Soil etc.	cum	5.5
7	Truck 5.5 cum per 10 tonnes	Material Transport	cum	4.5
8	Vibratory Roller 8 tonne	Earth / Soil	Cum / hour	100
9	Smooth Wheeled Roller 8 tonne	Soil Compaction	Cum / hour	70
10	Water Tanker / Sprinkler	Water Transport & Sprinkling	Kilo litre	6
11	Tractor with Scrapper / dozer blade	Pulling / Spreading	HP	50
12	Rotavator	Scarifying	cum/hour	25
13	Ripper	Scarifying	cum/hour	60
14	Air Compressor	General Purpose	cfm	170 / 250
15	Concrete Mixer			
	0.40 / 0.28 cum	Concrete Mixing	Cum / hour	2.5
	1.0 cum	Concrete Mixing	Cum / hour	7.5
16	Vibrators MK6 / MK7	Compaction of concrete		
17	Diesel pumping sets	Dewatering		
18	Pneumatic vacuum cleaner / blower	Cleaning of old concrete surface		

4.0 Extra items / quantities

While preparing estimates, adequate provisions should be made for different items required for completion of work. However due to variation in site conditions or due to unforeseen reasons / change in design / scope of works etc, it may be

necessary to execute additional items / quantities of an item which should be assessed and sanctioned by competent authority, at the earliest.

5.0 Running payments of the work

When work is in progress and contractor demands payments, running payments shall be done as per terms and conditions of the agreement. The work done satisfactorily will be measured and entered in the measurement book by Junior Engineer. Any excavation done by contractor in excess to that shown in drawings will not be paid for. The bill stating the cost of work done shall be prepared in specified format and shall also be entered in the measurement book. The work and measurements will be checked by the competent authority of UPID. The payment of the work done by the contractor as per bill will be made by Executive Engineer.

When full security amount is not deposited at the time of signing the agreement, the security deposit to the extent of 10% of the value of running bill may also be deducted from the bill. However, the earnest money shall be adjusted against security deposit.

C. POST CONSTRUCTION STAGE

1.0 Final bill of works

After completion of construction works, final cross sections of minor for earth work will be measured and entered in the MB as mentioned in para 14 Chapter-3 Section A. Quantity of earthwork executed in construction works will be calculated by superimposing initial cross sections over final cross sections. For other items of work, quantities executed shall be measured as mentioned in para 14.0 Chapter-3 Section A.

During the execution of construction works, several running bills might have been paid to the contractor. The total quantities of each item of work done must be determined and previously paid quantities be deducted. The net quantities of different items to be paid must be shown in the final bill.

The bill shall be prepared in specified format and shall also be entered in MB by Junior Engineer and signed by him and contractor. The bill shall be passed by competent authority (Assistant / Executive Engineer) after due checking.

2.0 Completion of work

After completion of work, the contractor will be asked to remove the unutilized material and debris etc. at his cost and clean the construction site and to prepare as- executed drawings of construction works. The completion report / certificate of works should be prepared in the format enclosed at Appendix – E by JE, UPID. In case the actual expenditure on works exceeds the estimated amount by

more than 5%, the estimate of work shall be revised. Completion report shall be duly approved by competent authority.

3.0 Removal of defects

The contractor shall be liable at his own cost, for removal / repair of any defects observed in works after their completion within defect liability period & before releasing of bank guarantee /security deposit.

4.0 Releasing bank guarantee / security deposit

Six months after date of completion of work as per drawings and specifications the bank guarantee / security deposit may be released by the competent authority.

5.0 Recording data for future use

A record should be maintained by concerning AE, UPID for the data of construction works executed. The record of different difficulties encountered, changes made, any other significant happenings during construction should be recorded. This will help in preparing drawing, specifications, estimates and works of similar nature in future. The cost of overheads like expenditure in supervision of works etc. should also be recorded and analyzed for future use. A case history may be prepared for the work from its initial to final stages and the lessons learnt should be indicated in the conclusion. This will be useful for planning and execution of similar works in future.

Do's and Don'ts

Do's

1. The estimate of works should be sanctioned before execution of works.
2. The estimate of work shall contain a certificate by Executive Engineer regarding correctness of leads of carriages of various construction materials.
3. The approved construction drawings shall be given to the contractor before start of work.
4. The Executive Engineer should obtain the construction program from the contractor and check its correctness and achievability to complete the works during contract period.
5. The extra items or quantities shall be reported in time to competent authority and got sanctioned at the earliest.
6. The quantities of work already paid for in the running bills shall be properly accounted for while preparing final bill of works.
7. Any defects observed in the completed works within defect liability period shall be rectified by the contractor.

Don'ts

1. Don't allow any lumpsum provisions (without proper justifications) in the estimate.
2. Don't allow the tenders to be sold to unregistered contractors.
3. Do not accept any conditional tender or tenders without earnest money.
4. Rejected construction materials shall not remain at site for more than one day to avoid its possible use in work.
5. Do not release the security before the expiry of six months after the completion of work.

References

- 1- उ० प्र० लोक निर्माण लेखा पद्धति – (Based on FHB, Volume-6) – A.K. Srivastava, Assistant Accounts Officers, Office of AGUP (A&E), Chapter-5 para 9.
- 2- उ० प्र० लोक निर्माण लेखा पद्धति – (Based on FHB, Volume-6) – A.K. Srivastava, Assistant Accounts Officers, Office of AGUP (A&E), Chapter-5 para 12.
- 3- उ० प्र० लोक निर्माण लेखा पद्धति – (Based on FHB, Volume-6) – A.K. Srivastava, Assistant Accounts Officers, Office of AGUP (A&E), Chapter-5 para 15.
- 4-
 - (i) Central Design Directorate UPID, Lucknow drawing no. 11-C-S-S/50 – Standard form of analysis of rates for earthwork by manual labor
 - (ii) Central Design Directorate UPID, Lucknow drawing no. 16-M-S-S/55 – Standard form of analysis of labor rates for earthwork by manual labor.
- 5- Standard Data Book for Analysis of Rates, MOSRTH, Chapter-17 - Usage rates of plant and machinery.

CHAPTER – 5

GUIDELINES FOR MAINTENANCE OF MINORS

1.0 Introduction

Maintenance refers to operations performed in preserving the irrigation distribution system and facilities in good condition without increasing their capital cost. All physical systems deteriorate with use and age. Some deteriorates faster than others. With proper maintenance their life can be prolonged.

All works shall be carried out as per IS: 4839 Part I & III and UPID specifications.

2.0 Need for maintenance

Proper maintenance of irrigation distribution system is imperative and essential so that,

- a. The conveyance and delivery system of the irrigation channel may be in a good condition for effective water management and to retain operational efficiency;
- b. Reliable and equitable deliveries to the outlets up-to tail may increase crop productivity from the existing irrigation systems and such deliveries can be assured by timely rectification of deficiencies;
- c. Precious water resources for irrigation may be conserved.

Maintenance is equally required during running of canal, canal closure and also during rainy season. This manual has been prepared as a guideline for maintenance of minors and pucca works constructed across them.

3.0 Principle of maintenance

Principle of canal maintenance is that canal should accomplish its purpose of systematic and equitable distribution of available water in the canal from its head to tail in its command area. For this purpose it is very essential that:

- a. A clear regular bed with design slope and bed width is maintained
- b. Section of canal is kept clean and clear. Designed free board is available in full length of the canal.
- c. The top surface of bank is kept at designed level and bank with service road is in good condition and top width is uniform and regular.

- d. Cross drainage works and other pucca structures are in good condition.
- e. The structures constructed across the canal are able to perform their desired functions.

4.0 Inspection of Canal

The damages in canals during their running condition are natural. It is necessary to minutely inspect the canal during canal closure as well as during canal running condition. Most of the deficiencies may be observed in closure time while some of them during canal running. Therefore continuous supervision / inspection of canal is essential.

Information of date and duration of canal closure will be given, well in advance, by Team Leader of PIM task team to the office bearers of WUA and members of PIM team.

Office bearers of WUA will conduct joint walkthrough with PIM team and farmers in the command area of minor, to identify the nature and location of various deficiencies occurring in the minor and plan the necessary remedial measures after discussions amongst members of WUA.

4.1 Observations to be made during canal closure

Walk through inspection of the canal should be done and any damage / abnormality should be noticed. Following points should be specifically observed

- a. Silting of canal bed, change in bed width,
- b. Any erosion / scouring of bed and banks of canal
- c. Growth of vegetation or weeds in the internal section of canal.
- d. Decrease in free board of canal as compared to designed one due to lowering of bank
- e. Depression / erosion / scouring of bed near the foundations of pucca structures, in down stream of falls / weirs
- f. Any chocking of pipes and openings in the crest of falls
- g. Whether all masonry works are clear of rubbish, stone, bricks etc especially the syphons and aqueducts.
- h. Any damage to pucca structures on canal caused by the expanding roots of a tree or vegetation grown in the vicinity of these structures.
- i. Settlement and/ or cracks in the pucca structures
- j. Condition of outlets for any chocking / damage.
- k. The drain bed 200 metre upstream and downstream of each cross drainage work should be observed for scouring in bed and sides. After every heavy rainfall, these works should be inspected to rectify any scouring / damages.
- l. Damages to gates of head regulators / weirs etc.

4.2 Observations to be made during canal running

Minute Inspection is necessary during running of canal. Following points observed at any particular locations must be given special attention.

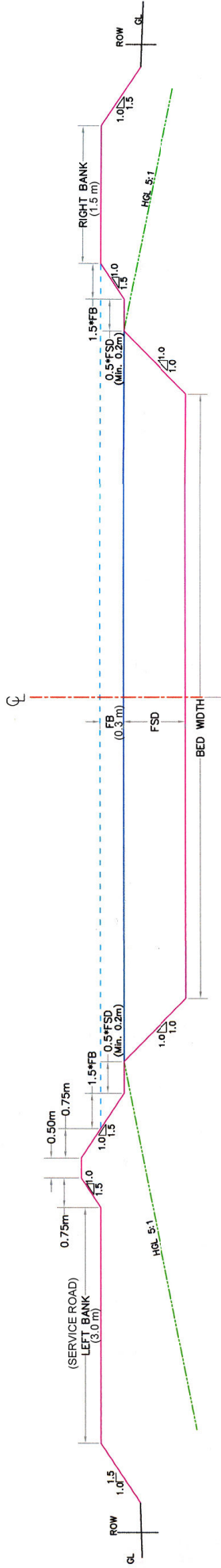
- a. Whether air bubbles are continuously developing at canal water surface. Air bubbles in canal water indicate that there is excessive loss of water. This also indicates that the process of excessive seepage / leakage has started.
- b. Whether any seepage of water is visible at the exposed surface of outer toe of banks. If there is seepage, whether the water coming out is clean or mixed with soil. Clear judgment is required regarding quality of water. If the seepage water coming out is mixed with soil, the canal can breach any time due to piping. Therefore the muddy seepage water should be taken as a warning and immediate remedial steps should be taken. .
- c. Whether there is any excessive growth of greenery like grass etc. at the outer toe of banks Excessive growth of grass gives indication of continuous seepage, leading to likelihood of a breach of canal..
- d. Illegal bank cuttings / cross bandhas in minor for taking water

4.3 Typical cross section of minor¹

Typical cross sections of a minor with head discharge lesser than 0.3 cumec and head discharge between 0.3 – 0.6 cumec is shown as under:

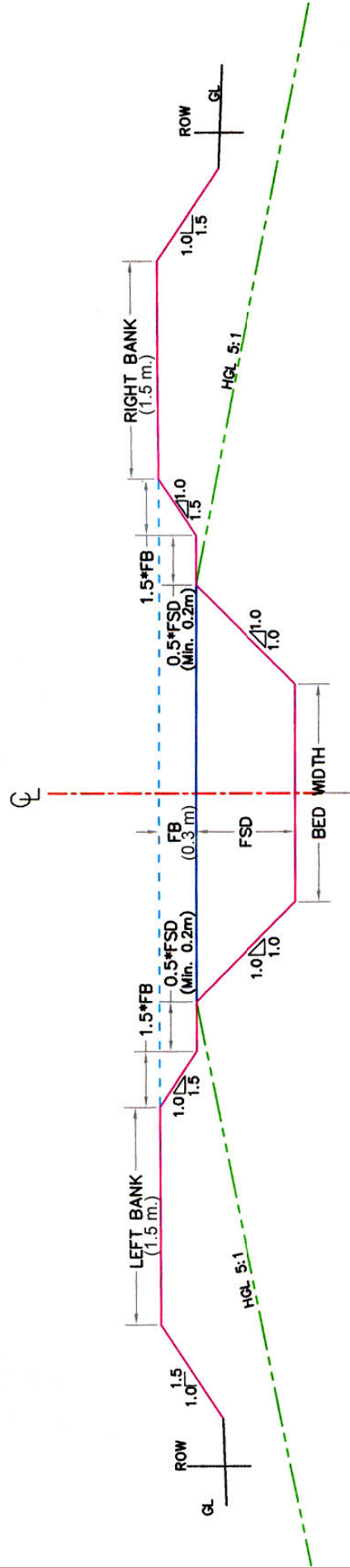
4.4 Setting out

This will be done as per para 1.0, Section-A, Chapter- 3.



FB = Free Board
 FSD = Full Supply Depth
 HGL = Hydraulic Gradient Line

TYPICAL CROSS-SECTION OF A MINOR WITH SERVICE ROAD
 (Head Discharge > 0.3 cumec & < 0.6 cumec)



FB = Free Board
 FSD = Full Supply Depth
 HGL = Hydraulic Gradient Line

TYPICAL CROSS-SECTION OF A MINOR WITHOUT SERVICE ROAD
 (Head Discharge < 0.3 cumec)

5.0 Clearing of site

It shall be done as specified in para 2.0 Chapter-3 Section A.

6.0 Drawings

All works shall be carried out in accordance with the approved drawings.

7.0 Scraping of bed / internal banks of minor

- a. Generally silt does not travel up to the mid and tail reaches of a minor taking off from a Distributory. Therefore only scraping of grass in the internal section of minor is sufficient.
- b. Before starting work on either the bed or the berms of a canal, these must be lined out with flags and string. The former are necessary for the alignment in general and the latter, to correct small irregularities therein.
- c. All grass must be scraped and weeds removed from the bed by *phaoras* wherever they are found to exist except where the bed is lower than the theoretical bed, when *darantis* should be used. The presence of these induces the deposit of silt.
- d. All *theks* i.e. local accumulations or mounds of silt above designed bed level must be removed down to correct bed level. Bed should be leveled and its gradients regularized to the designed slope.
- e. The bed levels should be fixed correctly at close intervals with the help of bed bars in the minor.
- f. The practice of cutting out the *theks* in the corners and throwing them into the centre of the bed to level it up shall on no account be permitted.

8.0 Bed bars / Profiles

As soon as a minor is closed for a fairly long period, the following measures should be taken:

- a. Bed bars should be examined to see that they are intact and clearly visible. They serve no useful purpose if they are allowed to be buried and hidden in silt.
- b. Existing bed bars constructed in masonry should be repaired where needed in cement mortar and no loose bricks should be left lying in the bed, on bank or on service road.
- c. Highly damaged bed bar should be replaced by a new one at the level as per drawing.
- d. Pucca profiles defining the designed internal section of a minor at 200 m interval will help in the effective monitoring of maintenance works.

