Government of Maharashtra
Water Resources Department

WRD HANDBOOK CHAPTER NO. 2

PIPE DISTRIBUTION NETWORK FOR IRRIGATION

VOLUME I

2019

PREFACE

To achieve more crop per drop, it is not advisable to use conventional flow irrigation system for irrigation viz canals & distributaries. There is large scale water loss in this system. In the wake of above, Govt. of Maharashtra has adopted the policy to distribute irrigation water through Piped Distribution Network, vide Govt. Resolution of 09.06.2016 and Revised 13.01.2017. The Central Govt. has decided in 2017 to increase the water efficiency by 20% and directed the State Govt. accordingly. As there is significant use of water for irrigation, it is sensible to increase water use efficiency in the agriculture sector. This can be solely possible by adopting PDN as it overcomes the lacunas of the flow irrigation system viz land acquisition, lavish use of water from the farmers in the upper reaches of the canal and in high cost in hilly areas.

The design and construction of PDN network in no. of projects is stated in Maharashtra. To have uniformity and for optimisation of design for cost reduction field engineers and planners felt need of detailed guidelines for PDN plannig, Design, estimation and execution. So, Govt. of Maharashtra constiueted a committee for drafting of PDN Handbook (As per Govt. Resolution dated12.02.2019). Handbook Committee gone through detailed literature, deliberation and practical experience on site and prepared Two Volumes of PDN Handbook. Volume one covers PDN plannning to estimation and second volume is dedicated to detailed specifications of pipe and appurtenant works.

I Specialy thanks our Principal secretary Shri. Chahal Sir for giving us opportunity for writing of handbook on this important topic. I also give special thanks to Shri. R. R. Pawar, Secretary(CADA), Shri. S. K. Ghanekar, Secretary(Co-ordination) and Shri. Sanjay Belasare, Joint Secretary of Govt. of Maharashtra. I also notably mention the name of Shri R. E. Upasani, Chief Engineer(Retd.) who was member secretary and he has carried out the work with special interest. PDN Handbook Volume-I was mainly contributed and drafted by Shri. S. N. Kulkarni, Executive Engineer, Canal Design Div. No.4, CDO, Nasik. As well as Second volume Detailed Specification of pipe is drafted by Shri. R.R Shaha, Chief Engineer(Hydro), Pune and Shri. I. M. Chisti, Superintending Engineer, Quality Control Circle, Aurangabad. The efforts and contribution of these three people are noteworthy and committee is glad to appreciate & thanks these three persons. Shri. H. V. Gunale, Superintending Engineer, Sangli Irrigation Project Circle, sangli has contributed by writing on Estimate preparation guidelines. Committee also appreciates and thanks him. I also thank all the members of the committee for their studied opinion,utmost concentration during meetings and sharing of knowledge.

This is the second chapter of WRD after publication of chapter on Ferrocement. I am happy to publish the second chapter of WRD Manual on PDN.

Hope, it shall be useful for the engineers for the successful implementaion of PDN policy and achieving its objectives. It will be useful for project planners, design engineers, field engineers and maintenance staff as well.

(N. V. Shinde)
Director General
Design, Training, Hydrology,Research & Safety
MERI, Nashik.

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ABBREVIATIONS

PDN :- Pipe Distribution Network.

GOI :- Government of India.

GOM :- Government of Maharashtra.

CDO :- Central Designs Organization.

MOWR :- Ministry of Water Resources.

CPHEEO :- Central Public Health and Environmental Engineering Organization

CWC :- Central Water Commission.

GIS :- Geographical Information System.

C.C.A. :- Culturable Command Area.

I.C.A. :- Irrigable Command Area.

H.G.L. :- Hydraulic Gradient Line.

U.T.M. :- Universal Transverse Mercator.

B.C. Soil :- Black Cotton Soil.

G.R. :- Government Resolution.

C_R :-Coefficient of pipe roughness

lps :- Liter per Second.

SCADA :- Supervisory Control And Data Acquisition.

WUA :- Water User Association.

G.C.A. :- Gross Command Area.

CONTENTS

CHAPTER-I

INTRODUCTION

Preamble

A water is scarce natural resource, also it is fundamental to life, livelihood, food security &sustainable development. Also it is a premier resource of agricultural production on which almost all rural income depends. It is also identically important to the urban development & industrial growth. Hence its accountable use is imperative.

इमा आप शिवतमII II(This water is sacred)

II इमा सर्वस्व भेषिजी II(It nourishes everyone.)

II इमा राष्ट्रस्य वर्धिनी II (It flourishes the Nation.)

Now a day's demand for drinking water, irrigation and non-irrigation in the state is increasing exponentially day by day. Considering above fact, the seriousness of the meaning of these Rucha's in *Varunsukta* can be easily understood. Since the availability of water in Maharashtra State every year is not assured, obviously the lavish use will not be possible in the coming days. In Maharashtra the variation of rainfall is uneven and variation from 2500 to 5000 mm in Konkan Region to 450 mm in Marathwada Region is observed. To achieve more Crop Per drop, it is not advisable to use conventional flow-irrigation system for irrigation Viz. Canals and distributaries. There is large scale loss of water in this system. Also almost 75% of water is used for irrigation out of total water available. In the wake of above, the Government of Maharashtra has adopted the policy to distribute irrigation water through piped distribution network, vide Govt. Resolution of 09/06/2016 and revised 13/01/2017. The usable water in the state is limited. (as per the second Irrigation Commission of Maharashtra) The total cultivable area for irrigation can be increased to a maximum of 85 lakh hectare. It is estimated that only 37.37% of the total cultivable land area (Around 226lakh hectares) can be irrigated through the total water available. Apart from this, only 41 lakh hectares irrigations possible through water conservation, local sector and agriculture department. This reveals that maximum irrigation area of 56% is only possible out of total cultivable area of 226lakh hectares, from all sources. The average irrigation potential of India is 76.44% so there is no alternative besides to increase the water use efficiency of the irrigation sector in the state. This can be possible only, by converting ongoing flow irrigation system in to micro irrigation system (Drip + Sprinkler).

According to Section 14 (4) of Maharashtra state Water Resources Regulatory Authority act it has been become mandatory to adopt micro irrigation for perennial crops in the state from June 2019. Also the state has adopted a water policy for micro irrigation system vide Govt.R.No.02/05/2017 (सिंचन प्रकल्पांच्या लाभक्षेत्रात सुक्ष्म सिंचनाचे अंतीम उद्दिष्ट ठेवून वितरण व्यवस्था करण्याचे धोरण). Also the central Govt. had decided in 2017 to increase the water application efficiency by 20 percent &directed to the State Govt. accordingly. As there is significant use of water for irrigation, it is sensible to increase the water use efficiency in the

agricultural sector. This can be solely possible by adopting Piped Distribution Network (PDN) as it overcomes the lacunas of the flow irrigation system viz. land acquisition, lavish use of water from the farmers in the upper reaches of the canal, System becomes expensive in hilly areas etc.

CHAPTER-II

SURVEY FOR PIPE DISTRIBUTION SYSTEM

2.1 As per the Government Resolution dated 02/02/2017; a piped irrigation system should preferably be used for the command areas, having ground slope 1:500 or more. Piped irrigation depends upon hydraulic gradient (H.G.L.) of the source hence piped irrigation system depends upon the topography of the area and H.G.L. of the source.

VIZ- 1) Land Acquisition is not amicable or expensive.

2) In hilly areas, where construction of traditional canal become more expensive.

3) In regions like Vidarbha, where horticulture crops are popular.

4) Commands having sandy soil, where percolation losses are predominant.

2.2 A detailed survey should be carried out by the state of art instruments like Total station, DGPS or Drone camera. This data becomes compatible to the Geographical information system (GIS) and also to many software used for the design of Pipe distribution system (Like Water Gems).

2.3 Based on a detailed survey carried out, the contour map should be prepared for 0.2 m contour intervals. A single command map of 0.2 m contour interval in a scale of 1:10000 should be prepared. Also for detailed planning of the PDN, the aforesaid command map in a scale of 1:6000 or 1:4000 are also required for chak planning. Or in case of large project at least command area should be readable. The map should be inclusive of all the details like Buildings, Gavthan, Forest, Roads, Railways, Nallas, & Rivers etc. and it should be in a Auto-cad drawing format.

2.3.1. In the wake of above, a detailed circular vide letter no. जा.क्र.मसंसं/अ.अ.(का)/ परिपत्रक/726/2018 दिनांक 05/10/2018 issued by the C.D.O. should be followed regarding this.

2.3.2. Based on the command area, the tentative chak size and alignment should be finalized from concerned C.D.O. circle. The chak area should cover minimum two contoursin order to fix the outlet position. Following grid size shall be used for contour survey.

For Ground slope < 1:500	15 M X 15 M(Grid)
For Ground slope > 1:500	30M X 30 M(Grid)

2.3.3. After finalization of entire pipe line network, the detailed ground level at every 30M chainage should be taken, to draw the necessary L- Sections.

2.3.4. Spot elevation in CAD & GIS format having Z ordinates (Elevation data).

2.3.5. The contour interval should be such that at least two contours are falling within each chak. Depending upon ground slope contour interval may vary.

2.3.6. DEM (Digital Elevation Model) (GIS shape file) or Bentley DTM (Digital Terrain Model) in DGN (Design) format.

CHAPTER-III

PLANNING OF PIPE DISTRIBUTION NETWORK

3.1 General

A pipe distribution network is a network installation consisting of pipes, there fittings structures like thrust blocks, various valves & outlet, installed in the system, to supply water under pressure from the source of the water to the irrigable area. Pipelines also permit the conveyance of water uphill against the normal slope of the land and, unlike open channels, can be installed on non- uniform grades. The use of buried pipe allows the most direct routes from the water source to fields, and minimizes the loss of productive land (since crops can be planted on the fields above the pipelines).

An analogy between the Canal Distribution Network (CDN) and Pipe Distribution Network (PDN) is pictorially depicted in Fig 3.1 &Fig 3.2 respectively below.

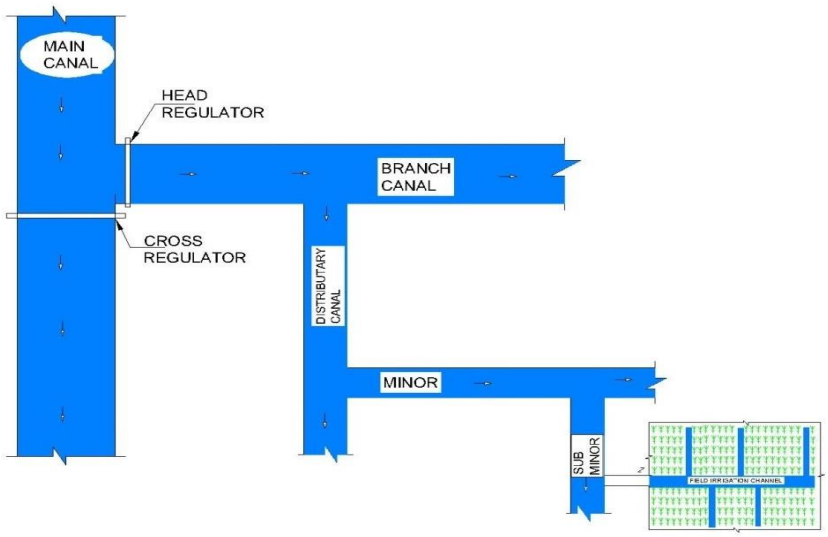


Fig 3.1Canal Distribution Network (CDN)

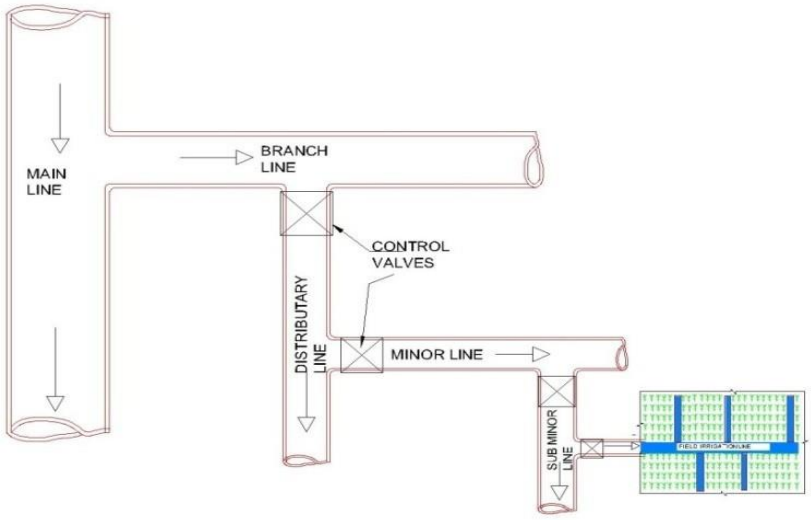
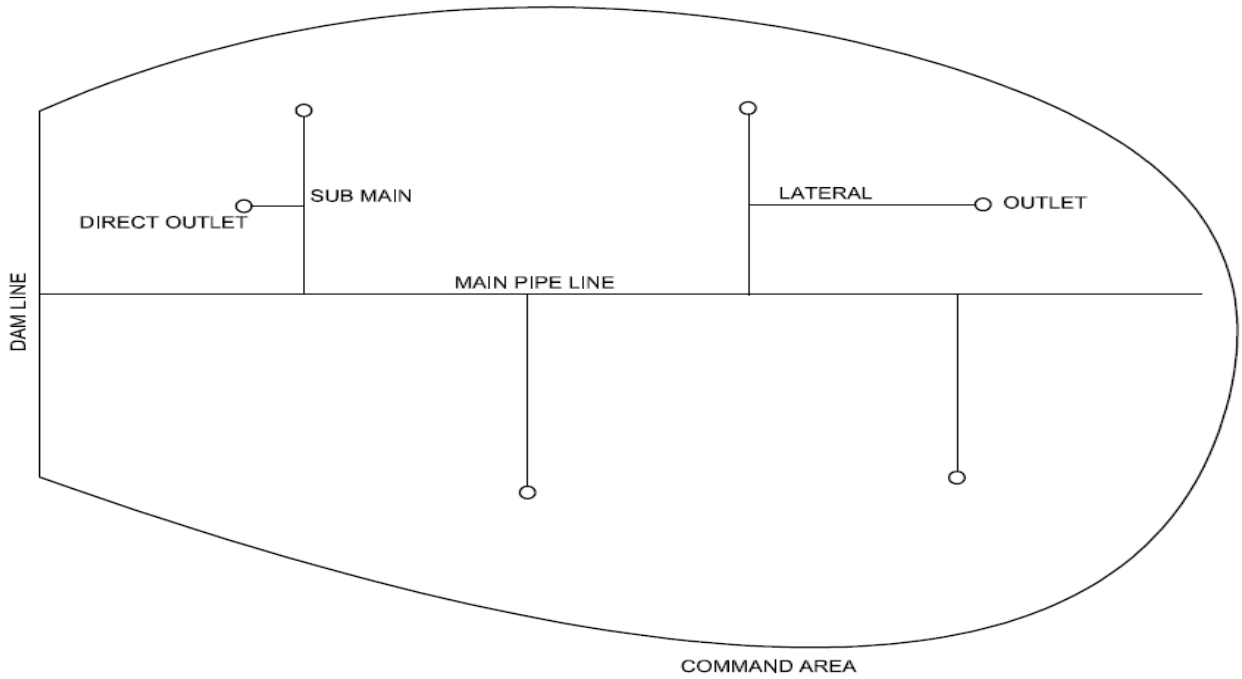


Fig 3.2 Pipe Distribution Network (PDN)

In case of Irrigation project, this network is mainly of tree type, having main pipeline sub mains emerging form mainline. They are square or oblique to the main line &then as per requirements the laterals or sub laterals emerge from this sub main.

The sketch is shown as below : -



3.3 Line diagram of PDN

3.2 Pipe Distribution Network (PDN) Planning

3.2.1 The planning and layout of Piped Irrigation Network unlike CDN is not controlled by the command area to be irrigated and the source of supply. The layout of main lines and branches is generally fixed on the consideration of economy. For the layout of minors and distributaries, points of off take may be suitably selected but their layout is more or less governed by the blocks of areas to be irrigated taking into consideration watersheds and drainages. The main lines and branches are feeder lines for distributaries and generally no irrigation is done directly from them. Irrigation outlets are provided on distributaries or minors off taking from distributaries.

3.2.2. The stage for general planning and layout of Piped Irrigation Network arises after the general feasibility of the project has been established. The area to be irrigated by pipe line system shall be planned by preparing land use maps, preferably on a scale of 1: 50,000, showing on them the area already under cultivation, soil types, habitation, roads, drainage and contours of the area. The intensity of irrigation to be provided in the project shall be decided after taking into account the factors like socio economic factor, area and intensity of the irrigation being achieved on the other projects in the neighborhood etc.

3.2.3. The important crops of the area and their water requirements shall be determined in consultation with the department of agriculture and the agriculturist of the area proposed to be served allowing for the anticipated change in crop pattern due to introduction of wet farming in the area. Knowing thus the duty for various crops, the area under cultivation under different crops, the intensity of irrigation, the cultivable area to be commanded shall be worked out and marked on the map. Areas that are higher and may not be supplied with the flow/gravity irrigation should be marked on the map with separate colour and the pumping requirements for that area need to be worked out separately. The important crops of the area & their water requirements shall be determined.

3.2.4 The government of maharashtra has adopted ambitious policy to distribute water through pipelines hence; Pipe Distribution Network program has primarily adopted in all over maharashtra by water resources department. To have uniformity in design & planning as well as to achieve economy and optimization, the general layout of Pipe Distribution Network should be finalized by advice of Central Designs Organization. and subsequently field chief engineer should accord sanction to it. however when the schemes included in PMKSY, BALIRAJA, JALSANJEEVANI, ANUSHESH are to be designed in short time then field officers should take prior permission from government and then field chief engineer can accord sanction to general layout and design by taking design and general layout from reputed government approved consulting institutions (without consultation with Central Designs Organization). However, this should be an exception and not a rule. This will be applicable from the date of publication of handbook.

3.3 Data Required for Piped Irrigation Network Planning

The following data is required for planning and layout of a Pipe system:

i. Topographical map of the area
ii. Subsurface data
iii. Texture and salt component of the soil
iv. Soil characteristics including mechanical properties and shear parameters
v. Permeability of the soil in relation to seepage losses
vi. Rainfall data
vii. Water availability, Subsoil water level in the area and quality of the underground water
viii. Possibility of water logging and salination
ix. Availability of suitable construction material
x. Existing drainage and drainage facilities
xi. Existing crop pattern
xii. Existing communication and transportation facilities
xiii. Socio economic study and agro economic survey of the project area
xiv. Adequate investigation should be carried out to collect the data given by digging trial pits and bore holes, where necessary, to ascertain the nature of soil encountered along different alternative alignments.

3.4 Route Selection of Pipe Network

1. As far as possible Length of pipelines in the network shall be kept minimum.
2. Pumping is avoided if possible or least pumping effort is needed.
3. High water pressure is avoided. Numbers of appurtenances (gate valve, check valve, drain, air release valve, pressure break valve) are minimized.
4 Very low or high velocities are avoided because low velocities cause Sedimentation in pipes and high velocities cause corrosion of pipe as well as more headloss. This results into most economical system.
5. If horizontal pipe sections are used, release of air and drain the dirt will not be possible. So, in case of horizontal ground surface, artificial slopes are given to pipes to be laid.

3.5 Guiding Principle for deciding Carrying Capacity of Pipe/Canal

The carrying capacity of the Piped Irrigation Network/CDN shall be maximum of;

a) The carrying capacity calculated on the basis of the fortnightly crop water requirement as per the design cropping pattern and planned Irrigated Cropped Area (ICA) of the project as per Administratively Approved project report but considering 12days flow period in a Fortnight.

OR

b) The carrying capacity calculated on basis of due water entitlement of the Culturable Command Area (CCA) of the Pipe line or distributary as per the provisions of Acts of State Level Authorities.

OR

c) The carrying capacity calculated on basis of the operation schedule of the pipe/canal or distributaries. The operation on the basis of 12 days on and 2 days off in a fortnight is preferable or as per the requirement.

The procedure to work out carrying capacity of canal for above alternatives is as given below:

3.5.1 Carrying capacity of pipe on the basis of crop water requirement:

While deciding the carrying capacity of the pipe, the fortnightly crop water requirement of the planned Cultural Command Area (CCA) of the Canal/Pipe shall be calculated by Modified Penman Method, for this cropping pattern approved by the concerned Authority shall be considered. Generally the C.C.A. of the pipe line shall be decided after completion of detailed command area survey of the project. PDN is such a water conductor system which have minimum losses is transit, so every effort should be made that maximum area should be brought under irrigation, hence there should not be any distinction between C.C.A. & I.C.A. so, as much as C.C.A. can be brought under irrigation and efforts should be made to restore the loss of irrigation area due to diversion of water to non irrigation use **.**

3.6 Design of a Network for Irrigation By Rotation

When pipe irrigation system is designed to run entire outlets in the command at the same time, due consideration must be given to strictly maintain the water level in the source. Abusive use of water is immediately detected at once by the rightful user whose supply vanishes in so far as the area of the chak /block is comparatively very small.

Piped Irrigation Network, can be easily designed to keep the discharge of pipe outlet proportionate to it culturable area, and entire outlets to run at a time, hence there is no head, middle and tail reach differentiation of the command. It is essential to form user group before execution of the Piped Irrigation Network and hand over the network immediately to the user group for further supervision and protection.

3.7 Preliminary Carrying Capacity of Distributary & Minor

Detailed layout planning of Piped Distribution Network (PDN) should be done after completion of detailed command survey. The procedure for deciding carrying capacity of Distributaries / Minor is given below:

i. It shall be presumed that the fortnightly peak water requirement at the outlet head with Piped Irrigation Network is to fulfill with a flow period of 12 days, in a fortnight. The discharge at the chak head is kept proportionate to the chak areas. Thus the time period of entire outlets is constant and delivering (equitable distribution) same amount of total volume of water per ha.
ii. As per the guideline given in GR dtd 02/02/2017, chak size should be 5 -12 ha. If the required discharged at outlet as per cropping pattern is less than 10 lps, then outlet should be grouped or scheduled in such a way that group of outlet will have 10 lps discharge & each outlet will run at 10 lps for few days within group.
iii. For the rotation there should be proper grouping and scheduling of chak on sub-minor or lateral so that each outlet can discharge 8-10 lit/sec of water.
iv. Estimate maximum running days of PDN (Entire outlets) in the respective fortnight for water requirement by using appropriate efficiency from root zone to outlet head having proportionate discharge.
v. Determine carrying capacity of minor / distributaries in different reaches considering appropriate conveyance efficiency as given in Table 3.1.

3.8 Procedure for Deciding the Carrying Capacity of Main / Branch Line

Prepare a statement of fortnightly net irrigation requirement (NIR) at root zone in mm.

i. Select the fortnight having maximum irrigation requirement i.e. peak water requirement and use this peak water requirement for designing the system.
ii. Convert the peak water requirement of root zone to the requirement at Main Canal/Pipe or Branch head using appropriate efficiencies.
iii. Workout the total volume of water required at canal head or Head Regulator for complete ICA of the system.
iv. Workout Canal/Pipe capacity for delivering the peak volume in a given flow period (if rotation is adopted for distributaries use 12days flow period for the peak rotation). If original canal or distributary is designed for 6 days rotation then design PDN system for 6 days accordingly.

3.9 Water Losses and Irrigation Efficiencies

To account for losses of water incurred during conveyance and application to the field, and efficiency factor should be included while calculating the project irrigation requirements. The project efficiency is normally divided into two stages each of which is affected by a different set of conditions.

a) **Conveyance Loss-** It is quatum of water loss in the system due to leakage etc. and it is assumed as 5% of Net irrigation requirement for PDN.

b) **Field application Efficiency, E_a*: Ratio*** between water directly available to the crop and that received at the field inlet.

Table 3.1

Conveyance Efficiency Of pipe

Method of conveyance/ irrigation		Micro Irrigation		Surface Irrigation
		Sprinkler	Drip	
Pipe based Conveyance	Water Loss in conveyance system	5 %	5 %	5 %
	Field Application efficiency (%)	75	90	75

3.10 - Parameters to be borne in mind for economical pipe network: -

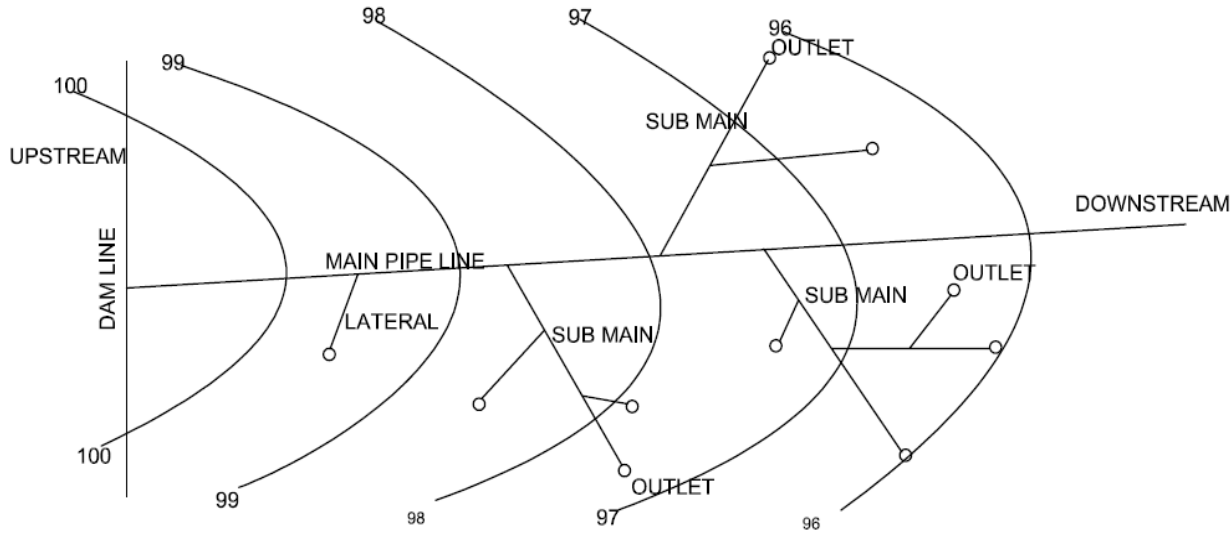
1) Length of the pipe lines in the network is to be minimum, as much as possible
2) Most preferably, pumping is to be avoided.
3)Sometimes, due to Geography of the command area, high pressures are unavoidable, but to be
avoided.
4)The maximum velocity limit in each pipeline except PVC pipe is increased to 3 m/s(As per MOWR guidelines on PDN, July.2017). According to available residual head velocity in each pipe should be controlled.
5) Number of valves & thrust blocks, should be minimum.
6) Choice of proper pipe type can render a good economical network.

3.11 How to carry out Planning: -

The Engineer in charge of the work are the men who are closely acquainted with the project or command area, so he should be involved in the pipeline alignment planning.

Basically the contour map of the command area to be studied in detail, before fixing the alignment. Two types of command come across while planning.

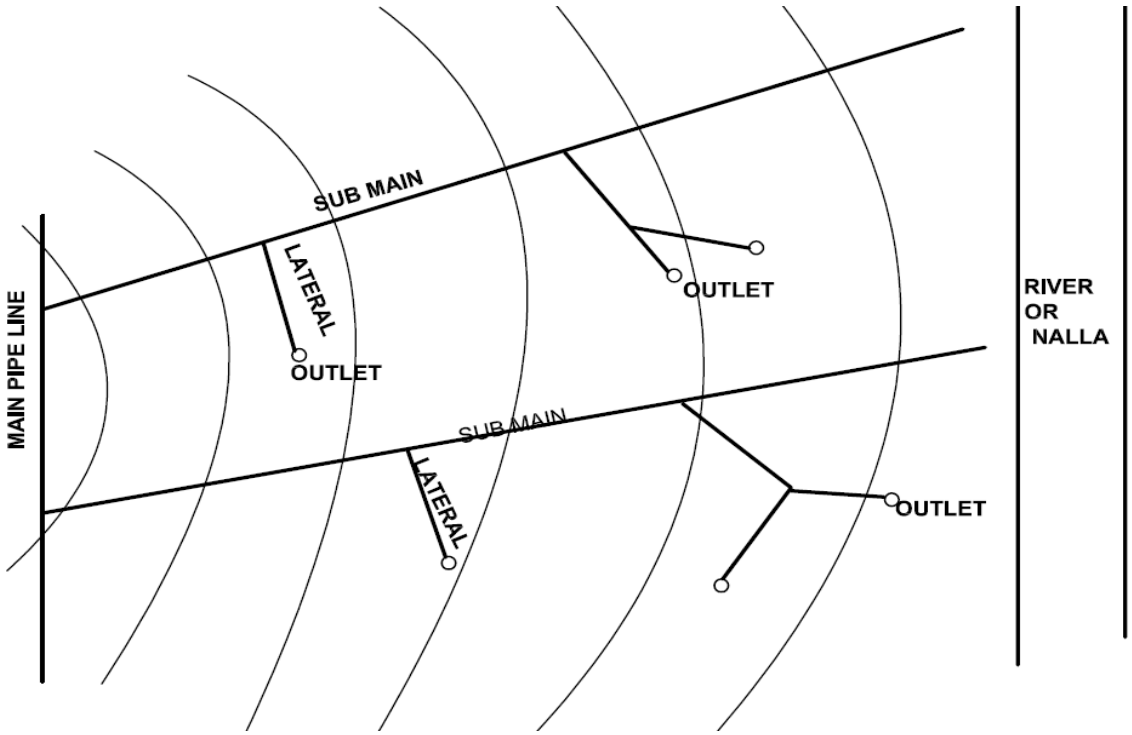
3.11 (a) If the contour lines are ridging @ the center& contour interval is decreasing to the downstream**.**



3.4 Alignment of PDN If contour lines are ridging @ center & decreasing to the downstream**.**

In this case ridge line can be mark as the main line for piped distribution network and sub main and laterals can be aligned towards downstream along the ridge line. As the main line is considered as the ridge line natural head can be utilized easily to irrigate farthest chak with economical pipe diameter

3.11 (b) In this case the contour lines are as below-



3.5 Alignment of PDN if ground is flatter

In this case ridge line cannot be marked easily. The ground is flatter, so the main line for piped distribution network is considered as the one of the contour line. Command area can be divided into different zones according to decreasing contours and each zone should be irrigated through sub main emerging from main line.

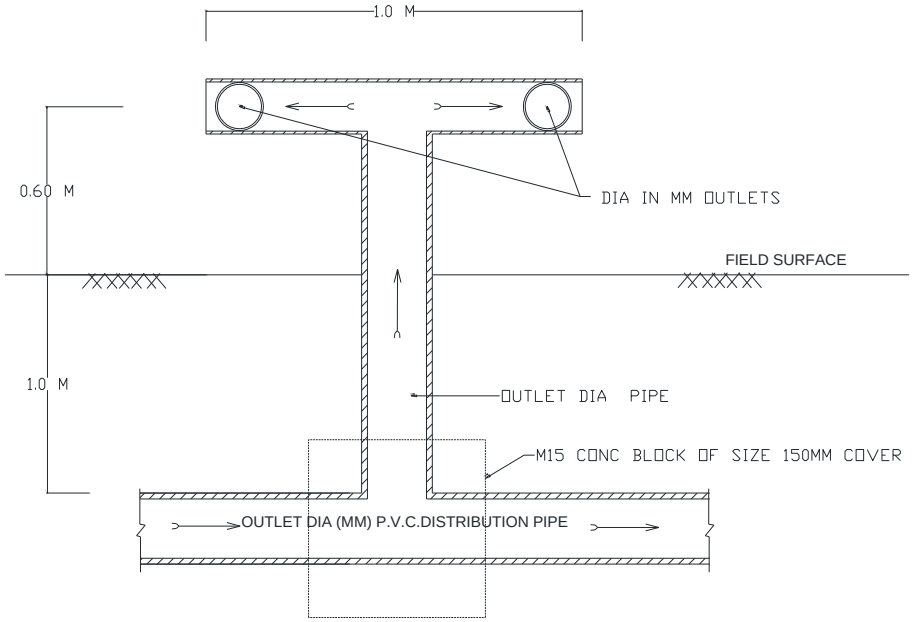
3.11 (c) Chak size: -

The chak size should be between 5 ha to 12 ha, so that every farmer can easily irrigate his farm. The per hectare discharge of command area (m3/sec/ha) is a governing factor for deciding the Chak size. A minimum 10 lit/sec discharge is required at every outlet point to exercise the option of conventional flow irrigation behind pipe outlet. However actual discharge required as per modified penman method for a chak may be less than 10 lps discharge, in such cases keeping total quantum of water required to irrigate chak; we have to schedule two or three chak outlet operation in sequence.

3.12 Outlet: -

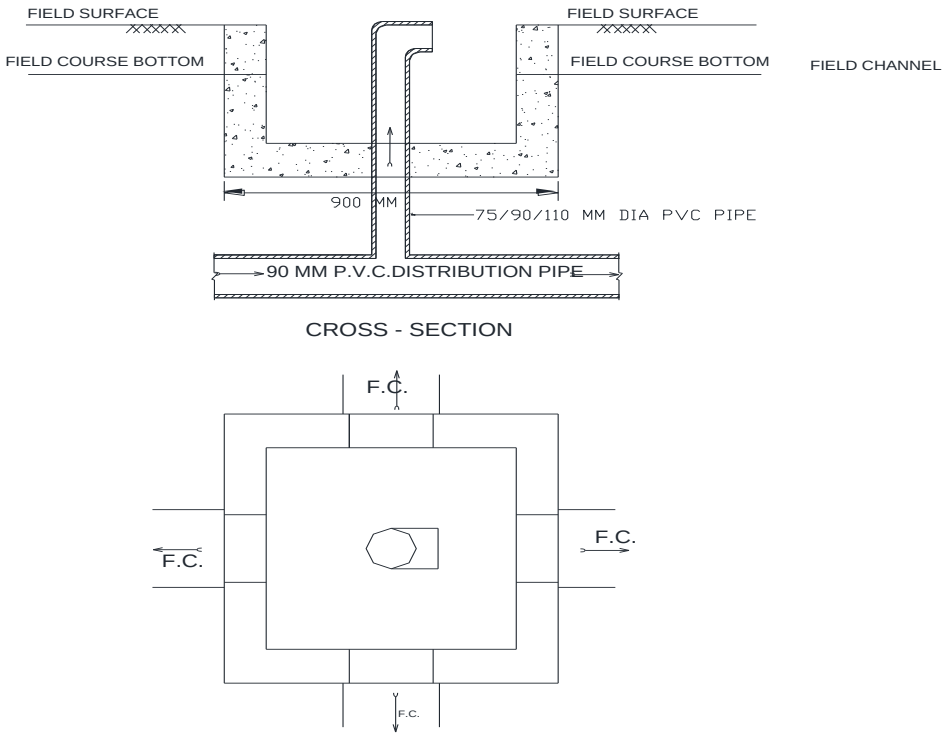
Outlet is the last appurtenance in pipe distribution network which actually supplies water to each chak. Outlet position is decided on the basis of the topography of chak. It is provided at the highest location in chak so that water can be supplied to each farm by gravity. As Every chak contain more than one farm so the local arrangement is made to facilitate the supply of water to each chak; On the basis of this arrangement oulets are devided into following three categories.

3.12 (a) In this type of arrangement main outlet pipe is divided into two or more openings according to number of farmers in each chak. As shown below.



3.6 Outlet with Stand Post

3.12 (b) In this type a arrangement is made such that small chamber is constructed at the location of outlet and water is distributed through field channel. As shown below.



3.7 Outlet for Field Channel

3.12 (c) This type of arrangement is generally used in Gujarat where chamber is constructed at outlet location and main outlet pipe is divided at into number of pipes as shown below to have easy access to each farmer.

3.8 Gujrat type Outlet

CHAPTER-IV

TYPES OF PIPE DISTRIBUTION NETWORK

In Water Resources Department (WRD) after studying different Irrigation Configurations; following four types of Irrigation Systems comes in to picture.

1. Direct pumping / Entire pressurized system
2. Partial Gravity & Partial pressurized system
3. Partial pressurized up to storage point & then gravity system.
4. Pumping through booster pump from canal.