9.0 Silt Clearance

- a. Before starting the work of general silt clearance, silted L- section along with cross-sections shall be measured as mentioned in para 14 Chapter-3 Section A and designed longitudinal section and cross sections should be marked over it to calculate quantity of silt to be cleared.
- b. Canal should always be cleared from downstream to upstream, starting either from the tail or a fall on the canal. The clearance of isolated lengths should never be allowed.
- c. Silt should not be cleared below falls but if outlets in such places are over drawing due to rise in water surface, they should be raised².
- d. Any over-excavation in width/depth with respect to designed values of a canal section during de-silting leads to fall in water level in canal. This reduces discharge through outlets in such reaches.
- e. Silt clearance should as far as possible be finished by the time Rabi sowing starts.
- f. While de-silting, the bed of the canal will have a longitudinal gradient as given in L-section and will be kept level transversely. The cross section shall conform to those given in the drawings (designed) and shall be neatly finished. Any excavation below the prescribed bed level shall not be paid.
- g. Bed bars should be exposed before the de-silting of canal. Excavation of silt shall be done as per drawing and level / section defined by bed bars. Care shall be taken that bed bars are not damaged during de-silting works.
- h. After completion of de-silting, final cross sections of the canal shall be taken at the same locations as that of initial cross sections. Quantity of excavated silt shall be calculated by super imposing final cross sections over initial sections.
- i. If the minor is taking its authorized discharge, there is no need to clear the silt from such a minor.²
- j. Silt clearance in a minor shall be done in a manner that FSL is maintained with designed discharge.²

10.0 Silt disposal

Disposal of silt from bed depends on its quality as given below³

- a. **Coarse Silt** – In case of minors directly taking off from main canal or branch canal, coarse silt is found in head reaches of canal. It contains a large percentage of sand which does not stabilize and is useless for any repairs. This should be disposed off in filling old borrow pits first and then on long outer slopes of banks; care being taken that the top of the heap is never allowed to come above the bank level. Silt thrown on outer slopes of banks

should be disposed off in a regular and uniform manner and not in irregular heaps.

- b. Medium Silt** – In case of minors directly taking off from main canal or branch canal, it is found in middle reaches of canal. It stabilizes after one monsoon passes over it, if taken out before or during the monsoon. It may be utilized in: closing leaks, securing outwards slopes, widening bank only as supplement to the berm earth if it proves insufficient.
- c. Fine Silt** – In case of minors directly taking off from main canal or branch canal, it is found in tail reaches of canals. It contains a good proportion of clay, settles down to a very smooth surface and allows grass to grow freely on it. It is valuable for all repairs and should be used like berm earth.

In case of minors taking off from a distributary, generally fine silt is found in head reaches and no silt is found in mid and tail reaches.

- d.** Coarse and medium silt should not be spread on canal service road. If medium silt has to be used for any reasons, surface should be covered by a 20 cm thick layer of good loamy soil or fine silt⁴.
- e.** Bed silt may be thrown on the outer slopes and in hollows. Silt should not be heaped above bank level.
- f.** *Tattis* should be left at 30 meter (100 ft.) intervals for intermediate measurement, but they must be removed before the channel is opened. Boning rods should be used to see whether the silt has been properly cleared.
- g.** False *tattis* at all intermediate theks or other high places in the bed shall not be allowed to avoid over-measuring.
- h.** In case of minors directly off taking from a main or branch canal, disposal of silt will be done as under
 - i.** Fields nearby the canal are identified before de-silting of canal is started and a silt disposal plan is prepared for the canal Km wise showing *Khasra* no. of the fields identified on *Shazra* plan and quantity of the excavated surplus silt to be disposed off in each of these fields. Consent of the owner farmers is obtained prior to the disposal. Silt is disposed off as per disposal plan for each canal.
 - ii.** In cases where consent for disposal in the fields is not given by owner and disposal work is obstructed, the silt may be disposed off in the low lying Government, *Gram Sabha* or Private land in nearby project area. These areas shall be identified by a *Tehsil* level committee under chairmanship of concerned SDM and to be constituted by District Magistrate as per

order no.1596/PACT/Env.Cell/Silt disposal / 07 Dated 03.04.07 issued by Secretary UPID and Chairman PACT.

- i. Suitable excavated silt will normally be used for repairs of banks, daula, and outer slopes of banks.
- j. The contractor shall ensure that there is no blockage of existing outlets of the minor due to disposal of the excavated surplus material. If anything found contrary, the contractor shall arrange to rectify at his own cost.

11.0 Sources of Earth for Repairs

11.1 Earth for repairs can be obtained

- a. From internal clearances. Material obtained from there should be utilized as given in para 9.0 above.
- b. By removal of irregularities existing in banks in excess of required section. High banks can be lowered and bumps or projection on top or sides cut down to fill in the hollows.
- c. From prominent mounds in the fields near the site.
- d. From beds of drains near the site.
- e. From beds of guls.
- f. From borrow pits in the beds of minors. These borrow pits should be in the centre leaving at least 30 cm on either side in the bed and its length should not exceed 6 meter or 2 B where B is Bed width, whichever is less and depth not more than 30 cm. A strip of 1.5 meter width should be left between two successive borrow pits. Borrow pits should be avoided at the tails of minors where negligible or no silt deposition is observed⁵.

11.2 Earth for repairs can also be obtained from outside borrow pits, as a last resort.

The following precautions should be observed in taking earth from this source⁵.

- a. No borrow pits shall be dug within 5 metre from the toe of banks or driving road or ramps of bridges.
- b. No borrow pits shall be dug within old borrow pits.
- c. No borrow pits shall be more than 30 cm deep and in cultivated fields, they should be kept 15 cm deep as far as possible.
- d. Where old borrow pits exist, diagonal tattiis (from corner to corner) shall be insisted on the new pits to avoid any exaggeration of the measurements of the works done by enlarging the old pits.
- e. Earth required for repairs should not be taken from the hollows near bridges or from old borrow pits in plantation.

- f. Borrow pits in parti land near habitations should be prohibited.
- g. In addition the precautions mentioned in para 5.0 Chapter 3 Section A shall also be observed.

12.0 Banks of Minor

- a. The minimum width of banks and the free board above designed FSL shall be as under⁶

S. No.	Discharge (Cumec)	Minimum bank top width (m)		Free board above FSL (Excluding Daula height) (m)
		Riding Bank	Non-riding Bank	
1	2	3	4	5
1	< 0.30	1.5	1.5	0.30
2	0.3 to 0.6	3.0	1.5	0.30

- b. Driving road ramps should be complete and well consolidated everywhere. A horizontal stretch of 15m length with ramps in 1:30 slope should be provided over bridge crossings / outlets where top of bank is higher at these places.
- c. Driving road ramps to the bridges should be horizontal and at right angles to the canal till they are 1.5 meter from the edge of the banks or driving road. Most of the damage to bridge parapets, canal banks and driving road is the direct result of wrongly aligned ramps.
- d. Stakes or branches should not be used to support the earth filled into “*ghattas*” or used in petty repairs to the banks.
- e. *Jhunds* must always be uprooted and not merely cut. The earth should be dusted from the roots to prevent them from taking roots again when thrown outside, which they easily do, thus increasing the work of jungle clearance from year to year.
- f. Dried jungle and *kabar* should be burnt or used for compost, as it is liable to get into the channel and obstruct it.
- g. No work shall be commenced on the land that has not been duly handed over to the department by the responsible authorities.
- h. Banks should be brought up and maintained to full section as per drawing.
- i. Top of bank must be smooth and free from clods, theks and *leeks* while transversely they should be given a slight outward slope of, say, 1 in 80 to take the rain water away from the canal thereby preventing formation of *ghattas* and washing of bank earth into canal.

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- j. Both edges of banks, especially the inner ones, should be neatly aligned parallel to the channel. They should be absolutely straight in straight reaches and regular in curved reaches.
 - k. The bank slopes must, on no account, be scraped or cut back throughout as a general rule. Only where the whole bank slope is so irregular that nothing less than redressing it from top & bottom will do, cutting the slope shall be done but only after obtaining prior approval of the Engineer in charge.
 - l. Grass or turfing should on no account be scraped. It should only be cut as far as necessary to avoid the holes being hidden under long grass.
 - m. Banks that are too low should be raised to the proper designed levels as early as possible.
 - n. Banks should generally be at least 30 cms above the country level to prevent drainage getting in the canal.
 - o. When banks show signs of damage owing to saturation, they may be protected with an appropriately designed filter on outer slopes and/ or seepage drain.
 - p. In case of banks where there is trouble due to burrowing animals, a sand core may be provided.
 - q. In pervious reaches where seepage is excessive, puddled clay core in place of sand core may be provided. Where water logging is observed, seepage drains should be provided on either bank.
 - r. A *daula* should be made to the size and shape specified in the drawing. The bottom edge of the *daula* should not be cut for repairing the banks.
 - s. If a portion of the *daula* falls into the canal, another *daula* should be made a short distance behind and parallel to the old one. The new and old *daula* should be joined with a reverse curve.
 - t. Trees should not ordinarily be allowed to grow on canal berms or within 3 meters of the inner edge of the non riding bank. If they are permitted in certain reaches, the fact should be recorded in the register of plantation.
 - u. Hollows at bridges and elsewhere should be filled up with silt as opportunity offers.
 - v. Jungle on minors should, as a rule be cleared from toe to toe of the outer slopes of the banks. *Kans* grass, *gundar*, *jhunds* and small trees, especially *dhak* should be dug out by the roots. Stumps of trees that have been sold standing should be cut down, to at least 30 cm (1 foot) below the ground.
 - w. In filling reaches, damaged filter, if provided, at the toe of outer slope of the bank shall be restored appropriately.
 - x. No tube-well should be bored within 25m of either bank of minor.

13.0 Rehabilitation / Widening of damaged minor banks

In addition to the guidelines in para 12 above, the following precautions shall also be observed:

- a. In reaches where more than 50% section of canal embankment is damaged, the alternative of reconstructing the whole section afresh may be considered. However the earth obtained after dismantling the existing section should be used in reconstruction of bank.
- b. Benching of slopes of the existing embankments of canal shall be done with a maximum slope of 2H:1V so as to give a proper bond to the freshly laid embankment soil with the existing soil. The benches shall be 0.3m (V) x 0.6m (H) or as directed by Engineer-in-charge. The base of the extension portion of the existing bank should be stripped of all the vegetation up-to a depth of 5.0 to 7.5 cm.

14.0 Maintenance of Pucca works

14.1 General

- a. Pucca works on canal include the structures specified in para 3.0 of chapter-1 above. These are required to be in good operational condition for which regular inspection, maintenance and repair is necessary. The structure must be maintained as per their drawings.
- b. Guidelines for maintenance of pucca works are given below:
- c. All the dismantled material of a pucca structure to be repaired shall either be used in filling or disposed off at pre identified place away from canal.
- d. All the canal gauges fixed at head regulator / weir / fall / tail wall with zero at bed level should be cleaned periodically for proper visibility.
- e. Jungle and accumulations of silt should always be cleared from around kilometer and Hectometer stones to enable them to be seen from a suitable distance.
- f. All kilometers, Hectometer stones and boundary-pillars should be kept in proper order. Displaced boundary-pillars should be re-fixed only after reference to the land plan. Land width should occasionally be checked at site with reference to boundary pillars.
- g. There should be no grass growing near the parapets or wings of bridges and falls which should be kept scrupulously neat and tidy. Grass growing against masonry works should not be scraped off as the masonry would get damaged in the process. The bajri or fine brick ballast in a thickness of 75 mm, spread round the masonry will prevent grass from growing up⁷.

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- h. Neither trees such as *pipal*, *gular*, *pilkhan* or *bargad* & tall grass, nor jungle of any kind should be allowed to grow near a masonry work, as the roots of these trees grow into the joints and damage the masonry⁷.
 - i. Grass and jungle must never be allowed to grow on masonry work. It should be dug out by the roots and the masonry should then be pointed or plastered.
 - j. Slime and moss, which often coat masonry, should be carefully scraped off, care being taken not to damage the mortar or plaster in doing so.
 - k. All masonry / concrete works should be inspected and soundings taken in the vicinity and repairs carried out during the closure period. A register of masonry / concrete works for canal should be maintained and updated from time to time when improvements are affected. In addition to the register, the drawings of all the masonry / concrete structures should be maintained on tracing cloth and remodeling or repairs carried out from time to time should be marked in different colours and note to this effect should be given on tracing cloth itself so that the relevant case and the documents could be linked⁸.
 - l. At drainage crossings and in down stream of canal structures where significant erosion may persist due to turbulence and wave action, the dumped rip rap consisting of brick bats or boulders should be provided. Protection by launching apron should be provided only in a length so as to cover maximum scour in a slope of 2:1. Dumping of boulders / brick bats should not be above bed level. Embankment should be protected by pitching on the side slope with bricks / stones. Bricks / stones left out protruding in a staggered fashion will be helpful in the dissipation of energy⁸.
 - m. Special care shall be taken to see that the masonry repair work is kept wet for 10 days. Therefore such repairs should preferably be done in rainy season.
 - n. Wheel guards should be fixed in the line with the straight portion of the parapets.
 - o. A line marking the full supply level should be painted on the upstream face of every pucca work. If there is no structure in a considerably long reach, the full supply level should be marked on profile walls specially constructed for this purpose such that it is conveniently visible from the inspection bank.
 - p. Details of each pucca structure, such as its chainage, name and top level should be painted on its u/s and d/s faces, clearly visible from bank of the canal.

14.2 Damaged Masonry Works⁹

- a. The work involved in repairs to masonry works shall mostly require joining new masonry with old damaged masonry in abutments, piers, wing walls, parapet of bridges, head & cross regulators, falls, weirs, tail walls, siphons etc. The exposed

joining surface of the damaged masonry shall be roughened by removing all loose brick masonry or mortar using air compressor or wire brush, cleaned and washed. A 10 mm thick layer of the fresh cement sand mortar having same mix as for masonry shall be applied on the existing surface before doing fresh masonry to give a proper bond. All vertical joints in the masonry shall be made by making proper teeth in the existing masonry.

- b. While carrying out masonry work, templates prepared to the correct shape and approved by competent authority shall be used to ensure correct batter as well as correct shape of masonry specially at cut & ease water ends. For brick work in piers of VRB, mortar shall be prepared by mixing cement and sand in proportion of 1:3 and for pointing work over brick masonry, in a proportion of 1:2 by volume.

14.3 Damaged pointing / plaster⁹

- a. The damaged pointing shall be thoroughly removed by scraping and racking the joints to 15 mm depth. All loose and undesirable material shall be removed and surface washed. The surface shall be kept wet till for at least 2 days fresh pointing is started. The pointing shall then be carried out by using 1:2 cement sand mortar in general but in no case mortar leaner than 1:3 shall be used. The mortar shall be filled and pressed into the racked out joints before giving the required finish. The superfluous mortar shall be taken off from the edges or the lines of joints and the surface of masonry shall be cleaned of all such mortar.
- b. In case of building walls, the patches of damaged plaster measuring upto 2.50 x 2.50 m shall be repaired. For greater patches, the plaster of the whole wall shall be redone. The mortar of the patch where the existing plaster has cracked, crumbled or sounds hollow when gently tapped on the surface shall be removed. The patch shall be cut out to a square or rectangular shape. The edges shall be slightly undercut to provide a neat joint.
- c. The exposed surface of masonry shall be prepared as for pointing. The plastering shall be done with cement sand mortar not leaner than 1:3. . The surface shall be finished even and matching with the old surrounding plaster.

14.4 Damaged Parapets⁹

All RCC railings / masonry parapets on the bridges which are extensively damaged by more than 70% shall be replaced by fresh masonry as per drawing. In cases where damages are less than 70%, the railings / masonry parapets shall be rebuilt as per existing design. Specification for normal brick work shall be followed.

14.5 Curing of masonry works⁹

All green masonry shall be protected from rain by suitable covering. Special care shall be taken to see that the repair work to masonry is kept wet for 10 days beginning after 24 hours of laying. Should the mortar perish i.e. become dry, white or powdery through neglect of curing, work shall be pulled down and rebuilt.