4.1 Direct pumping / Entire pressurized system

The Pipe Distribution Network where water is directly distributed to field with external force by pump is called as Direct Pumping Distribution Network. In this system water is pumped from source to field outlet. This type of Irrigation system is adopted in Command Area which is to be irrigated is at higher level than source also when whole Command Area is proposed to be irrigated by drip irrigation system ; where at each outlet 20 to 30 meters residual head is required. In the direct pumping system surge analysis is very important as pumps can go off any time. Surge analysis of not only rising main but entire network is to be carried out to ascertain that no where there is distress in entire network due to in adequate rating of pipe or excessive surge head. If required surge protection device should be provided as per requirement after thorough surge analysis

It was observed that in previously sanctioned lift irrigation schemes where water is carried by pumping to highest point location distribution chamber and then by gravity to command area, now for gravity PDN is done. In such case it is preferable to directly pump water to command area as it will save considerable head. Hence, the schemes approved but not yet executed should be reviewed and revised general layout should be finalized.

In the case of direct pumping the block size is very important considering the efficiency, maintenance and management of irrigable command area. Decentralized pumping irrigation systems are more suitable in view of simplified management so block size should be restricted to maximum 500 ha.

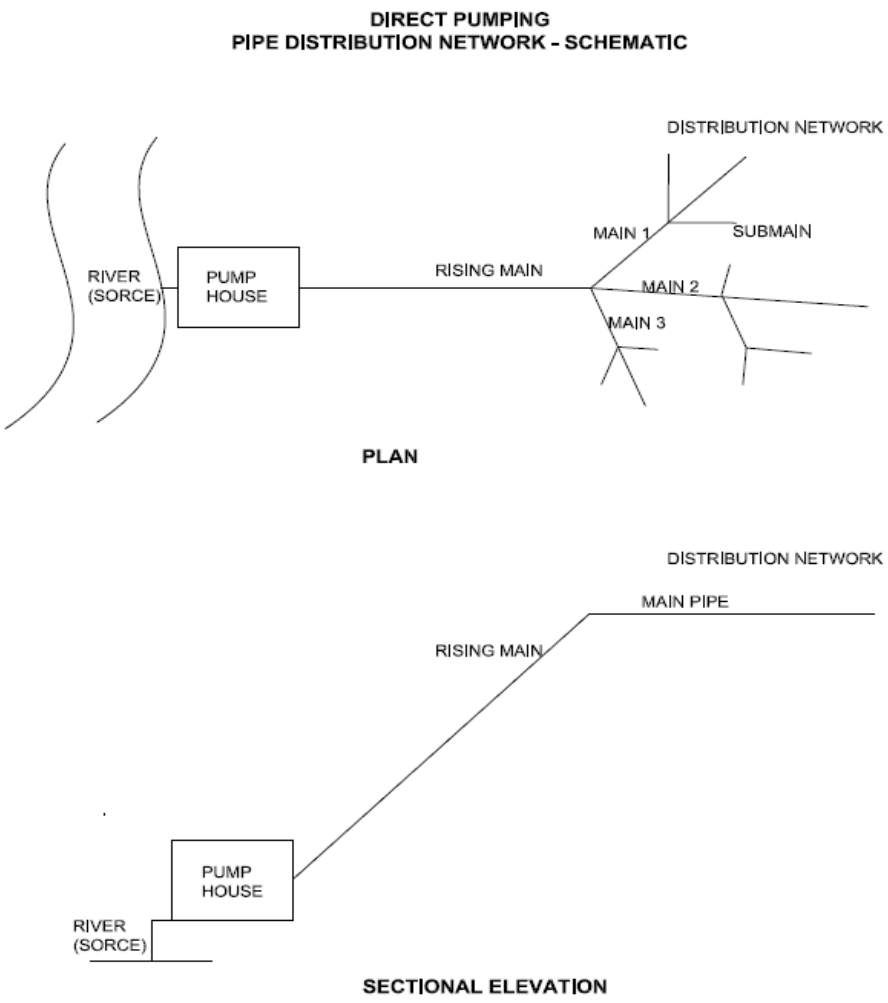


Fig 4.1 Schematic of Direct Pumping Pipe Distribution Network

4.2 Partial Gravity & Partial pressurized system

In this type of Pipe Distribution Network water is distributed by Gravitational Force as well as by external force given by pumps. This system is adopted when some area of command can be irrigated through gravity pipe line where levels of such area is less as compare to source, If sufficient head is available water can be distributed through gravitational force and if some area is unable to irrigate through gravity pipeline it can be irrigated by direct pumping. So this is a hybrid system and it can be utilize for filling local chain of reservoirs. in the case of flood canals, flood canals can be replaced by large diameter pipes and water is conveyed to local reservoirs after studying topography and levels of reservoir.

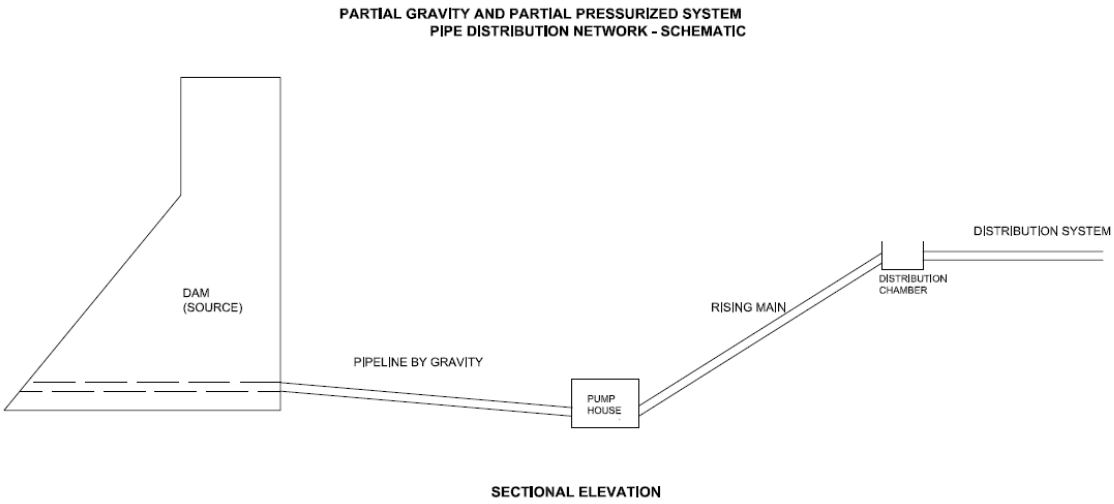


Fig 4.2 Schematic of Partial Gravity & Partial pressurized Pipe distribution Network

4.3 Partial pressurized up to storage point & then gravity system.

In this system source of water is river or bandhara or large reservoir and command is well above source altitude. In this case water is lifted by pumps and conveyed through rising main up to distribution chamber which is located at the highest location of command. From this D.C. we can originate no. of pipelines in the command as per spread and extent of command. Most of lift irrigation schemes in Maharashtra are planned in this pattern. When the water is distributed by gravity lines to the chaks between 5-12 ha then PDN should be designed as envisaged in the handbook. Irrigation is planned based on decentralized storage policy (As per GR Dt.2.5.17), then the chak size shall be 100 Ha

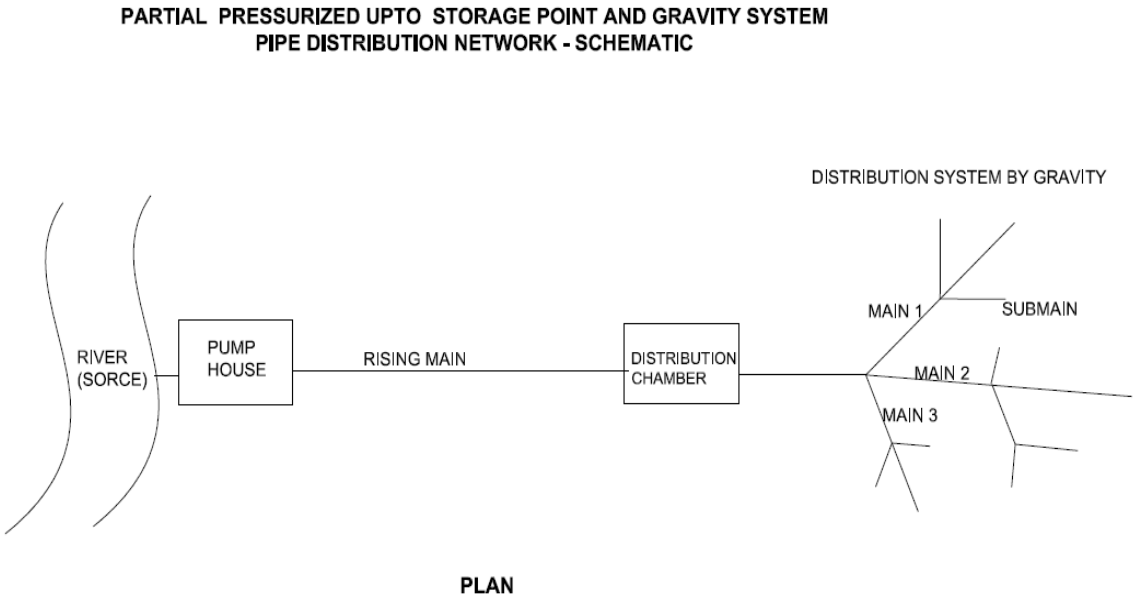


Fig 4.3 Schematic of Partial pressurized up to storage point & then gravity Pipe distribution Network

4.4 Pumping through booster pump from canal.

In the ghat portion of Maharashtra on. of projects command area is very flat. Normally PDN is economical when slope is steeper than 1:500. When the command is very flat and if we have to plan PDN network instead of canal network for distribution then it becomes empirical to have sufficient head to plan pipeline distribution network as natural sufficient head is not available then it can design PDN network by taking water from canals and providing booster pumps on this pipelines to negotiate the frictional head of pipelines. However, pipelines are not substitute for canals in all circumstances. Hence boosting should be restricted to maximum 10 m head. So the applying maximum 10 m boosting head command area scattered by PDN network then only such schemes can be plan and design. even in such cases there should be blocks of sizes not more than 500 ha.

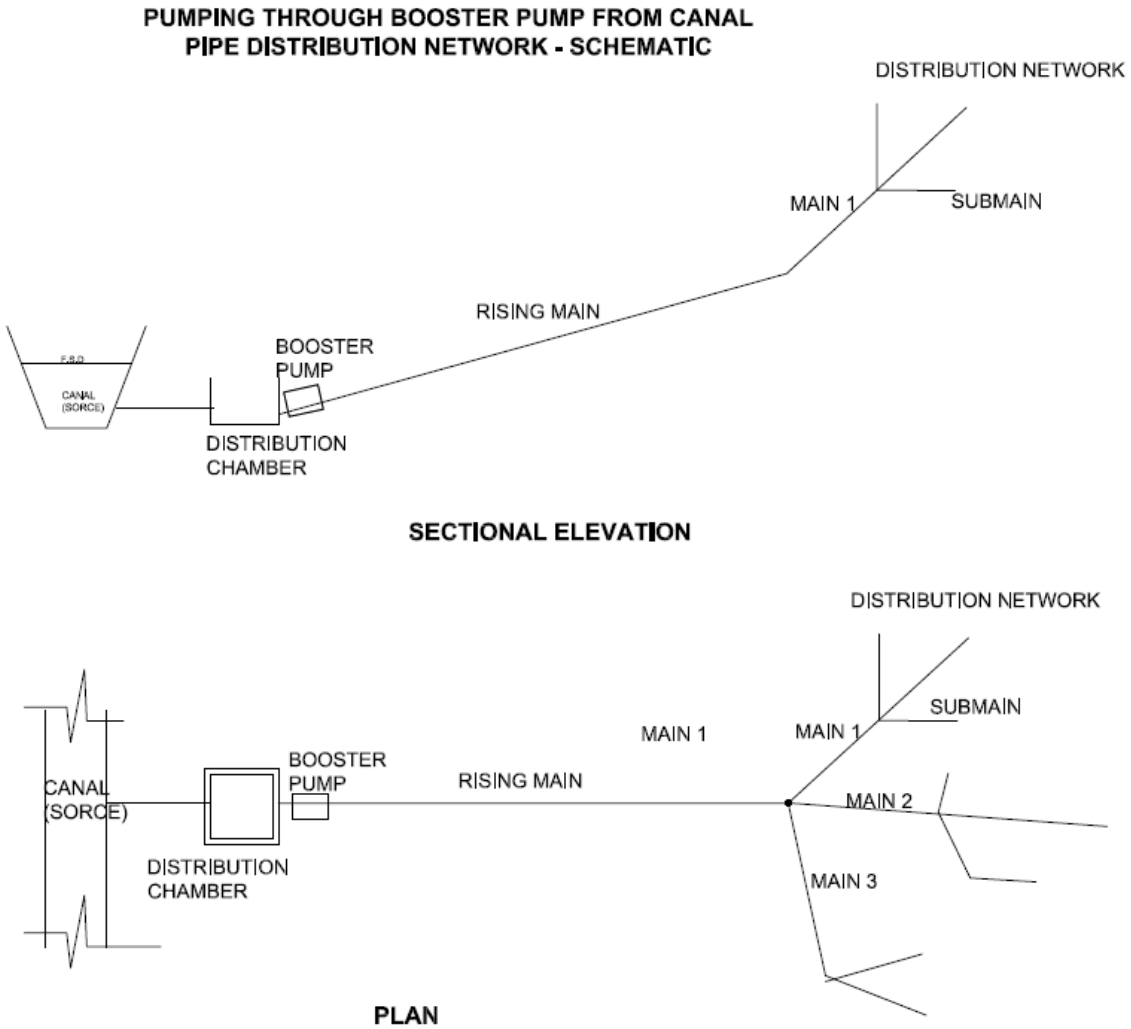


Fig 4.4 Schematic of Pumping through booster pump from canal Pipe distribution Network

CHAPTER V

SELECTION OF PIPE MATERIAL

5.1 Pipe Materials

Pipelines are major investments in water supply and piped irrigation projects and as such constitute a major part of the assets of water authorities. Pipes represent a large proportion of the capital invested in water supply piped irrigation undertakings and therefore are of particular importance. Pipe materials shall have to be judiciously selected not only from the point of view of durability, life and overall cost but also their suitability in performing the required function throughout the design life of the pipe network.

5.2 Selection of Pipe Materials

Selection of Pipe Material must be based on the following considerations.

i. *For the Proper Selection of pipe material various factors should be considered; whether the pipe distribution network is by gravit or pumping, type of subsoil condition, various type of pipe available in market and its economy.*

ii. The initial carrying capacity of the pipe and its reduction with use, defined, for example, by the Modified Hazen Williams coefficient (C). Values of C vary for different conduit materials and their relative deterioration in service. They vary with size and shape to some extent.

iii. The strength of the pipe as measured by its ability to resist internal pressure and external loads.

iv. The life and durability of pipe as determined by the resistance of cast iron and steel pipe to corrosion; of concrete and A.C. pipe to erosion& disintegration and plastic pipe to cracking & disintegration. Normally, the design life of pipelines is considered as 50 years (As per MOWR Guidelines on PDN July.2017 page 31).

v. The ease of transportation, handling and laying and jointing under different conditions of topography, geology and other prevailing local conditions.

vi. The safety, economy and availability of manufactured sizes of pipes and specials.

vii. The availability of skilled personnel for construction of pipelines.

viii. The ease of difficulty of operations and maintenance.

ix. Nominal pressure of chosen pipe material should not be less than the sum of design working pressure and water hammer pressure.

x. Connection between pipe and pipes, fittings and accessories should be simple and reliable.

xi. Nominal pressure of fittings and accessories should not be less than that of pipe; dimension and deviation should meet sealing requirements.

xii. When the sulphate concentration in soil exceeds 1%, concrete pipes and metal pipes should not be used

xiii. HDPE (6kg/cm2), DI,MS pipe should not be recommended for Gravity pipe distribution network if maximum residual head in pipeline is 30m.

xiv. In gravity pipe distribution network for main line if the diameter of pipe is above 800 mm then GRP or PSC pipe should be preferred.
xv. For lift irrigation with drip; use of HDPE pipe should be considered.
xvi. Cast -in-situ pipe should not be used for the piped distribution network.
xvii. After the laying of pipes proper quality control is mandatory.
xviii. Pipe line in B.C. soils/expansive soil: -
xix. A special care has to be taken while laying pipelines in black cotton soil and
xx. Expansive soils. for that following things should be strictly observed.
xxi. In black cotton soil or in expansive soil, PSC pipe should be avoided
xxii. in B.C. soils/ expansive soil alignment of pipe can be disturbed due to excessive soil pressure; in that case no. of anchor block should be increased and general criteria for providing anchor block should be at 100 m interval
xxiii. The pipe type having rigid joint can have crack in B.C. soils, in such case pipe having flexible joints should be preferred.
xxiv. while designing Pipe Distribution Network (PDN), correct data regarding swelling pressure of B.C. soils/expansive soil should be taken into account from field to avoid further displacement of alignment and also provide design of CNS material with appropriate thickness.

The life and durability of pipe depends on several factors including inherent strength of the pipe material, the manufacturing process along with quality control, handling, transportation, laying and jointing of pipeline, surronding soil condition, and quality of water. Normally design period of pipeline is considered as 50 years(As per MOWR Guidelines on PDN July.2017 page 31). where the pipes have been manufactured properly as per specifications, & pipeline is designed and installed with adequate quality control and strict supervision.

The cost of pipe material and its durability or design life are the two major governing factors of selection of pipe material. The pipeline may have very long life but may also be relatively expensive in terms of capital recurring costs and, therefore, it is very necessary to carry out a detailed economic analysis / (Life cycle analysis) before selecting pipe materials.

Table 5.1(As per MOWR Guidelines on PDN July.2017) provides the comparison of various types of typical Pipe Materials. However, the list of pipes available in the market is exhaustive and due to space constraints, comparisons of typical pipe materials only have been given

Table 5.2(As per MOWR Guidelines on PDN July.2017) provides Various pipe material & dia. available

The determination of the suitabilty in all respects of pipeline for any work is a matter of decision by the engineer concerned on the basis of requirements for the scheme.

A checklist in Table 5.3(Reproduced from CPHEEO manual May 1999) for the selection of pipe material has been provided to facilitate the decision makers in selecting the economical and reliable pipe material for the given conditions. As per GR dated 02/02/2017 Chief Engineer is authoried for deciding type of pipe. However this decision needs to be taken by considering various aspects mentioned above & reasoning for pipe type selection shall be documented.