14.6 Damaged deck slab⁹

The damages to RCC deck slab can generally be classified into following categories.

- a. Damage to concrete surface
- b. Cracks in concrete
- c. Corroded steel reinforcement
- d. Honey comb concrete & holes

a. **Damage to concrete surface**

Damaged and fractured concrete shall be removed to a sound surface by mechanical methods like milling, chipping and use of compressed air. It must be ensured that the sound concrete and the reinforcement are not damaged during removal and cleaning. The existing surface shall be washed and sprayed with cement slurry. The damaged area shall be repaired with fresh concrete of the same grade as existing concrete and brought to the original shape. The surface is finished with cement mortar with polymers.

b. **Cracks in concrete**

Crack resulting from one time load application and which have seized to propagate and the shrinkage or settlement cracks having width of less than 3mm shall be repaired by first sealing the cracks with adhesive packer and then pressure injecting the Epoxy resins such that stability of the structure is restored.

c. **Corroded steel reinforcement**

The rust and all the scales from the exposed reinforcing steel shall be removed by sand blasting, needle hammer or wire brushing. A careful check and repeated treatment of the individual bar may have to be done. A corrosion protection such as lead oxide should be applied to the cleaned reinforcement surface prior to restoration of concrete cover.

d. **Honey comb concrete and holes**

All the honey comb concrete of the structure shall be carefully removed. The surface shall be roughened by cleaning all the loose concrete by air pressure jet. The surface shall be washed and sprayed with cement slurry. Then 1:2 cement sand mortar with a water cement ratio not exceeding 0.4 shall be applied and fully compacted.

14.7 Damaged wearing coat⁹

All damaged concrete in wearing coat of bridges shall be thoroughly removed and loose material around the damaged periphery shall be removed by chipping. The surface shall be cleaned with air compressor, washed and sprayed with cement slurry before laying fresh concrete of the specified grade for repairs.

14.8 Curing of concrete works⁹

All green concrete shall be protected from rain by suitable covering. Special care shall be taken to see that the repair work to concrete is kept wet for 14 days beginning after 6 hours of laying.

14.9 Damaged Civil Works for Installation of New Gates⁹

For installation of the new gates and hoists and their embedment, certain alterations will be required in the existing civil structure. The existing masonry shall have to be partially dismantled to such dimensions so as to accommodate the block out for the embedment including the sill beam. After properly positioning and securing the embedment including the sill beam these block outs shall be properly back filled with M-20 cement concrete and cured suitably

14.10 Railway / Road Bridges on Minor¹⁰

a. Railway Bridges

All the maintenance works will be done by railway authorities. Cost of protection works against scouring will be borne by WUA and for all other works railways will bear the expenditure.

b. Road Bridges

Repairs to approach roads and ramps will be done by PWD (road maintaining authority) at their cost. Cost of protection works against scouring will be borne by WUA.

15.0 Gates and Regulation

- a. All exposed surfaces of steel gates of head regulator, orifice module and duckbill weir shall be kept properly painted with specified anti-corrosive black enamel paint to prevent rusting. For the ironwork, such as in bridges railings and machinery, silicate paint of a selected color should be used.
- b. Rust shall be carefully removed from the ironwork and the surface rubbed clean before painting.
- c. Coal-tar should never be used on ironwork, as it does not prevent rusting.
- d. The projecting screw threads of the lifting gears of gates should always be kept covered with hollow bamboo caps to keep them clean. Castor oil is a good lubricant for such screws.

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- e. No leakage should be permitted through the gates of head regulator / weir of the minor that has been closed, as a little water dribbling down a minor promotes the growth of grass and weeds in the bed. It is not always necessary to use earth for closing leakages in the gates at head. Grass or *bhusa* packed between the gate leaf and the grooves will often be enough to practically stop the leakage. When earth is used it must not be dug from the banks but from outside.
 - f. To completely close the water flow in minor, the discharge in minor should be reduced in stages to avoid the sudden draw down in inner slopes due to pore pressure. Similarly the water in the empty minor should be released in stages i.e. full discharge should not be released in minor at a time. The procedures to increase or decrease water in minor should be fixed. The opening and closing of minor should be done accordingly.
 - g. On demand suddenly ceasing, minor shall not be closed without orders. Its supplies may be lowered to three fourths and the remainder got rid of by opening outlets.
 - h. All the gates of a head regulator or duckbill weir of a minor should be operated equally, as far as possible, to avoid possibility of any shoaling or scouring in the minor bed due to asymmetrical flow at down stream of head regulator¹¹.
 - i. Each outlet committee on a minor shall inform, in advance, any increase or decrease in water demand at its outlet to the upper level functionary of WUA such as President or Secretary of WUA. This will be done to regulate the water supply at the head of minor to avoid any wastage of irrigation water.

16.0 Miscellaneous

- a. Any seepage from minor should be drained off by means of seepage drains along the outer toe of banks of minor.
- b. Wastage of water into nearby depressions and hollows should be prevented.
- c. Gauges at the head and tail of the minor should be observed and recorded daily.
- d. Bed bars should be exposed and any damage should be promptly rectified. Highly damaged bed bar should be replaced by a new one at the level as per drawing.

17.0 Outlets

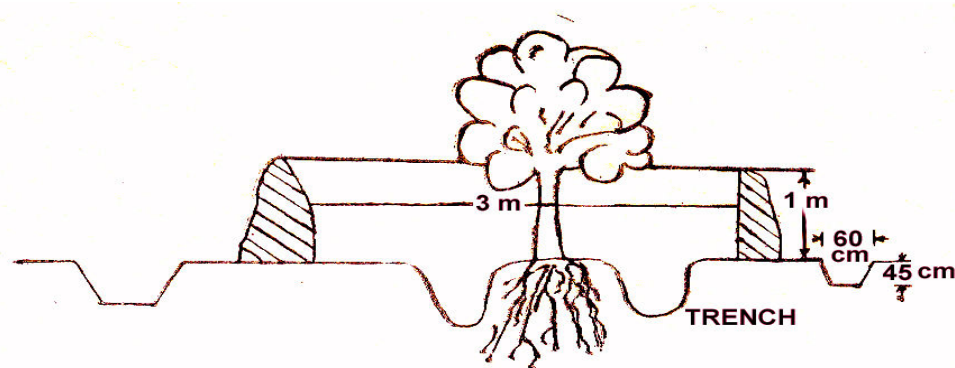
- a. All outlets during the specified closure period must be inspected thoroughly, especially for any chocking or tampering.
- b. The size or depth of an existing outlet must never be altered without previous sanction. If the bank at an outlet is narrow because the outlet pipe is damaged, it should be replaced with a new pipe with the approval of the engineer in charge.

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- c. All outlets should be checked as regards position, size and correctness of fixing, as per roster fixed by Executive Engineer. Any outlet fixed wrong should be corrected at once
 - d. When an outlet is abolished the gul should be leveled off for the first 15 meter of its length.
 - e. *Guls* should not be allowed to run along side of the bank of canal and inside the land of canal.
 - f. All the temporary outlets which are sanctioned for a particular *fasal*, must be removed after the expiry of period of *fasal*.
 - g. A register should be maintained and head at water (H) of each outlet i.e. the difference between the water level in the minor and the center line of the outlet at its exit when the minor is running at full supply level should be measured every month & be recorded in the register. It will be of great help for ensuring that the outlets draw their authorized share of canal water¹².
 - h. Pipe outlets are gradually being replaced by semi module outlets. These outlets should be inspected regularly for any damage to pipes / throat block / pedestal wall.

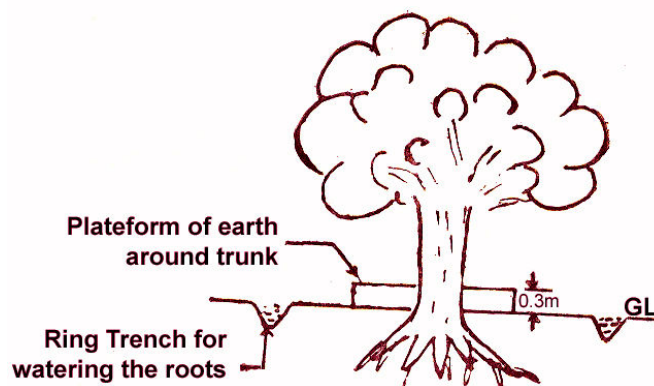
18.0 Felling / Plantation¹³

- a. When a dead tree is to be felled, a hollow should be dug round the base and the trunk cut through at least 30 cm down the ground / top surface of bank. The hollow then should be filled with earth and well rammed to cover the root.
- b. Shade line trees shall not be felled without special sanction.
- c. All fallen or dead trees should be immediately reported to the engineer in charge and his orders taken whether they should be stored for use at the nearest canal workshop/ inspection house or sold by auction.
- d. Pruning, if done, should not be carried out with axes. The branch should first be sawn about half through on the under side and then completely through from the top, so that the bank may not be torn off. It should be done in February just before the sap begins to rise. Branches and twigs overhanging a bank or roadway should be sawn or lopped off sufficiently to give a clear headway of 3 meters above the road or bank.
- e. All large roots found in the banks should be taken out during the rains and burnt into charcoal when dry.
- f. The parasite plants of *amarbel* and *banda* should be removed from trees at site, carried to an open space and then burnt. If the tree is completely covered by the parasite, it its better to cut it down at once and burn the parasite on the trees.

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- g.** Young plants should not be cut in the shade line until they have attained a height of at least 1.5 meter. It is better to lose a few plants by their being too large for transplanting than to undertake the nursing of small seedlings in the shade line.
 - h.** No trees, not even *kikar*, should be sown nearer than 4.5 meter apart. But if any have been sown more thickly they should be thinned out to an interval of about 4.5m when 3m high or so. If timber trees have grown up close together they should be thinned out to intervals of from 10m to 15m according to the size of which the trees grow.
 - i.** Trees that grow to a large size, such as mango, *mahua*, *jamun*, teak etc, should be put down at intervals from 12m to 15m from the start. Fuel trees can be grown in between to make full use of the land and thinned out later.
 - j.** Sowing should commence in first week of June and be finished by the middle of the month, so as to get the full benefit of the rains. But if irrigation is available, the best time for sowing is early in March, before the new leaves appear.
 - k.** In low ground liable to flooding, seeds should be sown on ridges.
 - l.** The roots of seedlings should neither be cut nor broken when transplanting. They should be dug out with a good ball of earth adhering, and so carried to the new site. If grown in pots, like eucalyptus, etc., the roots are sure to be pot-bound. In such cases the pot should be carried to the new site and the seedling roots should be bared of earth and straightened down into the holes dug for them. This greatly facilitates their subsequent growth.
 - m.** If the new "root and shoot" method of transplanting is adopted, when the seedlings are 75 cm to 90 cm high, their roots are cut off 30cm. below and their stems 6 cm above ground, and they are planted out direct in to the shade line plantation in February. If kept watered in summer these would be established during the rains.
 - n.** Detailed inspection of shade lines should be done weekly. Following clear instructions should be given.
 - (i) All newly planted trees and also those which are less than 2m in height should be properly protected by new guards 1.0m in diameter and 1m high made from the earth taken from the trench as shown below.



- (ii) Preferably, tree guards made of iron cages should be used as they required lesser space than earthen / masonry ones.
- (iii) The old tree guards must be repaired properly where necessary and all grass, jungle and 'Kans' weeded out from the bed and surface of the *thamlas* (tree guard).
- (iv) There should be a hole at the bottom of tree guards, enough to allow rain water to be drained off.
- (v) The small trees should be all erect and not leaning side-ways. Where necessary, a prop should be used for the purpose.
- (vi) There should be no double trees in any *thamlas* and branches taking off near the roots or lower down should be lopped off carefully to enable the plant to rise to its full stature.
- (vii) Newly planted trees must be watered regularly but not to excess and the top soil loosened soon after watering.
- (viii) Established plants which have only been less than two years on the shade line require to be given similar treatment though not so often.
- (ix) Large trees are well able to look after their own nourishment and giving them a bucketful of water is sheer waste. A good heavy watering of 5 or 6 bucketfuls about once a month only in the very hot weather is about all that is necessary for trees of medium growth; and even so, the very big and established trees don't even need this attention.
- (x) Watering of trees should be done in ring trenches made away from the trunk. As the tree grows the trench should be taken further away from the trees so as to lie over the root development where the water is required.



- o. All trees should, however, be carefully watched and any bad effects noticed should be immediately attended to
- p. Acquired land width of canal should be marked by planting suitable species of trees at suitable interval, besides the boundary pillars.
- q. Internal diameter of all earthen thamlas should be 2m to give sufficient light, space and air to the young plant for its growth. Thamlas around mature trees should be leveled and converted in to earthen platform around them.

19.0 General deficiencies in minors, their effects and remedy

A. Earth Work

a. General

General deficiencies found during inspection, their adverse effects and measures to be taken up for their mitigation have been tabulated below:

Sl No	General deficiencies	Effects on canals	Procedure for dealing with deficiencies and canal maintenance
1	2	3	4
1.	Growth of aquatic weeds	Irrigation canals that carry silt free water generally get infested with aquatic weed growth which reduces their capacity and thereby impairs their proper functioning. In some cases the excessive weed growth may cause breach in canal.	Aquatic weeds should be removed completely and regularly so that infestation does not spread. In case of old canals, where aquatic weed growth is profuse, suitable methods such as manual or mechanical may be employed at a stage as early as possible.

Notes:

It is easier to remove and uproot aquatic weed during canal closure. After removal of aquatic weed, pulverization of earth in bed by plough is essential to remove the seeds of aquatic weed. The vegetative material and aquatic weed removed from canal should be burnt when it is dry.

2.	Silting of bed of canal	The silting in bed of canal reduces its discharging capacity. The outlets at the silted bed will draw more water due to increase in water level in canal and less water will be available for outlets in d/s of silted portion of canal.	During canal closure, the canal bed should be desilted to carry design discharge. If top or outer slopes of bank are damaged, suitable silt removed from bed of canal may be used to repair them. The excess silt may be put on outer slopes of both banks in a regular manner and disposed off suitably. The silt should not be heaped above bank level.
3.	Cracks in the banks of canal	Any crack in the banks, especially near the outlet pipes or pucca structures, along with a continuous bubble formation on water surface at the location of the crack, indicates continuous seepage / leakage of water through the crack.	The cracks in the bank should be excavated in a trench with a minimum width of 0.5 m and in a depth 0.25m more than depth of the crack and should be filled with soil in 15 cm thick layers and duly compacted. The outer toe of bank where seepage / saturation is visible should be protected by laying suitable filter there.
4.	scouring of inner side slopes and bed of canal , especially at curves & in D/s of falls / head regulators / other pucca structures	Causes Irregular or hanged inner side slopes and scoured bed which may endanger foundation of nearby pucca structure.	Regular scraping should be done to maintain the inner slope as per drawing. Damaged inner slopes should be repaired by filling suitable soils in 15 cm thick layers and compacting it. Stone or brick pitching should be provided over compacted earthen slope. Alternately, the damaged length of the canal bank may be filled in excess to design section with

			<p>suitable soil in 15cm thick layers and duly compacted. Then the lip cutting should be done to obtain the design section.</p> <p>In the bed of canal in D/S of head regulator, fall or other pucca structures, an adequate filter / launching apron should be laid in the scoured portion.</p>
5.	<p>A. Formation of followings in canal banks</p> <p>I. rain cuts, gullies, improper drainage of rain water</p> <p>II. Rat holes, ant hills, crabs etc.</p> <p>iii. Ruts and pits due to traffic on banks</p> <p>B. Crossing of minor by cattles, bullock carts, tractors etc.</p>	<p>Banks become weak due to lowering and freeboard is encroached upon.. The un-drained rain water on service road will create difficulties to traffic. Rat holes may cause breach in canal.</p>	<p>The rain cuts, rat holes & ruts etc. should be excavated in a geometrical shape with minimum 0.5 metre width & depth 0.25 metre more than that of cuts. These should be filled in by suitable soil in 15 cm. layers & duly compacted. The top surface of banks should be leveled properly and a cross outward slope of 1.25% should be given. The grass on the outer slope of banks should not be scraped and be allowed to grow. This vegetative cover checks any erosion of banks due to flow of rain water. The proper drainage of rain water from service road or top of bank should be ensured by constructing pucca chutes on outer slopes at suitable interval.</p>
6.	<p>Sliding and slips in canal banks soil</p>	<p>Banks become weak due to reduction in section which increases possibility of damages to canal.</p>	<p>The soil of banks damaged on outer or inner slopes due to sliding or slips should be got tested and repaired with suitable soil in 15 cm thick layers and should be properly compacted to obtain prescribed maximum dry density of compacted soil. The slides and</p>

			slips may also be due to improper design. Therefore redesigning of section of banks should be done considering the soil test results.
7.	Growth of trees / bushes on the dowel, berms of the banks	Possibilities of breach in canal due to piping caused by roots of trees & bushes	The trees, bushes etc at the banks, service road and slopes causing damage to bank should be cut and removed. Pits caused by cutting of trees should be filled with earth as specified above & compacted.

b. Excessive seepage

In case of excessive seepage in filling reaches of minor, the place in the inner portion of canal from where the water is seeping out and on the outer slope of bank, the place where this seepage is coming out, should be identified. For this, the surface of water in canal should be checked for any bubble formation in line of seepage on outer slope or near to it. Place of bubble formation is the point from where water is seeping into the bank. Seepage should be plugged by clay puddling in the bank. A filter toe on outer slope may also be constructed to prevent any soil coming out, if any, to make the canal bank safe

B. Pucca Works

The general probable damages to pucca works and methods for their rectification are given below

a. Leakage

Near pucca works trees should not be allowed to grow, because their expanding roots may cause cracks in masonry / concrete which allow water to flow along the roots / cracks. The damages to concrete, masonry, pitching etc. should be regularly rectified. Length of pitching may be increased if necessary. All such trees should be cut and removed.

b. Obstructions in flow

The silt or floating debris should not be allowed to accumulate in upstream of pucca structures such as bridges and should be removed regularly. The silt and debris obstruct flow of water through the pucca works causing increase in water level in canal and thus water may overflow canal banks causing damage to banks.

c. General Damages to gates

Due to lifting / handling of gates in an improper way, gate leaf may get damaged. Rusting, cracks in rubber and copper seals, bending of rod, breaking of head post, etc are general damages observed in gates. These should be timely rectified. The seepage from gate seal should be immediately stopped. The locks of gates should be in proper order, so that unauthorized person may not be able to operate the gates.

d. General damage to pucca works

Damages to plaster, concrete, decay of mortar in joints in masonry & pointing, decay of concrete cover due to reaction by salts, damages to parapet and wing walls caused by vegetation & animals etc. are general damages observed. Their repair is necessary in a regular way, as detailed in para 14.0 above.

20.0 Breaches in Minors¹⁴

In spite of above mentioned maintenance and precautions, breaches in minors may still occur. Breaches may also be caused by unauthorized cutting of banks of minor or cross bandhas in the bed of minor by farmers. It is essential that breaches are closed in minimum time and at minimum cost.

Methods for closing breaches in running canals are recommended for general guidance only. However, expert technical advice should also be immediately sought to close the breaches.

20.1 Breach in a small minor

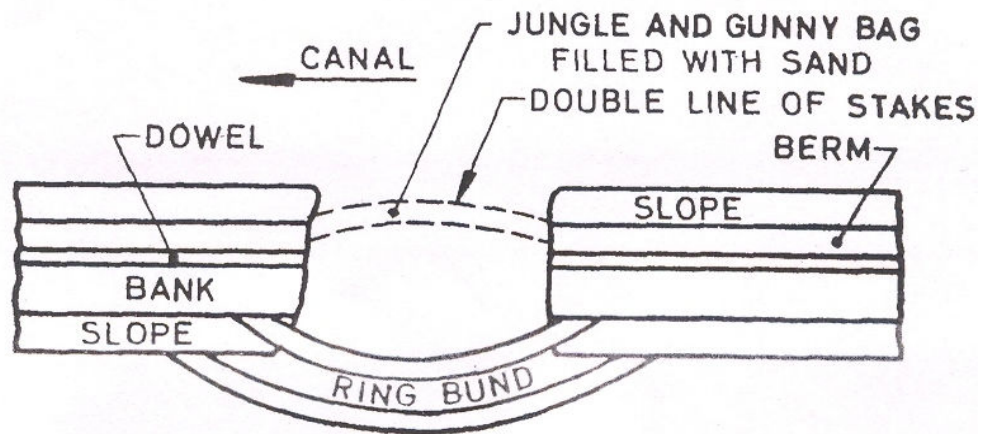
Water of the breach spreads on the adjoining lands and usually there is no place to take earth for closing the breach. The earth has to be obtained by cutting the outer slope of the existing bank. Enough earth should be collected on both sides of the breach on the existing bank. The earth baskets should never be thrown in the water. The closing process should be started from both ends by slipping the earth from the heap and protecting the canal side by grassy clods usually available from the breach site. With a rush of earthwork at the ends, the breach may be closed straight away progressing from the bank.

20.2 Breach in a large minor and Distributary

In case of a breach in a large minor, the first action should be to get the minor closed or its discharge be reduced depending upon the N.S.L and the bed level of the minor to reduce the flow through the breach otherwise a lot of earth will be washed away before the breach is closed. It has been experienced that plugging of a breach by placing of gunny bags filled with sand in two layers in the bed of the minor or outside of the minor depending upon the levels of the bed and N.S.L and the extent of scour proves an effective method for initial stopping of flowing

water through the breached bank. Once the flow of water is stopped the bank can be reconstructed and brought to shape

This should be done by driving a double line of stakes and then putting planks of mattresses against them if available and if not then filling jungle in between the stakes pressing it down with bags filled with sand and by men walking over them. No earthwork should progress before the flow through the breach has been arrested to some extent in this way. Meanwhile earth should be piled up on both sides. The closing should then be started from both sides by slipping earth from the heap in form of a ring bund. All jungle from the ring bund site should be removed before earth work progresses. No earth basket should be thrown in water. It must always be slipped from a heap. The last gap of about 3 m should be closed with a rush when enough earth has been collected on both sides.



Method of closing breach on canals

21.0 Inspection by walkthrough before start of rainy season

WUA shall inspect minor by walkthrough with local farmers in month of May before the rainy season so that precautions may be taken against the possibility of damages during rainy season. Following points are important for observation during the inspection:

- a. All the accumulation of floating debris, or cross bundhas across minor constructed by farmers to raise water level should be removed.
- b. No obstruction should be there in the drain at u/s of the drainage crossing at the minor.
- c. Inspect path of drains / rivers which flows towards minor and observe that, there is no unwanted turn / obstruction. If something like this is observed, its proper treatment is must. It is important to make sure that rain water does not get accumulated near the canal.

22.0 Inspection by walkthrough during and after rainy season

WUA shall inspect minor through walkthrough with local farmers during and after the rainy season. Following points are important for observation during the walkthrough:

- a. The water overflowing the banks may cause heavy damage to them. This happens when flow in canal is obstructed or available free board is very small due to damaged banks. The flow of water over banks should be prevented by raising the banks by putting sand bags on them or by any other means. This is only the immediate care. After preventing overflow, the causes of overflow should be investigated and remedial measures should be taken.
- b. Change in nalla course / river course due to floods. This may cause damages to wing wall, return wall, guide wall etc. It may also cause scouring at the foundation of piers and abutment. The drainage crossings may also get damaged

23.0 Measurements

Before start of the earthwork, initial silted cross sections, covering full width of minor including its banks, as per drawing, will be measured jointly by contractor and PIM task Team Leader @ 50m. c / c in straight reaches of minor and 25m. c / c in its curved reaches.

After completion of maintenance works, final cross sections of the minor will be jointly measured in the same way and at the same locations as for initial cross sections.

All the measurements will be entered in the measurement book (MB) by PIM task Team Leader. The contractor will have to record acceptance of measurements under his signatures in M.B.

Measurements of other items of repair works shall be done as mentioned in para 14.0 Chapter-3, Section-A.

24.0 Norms of maintenance works¹⁵

Normally maintenance works are classified as Regular, Periodical and Emergency and are carried out as per following norms

- a. **Regular** :- These works are carried out in each *fasal* and include the following
 - i. De-silting, clearance of weeds, vegetation and removing cross *bandhas* from internal section of minor.
 - ii. Cleaning of gauges , oiling & greasing of gates.
 - iii. Prevention of any seepage through gates.
 - iv. Repair of outlets.

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- b. Periodical :-** These works are carried out after a fixed time and include the following
 - v. Strengthening of banks
 - vi. Repair of pucca structures
 - vii. Repair of gates & water flow measuring devices (Orifice Modules).
 - c. Emergency :-** These works include the following
 - viii. Closing breaches in canal
 - ix. Rectifying damage due to floods, if any

25.0 Prioritization of maintenance works

The Execution of maintenance works depends upon the availability of funds. If sufficient funds are not available then maintenance works are prioritized and the works at lower priority can be done later depending upon the availability of extra funds.

The priorities will be fixed by President of WUA in monthly meeting of WUA after joint walkthrough of minor. Normally the priority is fixed in the following manner

a. Water distribution

- a. Closing breaches in canal
- b. De-silting of Canal
- c. Removal of weeds / vegetation in internal section of canal and floating debris in u/s of pucca works.
- d. Checking and repair of damaged pipes of semi module / pipe outlets.
- e. Oiling / greasing of gates at head regulator, duck bill weir and water measuring structures(orifice modules).

b. Safety of minor and structures

- a. Rectification of erosion of the internal slope of bank by providing pitching.
- b. Rectification of damaged toe filter, if any, at the outer slope of the bank.
- c. Rectification of bed scouring by providing suitable filter / apron.
- d. Removal of all vegetation and trees near to & causing injuries to pucca structures and in u/s of drainage crossing.
- e. Repair of damaged pointing / plaster / masonry / concrete of pucca structures.
- f. Other maintenance works

26.0 Maintenance works and WUA¹⁵

26.1 Important activities by WUA

S. No.	Activity	
1.	Timely Action	Maintenance works should be done promptly at scheduled / proper time
2.	Knowledge of causes	Causes of damages to works on minor should be identified and remedial measures should be taken after removing these causes, for effective maintenance
3.	Preparations	Survey work plan should be prepared for identification of troubled areas on a minor & procurement of required materials should be planned.
4.	Resources & funds	Arrangement for required materials, labour at work site and funds in sufficient quantity should be made in advance

26.2 Procedure to be followed by WUA

- a. Walkthrough on minor to identify the works to be done.
- b. Assessment of resources required.
- c. Deciding priority of works depending upon availability of funds & time and preparing the estimate of works.
- d. Selection of agency for execution of works.
- e. Monitoring the progress of works for timely completion.

27.0 Checklist for Minor

Checklists to assess the extent of damage to the minor section along with pucca works on it and requirements for maintenance of pucca works and earth work in various reaches are enclosed as Appendix- G & H respectively.

The checklist is a useful tool for planning the works. The priority assigned to a work should reflect the gravity of potential rapid deterioration and the area at risk of being flooded.

Do's and Don'ts

Do's

1. The silt clearance should be finished before sowing of Rabi crop.
2. The final cross sections should be measured jointly by contractor and PIM team leader after completion of de-silting works.
3. The excavated coarse silt should be disposed off in filling old borrow pits and on outer slopes of banks of minor.
4. The excavated medium silt should be utilized in closing traffic leeks on banks, widening banks as supplement to berm earth.
5. The excavated fine silt should be used for all repairs of the earthwork on minor.
6. The disposal plan should be prepared on Shazara sheet of the area giving Khasra numbers of the fields identified for disposal before start of de-silting.
7. The surplus excavated silt should be disposed off as per disposal plan.
8. The consent of the farmers should be taken before disposal of silt in their fields.
9. The earth for repairs should be obtained from specified sources such as internal clearances of minor, beds of nearby drains / guls and borrow pits in bed of minor as well as outside pits.
10. The top of bank should be dressed in an outward cross slope of 1.25%.
11. The banks should be 30cm. above the country level.
12. Where more than 50% section of bank is damaged, reconstructing whole section afresh should be considered.
13. All canal gauges should be cleaned periodically.
14. The displaced boundary pillars should be re-fixed as per land plan of the minor.
15. A register of masonry / concrete works on minor should be maintained and any improvements in the structure should be recorded regularly.
16. A line marking the FSL of minor should be painted on the upstream face of every pucca work on it.
17. All exposed surfaces of steel gates of head regulator, orifice module and duck bill weir should be kept painted with specified anti-corrosion enamel paint.
18. The regulation schedule for the minor should be available.
19. All outlets should be inspected thoroughly for any choking or tampering during closure period of minor.
20. The outlets should be checked for their position, size and correctness of fixing as per roster.
21. A register of outlets should be maintained giving details of their size, location, discharge and water head corresponding to FSL of minor.
22. Water head at outlet should be measured monthly.
23. All fallen or dead trees should be immediately reported to Engineer-in-Charge / President WUA.
24. The pruning of trees should be done by sawing in February.

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25. The roots of seedlings should be dug out with a good ball of earth adhering to it when transplanting.
 26. All newly planted trees and the trees less than 2m in height should be properly protected by tree guards with 1m. dia and 1m height.
 27. Suitable species of trees should be planted at boundary line of the land of the minor.
 28. The branches of a newly planted tree, taking off near its roots should be lopped off.
 29. The aquatic weeds should be completely and regularly removed manually from the internal section of minor.
 30. The routine damages to gates such as rusting of gate leaf, cracks in rubber seal, bending of lifting rod, damage to head post etc should be rectified promptly.
 31. The routine damages to pucca structures such as broken plaster, masonry & concrete, decay of mortar in joints of masonry / pointing and concrete cover to steel, broken parapet and wings should be repaired regularly.
 32. The discharge in the minor should be reduced from the head of minor in case of breaches in large minors.
 33. Joint walkthrough of minor with office bearers of WUA and PIM team should be done before and during rainy season.

Don'ts

1. Don't allow any over- excavation than designed section of minor during de-silting.
2. Don't allow that coarse or medium silt is spread on canal service road without a cover of 20cm. thick layer of good soil.
3. Don't allow any blockage of existing outlets on minor due to disposal of excavated silt.
4. Don't allow digging of borrow pits within 5m from the outer toe of banks / ramps of bridges.
5. Don't allow digging of borrow pits within old borrow pits.
6. Don't allow borrow pits more than 15cm. deep in cultivated fields.
7. Don't allow that daula is cut for repairing the banks.
8. Don't allow trees to grow on canal berms & daula.
9. Don't allow that a tube-well is bored within 25m of banks of minor.
10. Don't allow painting of coal tar on steel work.
11. Don't allow sudden increase or decrease of discharge in minor.
12. Don't allow any temporary outlet to function beyond sanctioned period.
13. Don't allow double trees in any tree guard.
14. Don't allow any floating debris to accumulate in U/s of pucca structures.
15. Don't allow any obstruction in a drain at U/s of the drainage crossing on the minor.