Table 5.1 Comparison of various Pipe Materials (As per MOWR Guidelines on PDN July.2017)

Specific Issue	MSP (Mild Steel Pipe) (IS 3589:2001)	DIP (Ductile Iron Pipe) (IS 8329:2000)	GRP (Glass Fibre Reinforced Plastic Pipe) (IS 12709:1994)	PVC Pipe (IS 4985-2000)	HDPE Pipe (IS 4984-1995)	RCC Pipe (IS 458-2003)	PCCP (Prestressed Concrete Cylinder Pipe (IS 784-1985)	PSC (Prestressed Concrete non cylinder Pipe) (IS 784-1985)	BWSC (Bar Wrapped Steel Cylinder Pipe) (IS 15155-2002)
Design Concept	Flexible Structure	Semi Flexible Structure	Flexible Structure	Flexible Structure	Flexible Structure	Rigid Structure	Rigid Structure	Rigid Structure	Based on semi rigid pipe theory
Bedding Requirement	The bottom of the trench shall be properly trimmed to permit even bedding of the pipeline. For pipes larger than 1200 mm diameter in earth and murum the curvature of the bottom of the trench should match the curvature of the pipe as far as possible, subtending an angle of about 120^0 at the centre of the pipe. Where rock or boulders are encountered, the trench shall be trimmed to a	Where pipes are to be bedded directly on the bottom of the trench, it should be trimmed and levelled to permit even bedding of the pipeline and should be free from all extraneous matter which may damage the pipe or the pipe coating. Additional excavation should be made at the joints of the pipes so that the water main is supported along its entire length. Where excavation is through rocks or boulders, the pipeline should be bedded on concrete bedding or on at least 150 mm of fine grained material, or other means are used to protect the pipe and its coating. Material harmful to the pipeline should	The pipe should be uniformly and continuously supported through its whole length with firm stable bedding material. Pipe bedding material should be sand or gravel as per the requirements on the backfill material. The bedding should be placed so as to give complete contact between the bottom of the trench and the pipe and should be compacted to provide a minimum compaction corresponding to 90% maximum dry density. If the pipe is supported on grade elevation with use of timber or of tapered wedges, they must be removed and not left in place. They can usually be pulled out after the bedding has been compacted to	The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipeline. There should be no sharp objects that may cause point loading. Any large rocks, hard pan, or stones larger than 20 mm should be removed to permit a minimum bedding thickness of 100-150 mm under the pipe. For pipes of diameters 100 mm or greater, bell holes in the bedding, under each socket joint, shall be	Polyethylene pipe requires no special bed preparation for laying the pipe underground, except that there shall be no sharp objects around the pipe. However, while laying in rocky areas suitable sand bedding should be provided around the pipe and compacted. **(Refer Cl. No. 6.3 of IS 7634 Part 2 : 2012)**	Types of bedding suggested as per IS 783 1) Type A Bedding – concrete cradle support to the pipe (continuous concrete cradle of monolithic cross section if unreinforced) 2) Type B Bedding – Sand or other granular material shaped to fit lower curved shape of the pipe. 3) Type C Bedding – Ordinary Type of Bedding with normal	Bedding requirements are minimal due to Rigid nature. Types of bedding suggested as per IS 783 1) Type A Bedding – concrete cradle support to the pipe (continuous concrete cradle of monolithic cross section if unreinforced) 2) Type B Bedding – Sand or other granular material shaped to fit lower curved shape of the pipe. 3) Type C Bedding – Ordinary Type of Bedding with normal care 4) In rocky portion,	Bedding requirements are minimal due to rigid nature. Types of bedding suggested as per IS 783 1) Type A Bedding – concrete cradle support to the pipe (continuous concrete cradle of monolithic cross section if unreinforced) 2) Type B Bedding – Sand or other granular material shaped to fit lower curved shape of the pipe. 3) Type C Bedding – Ordinary Type of Bedding	Bedding requirements are minimal due to semi rigid nature. Smaller diameter pipes upto 600 mm are rigid in nature.

	depth of at least 100 mm below the level at which the bottom of the barrel of the pipe is to be laid and filled to a like depth with lean cement concrete or with non-compressible material like sand of adequate depth to give the curved seating. **(Refer Cl. No. 4.2.1 of IS 5822 : 1994)**	not be used.**(Refer Cl. No. 4.2.5 and 4.2.6 of IS 12288: 1987)**	the specified minimum compaction. The voids from which the timber has been removed must be properly filled and compacted. **(Refer Cl. No. 7.1 of IS 13916:1994)**	provided by removing some of the bedding material, to accommodate the larger diameter of the joint and to permit the joint to be made properly. Prepare the bedding by laying on soft soil and alternatively compacting and watering sparingly until an effective thickness of 100 to 150 mm is achieved. **(Refer Cl. No. 6.2.3 & 6.2.7 of IS 7634 Part 3 : 2003)**		care 4) In rocky portion, where excavation is through rock, the trench should be excavated 150 mm more and filled with fine granular material	where excavation is through rock, the trench should be excavated 150mm more and filled with fine granular material.	with normal care 4) In rocky portion, where excavation is through rock, the trench should be excavated 150mm more and filled with fine granular material.	
Backfill Materials / Compaction Required	Backfilling should closely follow the welding of joints of the pipe so that the protective coating should not be subsequently damaged. Material harmful to the pipeline shall	For the purpose of backfilling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top: Zone - A: From the bottom of the trench to the level of the centre line of the pipe,	Back filling should be placed in layers not exceeding a depth per layer which can be compacted to a minimum of 85% maximum dry density. Lift should normally not be greater than 30 cm in height and the height differential on each side of the pipe should be limited to this amount so as to	Excavated material should be deposited at a sufficient distance away from the trench to prevent damage to the pipeline through falling stones or debris. The first side-	Only soft earth and gravel of good quality free from boulders, roots vegetable matter, etc, shall be used first. If sufficient quantity of suitable (sharp edge stone free) excavated earth is not available, the trench shall be filled by borrowed	For Type A,B and C , Bedding – selected fill material compacted in layers not exceeding 150 mm to a height of 300 mm above top of the pipe in case of earth foundation and 150 mm in case	For Type A,B and C ,Bedding – selected fill material compacted in layers not exceeding 150 mm to a height of 300 mm above top of the pipe in case of earth foundation and 150 mm in case of rock foundation. **(Refer IS 783 :**	Backfill compaction is minimally important due to rigid nature as the pipe does not rely upon side support.	Backfill compaction is minimally important due to semi rigid nature as the pipe does not rely upon side support.

	not be used for backfilling. Refilling shall be done in layers not exceeding 300 mm. Each layer shall be consolidated by watering and ramming, care being taken to prevent damage to the pipeline. The filling on the two sides of the pipeline should be carried out simultaneously. The spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipeline to aid alignment, these shall be	Zone - B: From the level of the centre line of the pipe to a level 300 mm, above the top of the pipe, and Zone - C: From a level 300 mm above the top of the pipe to the top of the trench. Back-fill material shall be free from cinders, ashes, slag, refuse, rubbish, vegetable or organic material, lumpy or frozen material, boulders, rocks or stone or other material, which in the opinion of the authority, is unsuitable or deleterious. However, material containing stones up to 200 mm as their greatest dimension may be used in Zone C, unless specified otherwise herein. The excavated material may be used for backfill in the following cases: In Zone C, in cases where settlement is unimportant and when shown on the	prevent lateral movement of the pipe. Most coarse grained soil are acceptable. This may comprise of gravel or sand. However, silty sand, clayey sand, silty and clayey gravel shall not be used unless proposed to be used in conjunction with gravel or clean sand. It is very important that the pipe zone backfill material dose not wash away or migrate into the native soil. Likewise, potential migration of the native soil into the pipe zone backfill must also be prevented. Heavy earth moving equipment used for backfilling should not be brought until the minimum cover over the pipe is 90 cm in the case of wide tracked bulldozers or 120 mm in the case of wheeled roaders or roller compactors. Vibratory methods are preferably for compaction.	fill or haunching layer should be placed by hand and compacted in layers under the lower quadrants of the pipe upto the spring level (half the vertical diameter) of the pipe. Compaction can be done by careful trampling with the feet or with tamping tools. Successive layers of backfill of 75 mm thickness may then be placed over and compacted to a height above the crown of not less than 150 mm. Light vibrating machinery may be used, but not directly above the pipe. On completion of the surround to the pipe, suitable	gravel or material up to 300 mm above top of the pipe. Care shall be taken during back filling for not to damage the pipe or joints. Filling has to be carried out simultaneously on the both sides of the pipes so that unequal pressure does not occur. Load on the buried pipeline shall not be permitted unless the trench has been filled to the height of at least 300 mm over the top of the pipe. Filling shall be done in layers of 150 mm, with the first layer watered and compacted by stamping or by mechanical means. The initial back fill up to 150 mm above the crown of the pipe should be compacted with screened excavated material free of sharp	of rock foundation. **(Refer IS 783 : 1985)**	1985)		

	removed before backfilling. For further precautions and use of material in backfilling, reference should be made to IS 3114 :1994. **(Refer Cl. No. 8.2 of IS 5822 : 1994)**	drawings or specified, the back-fill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the required level. In any zone, when the type of back-fill material is not indicated or specified, provided that such material consists of loam, clay, sand, fine gravel or other materials which are suitable for backfilling in the opinion of the authority. **(Refer Cl. No. 4.11 of IS 12288 : 1987)**	Compaction within distances of 15 cm to 45 cm from the pipe is usually done with hand tempers. **(Refer Cl. No. 7.2 & 7.3 of IS : 13916:1994)**	excavated material may be then replaced as backfill in 250 mm compacted layers upto the top of the trench. No heavy compaction equipment may be employed until there is at least 300 mm of fill above the crown of the pipe. **(Refer Cl. No. 6.2.4 & 6.5 of IS 7634 Part 3 : 2003)**	stones or objects or with fine sand where no such material is available. Wherever road crossing with heavy traffic is likely to be encountered — a concrete pipe encasing is recommended. **(Refer Cl. No. 8.1.1 and 6.4.1 of IS 7634 Part 2 : 2012)**				
External Corrosion Protection	Spiral wall reinforcement cement mortar with seal coat paint or liquid epoxy or fusion bonded epoxy or tape coating. **(Refer Annex A-D, IS 3589: 2001)**	Metallic Zinc with finishing layer Bituminous Paint or synthetic resin compatible with the zinc coating. **(Refer Cl. No. 16.2, A-8 of Annex - A of IS 8329 : 2000)**	Not required	Not required	Not required	Not required	Portland cement mortar coating applied during manufacture	Portland cement mortar coating applied during manufacture.	Portland cement mortar coating applied during manufacture.
Internal Lining	Cement Mortar with seal coat paint or liquid	Portland cement mortar or Blast furnace slag cement mortar, or High	GRP pipe and fittings shall be composite laminate consisting of a	Not required	Not required	Not required	High-strength concrete core centrifugally placed.	High-strength concrete core centrifugally placed.	High-strength cement mortar lining centrifugally

	epoxy or fusion bonded epoxy. **(Refer Annex A to D, of IS 3589 : 2001)**	Alumina cement mortar or Cement mortar with seal coat, **(Refer Cl. No. 16.3 of IS 8329 : 2000)**	corrosion resistant inner liner.						placed.
Properties	Young's Modulus of Elasticity (E): 210,000 MPa **(Table 6.7, Chapter 6 of CPHEEO manual),** Tensile Strength 410 Mpa (Fe-410 Grade), Length: 4-7 m or 7-14 **m(Refer Cl No. 5.1, 12.4.1 of IS 3589 : 2001)** Elongation at Break – over 18%, Impact Resistance: 1.5, Structural strength (Crushing strength):4000 Kg/cm^2 (Approx.) stiffness needed for longitudinal welded pipes.	Minimum Tensile Strength 420 Mpa (Minimum)Minimum Elongation at Break 7-10% Hardness is 230 HB (maximum) Pipe Length: 5.5 m or 6 m each pipe **(Refer Cl No. 10.1.6 &13.1 of IS 8329 : 2000).** Young's Modulus of Elasticity (E): 170,000 MPa **(Table 6.7, Chapter 6 of CPHEEO manual),** Poisson's Ratio : 0.28 Impact Resistance: <0.713 Structural strength (Crushing strength): 5000 Kg/cm^2 (Approximate) Normal Backfill.	Length: 6 m, 9 m and 12 m **(Refer Cl. No. 7.2 of IS 12709 : 1994)** Tensile Strength: Composite Pipe, Impact Resistance: Brittle pipe at the point of impact Forms star crack which initiates crack propagation, Structural strength (Crushing strength): 250-300 Kg/cm^2 (Approx.) Compaction of Backfill essential	Length: 4 m, 5 m or 6m **(Refer Cl. No. 7.1.4.1 of IS 4985 : 2000)** Young's Modulus of Elasticity (E): 3,000 MPa **(Table 6.7, Chapter 6 of CPHEEO manual),** Tensile Strength: 600-800 kg/cm^2 (decreases with temp), Impact Resistance: Negligible, Structural strength (Crushing strength): 150-200 Kg/cm^2 (Approx.) Compaction of Backfill essential	Young's Modulus of Elasticity (E): 900 MPa **(Table 6.7, Chapter 6 of CPHEEO manual),** Length: 5-20 m**(Refer Cl. No. 6.4of IS 4984 : 1995),**Tensile Strength: 265-280 kg/cm^2 (decreases with temp),Impact Resistance: Good, Structural strength (Crushing strength): 200-250 Kg/cm^2 (Approx.) Compaction of Backfill essential	Tensile Strength (Minimum): 2.5 MPa, Elongation at Break: 0% Pipe Length: 2.5 m each pipe **(Refer Clause no. 5.5.2 &8.1 of IS 458 : 2003)** Young's Modulus of Elasticity (E): 31,000 MPa **(Table 6.7, Chapter 6 of CPHEEO manual)** Poisson's Ratio: 0.20 Impact Resistance: Negligible Structural strength (Crushing strength): 300 Kg/cm^2 (Approximate) Normal Backfill	Young's Modulus of Elasticity (E): 35,000 MPa **(Table 6.7, Chapter 6 of CPHEEO manual),**Length: up to and including 300 mm diameter – not more than 3 m, for above 300 mm dia – 2, 2.5, 4, 5 & 6 m **(Refer Clause no. 5.2 of IS 784 : 2001),** Tensile Strength: Composite Pipe, Impact Resistance: Negligible, Elongation at Break: 0% Structural strength (Crushing strength): 300 Kg/cm^2 (Approximate) Normal Backfill	High crushing and beam strengths, More resistance to majority of common chemicals, good abrasion resistance, Can be stored in the open for long periods, Simple to make flexible joints, able to withstand fluctuating internal pressures and surge conditions	Wider diameter range and higher working pressure, improved version of steel pipes, customised pipe design can be done with economical advantages, Highly corrosion resistance, Excellent and permanent hydraulic coefficient, C value above 140,No tuberculation, lap welded rigid joints, Easy to assemble to pipe joint, Highly durable

	Compaction of Backfill essential								
Supplemental External Protection	Cathodic Protection.	Polyethylene Sleeve **(Refer Cl. No. 16.2, Annex - D of IS 8329 : 2000)**	Not required.	Not required.	Not required.	In aggressive, buried environments, coal tar epoxy paint is generally used	In aggressive, buried environments, coal tar epoxy paint is generally used	In aggressive, buried environments, coal tar epoxy paint is generally used	In aggressive, buried environments, coal tar epoxy paint is generally used
Jointing	Plain ends or beveled ends for butt welding unless otherwise agreed, beveled ends shall be beveled to an angle of $30^{0}_{(+5^{0}-0)}$ measured from a line drawn perpendicular to the axis of the pipe. The root face shall be 1.6±0.8 mm. Joints with sleeves joint or swelled and plain ends for welding. **(Refer Cl. No. 17.1, of IS 3589 : 2001)**	Push-on Flexible Joint, Mechanical Flexible Joint, Restrained Joint and Flanged Joint. **(Refer Cl. No. 3.9 to 3.14 of IS 8329 : 2000)**	Unrestrained - Coupling or Socket or Spigot Gasket Joint Restrained - Coupling or Socket or Spigot Gasket Joint with supplemental restraining elements Butt Joint Socket and Spigot with laminated overlay Socket and Spigot with adhesive bonded Flanged Mechanical **(Refer Cl. No. 8 of IS 12709 : 1994)**	Solvent Cementing joint Elastomeric sealing ring joint **(Refer Cl. No. 7.2 of IS 4985:2000)**	a) Fusion welding: 1) Butt fusion welding; 2) Socket fusion welding; and 3) Electro fusion welding; b) Insert type joints; c) Compression fittings/push fit joints; d) Flanged joints; and e) Spigot and socket joints **(Refer Cl. No. 3.1.1 of IS 7634 Part 2:2012)**	Socket & Spigot – roll on joints or confined gasket joint, flush jointed and collar jointed **(Refer Cl. No. 6.3 of IS 458:2003)**	Spigot and socket type with rubber ring or with steel joint rings embeddedat ends for site welding. In case of pipes for culverts, joints may be spigot and socket, roll on gasket joint, confined gasket joint or flush joint **(Refer Cl. No. 11.1, Amendment 2 of IS 784:2001)**	Easy to assemble , Reliable confined joint system made with gasket, Flexible joint	Steel socket and Spigot joints rings made of profile steel & formed to accurate dimensions beyond Elastic Limit, Sliding overlap welded rigid joints which ensure 100% water tightness, Option for confined rubber ring joints