References

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3. IS: 4839 (Pt. I), Maintenance of Canals, Cl. 2.4
4. IS: 4839 (Pt. I), Maintenance of Canals, Cl. 2.4.1
5. UPID Instructions on Repair and Other Items for Use of Canal Officials April 1989- Channels – Sources of Earth for Repairs
6. UPWSRP, Second Final Report by TAHAL, Volume-2 Part A- Design Procedure and Canal Dimensional Parameters for Distributaries.
7. IS: 4839 (Pt. III), Canal Structures, Drains, Outlets, Jungle Clearance, Plantation and Regulation, Cl. 7
8. IS: 4839 (Pt. III), Canal Structures, Drains, Outlets, Jungle Clearance, Plantation and Regulation, Cl. 3
9. Technical specifications, UPWSRP, UPID, para 14
10. Irrigation Manual of Orders, para 248 (III)
11. IS: 4839 (Pt. III), Canal Structures, Drains, Outlets, Jungle Clearance, Plantation and Regulation, Cl. 9.3
12. IS: 4839 (Pt. III), Canal Structures, Drains, Outlets, Jungle Clearance, Plantation and Regulation, Cl. 4.4
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 - (i) IS: 4839 (Pt. III), Canal Structures, Drains, Outlets, Jungle Clearance, Plantation and Regulation, Cl. 8
 - (ii) UPID Instructions on Repair and Other Items for Use of Canal Officials April 1989- Plantation.
14. IS: 4839 (Pt. I), Maintenance of Canals, Appendix-A.
15. सहभागी सिंचाई प्रबंधन हस्त पुस्तिका – (UPWSRP) INDIA-N-PIM, New Delhi, August 2005, Chapter-8

CHAPTER – 6

GUIDELINES FOR VARIOUS MAINTENANCE STAGES (BY WUA)

A. PRE - MAINTENANCE STAGE

1.0 Preparation of Estimate

A walk through by office bearers of WUA with PIM task team & its leader shall be done on minor to identify details of works to be done before starting estimation.

PIM task team shall consist of following members:¹

S. No.	Particulars	Designation
1.	Junior Engineer, UPID	Team Leader
2.	Community Organizer from NGO(PACT)	Member
3.	Minor Level Functionary from NGO (UP-DASP)	Member
4.	Field Trainer from NGO (UP- WALMI)	Member
5.	<i>Seenchpal</i> , UPID	Member

Estimate shall be prepared by them for the works as per priority fixed by WUA as indicated in para 25 Chapter-5.

For de-silting of minors, before start of work, the quantity of silt may be estimated by observing average depth of silt over two consecutive bed bars and multiplying it with the distance between bed bars i.e. 200 m. and bed width of minor.

Alternately, initial silted cross sections shall be measured as specified in para 23 Chapter 5 and shall be super imposed over designed cross sections of minor at the same locations to calculate net area with the help of PIM task team leader. Quantity of earthwork to be executed shall be estimated after calculating average net area of two consecutive cross sections and multiplying it with the distance between these cross sections (25 or 50 m).

The estimate for maintenance of pucca works shall be prepared on the basis of detailed drawings containing plans & sections of the structure and available with WUA. The damaged portions of the works such as parapet & wings, plaster & wearing coat over deck slab of VRB etc. will be shown on the drawings in a geometrical shape for carrying out repairs. These drawings may be got prepared by PIM team leader.

The estimate shall include the followings

1.1 Technical Report

A technical report will be prepared as described in para 1.1, section A Chapter 4.

1.2 Bill of Quantities

The details of quantities of different items of work should be prepared in the following format.

Sl. No.	Item	No.	Length	Width	Height	Quantity
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1						
2						
3						

The quantities for earthwork shall be calculated as detailed in para 1.0.

For pucca works, the length and width can be obtained from the plan, and height can be determined from the elevation in the drawing. After writing the item in column No.2 the length, width and height are entered in column number 4, 5, 6.

The item of excavation of earth is placed at Sl. No. (1).The subsequent items are placed below in proper sequence. The sub totals of each item should be done.

Efforts should be made to include every item of work, which may have to be constructed / provided. The quantities should be worked out precisely.

The lump sum quantities should not be included as far as possible. If lump sum quantities / cost are provided, their due justification should be given.

1.3 Analysis of rates

The analysis of rates will be prepared as described in para 1.3, section A Chapter-4. The certificate for correctness of leads of carriage of various construction materials through shortest practicable route shall be recorded by President, WUA.

1.4 Abstract of Cost

After preparing the detailed bill of quantities and analysis of rates, abstract of cost shall be prepared in the following format.

Sl. No.	Item	Quantity	Rate	Amount
(1)	(2)	(3)	(4)	(5)
1				
2				

The cost of an item in column no (5) shall be worked out by multiplying the figures in column no (3) and (4).

The cost of all items is added. A sum of 2% of the total cost for contingencies is added to arrive at the final cost of structure.

If the schedule of rates is not based on current rates, then current rates should be worked out by adding specified / prevalent escalation per year.

This final cost is the total requirement of funds to be made available for the maintenance works.

1.5 Preparation of specifications and construction schedule

These shall be prepared as described in para 1.5, section A Chapter-4.

1.6 Sanction of estimate

Estimate for maintenance works, prepared within limits of available funds and as per priority of the work, shall be sanctioned and signed by the President of WUA after consultation with and in presence of the members of WUA in monthly / special meeting of WUA. A copy of approved estimate shall be sent to the Executive Engineer by President of WUA through its secretary.²

2.0 Tender document and allotment of work

WUAs shall get the maintenance works executed economically either by engaging labor or by contractor through work orders. For works with cost above Rs. 20000, the tendering process will be adopted. For preparing tender documents, activities at the following para 2.1 to 2.3 shall be carried out by PIM task Team Leader and office bearers of WUA nominated by its President.²

2.1 Preparation of tender document

When a work is executed by a contractor under an agreement, tenders for the work are invited. The tender document contains the followings

- a. Bill of quantities of the work.
- b. Technical Specifications
- c. Conditions of the contract
- d. Drawings of the work
- e. Estimated time of completion

The above items of tender document will be prepared as detailed in para 1.0 above. For preparing conditions of contract, forms IB 111&IB 112 may be consulted.

2.2 Tender Notice

Tender notice in the name of President, WUA, will state the following information:

- a. Name, location, nature and execution time of proposed works.
- b. Approximate cost of works
- c. Amount of earnest money to be deposited with sealed tenders
- d. Cost of tender documents
- e. Place of sale of tenders
- f. Place , date and time of deposition & opening of sealed tenders
- g. Category of registration of contractors eligible for purchasing tenders.
- h. A condition that tender accepting authority reserves the right to reject any or all the tenders without assigning the reason there for.

Such tender notice is advertised in leading local news papers at-least 30 days in advance (15 days for short term tender) to sale of tenders through Director of Publication, Government of U.P. Lucknow.

The tenders are sold to different willing contractors who are registered with the UPID, at a nominal price fixed on the basis of cost of the work, to encourage maximum sale to generate a healthy competition.

2.3 Evaluation of Tenders

After receipt of tenders in sealed covers from various registered contractors / firms, tenders are opened in the presence of tenderers and a comparative statement of all the tenders received, containing names of tendering contractors, earnest money equal to 2% of the estimated cost deposited by them and rates quoted, is prepared and is signed by rates dictating / writing office bearer of WUA as well as all the contractors present.

If any conditions are mentioned by the contractor in his tender or earnest money is not deposited with the tenders, such tenders are rejected.

The tenders are evaluated on the basis of rates of all the items in bill of quantities submitted in the tender by the contractors. The tender of a contractor, with lowest rates giving the reasonable cost of work is normally accepted with the condition that contractor should have adequate financial capacity.

2.4 Contract Negotiations

Contract negotiations will be done as described in para 2.4, section A Chapter-4.

2.5 Work Order

When the cost of the works is quite small, i.e., up to Rs. 20,000/-, works can be got executed through work orders without inviting tenders.

2.6 Allotment of Work²

Letter of acceptance stating the amount of security & its form such as bank guarantee or fixed deposit receipt of bank to be deposited by contractor is signed by tender accepting officer, i.e., President, WUA in presence of members of WUA in its monthly / special meeting in format given in Appendix B and is issued to the contractor whose tender is accepted . He is required to deposit the prescribed amount of security, usually 10% of cost of agreement and sign along with the President WUA the prescribed agreement format consisting of the followings, in token of his acceptance of the terms and conditions of the contract, within specified period:

- a. Form number IB-111 & IB-112
- b. Technical specifications
- c. Conditions of contract
- d. Copy of tender notice
- e. Copy of letter of acceptance
- f. Format of letter of undertaking
- g. Necessary drawings

After signing the agreement, the contractor will be given the date of start of the work by President WUA.

For a small work, to be executed as per estimate prepared on the basis of Schedule of Rates, work orders shall be issued by President WUA to contractors registered with the concerned Division of UPID

No work order or agreement for the execution of maintenance works shall be issued by WUA in the name of any office bearer of WUA.

2.7 **Work through labor**

The maintenance works with cost upto Rs 20000, which are urgent in nature and do not require machinery & material (except local earth), will be executed by WUA through labor. The labor shall be engaged on muster rolls by President WUA in the format given in Appendix C.³

B. DURING MAINTENANCE STAGE

1.0 Execution of works

The contractor, to whom the work has been allotted, will meet the President WUA &PIM task team leader before executing the work, who will provide necessary

drawings and other details to the contractor to arrange for necessary labor and equipments required for the work.

The works shall be executed as per the specifications and drawings.

Before start of work, initial cross sections of minor as mentioned in para 23.0 Chapter 5 will be measured and entered in MB.

A check list is enclosed at Appendix – A to help the contractor & President WUA to make suitable arrangements before starting and during maintenance works. The coarse aggregate, sand, cement, bricks and reinforcement steel should be got tested as tabulated in para-11, Chapter-3 section B. Soil shall be tested as tabulated in para 13 Chapter 3 Section A.

WUA shall ensure cooperation of office bearers of Outlet Committees of the minor in ensuring the quality of maintenance works during execution. Members of PIM task team shall also inspect the works during execution to ensure quality. The de-silting works of a minor shall be carried out in such a manner that feeding of tail of minor is ensured.

2.0 Site management

Site management will be done as described in para 2.0, Section B Chapter-4.

3.0 Requirement of man power

The requirement of man power for different maintenance works on the minor can be estimated on the basis of the working capacity as per norms described in para 3.0, section B Chapter-4.

4.0 Helping in material procurement

For maintenance works, some times the contractor may require help of the WUA in procurement of material like cement, steel, sand & aggregate etc. The WUA may help him by writing to the concerning authorities of the state government, manufacturers, distributors in the procurement of material.

5.0 Running payments of the work

When work is in progress and contractor demands payments, running payments shall be done as per terms and conditions of the agreement. The work done satisfactorily will be measured and entered in the measurement book by Team Leader, PIM task team. Any excavation done by contractor in excess to that shown in drawings will not be paid for. The bill stating the cost of work done shall be prepared in specified format given in Appendix-D and shall also be entered in the measurement book. The work and measurements will be checked by the two office bearers of WUA. The payment of the work done by the contractor as per

bill will be made by WUA. Any payment shall be done after getting approval of the monthly / special meeting of WUA.

When full security amount is not deposited at the time of signing the agreement, the security deposit to the extent of 10% of the value of running bill may also be deducted from the bill. However, the earnest money shall be adjusted against security deposit.

C. POST MAINTENANCE STAGE

1.0 Final bill of works

After completion of de-silting / maintenance works, final cross sections of minors will be measured and entered in MB as specified in para 23 Chapter- 5. Quantity of earth work executed shall be calculated by super imposing final cross sections over initial cross sections. Over excavation shall not be paid. For other items of work, quantities executed shall be measured as mentioned in para 14.0 Chapter- 3 Section A.

During the execution of maintenance works, several running bills might have been paid to the contractor. The total quantities of each item of work done must be determined and previously paid quantities be deducted. The net quantities of different items to be paid must be shown in the final bill.

The final bill shall be prepared, as per terms of agreement in format given in Appendix-D³. The bill will be entered in the measurement book by the Team Leader PIM task team and will be signed by him. This will also be signed by the contractor and President of WUA in token of their acceptance. The bill will be checked by at least two office bearers of WUA.

In case the maintenance works are executed through labor, bill of the work shall be prepared in format given in Appendix-C by PIM task Team Leader after calculating the quantity of work, rate and amount.

After completion of maintenance works, the bill shall be presented in the monthly general / special meeting of WUA for approval. Only after approval, payment shall be made by WUA to the contractor / labor employed for executing the work.

2.0 Completion of work

After completion of work, the contractor shall be asked to remove the unutilized material and debris etc. at his cost and clean the construction site. The completion report / certificate of works should be prepared in the format enclosed at Appendix E by PIM task Team Leader. In case the actual expenditure on works exceeds the estimated amount by more than 5%, the estimate of work

shall be revised. Completion report / certificate shall be duly approved by President WUA in its special / monthly meeting.

3.0 Removal of defects

The contractor shall be liable at his own cost for removal / repair of any defects observed in works done after their completion before releasing of bank guarantee / security deposit. Such defects will not cover any silting of the minor during its running after completion of de-silting works.

4.0 Releasing bank guarantee / security deposit

Six months after date of completion of work as per drawings and specifications the bank guarantee / security deposit may be released by the competent authority.

5.0 Recording data for future use

A record should be maintained by Secretary WUA on behalf of President WUA for data of maintenance works executed as described in para 5.0, section C Chapter-4.

Do's and Don'ts

Do's

1. The estimate of works should be prepared and sanctioned before execution of works.
2. The estimate should be prepared as per availability of funds and priority of work.
3. A copy of sanctioned estimate should be sent to the Executive Engineer concerned.
4. The tender notice should be published in the name of President WUA.
5. The work orders for the works amounting to less than Rs. 20,000/- should be issued by President WUA to registered contractors.
6. The technical report on the estimate should contain necessity of works, technical data & cost of works, basis of rates taken, mention of specifications, time of completion of works and proposed environmental / social safeguards.
7. The tender document should contain bill of quantities, technical specifications, conditions of contract, drawings of the work and time of completion.
8. The sealed tenders should be opened in presence of tenderers and comparative statement should be prepared and signed by the tenderers and tender opening authority.
9. The prescribed amount of security should be deposited by contractor before signing the agreement.
10. The approved drawings should be given to contractor by President WUA / PIM team leader before start of work.
11. The final bill of works should be prepared in the specified format, entered in MB by PIM team leader and signed by contractor and President WUA.
12. The final bill should be presented by President, WUA in the monthly / special meeting of WUA for approval.
13. While preparing the final bill of works, the quantities already paid for in the running bills should be properly accounted for.
14. Any defects observed in the completed works before release of security should be rectified by contractor within defect liability period.

Don'ts

1. Don't allow any work order or agreement for maintenance works in the name of any office bearer of WUA.
2. Don't allow lump-sum provisions in the estimate without proper justification.
3. Don't allow that tenders are sold to unregistered contractors.
4. Don't allow acceptance of any conditional tenders as well as tenders without earnest money.
5. Any unsuitable construction material should not be used in the work.
6. Payment should not be made to contractor without approval of the WUA.

References

1. सहभागी सिंचाई प्रबंधनए हस्त पुस्तिका – (UPWSRP) INDIA-N-PIM, New Delhi, August 2005, Chapter-4
2. सहभागी सिंचाई प्रबंधनए हस्त पुस्तिका – (UPWSRP) INDIA-N-PIM, New Delhi, August 2005, Chapter-8, Enclosure-7
3. सहभागी सिंचाई प्रबंधनए हस्त पुस्तिका –(UPWSRP) INDIA-N-PIM, New Delhi, August 2005, Chapter-9, Enclosure-8

CHAPTER – 7

ENVIRONMENTAL AND SOCIAL SAFEGUARDS

A. Environmental Safeguards

1.0 Introduction

The State Water Policy, issued in 1999, calls for close examination of existing water resources in State and projects for water sector infrastructure from ecological and environmental perspective. It also stresses need for user's participation and decentralization of authority for qualitative improvement in water resources management. Adequate awareness needs to be generated in regard to environmental issues, so that the capacity gets built for encountering environmental challenges.