Handling	The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their outcoating. Pipes shall not be thrown down from the trucks nor shall they be dragged or rolled along hard surfaces. Slings of canvas on equally non-abrasive material of suitable width or special attachment shaped to fit the pipe ends shall be used to lift and lowercoated pipes so as to eliminate the risk of damage to the coating. **(Refer Cl. No. 5.2.4 of IS 5822 : 1994)**	Ductile iron pipes are less susceptible to cracking or breaking on impact but the precautions set out should be taken to prevent damage to the protective coating and brushing or damage of the jointing surfaces. **(Refer Cl. No. 7.1 of IS 12288 : 1987)**	Steel cables or ropes shall not be used for lifting and transportation of pipes. Ropes shall not be pass through the section of pipes end to end. Straight continuous length of pipe may be lifted at one point. However, owing to its very smooth surface it is usually safer for the pipe to be lifted at two points. Pipes shall not be dropped to avoid impact or bump. If any time during handling or during installation, any damage such as gouge, crack or fracture occurs, the pipe shall be repaired if so permitted by the competent authority before installation.**(Refer Cl. No. 4.3.1, 4.3.2, 4.3.4 of IS 13916 : 1994)**	As UPVC pipes are durable and light, they are more 1ikcly to be mishandled. Care should be taken to ensure that pipes are not damaged during handling, storage and transport. UPVC pipes should be handled keeping in mind that they are made of plastic and are also susceptible to damage if mishandled. They should not be thrown, dropped or dragged. **(Refer Cl. No. 4 & 4.2.1 of IS 7634 Part 3 : 2003)**	It is softer than metals, it is prone to damage by abrasion and by objects with a cutting edge. Such practices as dragging pipes over rough ground should therefore be avoided. If handling equipment is not used, techniques, which are not likely to damage the pipe are to be chosen. **(Refer Cl. No. 12.3 of IS 7634 Part 2 : 2012)**	Concrete pipes have to be properly handled, bedded and back-fined, if they have to carry safely the full design loads. Even the highest quality of concrete pipes manufactured in accordance with the specifications may be destroyed by improper handling, bedding and back filling. **(Refer Cl. No. 0.3, Foreword of IS 783 : 1985)**	Concrete pipes have to be properly handled, bedded and back-filled, to carry safely the full design loads. (Refer Cl. No. 0.3, Foreword of IS 783 : 1985)	Concrete pipes have to be properly handled, bedded and back-filled, to carry safely the full design loads. (Refer Cl. No. 0.3, Foreword of IS 783 : 1985)	Pipes are easy for handling and installation

Transportation	Delivery of the pipes and specials and appurtenances shall be taken from the stockyard of the authority and transported to the site of laying and stacked along the route on timber skids. Padding shall be provided between coated pipes and timberskids to avoid damage to the coating. Suitable gaps in the pipes stacked should be left at intervals to permit access from one side to the other. **(Refer Cl. No. 5.2.2 of IS 5822 : 1994)**	Pipes should be loaded in such a way that they are secured and that no movement should take place on the vehicle during transit. The pipes should be loaded on vehicles in pyramid or straight sided formation. In case of pyramid loading, the pipes in the bottom layer should be restrained by the use of broad wooden wedges secured to the vehicle being loaded. The pyramid is to be formed by resting pipes between the pairs of pieces in the preceding layer with the sockets in layers reversed. Straight sided loading may be used with supports along the sides of the vehicles. The use of straight sided loading is advantageous for utilizing full capacity of the vehicle. **(Refer Cl. No. 7.2 of IS 12288 : 1987)**	All pipes section and fittings shall be supported on timber saddles spaced at 4 m centers with a maximum overhang of 2 m. Stock height should not generally exceed 2 m. Pipes shall be strapped to the vehicle over the support points using non-metallic pliable straps or ropes only. Pipes and fittings with diameter of less than 1 m may be stored directly on sandy soil, the ground should be flat and free from sharp projection stones/rocks bigger than 40 mm in diameter or other potentially damaging debris. Pipes with diameter greater than 1 m may be stored on their delivery cradles at a maximum distance of 6 m c/c. If the surface is not flat or sloping , then all the pipes shall be checked to prevent rolling. All rubber rings, gasket and other items shall be stored in a cold, dry and dark place to avoid damage of any kind. **(Refer Cl.**	When transporting pipes, flat bed vehicles should be used. The bed should be free from nails and other projections. When practical, pipes should rest uniformly on the vehicle over the whole length. All support posts should be flat with no sharp edges. **(Refer Cl. No. 4.1 of IS 7634 Part 3 : 2003)**	When transporting straight polyetlylene pipes, use flat bedded vehicles. The bed shall be free from nails and other projections. The polyethylene pipes shall rest uniformly in the vehicle over their long length. All support posts shall be flat with no sharp edges. Polyethylene pipes shall not be transported with other metallic items in the same vehicle. **(Refer Cl. No. 12.4 of IS 7634 Part 2 : 2012)**	Pipes should be loaded at the works for transportation, in such a way that they are secure and that no movement can take place on the vehicle during transit. The same care is needed if pipes are to be transferred from one vehicle to another. Pipes may be placed directly on the ground provided it is reasonably level and free from rocks and other projections. Stacking in tiers is permissible provided timber bearer are placed between succeeding tiers. If pipes arc to be stacked more than two tiers high, reference should be made	Pipes should be loaded at the works for transportation, in such a way that they are secure and that no movement can take place on the vehicle during transit. The same care is needed if pipes are to be transferred from one vehicle to another. Pipes may be placed directly on the ground provided it is reasonably level and free from rocks and other projections. Stacking in tiers is permissible provided timber bearer are placed between succeeding tiers. If pipes arc to be stacked more than two tiers high, reference should be made to manufacture for advice before exceeding the two tiers specified. **Cl. No. 15.1.1 and 15.1.3 of IS 783 : 1985)**		

			No. 4.1 and 4.2 of IS 13916 : 1994)			to manufacture for advice before exceeding the two tiers specified. **Cl. No. 15.1.1 and 15.1.3 of IS 783 : 1985)**			
Risk against Flotation	Pipes are heavier. Hence, floatation risk is nil.	Pipes are heavier. Hence, floatation risk is nil.	Cannot be used in water logged areas.	In case there is a chance of floatation because of likely flood, the pipe shall be encased with concrete weights as per the buoyancy calculations. **(Refer Cl. No. 6.5 of IS 7634 Part 2 : 2012)**	In case there is a chance of floatation because of likely flood, the pipe shall be encased with concrete weights as per the buoyancy calculations. **(Refer Cl. No. 6.5 of IS 7634 Part 2 : 2012)**	Pipes are heavier. Hence, floatation risk is nil.	Pipes are heavier. Hence, floatation risk is nil.	Pipes are heavier. Hence, floatation risk is nil.	Pipes are heavier. Hence, floatation risk is nil.
Design Useful Service Life					IS 4984-1995 **50 Years**				
	ISO/FDIS 24516-1:2016(E) (annexure B) : **80-120 yrs**	ISO/FDIS 24516-1:2016(E) (annexure B) a) DI with PE, ZN or cement coating **90-120 yrs** b) DI without coating **40-80 yrs**		ISO/FDIS 24516-1:2016(E) (annexure B) : **50-90 yrs**	ISO/FDIS 24516-1:2016(E) (annexure B) a) PE63/PE80-**40-70 yrs** b) PE80 Gen/PE100-**60-100 yrs**				

IMPORTANT NOTE :
The life of various pipe materials indicated above are taken from various sources like IS,ISO & NEERI and shows wide variation. While adopting these values for design of Piped Irrigation Network (PIN) including Life Cycle Analysis, cautions may be exercised based on the past performance, actual experience, manufacturer's specifications etc..

Limitation	Never to be used near electricity transmission cables. Never to be used below ground unless proper protection against corrosion from soil and soil water is ensured. Choice of spiral welded Vsor horizontal welded pipes shall be evaluated with respect to overburden. **(Refer MS-1, MS-2 & MS-4 of Appendix A 3-10, Part A of CPHEEO Manual).**	DI pipes are not to be used near buried electricity transmission high tension cables. Wherever used above ground supports at each pipe length shall be ensured without any subsidence. Pipes with external synthetic coatings not to be used in marine coastal environments to prevent leaching of constituent chemicals into the environment. **(Refer CIDI-1, CIDI-2 and CIDI-3 of Appendix A 3-10, Part A of CPHEEO Manual).**	Not in area where future works may affect the pipes side support. Not in ground contaminated or possibly contaminated by certain chemicals in concentrations deleterious to the resin of the pipe. Do not use pipes/couplings with chips, cracks, crazing, layer delamination or exposed fibres or ends of pipes not sealed with resin. Do not use pipe and couplings, stored unprotected from sunlight for more than 9 months. Do not use in ground conditions having low stiffness, e.g. tidal zone. Not in location subjected to vehicular load and has insufficient cover. Not in areas subject to excavations by other service providers within 2m radial distance of pipeline. Not in ground subject to differential settlement of extreme movement. Not in ground offering	Not in location subjected to vehicular load and has insufficient cover. Not in areas subjected to third party interference, e.g. excavations within 2m of pipeline by other parties. Not in ground offering low side support strength to the pipe. Not in ground which allows migration of pipe embedment material into it. Not in ground contaminated with deleterious chemicals. Not suitable for above ground installation. **(Refer SP-1 to SP-6 of Appendix A 3-10, Part A of CPHEEO Manual).**	Not in location subjected to vehicular load and has insufficient cover. Not in areas subjected to third party interference, e.g. excavations within 2m of pipeline by other parties. Not in ground offering low side support strength to the pipe. Not in ground which allows migration of pipe embedment material into it. Not in ground contaminated with deleterious chemicals. Not suitable for above ground installation. **(Refer SP-1 to SP-6 of Appendix A 3-10, Part A of CPHEEO Manual).**	Not in aggressive soils / ground water or tidal zone **(Refer RCC-2 of Appendix A 3-10, Part A of CPHEEO Manual).**	In contaminated ground or possibly contaminated ground by certain chemicals in concentrations where it can affect the life of concrete , additional barrier coating of coal tar epoxy paint is to be provided and Sulphate resisting cement to be used for manufacturing pipes .	In contaminated ground or possibly contaminated ground by certain chemicals in concentrations where it can affect the life of concrete , additional barrier coating of coal tar epoxy paint is to be provided and Sulphate resisting cement to be used for manufacturing pipes . In Black Cotton Soil (Expansive Soil) care has to be taken for bedding and back filling.	In contaminated ground or possibly contaminated ground by certain chemicals in concentrations where it can affect the life of concrete , additional barrier coating of coal tar epoxy paint is to be provided and Sulphate resisting cement to be used for manufacturing pipes .

			low side support strength to the pipe. Do not use when control of construction practices is not adequate to ensure quality of embedment for flexible pipes. Not suitable for uncertainties in geotechnical analysis to determine if flexible pipe structurally suitable. Uplift precaution in locations where high groundwater table and empty pipe may be encountered. **(Refer GRP-1 to GRP-12 of Appendix A 3-10, Part A of CPHEEO Manual).**	**Manual).**					

Table. 5.2 Various pipe material & dia. available (As per MOWR Guidelines on PDN July.2017)

Sl. No.	Pipe IS No.	Usual Diameter (mm)	Class	Test Pressure at Works (kg/cm^2)	Maximum Working Pressure at Field (kg/cm^2)
1	DI pipe IS: 8329-2000	80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700, 750, 800, 900, 1000, 1100, 1200	K-7 K-8 K-9 K-10	12 – 32 18 – 40 25 – 50 25 – 50	17.5 – 40 20 – 96 36 – 96 40 – 96
2	Cast (Spun) Iron Pipes IS: 1536-2001	80 - 1050	LA A B	15 - 35 20 - 35 25 - 35	15 – 16 20 25
3	RCC Pipes IS:458-2003	90 – 2000	NP3 NP4	0.7	Non Pressure Pipes
4	(Prestressed Concrete Non Cylinder Pipes RC pipes IS:784-2001	350 – 2500	Up to 20 Kg/cm2 Factory Test Pressure (FTP)	1.5 times design pressure	unto 12 Kg/cm^2 Working Pressure (WP)
5	Steel Pipes IS:3589-2001	168.3 -2540	Fe330 Fe410 Fe450		
6	i. PVC Pipes IS: 4985-2000, ii. HDPE Pipes IS:4984-1995 iii. Spirally Wound Profiled PE/PP Pipes (IS code: 16098 part 2:2013)	50-630 50-2500 300-3000	PN 2.5/ 4/6/ /10 /12.5 PN 2.5/ 4/6/ /10 /12.5 PN 2.5 /4/6	should not be less than design pressure at 27°C for duration of 1 hr.(ISO 1167 Part-1)	3.6 X PN 0.25 MPa (2.5 kg/cm^2) 0.4 MPa (4.0kg/cm^2) 0.6 MPa (6.0kg/cm^2) 1.0 MPa (10.0 kg/cm^2) 1.25 MPa (12.5 kg/cm^2) 1.6 MPa (16.0 kg/cm^2) 2.5 4 6
7	GRP (Glass Fibre Reinforced Pipes) IS: 12709	200-2000	3 6 9 12 15	4.5 9 13.5 18 22.5	6 12 16 24 30
8	BWSC (Bar Wrapped Steel Cylinder Pipes) IS 15155	250 - 1900	up to 28 Kg/cm2 Factory Test Pressure (FTP)	1.5 times design pressure	unto 17 Kg/cm2 Working Pressure (WP)
9	PCCP (Prestressed Concrete Cylinder Pipes) IS 784	350 - 2500	up to 25 Kg/cm2 Factory Test Pressure (FTP)	1.5 times design pressure	up to 15 Kg/cm2 Working Pressure (WP)

TABLE -5.3 (As per CPHEEO may1999)

TABLE 5.3 : CHECK LIST FOR SELECTION OF PIPE MATERIAL

Sr. No.	Attribute	Types Of Pipes										Remarks if any
		PVC	AC	CI	DI	MS	PSC	GRP	HDPE	GI	OTHERS	
1	Hydraulic Smoothness (C value)											
2	Structural Strength for external loads											
3	Strength to sustain internal pressure											
4	Ease in handling, transportation and storage											
5	Capacity to withstand damage in handling and maintenance											
6	Resistance to internal corrosion											
7	Resistance to external corrosion											
8	Resistance to heat / sunlight											
9	Resistance to rodent attack											
10	Sustainability in Black Cotton Soil											
11	Reliability and effective joints											
12	Capble to absorb surge pressure											
13	Ease in maintenace and repairs											
14	Use experience											
15	Durability (Sustainable trouble free maintenance)											
16	Consumer satisfaction											
17	Resistance to tampering by anti-social element											
18	Economy											
19	Availability of specials											
20	Availability of skilled personnel for installation & maintenance											
21	Behaviour of pipeline likehood of interruptions due to leakage,bursting etc; & time for repairs											
	Recommended Size range for											
	Rising Main											
	Gravity Main											
	Distribution Main											
	Note : Weightage - 0 to 10 numbers in relation to significance of attribute (10 stands for highest quality) may be considered											

CHAPTER VI

HYDRAULICS OF PIPE FLOW

6.1 Free Surface Flow: -

The flow in an open channel or in a closed conduit having a free surface is referred to as free-surface flow or open-channel flow (Figure 6.1). Free surface is usually subjected to atmospheric pressure.

6.2 Pipe Flow or Pressurized Flow: -

A conduit flowing full having no free surface, such a flow is called pipe flow, or pressurized flow (Figure 6.2).

6.3Steady Flow:-

6.3.1 Law of conservation of Mass:-

If it is assumed that water is incompressible, from the law of conservation of mass the Continuity equation of flow can be established as follows.

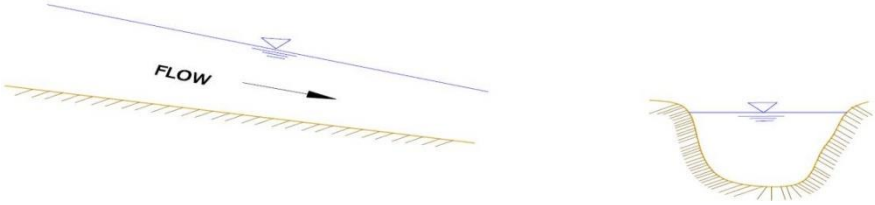
$Q = A_1V_1 = A_2V_2 = A_3V_3 = \text{Constant}$

Where,

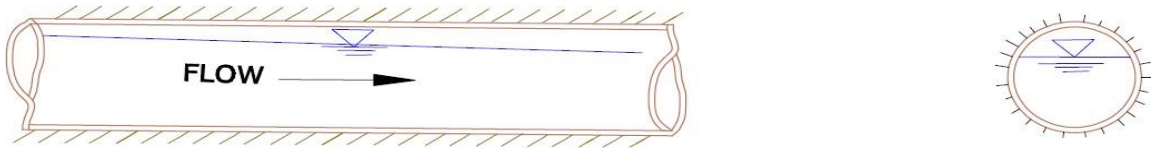
Q = Discharge

A_i = Cross-sectional area (i=1,2,3, ...)

V_i = Velocity of flow



Open Channel Flow



Free surface flow in closed conduit

Figure 6.1 Free Surface Flow

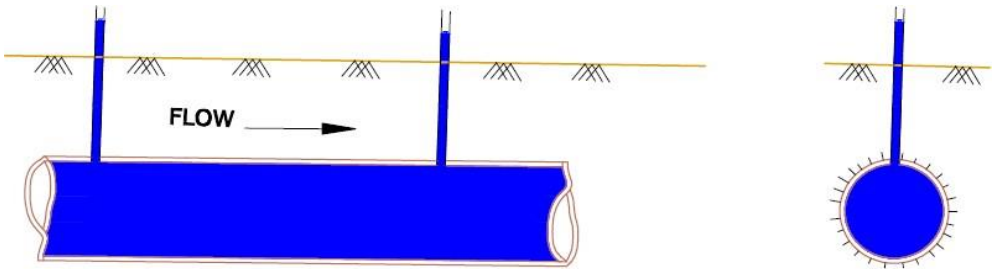


Figure 6.2 Piped or Pressured Flow

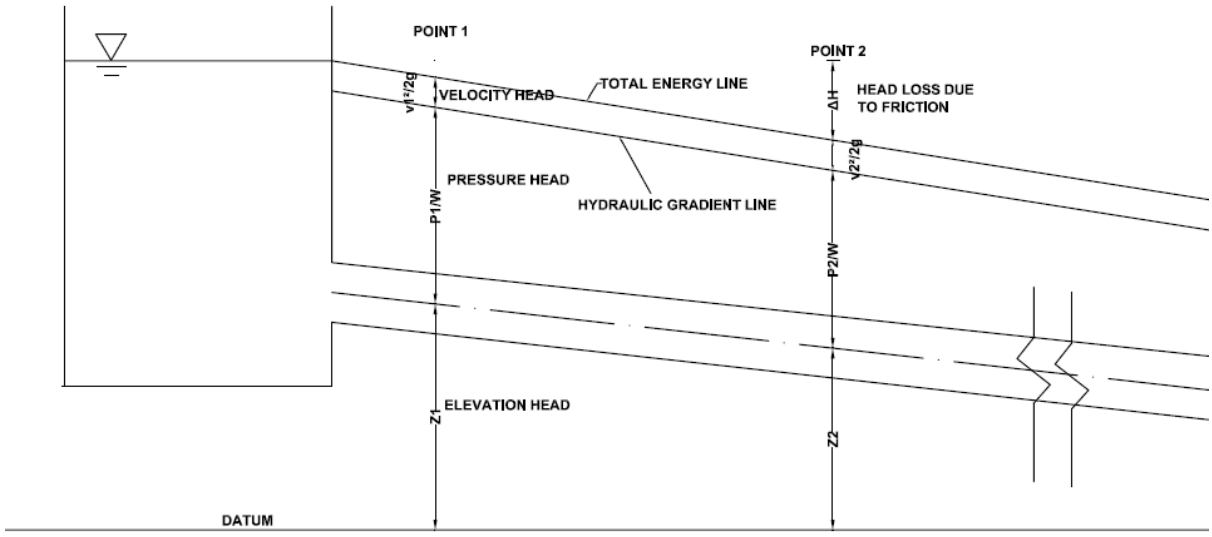
6.4 Basic Hydraulic to be used in design of Pipe Distribution Network:-

When water flows through a closed conduit under pressure, the total energy of pipeflow consists of Elevation head, Pressure Head and Velocity Head. However if the water begins to move, headloss generated by friction will occur.