Several unforeseen environmental problems emerge under irrigation system. These problems if neglected can cause considerable damage to irrigated agriculture and to the local population. Irrigation water when used properly provides the required soil moisture and thereby increases crop production.

Excessive use of water, improper response to rainfall and inadequate maintenance of field channels, minors & drains lead to water stagnation and salt accumulation. This causes water logging of culturable land which favour the proliferation of pests and water borne diseases to crops, animals, and human beings.

It is therefore, necessary that the Water Users Associations are aware of such problems that threaten the health of soils, and crops in the command area.

Such problems are best tackled in early stages. Any negligence in this respect may lead to environmental degradation and deterioration in social values.

2.0 Environmental Monitoring in Irrigation System

Relevant environmental value indicators include – water logging, soil salinity, fluctuation in groundwater table, water salinity, and presence of pesticides in the surface soil and ground water. These indicators should be monitored on an individual as well as overall scheme level. The performance monitoring should show a lowering of all the “value indicators”, which is the ultimate objective.

3.0 Mitigating Environmental Challenges & Imbalances

Environmental degradation is normally a slow and gradual process and does not arise suddenly. Environmental imbalances very often are felt only when the resulting damages become obvious. The WUAs and farmers should, therefore, pay more attention on emerging environmental issues in the command area well in advance.

2.1 Environmental imbalances

A range of environmental imbalances most commonly noticed are as follows:

- a. Water logging;
- b. Salt deposition in soils;
- c. Excessive obnoxious weed growth & breeding ground for the disease causing vectors in pools of stagnant water;
- d. Crop pest problems;
- e. Public health problems;

2.2 Mitigation Measures

The measures to be adopted for mitigation of environmental problem of water logging are given below:

- a. Equitable distribution of water in whole of the command area by proper war bandi
- b. Adjusting the canal discharge after accounting for the rainfall
- c. Prevention of over irrigation of crops by releasing water in the field as per requirements of crop grown
- d. Adoption of suitable land slopes and layouts for uniform application of irrigation water in fields and to reduce wastage of water
- e. Irrigate judiciously as per soil classification for agriculture
- f. Maintenance of main drains for unobstructed flow to improve drainage
- g. Maintenance of field drains and to connect them with main drain to remove excess water
- h. Plantation of water absorbing species such as Eucalyptus in water logged area.
- i. Through conjunctive use of water.
- j. By developing fisheries or growing suitable specie of fodder, wherever feasible, in the water logged area in consultations with Department of Fisheries / Agriculture, U.P.

4.0 Industrial waste and non-point-source pollution¹

- 4.1 Industrial wastes include untreated effluents from sugar mills, tanneries etc. located near the canal. These untreated effluents must not be allowed to be

released in the drains / canals, as they contaminate the drain / canal water and renders it unfit for livestock and other needs of villagers. Release of such effluents in drains / canals also causes the incidences of diarrhea. Measures must be taken by industry to treat the effluent to make it pollution free, within specified limits in consultation with State Pollution Control Board before releasing it in the drain. The Water (Prevention & Control of Pollution) act 1988 sets the standards for effluent discharge for industries and penal action against the defaulters.

Tendency of discharging untreated industrial effluent in the canals / drains should be discouraged / prevented by WUAs through social pressure groups.

- 4.2 Non point source pollution includes the pollution caused by bathing of cattle and washing clothes in the canals. These activities also damage the canal banks and therefore should not be allowed. Suitable penal provisions for such activities exist in the Northern India Canal & Drainage Act 1873 which are reproduced in para 5.0 of Social Safeguards section.

5.0 Over irrigation

Farmers always try to over irrigate their crops to get more yield. Except rice, the yield of all other crops is reduced due to over irrigation. Excess application of water also creates serious environmental problems as explained above.

Over irrigation in upper reaches of a canal results in wastage of water which, otherwise, could flow to the tail reaches of canal. This quantity of water could ensure a fair supply of water to the fields at the tail to the benefits of farmers there.

Farmers should be encouraged by WUAs to adopt irrigation practices consuming lesser quantity of water such as drip irrigation, *kiari* formation in the fields etc. to conserve precious water resource..

Farmers should be made aware by WUAs that light type of soils in the fields requires higher frequency but lesser depth of watering to the crops. On the other hand heavy type of soils requires lower frequency but greater depth of watering.

In order to avoid over-watering, the WUAs will spread awareness amongst farmers by explaining the demerits of over irrigation

6.0 Environment and De-silting

In addition to above mentioned challenges, there are certain other environmental problems associated with the maintenance of irrigation infrastructure. Some of the problems along with operational guidelines are as under:

5.1 De-silting

There are many aspects which need to be taken care of during de-silting of canals. These aspects are as follows:

a. Labor related problems:

It will be highly important to instruct the labor to take care of the structures on minor and banks so that they are not damaged. The de-silting should be supervised to ensure intactness of structures. The de-silting as well as construction of minor involves two key issues related to labor.

- **When the labor is called from outside**

If the labor is brought from outside, even for a short period, they would need temporary housing with water supply and sanitation systems put up for them. It will be quite critical that, any shelters put up should neither cause conflict with the local villagers nor create any disturbance for them. Therefore, before selecting a site for the temporary shelter, the villagers should be consulted. Once the de-silting activities are completed, the temporary structures should be removed and the land be restored, to the extent possible, to its earlier shape.

- **When the labor is local**

This will be the better option as this could provide employment to the villagers. It should be ensured that no internal conflict occurs among the villagers for their turn regarding employment. The routine activities like lunch & easing may produce waste which should not contaminate the local environment. Spots for dumping of such waste may be identified and it should be watched that directives in this regard are adhered to.

b. Disruption of local life cycle

Although the de-silting as well as construction activities are proposed to serve the farming community in a significant way, still there will be certain short-term problems for the natives of that area, such as – blocking of the thoroughfare and hindrances in villagers' movement. Another associated problem is related to traffic. The usual traffic will be affected due to parking of tractors/trucks/machinery/equipment, if used, in de-silting or transportation of desilted matter.

The demarcation of space for parking and other construction/desilting activities needs to be ensured in such a way that the impact on usual movement of traffic should be minimized. Vehicles or machinery not in current use should be parked at pre-identified parking-bays, which should be far away from the usual pathways to avoid obstruction to traffic movement.

c. Disposal of de- silted matter

The disposal of de- silted matter is a critical activity, which if not done properly and as per disposal plan, may lead to many environmental and socio-political problems. So the contractor has to ensure strict compliance in this regard. Normally, the excavated silt is disposed off on the banks of the minor itself.

d. Air pollution by suspended de-silted matter

Suspension of de-silted matter into the air leads to health hazards. It also becomes a challenge for the villagers to undertake their usual field related activities, as the polluted air would cause irritation in eyes and choking of nose and lungs (due to inhalation of desilted matter suspended in the air). These impacts become quite critical during the high surface winds. Fine silt blowing with the winds, covers the nearby articles / bodies, for instance – floral varieties, food articles, etc. and in addition to this, it may also cause excessive dusting in the houses, thereby leading to unhygienic conditions.

The tractors used for transportation should be leak-proof and it should be ensured that, the de-silted matter to be transported in these vehicles should be thoroughly covered (may be with a poly sheet). This will be helpful in minimizing air pollution due to suspension of silt particles in the air.

Overloading of tractors should be avoided as this will lead to spilling of de-silted matter in the transit. So there should be a proper check on the quantum of de-silted matter being loaded into the vehicles. This can be monitored by WUAs.

It is important and quite essential to ensure immediate disposal of de-silted matter at the pre-decided disposal sites.

Tractors being used for de-silting of minor and disposal should not enter the fields located nearby. This could bring unnecessary confrontation with the local farmers leading to a law and order problem. Such situations may be handled by consultation with local farmers.

e. Aesthetical issues

The local ambience or aesthetics will get affected as the tractors movement will disturb the local environment. It will be pertinent for WUA to make aware the villagers about the proposed de-silting activities. This will help in bringing consensus and cooperation regarding the works. The work agreement should clearly spell restoration of original shape and form of the area, disturbed during construction/maintenance activity and stringent action including penalty should also be clearly defined. The compliance for the same has to be ensured by the departmental field functionaries.

f. Malfunctioning of tractors

Tractors engaged in de-silting and disposal, if not well-maintained, create lot of smoke and pollute the air. Such tractors may leak oil / fuel and cause pollution to local area and may also produce wastes which will contaminate the environment.

In order to overcome these avoidable problems, the tractors used for desilting and disposal should be well maintained. Any waste from the tractors should be collected and immediately taken away from the site. This is also applicable for machines deployed for construction of minor

g. Disposal of Weeds / Dismantled material

All the weeds and vegetation removed from internal section of minor shall be dried and promptly burnt at a suitable place away from the canal banks. The dismantled material of pucca structures may be used in nearby filling or may be disposed off at a pre-identified place.

h. Rehabilitation of borrow area

After completion of borrowing of the earth, borrow area should be rehabilitated. This includes

- Any unused loose earth at the site of borrow area should be spread evenly and leveled properly.
- Borrow pits should be connected by a drain at their bottom level for drainage to avoid stagnation of water in the pits which may cause health hazard.

i. Unauthorized dumping of waste material

The unauthorized dumping of waste mainly silt, debris etc. may lead to Environmental deterioration and Social problems thereby triggering local conflicts. The WUAs and villagers will have to ensure that disposal is done at pre-decided disposal site. In the contract document the penalty and action against unauthorized dumping should be clearly spelled out.

5.2 Conservation of water bodies

Another key issue is conservation of existing water-bodies in the villages. The water-bodies near the minors need to be well taken care of. The WUAs should ensure that de-silting of the canal and disposal of the silt in the adjacent areas does not pollute or cover the nearby water-bodies in anyway. These water-bodies are lifeline for the villagers and are generally used by them for (i) bathing and drinking by cattle, (ii) water chestnut & lotus cultivation, and (iii) other domestic purposes.

A well thought disposal plan should take care of these aspects,. In such a plan, efforts should be made to identify and delineate such water-bodies so that disposal is not done in close vicinity of these water-bodies. Water-bodies can be identified with the help of village khasra maps, village land records and in consultations with the WUAs / villagers. One of the measures could be that, the disposal should be made on the opposite bank of canal, so that spillage and dispersion of de-silted matter are not able to pollute or contaminate the nearby water-bodies.

5.3 Conservation of Canal bank flora

Young plants, bushes, shrubs etc on canal bank & at the boundary line of land of the minor near the outer of toe of banks are prone to destruction during de-silting and transportation of de-silted matter. Movement of the machinery / vehicles and the labor movement may also trample the floral species available on the canal banks.

The deposition of de-silted matter on the canal bank leads to choking and destruction of flora present on the canal bank, thereby leading to temporary termination of their growth and if the de-silted matter is not immediately disposed to pre-decided disposal sites, it would cause killing of floral varieties buried under the de-silted matter.

WUAs should make an informal inventory of local varieties of flora available on the banks, so that later- on, flora on canal banks can be restored to its original position. Although this will be the responsibility of the contractor still the WUA and departmental field functionaries should ensure the restoration of the flora.

5.4 Checking of Soil Erosion

Soil erosion on minor banks may be checked by turfing the outer side slopes of the bank as explained in para 12.0, Chapter-3 Section A. Soil erosion on internal slopes of banks of minor may be checked as explained in para 8.0 Chapter 3 Section B. Silt disposal sites may be protected against erosion by providing suitable vegetative cover over the disposed soil / silt.

7.0 Mitigation of Environmental problems- General Awareness

The current scenario and mindset in the community is that, the existing irrigation infrastructure belongs to government and they are not responsible for its up-keeping. The villagers need to understand that, this infrastructure is for them and they are equally responsible for its proper up-keeping, as they will be the first ones to get affected by a deteriorated system. Therefore, the WUAs have a key role to organize and convince the community in this regard.

WUAs need to act as an interface between the department and the community. WUAs should create awareness in the community about their rights and responsibilities. This will serve dual purpose. Firstly, they become aware about their rights and responsibilities and then they can behave in a more responsible manner. Secondly, they will become more vigilant towards the existing irrigation infrastructure, which will help them to avail better irrigation facilities for their crops. The members of working committee of WUA and if possible, the enthusiastic general members of WUAs should regularly inspect the minors and associated structures to ensure their proper functioning. In case the de-silting or construction works are going on at the canal, they should act as watchdogs and keep a close vigil on the ongoing works. This will curb down discrepancies with regard to maintenance of minor.

Regarding the ongoing works on the canals, it is pertinent for the WUAs to encourage the villagers about the need of their active involvement in keeping close vigil on these works, so that they can be sure of quality and quantity of such works. Another added advantage of doing so would be that, the contractors will be more careful during execution. This will assist the departmental field functionaries to have a better check on the works. In this way, the villagers may get convinced that these works will ultimately benefit themselves, as better quality works can be more helpful about quantum and timing of canal water availability.

8.0 Useful Information for Farmers

Appendix-‘J’ has been added which contains following useful information. The WUAs and local farmers should be encouraged to know and understand these contents in the interest of environmental issues:-

- a. Draft U.P. Environmental Policy 2005
- b. Mitigation Measures for commonly noticed environmental imbalances.
- c. Conjunctive use of surface and sub soil water available.
- d. Chemicals and salts in soil.
- e. Salt tolerance levels of crops.
- f. Phenomenon of over irrigation.
- g. Water borne diseases caused by improper drainage.

B. Social Safeguards

1.0 Introduction

Water is essential for life. Water is crucial for sustainable development, including the preservation of our natural environment and the alleviation of poverty and hunger. Water is indispensable for human health and well-being.

Several unforeseen social problems emerge under irrigation system. In-equitable water distribution, water borne degradation of land, reduced agricultural production and loss of earnings of farmers are directly associated with irrigation infrastructure. These problems, if neglected, can cause considerable damage to agriculture and to the local population / society. Quality of social life is degraded.

Water when used properly provides the required soil moisture and there by increase crop production leading to higher earnings of farmers. Damaged crops directly reduce the earnings of farmers thereby degrading the quality of their lives.

It is important that the WUAs and farmers are involved in the whole process right from the very beginning and are also aware of the problems that threaten the irrigation system, health of soils, and crops in the command area. As women can play a central role in water management, special emphasis may be placed on ensuring the participation and involvement of women in mitigating above problems.

These problems should be addressed and mitigated at the earliest. Any laxity in this regard will lead to considerable adverse impact on the lives of the people.

2.0 Social Issues

The commonly noticed Social issues are as follows:

- a. Loss of productive land due to poor maintenance of irrigation and drainage system
- b. Diminishing income leading to less flow of resources resulting in poor purchasing power
- c. Lesser expenditure on health, education etc. leading to lowering of the quality of life
- d. Decreased working potential of the inhabitants in the area due to poor health conditions
- e. Lack of related information with the users on above social issues
- f. Absence of consultation with the community on above issues
- g. Lack of involvement of the NGOs, working in the area

3.0 Mitigating Social Imbalances

3.1 Specific measures

The measures for mitigating social imbalances are tabulated below:

Problems	Mitigation measures
Absence of Community consultation	The community consultation is proposed through WUAs, as mentioned, under Social Safeguards , in para 4 (a) – WUAs & Social Concerns and in para 12.0 - Mitigation of Environmental problems- General Awareness , under Environmental Safeguards
Lack of Involvement of NGOs	Involvement of NGOs to help WUAs should be encouraged.
Public health problems	<ul style="list-style-type: none">- Avoid growing paddy in areas around the villages- Avoid stagnation of water- Drain the fields for controlling mosquitoes & other vector population
Information Dissemination	The ways and means should be searched out to convey correct and timely information to farmers & WUAs. Provision of display boards as mentioned in para 4 (f) - WUAs & Social Concerns- may be one of the ways.