So Actually the energy equation will be as follows,

$$\boldsymbol{Z_1 + \frac{P_1}{W} + \frac{{V_1}^2}{W} = Z_2 + \frac{P_2}{W} + \frac{{V_2}^2}{W} + \Delta H}$$

ΔH is the total head loss between point 1 and 2.
Diagram 6.3 shows energy equation in pictorial form, which is the case of gravity piped distribution network without pump.

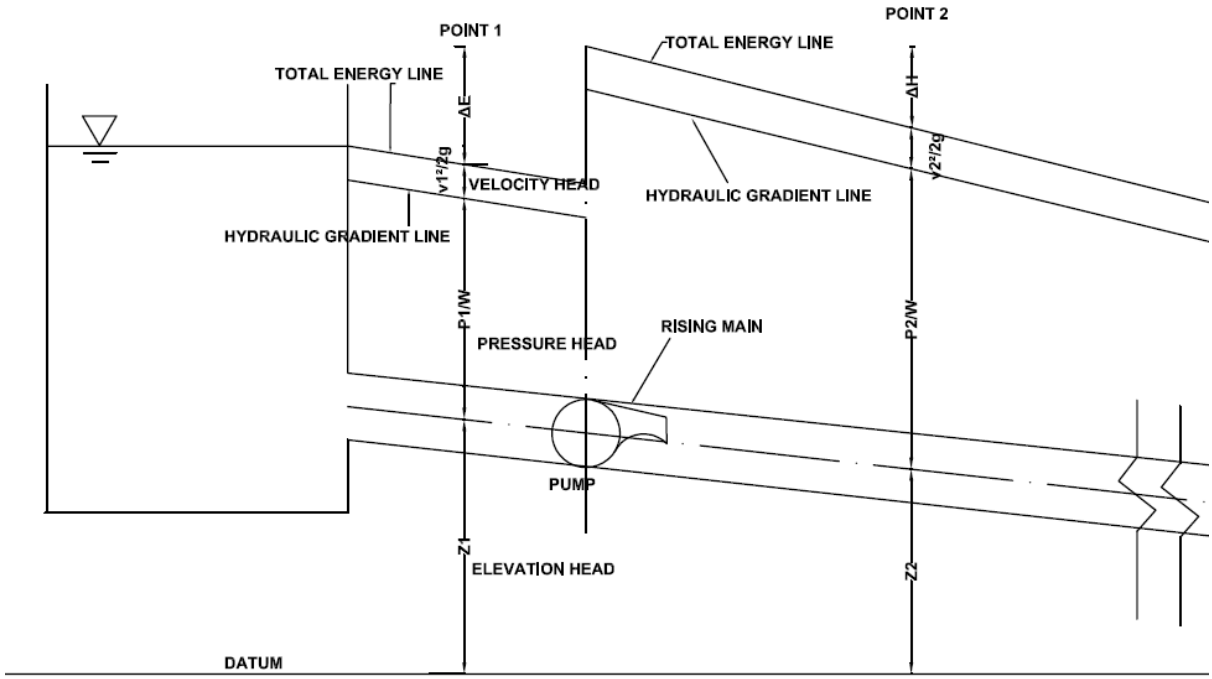


6.3 Energy Diagram without pump

Based on this Energy principle, a piped distribution Network design is carried out.

$$\boldsymbol{Z_1 + \frac{P_1}{W} + \frac{{V_1}^2}{W} + \Delta E = Z_2 + \frac{P_2}{W} + \frac{{V_2}^2}{W} + \Delta H}$$

Where, ΔE= Energy addition to the System by Pump
Diagram 6.4 shows energy equation in pictorial form, which is the case of piped distribution network with pump.



6.4 Energy Diagram with pump

6.5 Various losses in the Pipe Distribution Network:-

6.5.1 Friction loss :-

A major friction loss is to be worked out, based on Modified Hazen William's formula, as mentioned in the guidelines for PDN design specified in G.R.सिंचन 2015/ प्र.क्र.24/(भाग-2)/2015/ जसं (धोरण) मंत्रालय मुंबई -400032 दिनांक 02 फ़ेब्रुवारी,2017.

The Modified Hazen William's formula

$$V = 143.534\ C_R \times r^{0.6575} \times s^{0.5525}$$

$$h = \frac{L \times [Q / C_R]^{1.81}}{994.62 \times D^{4.81}}$$

In which;

V = Velocity of flow in m / sec.

C_R = Pipe roughness coefficient (as shown in table No.6.1)

r =Hydraulic radius in m. (for circular pipe, D/4= internal diameter)

S = Friction slope (i.e. slope of HGL line)

D = Internal diameter of pipe in m.

h = Friction head loss in m.

L = Length of pipe in m.

Q = Flow of pipe in m^3 / sec.

Table No. 6.1

Recommended C_R values in The Modified Hazen William's formula (at 20^0C)

Sr. No.	Pipe Material	Diameter (mm)		Velocity (m/s)		C_R value when new	C_R value for design period of 30 years.
		From	To	From	To		
1	R.C.C.	100	2000	0.3	1.8	1	1
2	HDPE/PVC	20	1000	0.3	1.8	1	1
3	C.I (For water with positive Langelier's Index)	100	1000	0.3	1.8	1	0.85
4	C.I (For water with negative Langelier's Index)	100	1000	0.3	1.8	1	0.53
5	Steel (For water with negative Langelier's Index)	100	2000	0.3	2.1	1	0.73
6	GI(For water with positive Langelier's Index)	15	100	0.3	1.5	0.87	0.74

6.5.2 Minor Losses :-

Besides this major frictional loss(hf)) also there occur some minor head losses in the system, viz-entry loss, exit loss, loss due to sudden enlargement, loss due to sudden contraction, loss of head at valve location etc. These minor losses should not be calculated separately. As per G.R.सिंचन 2015/ प्र.क्र.24/(भाग-2)/2015/ जसं (धोरण) मंत्रालय मुंबई -400032 दिनांक 02 फ़ेब्रुवारी,2017 the total minor losses should be considered as 10% of total frictional loss, in the system.

Total head loss

$\Delta H = hf+10\%hf$

CHAPTER – VII

PIPE IRRIGATION NETWORK DESIGN

7.1 The hydraulic design of Pipe Distribution Network,envisages the following important points.

1. To estimate the first discharge through pipe @ the start.
2. To design the diameter of pipesinnetwork.
3. To decide the velocity of water through pipe.
4. To estimate the residual head at outlet location, above groung & above pipe top.

7.1.1 While designing the Piped Distribution System, it is very vital to workout the first discharge at start of pipe.

7.1.2 The first discharge at the start of pipe should be, worked out on the basis of, approved cropping pattern for the project based on maximum of para 3.5 a), b) or c).

The maximum fortnight water demand of the approved cropping pattern of the project should be considered for this.Many times this demand of water requirement is given for 1000 ha in Mm3 or in Ham.(Hectare Metre)

7.1.3 For estimating the exact demand, the 5% water loss and 75% field application efficiency should be considered.Shown in Table No.7.1.

Table No.7.1 Efficiency for surface & micro irrigation in pipe

Method of conveyance/ irrigation		Surface irrigation	Micro Irrigation	
			Sprinkler	Drip
Pipe based Conveyance	Conveyance Efficiency (%)	100	100	100
	Water loss	5%	5%	5%
	Field Application efficiency (%)	75	75	90

7.1.3 The discharge should be calculated for entire Culturable Command Area(C.C.A.) in m^3/sec as the first discharge and m^3/sec/ha for evaluating the outlet disharges for all the chaks at every location.

7.1.4 Every oulet should be designed for minimum disharge of 8to 10lit/sec. Also water demand (i.e. discharge) should be calculated, for 12 days rotation period, considering all outlets are in open position.

7.1.5 Solved example to calculate first discharge and discharge/ha.

Data:- For Chalkewadi Minor Irrigation Project

1. C.C.A.(Culturable Command Area) = 232 ha.
2. Fortnightly water damand for a (Dec- II)as per Modified Pennaman Method for Project = 0.591 Mm^3 for 1000 ha.

The water demand is given in Mm^3 and it is for 1000 ha, The C.C.A. for the Chalkewadi Project is = 232 ha.

Hence water demand Volume for this area = $\underline{0.591X10^6}$ (m^3) x232 (ha)/1000 (ha) =137112 (m^3)
(This Net volume of water is required for Dec-IInd fortninght at outlet location and that is to be discharged continuously in 12 days)
The above volume of water is to be increased by 5% for water loss and 75% for Field Application Efficiecy

Hence Gross Volume of water required = $\frac{137112 \times 1.05}{0.75}$

$= 191956.80$

$\approx 191957\ m^3$

Hence,

First Discharge for 232 ha = 191957/ (12 days x 24 hrs x 3600 (Sec))

$= 0.185\ m^3/sec$

Discharge/ ha = 0.185/232 (CCA)

$= 0.00079$

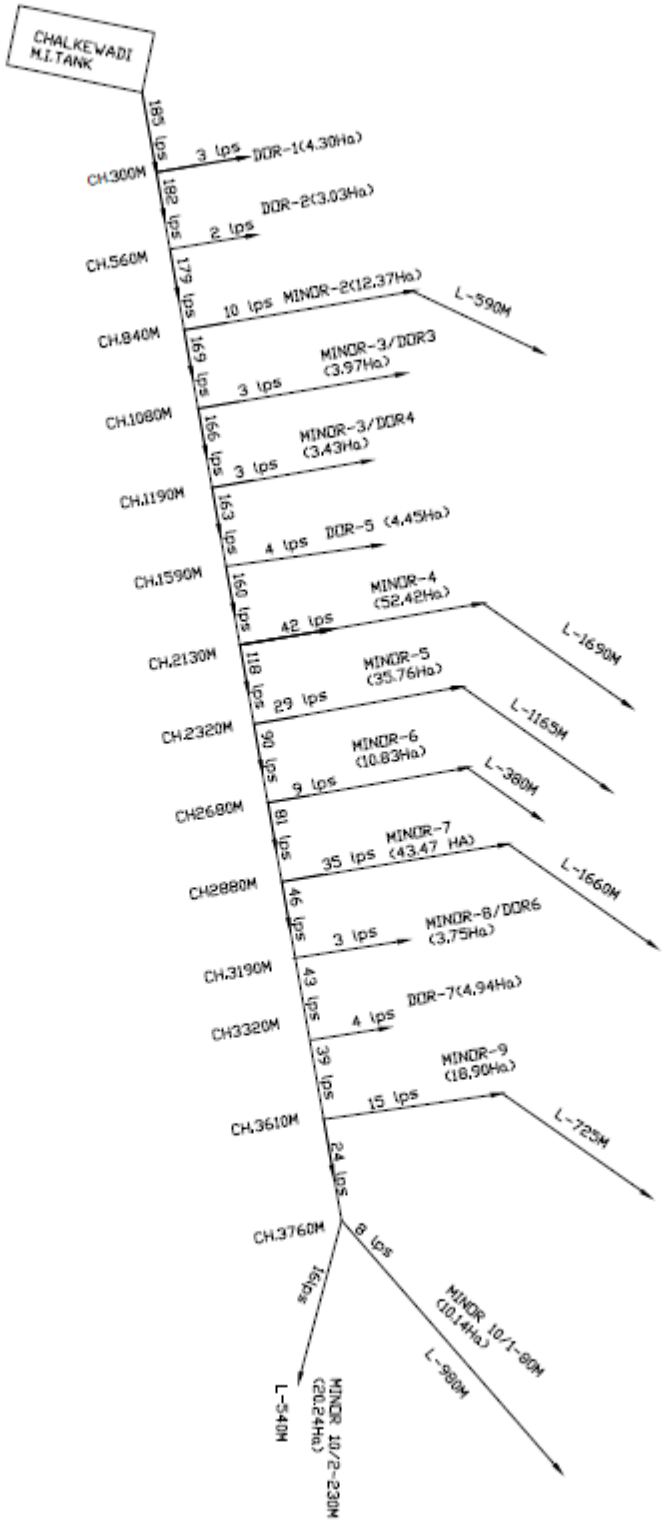
$\approx 0.0008\ m^3/sec \approx 0.8$ lit /sec

7.2 Before estimating, the other three factors, viz. diameter of pipe, velocity of water through pipe and residual head at outlet location, it is imperative to prepare, Discharge Distribution Table, based on the actual pipe alignment. To understand this an example of Chalkewadi Project isgiven below, As shown in Table No. 7.2; refer diagram 7.1

Table No. 7.2
Discharge Distribution Table

Basic discharge- 0.0008 cum/sec/ha (0.8 lps)

Sr. No	Chainage in m.	Total Area (ha.)		Outlet discharge cumecs	Discharge through main line cumecs	Minors / Outlets
		CCA	Cumulative CCA			
1	0 to 300	4.30	232	0.003	0.185	L2 cum DO1
2	300 to 560	3.03	227.70	0.002	0.182	L1 cum DO2
3	560 to 840	12.37	224.67	0.010	0.179	Minor 2
4	840 to 1080	3.97	212.30	0.003	0.169	Minor 3 cum DO3
5	1080 to 1190	3.43	208.33	0.003	0.166	Minor 3 cum DO4
6	1190 to 1590	4.45	204.90	0.004	0.163	L4 cum DO5created
7	1590 to 2130	52.42	200.45	0.042	0.160	Minor 4
8	2130 to 2320	35.76	148.03	0.029	0.118	Minor 5
9	2320 to 2680	10.83	112.27	0.009	0.090	Minor 6
10	2680 to 2880	43.47	101.44	0.035	0.081	Minor 7
11	2880 to 3190	3.75	57.97	0.003	0.046	Minor 8 cum DO6
12	3190 to 3320	4.94	54.22	0.004	0.043	L1 cum DO7
13	3320 to 3610	18.90	49.28	0.015	0.039	Minor 9
14	3610 to 3760	10.14	30.38	0.008	0.024	Minor 10/2(230m)
15	3610 to 3760	20.24	20.24	0.016		Minor 10/1(80 m)
		232		**0.185**		



7.1.Schematic of Alignment of Piped Distribution Network

7.2.1 Now Look @ the Pipe line alignment diagram above, where the first discharge of 0.185 m^3/sec (185lps) is shown, up to 300m length. At CH.300m,there is one direct outlet, which irrigates the area of, 4.30 ha, for which outlet discharge can be worked out

= 4.3 ha x 0.0008 m^3/sec/ha

= 0.00344 m^3/Sec

= 3 lps

Now from the chainage 300 m onwards, the total discharge which will flow in the main pipe line, up to 560m.

= (0.185-0.00344) m^3/sec

= 0.182 m^3/sec

In this manner, the discharges in the entire command area, for all the outlets can be worked out.

Thus by adopting the aforesaid procedure, the Discharge Distribution for, the entire Network can be prepared, which is shown in Table 7.2.

The remaining three Parameters viz- Pipe Diameter, Velocity of Water through Pipe and Residual Head can be worked out through Excel program

7.3 The Excel Program

Table No 7.3 :- Excel Sheet For PDN Design

Sr. No.	Chainage (m)		G.L. @ start	G.L. @ end	Pipe top		Discharge	Length	Dia provided (Inner)	Dia provided (Outer)
	From	To	m.	m.	At start	At end	cum/ sec	(m)	(m)	(mm)
1	2	3	4	5	6	7	8	9	10	11
1	0	30	93.99	93.95	93.44	93.43	0.185	30	0.409	450
2	30	60	93.95	93.85	93.43	93.41	0.185	30	0.409	450
3	60	90	93.85	93.82	93.41	93.29	0.185	30	0.409	450

Loss of head due to friction by Hazen William's formulae with 10% extra for bends	HGL		Type of pipe	Class of pipe (kg/ cm2)	Head w.r.t G.L		Residual head available @ top of pipe		Velocity in Pipe by Hazen William's Formula.
	At start	At end			At start	At end	At start	At end	
12	13	14	15	16	17	18	19	20	21
0.115	106.000	105.885	BWSC	6	12.010	11.935	12.551	12.451	1.5
0.115	105.885	105.769	BWSC	6	11.935	11.919	12.451	12.350	1.5
0.115	105.769	105.654	BWSC	6	11.919	11.834	12.350	12.360	1.5

Total 21 column program in which column No. 1 to 7 is a field data, which is to be furnished accurately by field Authorities, and the values of Discharge in the column No 8 to be taken from Discharge distribution table. Also first value in column No 13 is to be furnished by Field Authorities as First Hydraulic Gradient Line level (HGL) Now, How to work out the other columns values are given as under.

1) Length = Column No.3 - Column No.2
   = 30 - 0
   Hence, it is 30 m
2) Diameter :- Generally, 1m/sec to 1.2 m/sec velocity is assumed through pipe line & based on this the area is worked out

$$= \frac{\text{Discharge}}{\text{Velocity}}$$

$$= \frac{0.185 m^2}{1.2}$$

$$= 0.154\ m^2$$

Based on this area the diameter can be worked out

$$D = \sqrt{(AX4/\pi)}$$

$$= \sqrt{(0.154X4/\pi)}$$

$$= 0.443\ m$$

e.g. Here, it is assumed that, the pipe is , BWSC& then compatible inner Diameter to the above value can be selected from respective CSR/DSR

After selecting the diameter in this manner, many iterations required to be carried out, to have other parameters within permissible limit for the chainage at 0m, at least 1.20m residual head on the top of the pipe is required. In the command area where the outlets are to be provided, the residual head at least0.6 m above the outlet height is required. However more than 1 m residual head should be provided preferably. Now to calculate this residual head, use the following formula in the Government circular dated 02/02/2017 for the purpose of calculating the headless due to the water flow in the pipes

$$h = L \frac{[Q / C_R]^{1.81}}{994.62 \, XD^{4.81}}$$

where,

h = Headloss in m

L = Length of pipe in m

Q = Discharge in m^3/sec

C_R = Pipe Roughness Coefficient

D =Diameter of Pipe in m

In this way head loss in pipe is calculated. For the provision for minor losses in pipes viz. Bends / Tees, exit, entry etc. this frictional head loss is increased by 10% as per Government Circular. If the residual heads and velocity of the flow is as per norms of circular, then the proposed Pipe Diameter is adequate. According to this method is To be repeated for all the remaining chainage. As you progress through the Network the discharge through pipe gets decreased and subsequently the pipe diameter also gets decreased.

Now, let's look at how to check the residual head.

Residual head= First Hydraulic Gradient Level – Head Loss

e.g.- The first HGL is 106.00 m at 0 m Ch.

Head loss for 30m pipe length is to be calculated by Modified Hazen Williams Formula is 0.115m including 10% other Losses.

H.G.L. @ 30m Ch. is =106-0.115

=105.885 m

To calculate Residual head above pipe top @ 30m ch.

=H.G.L.-Pipe Top

=105.885-93.434

=12.451 m.

To calculate Residual head above Ground Level @ 30m ch.

=H.G.L.-Ground Level

=105.885-93.95

=11.935 m.

To calculate Velocity in pipe @ 30m ch.

As mentioned in the guidelines for PDN design in G.R.सिंचन 2015/ प्र.क्र.24/(भाग-2)/2015/ जसं (धोरण) मंत्रालय मुंबई -400032 दिनांक 02 फ़ेब्रुवारी,2017.

The Modified Hazen William's formula for Velocity through Pipe

$$V = 143.534 \, C_R \times r^{0.6575} \times s^{0.5525}$$

Where,

V = velocity of flow in m / sec.

C_R = Pipe roughness coefficient

r = Hydraulic radius in m. (for circular pipe, d/4= internal diameter)
S = Frictions slope (i.e. slope of HGL line) =hf/L
d = Internal diameter of pipe in m.
hf = Friction head loss in m.
L = Length of pipe in m.

Now, V =?

C_R =1

d= 1.5 m.

hf =0.115 m.

L= 30

$V = 143.534 X1 X (1.5/4)^{0.6575} X (0.115/30)^{0.5525}$

= 1.5 m/sec.

The C_R value is given in the previous chapter as Table No 6.1.

7.4 SELECTION OF PIPE TYPE- In the Pipe distribution system, the role of selection of type of pipe is vital, in order to keep the cost of Pipe Network as minimum as possible. There are various types of pipes in that commonly used as MS pipe, PCCP, CI, DI, HDPE, PVC.

For this, the following factors should be taken into consideration.

1. Modified Hazen William 's Coefficient (C)
2. The inner and outer pressure in pipe
3. The durability of pipe material.
4. The ease of jointing and durability at workplace, as design life span for pipe distribution network is considered as 50years.
5. Ease of availability of many types of diameter and its viability.
6. Availability of skilled workers for setting up at work place.
7. The pipes and its fittings should be easy.
8. Fittings should also be able to tolerate the pressure of water in the pipes.
9. If the soil in which the sulfate content is more than 1%, then do not use metal pipes and cement pipes.

(For detail information refer CWC Manual (July 2017) Guidelines for Planning & Design of Piped Irrigation Network, Page no.32 to 43.

CHAPTER –VIII

USE OF SOFTWARE FOR PDN DESIGN

For the design of Piped Distribution Network for irrigation mainly following software Program are used.

1. EPANET
2. Water GEMS
3. M.S. EXCEL Sheet

8.1 EPANET

EPANET is a public domain, water distribution system modeling software package developed by the United States Environmental Protection Agency's (EPA) Water Supply and Water Resources Division. It performs extended-period simulation of hydraulic and water-quality behavior within pressurized pipe networks and is designed to be "a research tool that improves our understanding of the movement and fate of drinking/irrigation water constituents within distribution systems".

EPANET 2 is available both as a standalone program and as an open-source toolkit (Application Programming Interface in C). Its computational engine is used by many software companies that developed more powerful, proprietary packages, often GIS-centric.

8.1.1 **FEATURES**

1. EPANET hydraulics engine computes head losses along the pipes by using one of the three formulas:

A. Hazen-Williams formula: used to model full flow conditions under simplified conditions
B. Darcy-Weisbach formula: used to model pressurized flow under a broader range of hydraulic conditions
C. Chezy-Manning formula: used to model pressurized flow by using Chezy's roughness coefficients for Manning's equation

Since the pipe segment head loss equation is used within the network solver, the formula above is selected for the entire model

2. The visual network editor of EPANET simplifies the process of building piping network models and editing their properties. These various types of data reporting visualization tools are used to assist to analyze the networks, which include the graphics views, tabular views, and special reports.
3. EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats
4. EPANET provides a fully equipped and extended period of hydraulic analysis that can handle systems of any size.

5. The package also supports the simulation of spatially and temporally varying water demand, constant or variable speed pumps, and the minor head losses for bends and fittings.
6. The modeling provides information such as flows in pipes, pressures at junctions, propagation of a contaminant, chlorine concentration, water age, and even alternative scenario analysis. This helps to compute pumping energy and cost and then model various types of valves, including shutoffs, check pressure regulating and flow control.

8.1.2 INPUT DATA FORMAT

1. EPANET uses a binary file format, but also includes the capability for importing and exporting data in dxf, metafile, and ASCII file formats.
2. EPANET's ASCII file format is called an input file within EPANET, and uses a file extension ".inp".The input file can include data describing network topology, water consumption, and control rules, and is supported by many free and commercial modeling packages.
3. While EPANET is used as the computational engine for most water distribution system models, most models (KYPipe, WaterCAD, WaterGEMS, HAMMER and SewerCAD)are developed and maintained in hydraulic modeling packages based on EPANET's computational engine.

8.1.3 OBSERVATIONS

Presently Central Design Organization's PDN design wing is using EPANET. In most of the cases survey (command area) data available for PDN design is very old (In the form of toposheets). For PDN design in EPANET, it is required to fill ground level of all junctions as well as pipe diameter, pipe length, pipe mateial of each pipe section which is very leangthy and time taking procedure. This software carries out only head loss calculations and gives new hydraulic gradient level and velocity values. So this software only partially helpful for design of PDN network.This software based on Hazen-Williams formula (old). Due to manual feeding of data mistakes may occurs.There is no drawing output.

8.2 Water GEMS

Water GEMS is a hydraulic modeling application for water distribution systems with advanced interoperability, geospatial model building, optimization, and asset management tools, Water GEMS provides an easy to use environment for engineers to analyze, design, and optimize water distribution systems.

8.2.1 FEATURES

1. In Water GEMS geospatial data, CAD drawings, databases, and spreadsheets can be use for model building process. Water GEMS provides synchronized database connections, geospatial links, and advanced model-building modules that connect with format virtually any digital data
2. Water GEMS includes Demand Control Centre to allocate Water demand for each junction and TRex module to allocate node elevation based

   on geospatial data found in shape file, geodatabases, various types of DEMs, and even CAD drawings. These modules help engineers avoid potential manual-

input mistakes. Water GEMS also provides drawing and connectivity review tools to guarantee a hydraulically coherent model. This automatically removes network complexity, while maintaining hydraulic equivalence, to efficiently tackle a wider range of modeling applications

3. WaterGEMS includes Darwin Designer Tool in which synchronized database connection of junctions and pipe with allocated water demand and node elevation system of piped distribution network, the diameter can be automatically get selected within the range of given pipe diameter range and pipe material. This tool is important and useful for optimization of pipe diameter.
4. Darwin Calibrator evaluates millions of possible solutions to let users quickly find a calibration hypothesis that best matches measured flows, pressures, and on/off status, empowering users to make reliable decisions based on accurate hydraulic simulations of the real world.
5. Darwin Designer automatically finds maximum benefit or minimum-cost designs and rehabilitation strategies, based on available budget, construction cost, and pressure and velocity constraints.
6. In WaterGEMS a special tool named as Scenario & Alternative which allows multiple demand conditions, various pump position, various valve positions, piped distribution network with and without pump, can be use. It makes easy interpretation of results with different conditions. Data feed for piped distribution network can be used for each different condition.
7. WaterGEMS includes state-of-the-art genetic algorithm optimization engines for automated calibration, design and rehabilitation, and pump operations.
8. WaterGEMS' SCADAConnect® module lets modelers automatically acquire supervisory control and data acquisition (SCADA) data, creating a real-time system simulator that accurately represents current system conditions.
9. WaterGEMS model results to be published to a utility's existing SCADA control room screen(s), helping to forecast operating conditions and potential issues.

8.2.2 INPUT DATA FORMAT

- DGN, DXF, spreadsheet, database, and ODBC connections
- Shapefile, geodatabase*, Geometric Network*, and SDE* connections (*when running from within ArcMap)
- Oracle Spatial support
- GIS-ID property to maintain associations between records in the data source / GIS and elements in the model
- SCADAConnect 25-signal pack for live data connections (to and from SCADA systems)
- Graphical SCADA element
- Customer Meter element
- Lateral link (no need to split pipes)

- Automatic demand allocation from geospatial data
- Geospatial demand allocation from customer meters
- Demand allocation from lump-sum geospatial data
- Geospatial-based water consumption projection
- Daily, weekly, monthly, and superimposed patterns
- Unaccounted for water and leakage estimation
- Composite demands global edition
- Area, count, discharge, and population-based loading
- Pipe-length-based demand loading
- Elevation extraction from DEM, TIN, and shape files
- Elevation extraction from CAD drawings and surfaces
- Series, parallel, branch-trimming, multi-criteria automated skeletonization of pipes
- Skeletonization support for isolation valves
- User-data extension, including formula based

8.2.3 Model Management

- Unlimited scenarios and alternatives
- Comprehensive scenario management
- Global attribute tabular edition
- Pressure zone management
- Automated model skeletonization
- Personalizable engineering libraries
- Sorting and persistent filtering on tabular reports
- Statistical analysis from tabular reports
- Dynamic and static selection sets
- Local and global engineering-units management
- Sub-model management
- Drawing review tools for connectivity consistency
- Automatic topology review
- Orphaned nodes and dead-end pipes queries

8.2.4 Interoperability, Interface, and Graphical Editing

- Runs from within four compatible platforms:
- Stand-alone Windows
- ArcGIS (ArcMap license required)
- Micro Station (Micro Station license required)

- AutoCAD (AutoCAD license required)
- Unlimited undo and redo
- Element morphing, splitting, and reconnection
- Merge nodes in close proximity tool
- Automatic element labeling
- Scaled, schematic, and hybrid environments
- Element prototypes
- Aerial view and dynamic zooming
- Named views library
- Multiple background-layer support

8.2.5 OBSERVATIONS

At present central Design Organization PDN design wing has one Water GEMS software loaded in their computer lab. This software is based on GIS platform so all the input data of survey should be in synchronous with GIS. Command area survey should be carried out with the help of total station or Drone. In this survey atleast three points have reference with universal transverse Mercator (UTM) co-ordinate system. With the help of these reference points the whole piped distribution network can be mapped on Google Earth. Many more alternatives can be found out from this survey data. When command area drawing prepared from this data the countour (contour interval 2to 5m) plotted should be alloted with z co-ordinate or Elevation value in autocad drawing. It is easy to import such autocad file in form of .dfx to Water GEMS with the help of TRex tool. Command area drawing can be imported as background layer in Water GEMS.

As mentioned above, unless data is not received in proper format the use of Water GEMS for different scenarios and optimization of pipe by diameter is not possible. Hence if the design is to be done by Water GEMS the command survey should be carried out either by total station or drone.

8.3 M.S. EXCEL SHEET

Piped distribution network design with the help of M.S.Excel Sheet the following data need to be filled and first pipe diameter is assumed and required constraints such as length, head loss,velocity, Hydraulic Gradient level and residual head is worked out. (Detailed procedure given in Chapter No VII)

1. Ground Level along the PDN alignment approximately 20m or 30m interval is to be filled. It helps to understand the ground profile of command area to make the laying of pipe easily.
2. Discharge at each pipe section is to be filled.
3. Head loss and Velocity in the given pipe section is calculated by Modified Hazen-Williams formula.

For the provision for minor losses in pipes viz. Bends / Tees, exit, entry etc. this frictional head loss is increased by 10% as per Government Circular. If the residual heads and velocity of the flow is as per norms of circular, dtd 02/02/2017 then the proposed Pipe Diameter is adequate. Accordingly, this method is to be repeated for all the remaining chainages. As you progress through the Network the discharge through pipe gets decreased and subsequently the pipe diameter also gets decreased.

If the alignment of pipeline in the command are properly laid on the command map i.e. minimum length of pipe is laid to cover entire command area; The results achieved from excel sheet are quite satisfactory and economical because in the PDN design basic parameter which influences cost is difference between start HGL and outlet ground level so with the available head, we have to arrange pipes telescopically from start to outlet location. This is the basic approach to the design. Hence if we go by this theme whatever the method or software we use will have marginal impact on the final outcome.

CHAPTER – IX

VALVES AND BLOCKS

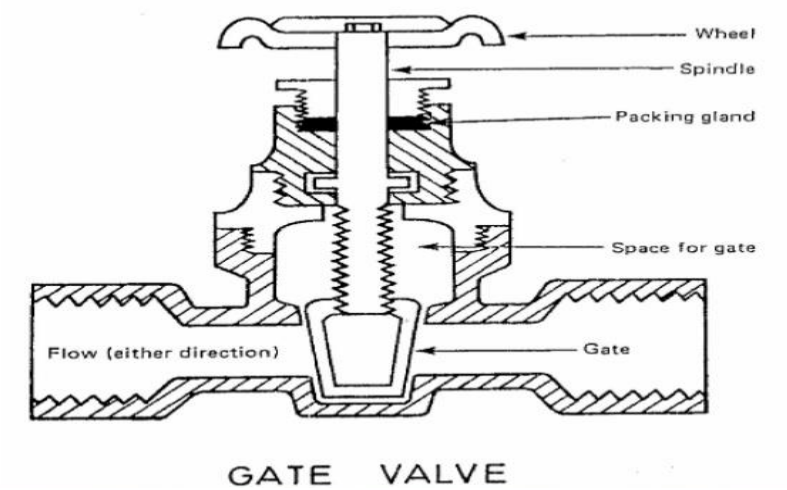
Valves play a critical role in a water distribution system for subsystem isolation(due to breakage or contaminant) and flow or pressure control.

Main type of valves are i) Gate valve ii) Check valve iii) Drain valve iv) Air release valve v) Pressure regulating valve vi) Pressure reducing valve.

9.1 VALVES

9.1.1 GATE VALVES:

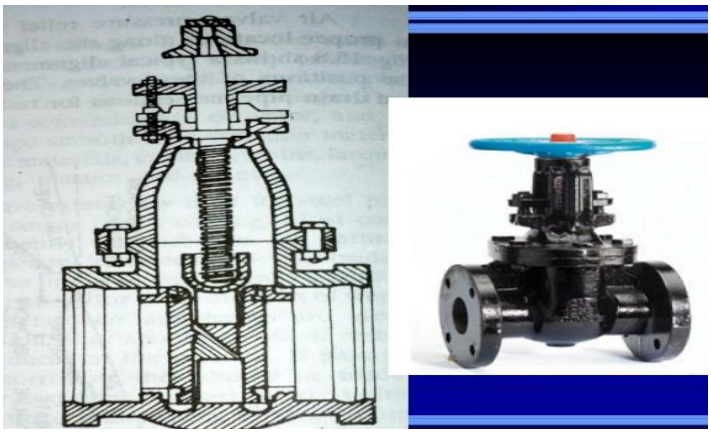
These are on-off valves and regulate the flow. Gate valves are for small diameter pipes and rotary butterfly valves are used for large diameter pipes. These are provided at end of lateral and at the branching of subsystem. It provides easy isolation of system.



9.1 Gate Valve

9.1.2 THROTTLING VALVES:

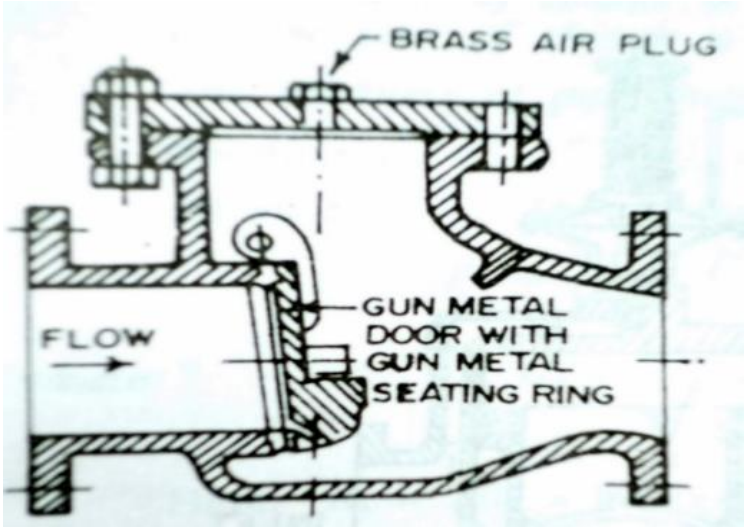
Throttling valves regulate the flow. To obtain this function, the closure member can be moved to any position and kept at the position including fully open and close so that throttling valve can do on-off function. It is butterfly and globe valves that are widely used as throttling valves. Sluice valves fall in this category.