3.2 Other measures

- a. In the execution of works, every care shall be taken that the safety and convenience of the public are duly attended to and that all operations are carried out in such a manner as to interfere as little as possible with everyday traffic.
- b. Where a public road has to be closed and diversion made, the following precautions to avoid accident shall be taken
 - An earthen bund or brick wall 60 cm high shall be constructed right across the road on either side of the work.
 - A board with 'Road Blocked' shall be displayed above the bund or wall on either side of work.
 - A red lamp by night shall be kept lighted above the bund or wall on either side of work.
- c. Borrow pits excavated outside the canal section shall be drained to avoid stagnation of water. The bottom level of borrow pits should be fixed with

reference to the prevailing ground slope towards the natural drainage course. The pits shall be connected together by a drain about 0.5 m wide. The bottom level of connecting drain should suit the bed level of the pits it connects.

- d. Gates / planks at heads of channels should be kept water-tight when channels are kept closed.
- e. Seepage from canal should be drained off through seepage drains.
- f. Wastage of water into depressions and hollows specially near habitations should be prevented.
- g. Rice cultivation in areas adjacent to all the habitations should be discouraged. Alternately, larvae eating species of fishes may be developed in the standing water of the rice fields in consultation with Department of Fisheries / Agriculture, U.P.
- h. All the damaged guls at the canal outlets shall be promptly repaired with the participation of local farmers.

4.0 WUAs and Social Concerns

- a. Construction / operation / maintenance problems on the minor will be identified by joint walk through with WUA and local farmers in the command area of the minor and the works proposed shall be finalized by President WUA in special / monthly meeting of WUA. This will encourage community consultation.
- b. Copy of construction program and all programs of concreting of works will be given by contractor to WUA.
- c. If any WUA member wants to supervise or inspect the maintenance works on a minor and informs the contractor, his presence shall be facilitated by the contractor.
- d. Local skilled / semi skilled labor will be given priority in execution of works on the minor. This will increase the income of the local farmers in the form of wages. Indirect income in the form of local business like tea stalls & grocery shops etc at the worksite will also accrue. Apart from this, increased sown area reclaimed due to reduced water logging will also increase their income by way of selling the higher quantities of agricultural products.
- e. A display board will be erected at the work site by the contractor with following information written on it.
 - Name of minor
 - Name of work
 - Reach of work
 - Cost of work
 - Dates of start and completion of work
 - Name of contractor / executing agency

This will provide wider dissemination of the technical information amongst the community.

- f. WUAs will ensure participation of women farmers in the command area of the minor in decision making regarding joint walk through, construction, operation and maintenance of the minor. Participation of prominent / progressive women members of WUA shall be ensured by President WUA in the meetings called for discussing and deciding the works to be taken up on the minor.
- g. WUAs shall check the misuse of water like over irrigation, water theft through cuts, drainage crossings and bandhas in minors through social awareness.
- h. WUAs shall help in proper disposal of silt and shall get the consent of farmers for disposal in their fields.
- i. WUAs, through social pressures on farmers, shall try to check / avoid encroachment of canal / drain land.
- j. WUAs shall help in arranging labor for emergent situations like plugging of breaches / cuts in the canal.

5.0 Provisions under Northern India Canal & Drainage (NICD) Act 1873

WUAs may deal with any interference with the water supplies in a minor or any damage to Bench Marks, under the provisions of section 70, NICD Act as detailed below.

5.1 Offences under Act

Whoever, without proper authority and voluntarily does any of the following acts-

- a. Damages, alters, enlarges or obstructs any canal or drainage work.
- b. Interferes with, increases or diminishes the supply of water in, or the flow of water from, through, over or under any canal or drainage work.
- c. Interferes with or alters the flow of water in any river or stream, so as to endanger, damage or render less useful any canal or drainage work.
- d. Being responsible for the maintenance of a gul or using a gul neglects to take proper prevention of wastage of water thereof or interferes with the authorized distribution of water there-from or uses such water in an unauthorized manner.
- e. Corrupts or foul the water of a canal so as to render it less fit for the purposes for which it is ordinarily used.
- f. Destroys or moves any level mark of water gauge fixed by the authority of a public servant.

shall be liable to the penalties mentioned below

5.2 Penalty

For the offences under Act mentioned in para 5.1, a person shall be liable on conviction before a Magistrate of such class as the Government directs in this behalf to a fine or to imprisonment or to both as prescribed under Act.

5.3 Appropriate trial court

WUAs can file a case concerning the above offences against the defaulters in the court of Deputy Revenue Officer (DRO), working in the capacity of Special Judicial Magistrate, of the Division of UPID under whose jurisdiction the minor falls.

Do's and Don'ts

Do's

1. The WUAs should be aware of problems like water- logging, over-irrigation & inadequate maintenance of minor and the resulting ill effects on the health of soils and crops in the command area.
2. The environmental imbalances like water -logging, salt deposition in soils, excessive weed growth and disease causing vectors in stagnant water, crop pest & public health problems should be tackled in time.
3. The effluents from industries such as Sugar-mill & Tanneries should be treated to make them pollution free within safe limits before their release in the drain.
4. The excavated silt should be disposed off promptly as per disposal plan.
5. After completion of work the borrow areas should be rehabilitated by spreading evenly any unused earth and connecting the bottom of the borrow pits by a drain to avoid stagnation of water in pits.
6. The water bodies should be identified with the help of Shazara maps and consultation with the WUA / villagers and disposal of silt should be done on the minor bank opposite to the bank near the water body.
7. During execution of works every care should be taken to ensure safety and convenience of the public.
8. When road diversion is to be made, a brick wall 60cm. high should be constructed right across the road on either side of the work.
9. A board with "Road Blocked" should be displayed above the wall on either side of the work.
10. Rice cultivation should be discouraged near all habitations.
11. The damaged *guls* at the canal outlets should be repaired promptly with the participation of local farmers.
12. The presence of a WUA member at the work site shall be facilitated by contractor, in case, member wants to inspect the ongoing construction / maintenance works.
13. A display board showing name of minor & work, reach & cost of work, dates of start & completion of work and name of contractor should be erected at site of work.
14. The participation of women farmers in the command area of minor in decision making regarding maintenance works should be encouraged by President WUA through participation of women in meetings of WUA called for discussing the works.

Don'ts

1. Don't allow non point source pollution like bathing of cattle or washing of clothes in the minor.
2. Don't allow over loading of silt into the tractors during its transportation.
3. Don't allow any pollution or covering / choking of the water bodies near the minor during de-silting of canal and disposal of silt.
4. The misuse of water like over- irrigation, water theft through cuts in banks & drainage crossing and bandhas in minor should not be allowed.
5. The canal / drain land encroachments by local farmers should not be permitted.

References

1. Environmental Guidelines,(TAHAL Consulting Engineers) Final Report, Volume I, UPWSRP, July 2006, Para 8.0, 8.1, 8.4 & 2.1(I).

CHECK LIST FOR QUALITY CONTROL

1. Name of WUA / Division:
2. Name of Minor:
3. Name of work:
4. Date of inspection:

Sl. No	Check Point	Observation
A)	General	
1.	Whether the reference lines and bench marks have been established and marked at site	
2.	Whether set of approved drawings, specifications & agreement are available at site.	
3.	Whether construction materials have been tested before use and are O.K.	
4.	Whether following records are available at site	
	• Work Program	
	• Measurement book & Level book	
	• Field Density Register	
	• Cement, sand, aggregate, bricks & labor Register (receipt, consumption & balance)	
	• Slump Test Register	
	• Cube Casting Register of concrete / mortar	
	• Test Results of construction materials	
	• Site Order Book	
5.	Whether initial / final measurements are being taken jointly as specified	
6.	Whether O.K. card system for each construction activity is being followed	
B)	Earthwork in embankment of minor	
1.	Whether borrow area plan with test results is available at site	
2.	Whether the competent authority has approved the borrow area regarding its suitability for work	
3.	Whether the earth is being carted from the approved and designated borrow area.	

4.	Whether the moisture content of the earth at the placement site is within permissible tolerance with respect to OMC.	
5.	Whether the existing surface over which the earth layer is to be placed is free from vegetation, harrowed and suitably wetted.	
6.	Whether the earth is being laid in horizontal layers of specified thickness on existing bank.	
7.	Whether the mode of compaction has been specified.	
8.	Whether the field density is being observed regularly.	
9.	Whether the density as observed is as per specifications. If not, whether corrective measures are taken.	
10.	Whether borrow area is being rehabilitated after completion of work as specified	
C)	Earthwork in cutting on minor	
1.	Whether bed bars / profile bars have been exposed and checked	
2.	Whether the bed width has been checked at regular intervals	
3.	Whether the bed levels have been checked at regular intervals	
4.	Whether the excavated earth has been properly placed on top of banks and compacted as specified & dressed	
5.	Whether both edges of the banks are neatly aligned symmetrically to the central line of channel	
6.	Whether surplus excavated earth is being disposed off as per disposal plan.	
D)	Concrete	
1.	Whether cement, sand & aggregate are as per specifications and are available in sufficient quantity	
2.	Whether concrete mixer is suitable and in proper working condition.	
3.	Whether measuring boxes for batching of	

	ingredients into the mixer by weight are as specified.	
4.	Whether surface of the previous layer is roughened, cleaned, washed and moist before laying next layer of concrete to have good bond.	
5.	Whether aggregates are free from dust, silt etc. If not, washing / screening of aggregate is being done.	
6.	Whether cleaning and washing of mixer is being done before starting of work and at the closure of the work.	
7.	Whether slump test of the concrete is being carried out.	
8.	Whether vibrators are being used for compaction of concrete and are employed in sufficient number.	
9.	Whether curing is being done	
10.	Whether mix of concrete has been specified.	
11.	Whether contraction joints are being provided as per drawing.	
12.	Whether cubes for compressive strength of concrete / mortar are being regularly cast	
13.	Whether shuttering conforms to the specifications and is in alignment as per drawings.	
14.	Whether reinforcement is as per specifications and placement as per drawing.	
E)	Masonry work	
1.	Whether bricks are as per specifications	
2.	Whether sand being used conforms to specification	
3.	Whether mortar mixing is as per specifications..	
4.	Whether thickness of joints is within permissible limit	
5.	Whether use of bats are within permissible limits.	
6.	Whether the workmanship of masonry is OK.	
7.	Whether the slump of mortar is as specified.	
8.	Whether mortar cubes are being cast	
9.	Whether bricks are soaked in water, as specified, before use	
10.	Whether proper curing is being done-	

F)	Preparation of existing surface of masonry before raising / plastering	
1.	Whether the racking out of the joints of existing masonry has been done as specified	
2.	Whether all loose material has been removed from existing surface and surface is cleaned / washed and wetted.	
G)	Brick pitching	
1.	Whether sub grade is being prepared as specified before laying of brick pitching	
2.	Whether bricks being used for pitching are as per specifications	
3.	Whether thickness of pitching is as per drawing.	

Format of Letter of Acceptance to be issued by WUA

Order No..... Date:
 Name of WUA..... Name of minor:.....

1. Name of contractor
2. Father's name
3. Address / Thana (Police Station)
4. Name of work
5. Location / Reach of work
6. Estimated cost of work
7. Prescribed date of start of work
8. Prescribed period of completion of work

S.No.	Estimated quantity of work	Unit	Details of work	Rate	Total cost
1	2	3	4	5	6

Total

Conditions

1. Work shall be done as per specifications of UPID.
2. The work executed as per specifications only shall be measured for payment.
3. Payments shall be made as per money received against the work from UPID. In case of any deficiency found in the quality or work not being completed in prescribed period, reductions made in the rates / amount as per rules of UPID, shall be binding upon the contractor.
4. Prescribed wages as per rules shall be paid to the labor by contractor.
5. All social and environmental laws shall be followed.

Signature of contractor

Signature / Seal

President

Witness (1).....

WUA

.....

Witness (2).....

.....

Format of details of works executed through Labor by WUA

Name of WUA:

Name of minor:

Serial No. of Muster Roll:

Date:

S.No.	Item	Name of Labor	Father's Name	Village & Address	Date / Month / Year						Total days	Rate per day	Total Amount	Acknowledgement of Receipt / Signature
					6	7	8	9	10	11				
1	2	3	4	5							13	14	15	16

Location & Details of work done

Quantity of work done

Rate

Total Amount Rs..... (in Figures)

Rs..... (in words)

Passed for payment

Signature / Seal

President

WUA

Grand Total: Rs..... (in Figures)

Rs..... (in words)

Verification by authorized representative(s) of WUA

Name / Signature

Cash Voucher No.: Date

Signature / Seal

Treasurer

WUA

Format of Bill to be presented by Contractor engaged by WUA

1. Name of WUA :
2. Name of minor:
3. Bill No.: Date:
4. Name of work:
5. Reach of work:
6. Order No.: Date:
7. Details of quantity:

S. No.	Details of work	Measurements			Quantity	Rate	Amount Due
		Length	Width	Height			
1							
Total							
2							
Total							
3							
Total							
Grand Total							

Verification by authorized
 Representative (s) of WUA
 No..... Date:
 Name / Signature
 Rs.....(in Figure)
 Rs..... (in words)
 Passed for payment

Cheque No..... Date:
 Cash Book Voucher

Signature / Seal
 Treasurer
 WUA

Signature / Seal
 President
 WUA

Construction / Rehabilitation of Minor**OK Card for Environmental Aspects**

OK Card No. :

Name of Work:

Date of Issue:

Package No:

Name of Contractor:

Location: Chainageto.....

Agreement No.:

RLto

Sl. No	Items of Work	Remarks of Contractor and reason for non-compliance	Remarks of Inspecting personnel
1.	Whether arrangement of land – i. for temporary construction of labour camps / cottages ii. for access to disposal sites iii. for disposing waste has been done through mutual consent with the owner		
2.	For outside labour, whether arrangements for temporary housing and sanitation systems have been made. Whether any shelters put up causes conflicts with the local villagers or creates any disturbance for them.		
3.	Whether parking place has been provided for the vehicles or machinery not in current use.		
4.	Whether government land is available for disposal & if not, then incase it is villagers' land, the required consent in this regard has been taken or not		
5.	Whether permission for cutting the trees has been obtained from competent authority		

**Name & Signature of
Contractor**

**Name & Signature of
JE, UPID**

**Name & Signature of
AE, UPID**

Construction / Rehabilitation of Minor**OK Card for Earth Work**

OK Card No.:

Name of Work:

Date of Issue:

Package No.:

Name of Contractor:

Location: Chainageto.....

Agreement No.:

RLto

Sl. No	Items of Work	Remarks of Contractor	Remarks of Inspecting personnel
1.	Setting out whether layout checked with drawing of the works		
2.	Preparation of surface Whether i. Removal of vegetation done ii. Harrowing / Benching done iii. Watering done		
3.	Whether initial joint measurements done		
4.	Whether Kaccha Namunas constructed at 50 m. interval in straight reach & 25 m. interval at curves between pucca profiles constructed at 200m interval		
5.	Excavation and compaction Arrangements- Manual / By Machines		
6.	Approval of borrow & disposal areas		
7.	Preparation for Compaction of embankment i. Type of soil to be used ii. Equipment to be used iii. Optimum Moisture content of soil iv. Maximum Dry Density (MDD) of soil v. Specified Layer Thickness is soil vi. Watering Arrangements		

Name & Signature of Contractor

Name & Signature of JE, UPID

Name & Signature of AE, UPID

Construction / Rehabilitation of Minor OK Card for Concrete Work

OK Card No.:

Name of Work:

Date of Issue:

Package No.:

Name of Contractor:

Location: Chainageto.....

Agreement No.:

RLto

Sl. No.	Items of Work	Remarks of Contractor (Quality & Quantity)	Remarks of Inspecting personnel
1.	Layout Whether layout checked with drawing		
2.	Preparation of surface Whether the foundation excavated as per drawing and bottom surface properly cleaned & compacted R. L. of bottom		
3.	Shuttering and form work i Alignment and location ii Supports iii Sealing of joints, oiling and greasing iv Block outs v Placement of rubber seal vi Placement of copper seal vii Placement of other embedment		
4.	Reinforcement i. Placement as per drawing and clear cover ii. Cleaning of reinforcement iii. Joints – overlap / welded iv. Whether Measurements done		
5.	Materials Availability i Cement ii Aggregate 40 mm, 20 mm, 10 mm iii Sand iv Water		
6.	Mixing and Pouring arrangements i Whether Design mix done ii Slump test iii Vibrators for compaction iv Moulds for casting of cubes v Curing arrangements		
7.	Time of concrete from .. to ...		
8.	Quantity to be done		

Name & Signature of
Contractor

Name & Signature of
JE, UPID

Name & Signature of
AE, UPID

Construction / Rehabilitation of Minor**OK Card for Brick Work**

OK Card No.:

Name of Work:

Date of Issue:

Package No.:

Name of Contractor:

Location: Chainageto.....

Agreement No.:

RLto

Sl. No.	Items of Work	Remarks of Contractor	Remarks of Inspecting Personnel
1.	Cement - PPC / OPC		
2.	Gradation / Zone of sand		
3.	Mix – proportion of mortar		
4.	Method of mortar mixing Manual / By mixer		
5.	Consistency & W/c ratio of mortar		
6.	Compressive strength of Bricks		
7.	Dimensions and physical appearance of bricks		
8.	Whether bricks are soaked for last 24 hours		
9.	Curing arrangements		
10.	Time of Brick work From.....to.....		
11.	Quantity of work to be done		
12.	Any other information		

**Name & Signature of
Contractor**

**Name & Signature of
JE, UPID**

**Name & Signature of
AE, UPID**

Checklist for Condition of Minor

Name of canal system :

Location with Chainage (Km)

Name of Minor:

Date of inspection :

SNo	Component	Reach in Km.	Location			Needs Repair			Needs Rehabilitation			Description	Priority		Remarks
			Left bank	Bed	Right bank	Yes	No	8	9	10	Urgent		Routine		
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1	Jungle / Weeds														
2	Silting														
3	Bank section														
4	Bank-top cuts														
5	Service Road														
6	Ramps at VRBs /outlets														
7	Longitudinal/ Cross slopes at Bank top														
8	Raptas at outer slopes of banks														
9	Filter at outer toe of banks														
10	Seepage drains														
11	Lining of canal														
12	Bed bars / profiles														
13	Reference pillar														
14	KM./ H-meter stones														
15	Water level gauges														
16	Cross bandha														
17	Floating debris/ Fallen tree														
18	Others														

Sign

Inspecting Personnel

Checklist for Pucca Structures on a Minor

Name of Minor: _____ **Date of inspection:** _____
Name of structure: _____ **Name of canal system :** _____
Type of structure: concrete / masonry / pitching **Location with chainage (Km):** _____

SNo	Component	Bank		Condition				Maintenance Needs			Remark
		Left	Right	Needs Repair		Needs Rehabilitation		Description	Priority		
				yes	No	yes	No		Urgent	Routine	
1	2	3	4	5	6	7	8	10	11	12	
1	U/S wing wall of VRB / fall / weir										
2	D/S wing wall of VRB / fall / weir										
3	Crest of fall / weir										
4	Abutment of VRB / fall / weir										
5	Bridge / Regulator Abutment										
6	Bridge / Regulator deck slab & joints										
7	Bridge / Regulator Parapets										
8	Gates of Regulator / weir										
9	Stop-log grooves										
10	Stilling basin of fall / weir										
11	U/S Pitching of VRB / fall/ weir										
12	D/S Pitching of VRB / fall / weir										
13	Pipe of outlet										
14	Earth cover over foundation of abutment / pier										
15	Launching apron / filter in bed at VRB/ Fall/ wier										
16	Functioning of drainage holes in deck / crest of fall										
17	Others										

Sign

Inspecting Personnel

Checklist for Environmental Aspects

Pre-rehabilitation / maintenance stage

Name of Work:
Date of Inspection
Name of Contractor:
Agreement No.

Package No:
Location: Chainageto.....
RLto

Sl. No	Check Point	Observations
1.	Whether EMP is part of contract agreement	
2.	Whether it is ensured that land acquisition and economic rehabilitation, if required, is done according to the frame work laid out in R&R policy of the sector	
3.	Whether joint walkthrough of the command area is done to identify environmental / social issues	
4.	Whether consent of stake holders is obtained in finalization of designs / maintenance works	
5.	Whether the silt disposal plan on Shazara sheet with Khasra no. of the filed and name of the farmer is finalized with the consent of the farmers and given to contractor.	
6.	Whether government lands for silt disposal, in case farmers do not give consent, has been selected as per consent of Tehsil level committee, marked on Shazara sheet and given to contractor	
7.	Whether contractor has apprised the key stake holders regarding the scope of work clearly.	
8.	Whether the borrow area plan on Shazara sheet with Khasra no. of the field and name of the farmer is finalized with the consent of the farmers and given to contractor.	

Name & Signature
Inspecting Officer

Checklist for Environmental Aspects

During-rehabilitation / maintenance stage

Name of Work:
 Date of Inspection
 Name of Contractor:
 Agreement No:

Package No:
 Location: Chainageto.....
 RLto

Sl. No	Check Point	Observations
1.	Whether the excavated silt is being disposed of as per disposal plan	
2.	Whether encroachment of the embankment of any existing water body is being done by contractor during disposal of silt.	
3.	Whether water tankers with suitable sprinkling system are deployed along haul roads to sprinkle water at-least 3 times a day all along a route for suppressing the airborne dust due to vehicular movement.	
4.	Whether vehicles deployed for silt / material transportation are spillage proof and covered suitably to minimize spillage of material during transportation.	
5.	Whether vehicles / equipment deployed for transportation silt / material are well maintained and any waste generated (spent fuel / oil etc) is collected and disposed off suitably immediately.	
6.	Whether existing outlets on the canals are functioning properly during de-silting.	
7.	Whether the access to borrow area and disposal sites are controlled to restrict entry of unauthorized people, grazing cattle & stray animals.	

Name & Signature
Inspecting Officer

Checklist for Environmental Aspects

Post-rehabilitation / maintenance stage

Name of Work:

Package No:

Date of Inspection :

Location: Chainageto.....

Name of Contractor:

RLto

Agreement No.:

Sl. No	Check Point	Observations
1.	Whether all temporary land used has been restored.	
2.	Whether borrow areas have been rehabilitated	
3.	Whether silt disposal sites have been reclaimed by suitable plantation.	
4.	Whether unsuitable material, if any, has been disposed off by contractor in a social / environment friendly manner.	
5.	Whether compensatory afforestation in degraded forests areas to the extent of twice the denuded area has been planned in consultation with forest department.	
6.	Whether outer slopes of banks of canals have been provided with turfing to check soil erosion during high surface wind and rains.	
7.	Whether occasional review of above activities has been done by Engineer-in-Charge after completion of works.	

Name & Signature
Inspecting Officer

Useful Information for Farmers

1.0 [Draft Uttar Pradesh Environmental Policy, 2005¹](#)

The Uttar Pradesh Environment Policy includes the following provisions relating to Irrigation Works

- 1.1 The draft policy lays a great emphasis on the impact of agrochemicals on the environment and the need to manage their use. Recognizing agrochemicals, and especially pesticides, as causes of soil and water pollution, the policy discusses the need for organic farming and the application of correct dosage of agrochemicals. In fact one of the strategies identified for environmental protection and improved land fertility is encouraging organic farming and IPM. The education and information of farmers on both traditional and modern methods of soil and land management is seen as important by this policy. The policy further reiterates the need for reduction in use of agro chemicals and encourages the correct usage of pesticides, as there is increasing concern of their build-up in the food chain.
- 1.2 Issues of land degradation due to improper agriculture and irrigation practices are also discussed in the policy. Concerns of increasing sodicity, salinity and water logging are raised along with the need for identification of appropriate land management techniques to improve soil quality and its productivity. However, the policy cautions for the need for identification of the carrying capacity of the land and developing agriculture accordingly.
- 1.3 While on one side, concerns of water logging are discussed, the decreasing ground water is considered an equally important concern. The management of water resources has received great emphasis in the policy with both resource degradation and the decreasing availability of water considered critical factors in its reduced availability.
- 1.4 The policy encourages resource conservation in agriculture through the use of sprinkler and drip irrigation as well as improved management of water bodies to enhance ground water recharge.
- 1.5 The management of wetlands is given great emphasis. The need to make an inventory of all wetlands and identify important wetlands is discussed as a path to manage them. Wetland conservation through stakeholder participation is encouraged. Also the need for Environment Impact Assessment (EIAs) for development projects that impacts wetlands has been recommended.
- 1.6 The policy also lays an emphasis on the development of Environmental Cells for development projects in all State level departments to identify the impacts of the projects on the environment. In fact the policy goes a step further reflecting on the need for developing EMPs and environmental mitigation plans for projects as required which should be fed into future policymaking. The policy also speaks of the need for undertaking the economic valuation of the environment in development projects and to encourage the development of environmental funds of the identified amounts for the management of the environment.

2.0 Mitigation Measures of commonly noticed environmental imbalances

S. No.	Imbalance	Mitigation Measures
1.	Salinity / Alkalinity / Salt Imbalance in Soils	<ul style="list-style-type: none"> - Mitigate water logging as explained in para 3.2, chapter-7, section - A - Land reclamation, where needed, through gypsum treatment - Adoption of salt tolerant crops (mentioned in para 5)
2.	Excessive obnoxious weed growth & breeding ground for the disease causing vectors in pools of stagnant water	<ul style="list-style-type: none"> - Do not let the water stagnate for days and try to drain it out in the nearby drains - Maintain cleanliness - Remove the obstructions in flow of water, so that it can have smooth and speedy passage and doesn't allow stagnation of water
3.	Public health problems	<ul style="list-style-type: none"> - Avoid stagnation of water - Drain the fields for controlling mosquitoes & other vector population - Avoid growing paddy in areas around the settlements
4.	Crop pest problems	<ul style="list-style-type: none"> - Follow updated schedule for preventing the pests - Suitable pest control measures such as spray of approved pesticides - Change in crop rotation or irrigation schedule, if possible

3.0 Conjunctive use of water²:

- 3.1** The groundwater development plan envisages the use of water from the topmost aquifer which would help alleviate some of the water logging problems while also supplying water for irrigation. It also recommends that deep aquifer, though with good quality of water, should not be used for supplementing irrigation water as it would be the equivalent of importing water into the area. The top aquifer is replenished by rainfall, seepages and return flows from irrigation water.
- 3.2** In identified areas with a water shortage, water harvesting structures should be built. These structures, it is expected, would help recharge the aquifers and increase the total water available in the area and therefore help provide water for irrigation, live stock or drinking according to the needs.
- 3.3** Through the conjunctive use plan, the groundwater table will be lowered. While this is desirable to reduce water logging, if not managed properly, it could lead to a drastic

reduction in the ground water level causing degradation and loss of vegetative cover. Therefore, along-with the conjunctive use plan, there should be a ground water level monitoring program that would ensure good health of the aquifers as well as surface water bodies.

- 3.4** Reduced water logging would lead to a reduction in the breeding grounds for waterborne vectors like Malaria carrying mosquitoes and would reduce the contamination of ground water with coliform and faecal matter and will have a significant impact on the quality of ground water, as at present, the use of sanitary toilets in the villages is low. A distinction should be drawn between the areas that are genuinely water logged, caused by seepage from canals due to its poor functioning and original wetlands to avoid any damage to the wet lands.

4.0 Chemicals and Salts in soil

4.1 Possible reasons for high level of chemicals and salts in soil are:

- a. Lack of knowledge in farmers regarding proper type and quantity of fertilizer and pesticide and its applications; improper disposal of fertilizer and pesticide containers close to watercourses, collector drains, etc
- b. Excess / wasteful use of irrigation water during or after application of fertilizer, pesticide and herbicide sprays,
- c. high seepage from canals
- d. Drainage systems not functioning properly thereby causing water logging.
- e. High water table.

4.2 Possible remedial measures are:

- a. Consultation with and training of farmers for the correct application procedures of fertilizers and chemicals and disposal of excess chemicals and their containers
- b. The farmers should get the soil tested to assess the requirement of the type and quantity of fertilizers for the different crops
- c. Consultation with and training of farmers for good irrigation management practices. The departmental officers and agriculture extension services officials may be involved in such initiatives
- d. Inspection of the functioning of drainage systems (collectors as well as close- piped) and to maintain a register for the same with inspection remarks
- e. Assessment / evaluation and provisions of additional drainage requirements & inspection of maintenance works.

5.0 Salt tolerance levels of crops

- a. The salt tolerant varieties of crops fall into three categories, viz. highly tolerant, moderately tolerant and sensitive. These are tabulated below.

Highly tolerant	Moderately tolerant	Sensitive
Date palm	Wheat	Sugarcane
Barley	Tomato	Peas
Sugar-beet	Potatoes	Beans
Cotton	Rice	Orange
Asparagus	Maize	Apple
Spinach	Onion	Almond

- b. The highly tolerant crops can withstand a salt concentration upto 10 gram/liter. The moderately tolerant crops can withstand salt concentration up to 5 gram / liter. The limit of the sensitive group is about 2.5 gram/liter.
- c. The Water User Associations (WUAs) can seek assistance of engineers, agriculture officers, doctors, village public representatives, and farmers for mitigating environmental problems.

6.0 Phenomenon of Over Irrigation

The phenomena of reduced agricultural output due to over irrigation can be easily understood with the help of following explanations

- a. Over-watering often leads to accumulation of water around the plant roots and doesn't allow the vertical passage of air. As a result of this, the oxygen finds it difficult to reach the root-zone and the process of oxygen intake by the roots doesn't take place. On the other hand, the carbon-di-oxide released by the plant roots gets accumulated around the roots, which leads to formation of methane and sulphide. This ultimately causes reduction in the agricultural yield.
- b. The water contains salts and over watering often leads to accumulation of such salts around the root-zone. This inhibits both the plant growth and its yield.
- c. The plant holding capacity of the soil gets severely affected by excessive watering and thus leads to weakening of soil's strength to face the pressure and stress while holding the plants.
- d. Excessive watering also affects the availability of vital minerals required by the plants, as these minerals get dissolved due to excessive water and moves below the root-zone, which leads to inhibited plant growth and yield.
- e. Excessive watering leads to excessive wetting of local soil which doesn't allow optimum temperature for the seed to germinate in time; which inhibits the plant's growth.

7.0 Waterborne diseases

- a. Some of the waterborne diseases caused by improper drainage and resultant water logging in the command area of a minor are: Malaria, Encephalitis, Viral fever, Dysentery, Diarrhoea, Cholera, Dengue, Filariasis and Pilia.
- b. The occurrence of the above diseases may be minimized by adopting suitable mitigation measures for water logging as detailed in para-3.2, chapter 7, section- A .

References

1. Environmental Guidelines, Final Report, Volume I, UPWSRP, July 2006, Para 2.1 (X) (TAHAL Consulting Engineers Ltd.).
2. Environmental Guidelines, Final Report, Volume I, UPWSRP, July 2006, 8.1, 8.4 & 2.1 (i) (TAHAL Consulting Engineers Ltd.).