9.2 Throttling Valve

9.1.3 REFLUX OR CHECK VALVE :

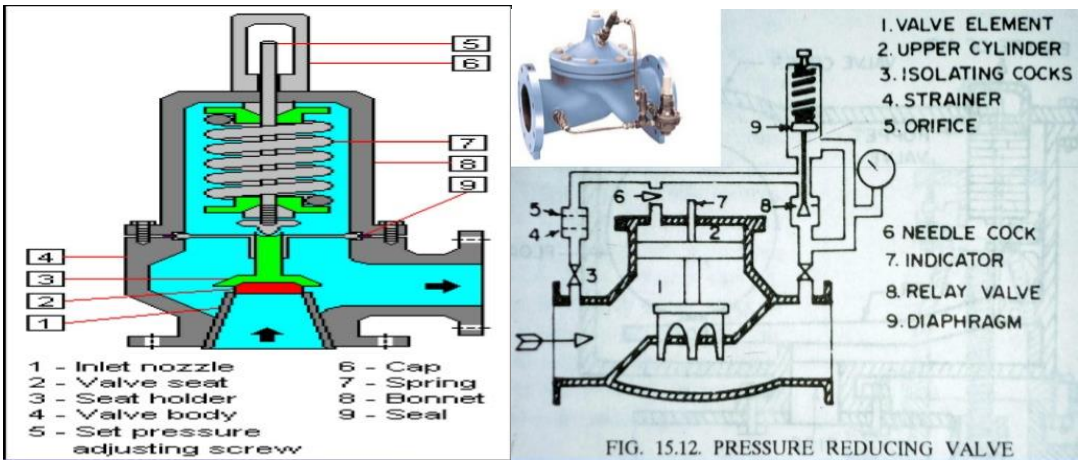
Check valves allow water to flow in only one direction. If the direction of flow changes, it is automatically closed to prevent backflow. Check valve is generally installed in the discharge pipe of a pump and at the foot of steep rise or fall, so it prevents backflow after the pump stops.



9.3 Reflux or Check Valve.

9.1.4 PRESSURE-REDUCING VALVES:

These valves control the pressure difference from inlet to outlet of a valve so that they are able to maintain outlet pressure which is designed. Pressure-reducing valves are generally installed at a connecting point where branch pipes are connected to a main pipe so it is required to reduce high pressure in the main pipe to lower designed pressure in branch pipes.

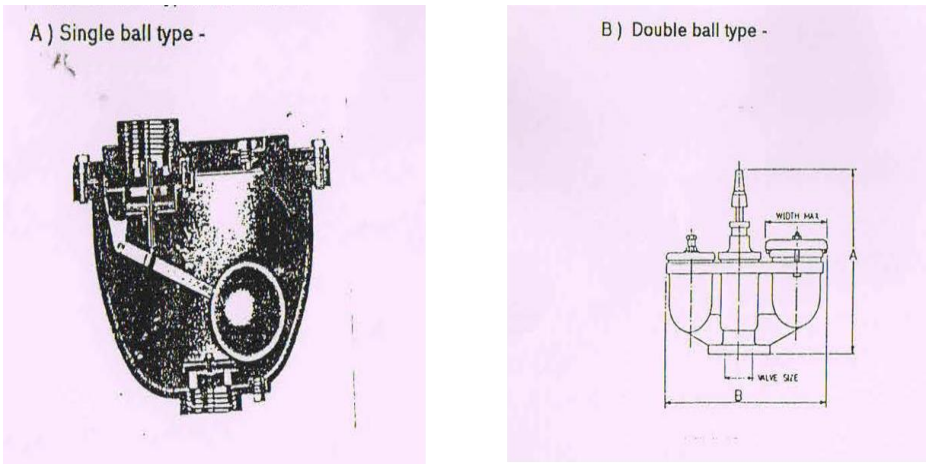


9.4 Pressure-Reducing Valve.

9.1.5 AIR VALVE:

The effect of air valve in the long-distance water pipelines are in the following three areas: firstly, in the water filled stage of the pipeline, filled with water by a certain velocity, the air valve can discharge the remained gas in the pipe; secondly, at the normal working stage, the air valve can discharge the small amount of gas gathered in the pipe timely; finally, during the pump failure or maintenance stages, the air valve will replenish the gas into the pipe to break the vacuum. According to the orifice size, displacement and work pressure, air valve is divided into high pressure trace exhaust valve, low pressure air release valve and combined air valve.

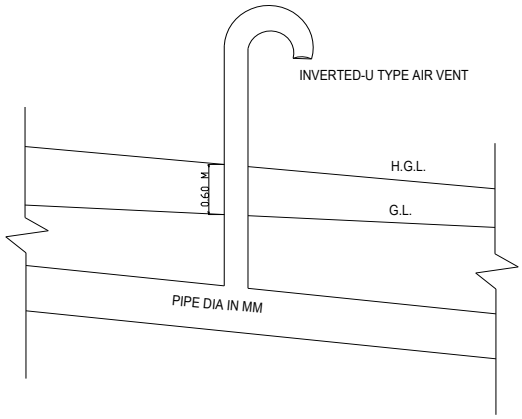
Double acting air valves are provided at the summit points in the system to release the air accumulated in pipes and also rush air to remove any vacuum developed. They are also provided at the change in direction of flow. The minimum internal dia is about 10 % of pipe internal dia. The spacing is about 300 to 500 m.



9.5 Air Valve

9.1.6 AIR VENT:

As per Govt. Guidelines of 02/02/2017 the air valve should be provided at 300 m interval or at the summit of the pipeline. But the air vent should be provided at the location where the difference between H.G.L. line & G.L. is less than 0.6 m or if the H.G.L. line is nearly equal to ground. Air vent serves its purpose as to release only air instead of water, eventually it avoids leakage of water through pipe. Normally height of air vent above ground id limited to 1.5 m in height with inverted U at top.



9.6 Air Vent

9.1.7 THE DRAIN OR SCOUR VALVE:

These Valves are generally provided to drain out the pipeline. The exact location of Scour valves is frequently influenced by opportunities to dispose off the water. Where the main pipeline crosses a stream or drainage structures, there will usually be a low point in the line but if the main pipeline goes under the stream or drain, it cannot be completely drained into the channel. In such a situation it is better to locate a scour connection at the lowest point that will drain by gravity and provide for pumping out the part below the drain pipeline.

Generally, sluice valve provided at the lowest depression to flush out the silt accumulated in the system. It is connected to natural nalla nearby. The dia is about 1/4 to 1/6 of pipe dia.

9.1.8 Control Valve :

A control valve is a valve used to control fluid flow by varying the size of the flow passage as directed by a signal from a controller. This enables the direct control of flow rate and the consequential control of process quantities such as pressure, temperature, and liquid level.

Common types of control valve are as given below.

A) Sliding Stem

- Globe valve
- Angle body valve

- Angle seat piston valve

B) Rotary

- Butterfly valve
- Ball valve

C) Other

- Pinch valve
- Diaphragm valve

9.1.9 Isolation Valve :

In case of distributary or large minor where one water user association will handle the irrigation management two isolation valve (sluice valve) on main pipeline are provided. The total area may be divided into head reach, middle reach and tail reach. To isolate these areas, the valve are provided on main line at a point approximately covering 1/3 and 2/3 irrigable area.

9.2 THRUST BLOCKS AND ANCHOR BLOCKS

Though the pipeline is laid and continuously buried with minimum ground cover of 1.50 meters, they develop unbalanced forces due to internal pressure especially at sharp deviations in alignment, inducing stresses in pipe shell. Concrete thrust blocks of sufficient cover on outer surface of pipe should be provided with respect to pipe dia; also with respect to sufficient length arrived at by considering the counteracting at-rest pressure of surrounding ground; Weight of concrete and frictional force as shown in table no 9.1. They shall be provided at vertical deviations exceeding 10^{o} and horizontal deviations exceeding 20^{o} for rigid pipes i.e. D.I. & concrete pipes.

Table No:- 9.1 Concrete Encasing For Thrust Block w.r.t Pipe Diameter

Pipe Diameter (mm)	Concrete Encasing (mm)
Above 1000	600
600 to 1000	450
below 600	300

a. The thrust blocks shall proposed in M-15 (40 MSA) concrete with nominal reinforcement of 10 mm diameter bars in the mesh of 200 mm on outer and peripheral face of pipe. There is no necessity to provide Thrust Blocks for pipes below 315 mm.

b. Similarly anchor blocks shall be in the portion of expansive soils like black cotton soil in straight reach @ 100mm gap. For others soils anchor blocks at every 300m can be provided for pipes above 315 mm Dia.

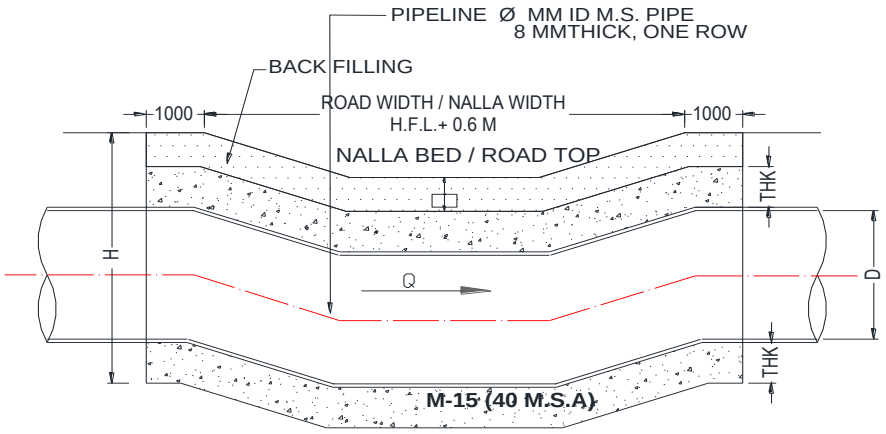
c. Steeply inclined pipeline should be secured by transverse anchors spaced as per IS: 12288-1987

9.2.1 Thrust Block For Direct Pumping PDN

Thrust block for direct pumping PDN or for L.I.S. system should be provided as norms given in IS 5330-1984

9.2.2 Nalla & Road Crossing

The pipeline should be safe against scouring and uplift effect due to flood. The pipeline is provided the minimum ground cover of 1.50 m. The M-15 (40 MSA) concrete encasing of sufficient thickness (as shown in Table no 9.1) with nominal reinforcement may be provided at such vulnerable points; locations and segments of which shall be finalized at field level depending upon the site conditions. This portion coming under submergence during flood shall not to be kept empty.



9.7 Typical Details Of Concrete Encasing At Nalla/Road Crossing

CHAPTER –X

SPECIFICATION FOR VARIOUS TYPES OF PIPES

1.0 The following types of pipes are commonly used in the pipe distribution network.

a. High density Polyethylene Pipe (HDPE)
b. Spirally Wound Steel Reinforced Pipe (SWSRP)
c. Polyvinyl Chloride Pipe (PVC)
d. Oriented Unplasticized Polyvinyl Chloride Pipe (PVC- O)
e. Glass Fiber Reinforced Plastic Pipe (GRP)
f. Prestressed Concrete Non-cylinder Pipe (PSC)
g. Pre-stressed Concrete Cylinder Pipe (PCCP)
h. Bar/wire wrapped steel cylinder pipe (BWSC)
i. Mild steel pipes (M S)
j. Ductile iron pipes (DI)

2.0 Vide Water Resources Department's governance circular no. Sinchan 2015/case no-24.2(Part- 2)/2015/WR (Policy) dated 02/02/2017, guidelines are issued to adopt entire or partial pipe distribution system for the distribution network of irrigation projects. Chief Engineer is authorized to decide the type of pipe for distribution system based on various parameters such as discharge, pressure, cost, etc.

3.0 While formulating specifications for each pipe type, provisions prescribed in guidelines laid down by Central Water Commission (Guidelines for Planning and Design of piped irrigation network, July 2017) and various Indian standards, codes are considered.

4.0 Specifications for various pipes cover following aspects.

1.0	Introduction
2.0	Applicable IS Codes
3.0	Raw Material
4.0	Manufacturing Pipes and Specials
5.0	Sampling Criteria for Selection of Pipes for Testing Purpose
6.0	Pre Delivery Testing of Pipes
7.0	Marking on Pipes
8.0	Transportation of Pipes
9.0	Stacking of Pipes at Site
10.0	Valves
11.0	Post Delivery Testing of Pipes
12.0	Site Preparation
13.0	Excavation for Pipe Trenches
14.0	Laying of pipes

15.0	Jointing of Pipes
16.0	Field Testing of Pipeline System
17.0	Backfilling of Pipe Trenches
18.0	Permanent Marking s of Pipe Alignment
19.0	Third Party Inspection
20.0	Quality Maintaining & Quality Assurance
21.0	Operation, Control & Handing over the System to WUA
22.0	Mode of Measurement & Payment

5.0 As mentioned above, detailed specifications for ten types of pipes viz. HDPE, SWSRP, PVC, PVC-O GRP, PSC, PCCP, BWSC, MS and DI have been prepared and attached in **VOLUME II** Important provisions from these specifications related to each pipe type are as enumerated below:

10.1 High density Polyethylene Pipe (HDPE):

Introduction - HDPE material is a polyethylene thermoplastic made from petroleum and its high level of impermeability and strong molecular bond makes it suitable for high pressure pipelines.

Raw Materials -Raw material used to manufacture the HDPE Pipes is High Density Polyethylene of PE 63, PE 80 and PE 100 grade

Classification of Pipes - Pipes shall be classified according to the grade of materials as given in following Table No.1

Table No.10.1 : Classification of Pipe material (Reproduced from IS 4984)

Sr. No.	Material grade	MRS (Minimum required strength) of material in MPa (N/mm^2)., @20 Degree Celsius, 50 years	Maximum allowable hydrostatic design stress Mpa. (N/mm^2)	
			At 20 degree Celsius	At 30 degree Celsius
1	2	3	4	5
i)	PE 63	6.3	5.0	4.0
ii)	PE 80	8.0	6.3	5.0
iii)	PE 100	10.0	8.0	6.3

Sampling criteria for Selection of Pipe for Testing Purpose For ascertaining conformity of the lot to the requirements of this specification, samples shall be selected as per IS 4984

Table No.10.2 : Scale of Sampling for Visual and Dimensional Requirements (Reproduced from IS 4984) & Scale of Sampling for Tests for Hydraulic Characteristics, Reversion, Overall Migration, Density, MFR and Carbon Black Content, Dispersion (Reproduced from IS 4984)

Scale of Sampling for Visual and Dimensional Requirements (Reproduced from IS 4984)

No. of Pipes in the Lot	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)
Up to 150	First	13	13	0	2
	Second	13	26	1	2
151 to 280	First	20	20	0	3
	Second	20	40	3	4
281 to 500	First	32	32	1	4
	Second	32	64	4	5
501 to 1 200	First	50	50	2	5
	Second	50	100	6	7
1 201 to 3 200	First	80	80	3	7
	Second	80	160	8	9
3 201 to 10 000	First	125	125	5	9
	Second	125	250	12	13
10 001 to 35 000	First	200	200	7	11
	Second	200	400	18	19

Scale of Sampling for Tests for Hydraulic Characteristics, Reversion, Overall Migration, Density, MFR and Carbon Black Content, Dispersion (Reproduced from IS 4984)

No. of Pipes	Sample Size
Upto 150	3
150 to 1200	5
1201 to 35000	8

Pre-Delivery Testing Of Pipes - Pipe selected as per sampling criteria mentioned in above para are subject to following tests before delivery from factory.

Dimension: Outside diameter, Wall thickness, Length of pipe	Visual appearance
Internal pressure creep rupture test,	Reversion test,
Overall migration test,	Density,
Melt flow rate (MFR),	Carbon black content and dispersion

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes

- When transporting straight polyethylene pipes, use flat bedded vehicles. The bed shall be free from nails and other projections. The polyethylene pipes shall rest uniformly in the vehicle over their long length.
- Polyethylene pipes shall not be transported with other metallic items in the same vehicle.

Stacking Of Pipes at Site

- PE pipes should not be subjected to rough handling during loading and unloading operations. Rollers shall be used to move, drag the pipes across any surface.
- Pipe shall be stacked on reasonable flat surface, free from sharp object, stone or projection likely to deform or damage the pipes.

Laying of Pipes

- The pipe line may be laid alongside of the trench and jointed there. There after the jointed pipeline shall be lowered into the trench carefully without causing undue bending. The pipeline shall be laid inside the trench with a slack of up to 2 m/100 m of pipe line.
- Polyethylene pipe requires no special bed preparation for laying the pipe underground, except that there shall be no sharp objects around the pipe. However, while lying in rocky areas suitable sand bedding should be provided around the pipe and compacted. 100 mm compacted fine sand bedding under and around the pipe be provided in rocky areas.
- Polyethylene pipes are non-metallic, so once buried, metal detector type locators are ineffective. To facilitate locating a buried PE pipe, metallic locating tapes or copper wires can be placed alongside the pipe. Locating tapes/wires are placed slightly above the crown of the pipe before the final back fill.

Jointing of Pipes - The Commonly used joints are as follows:

a) Fusion welding
   i. Butt fusion welding
   ii. Socket fusion welding
   iii. Electro fusion welding
b) Insert type joints;
c) Compression fittings/push fit joints
d) Flanged joints; and e) Spigot and socket joint

Field Testing of Pipeline System

- Polyethylene pipelines shall be pressure tested at ambient temperature. After filling with water the pipeline shall be left to stabilize for a period of 1 hour.
- The test pressure shall be 1.5 times the rated pressure of pipes or of the proposed maximum design pressure of the section.
- If the pressure remains steady (within 5 percent of the target value) for 1½ h, leakage is not indicated.

10.2 Spirally Wound Steel Reinforced Pipes (SWSRP)

Introduction -The Spirally Wound Steel Reinforced Pipes (SWSRP) are structured wall pipes comprising of an HDPE inner smooth layer, spiral steel skeleton and outer corrugated profile of HDPE.

The Spirally Wound Steel Reinforced Pipes (SWSRP) are structured wall pipes comprising of an HDPE inner smooth layer, spiral steel skeleton and outer corrugated profile of HDPE.

Raw material used to manufacture Pipes is Polyethylene, to which may be added those additives that are needed to facilitate the manufacture of

pipes and fittings conforming to the requirements mentioned in following table 10.3.

Table No.10.3 Material characteristics for PE material.

(Reproduced from IS 16098)

Sr. No.	Test method	Test Parameter	Requirement
1	As per IS 7328	Base Density	≥ 0.930 g/cc
2	As per IS 2530	Melt Flow Rate	≤1.6g/10minutes.
3	As per IS 16098(part 2)	Thermal Stability (Oxidation Induction Test)	≥ 20 minutes

The addition of the manufacturer's own rework material (Clean & reprocessable) is permissible. The quantity of rework material used is to be declared by the manufacturer. No other rework material shall be used. The addition of the manufacturer's own rework material (Clean & reprocessable) is permissible. The quantity of rework material used is to be declared by the manufacturer. No other rework material shall be used.

Sampling criteria for Selection of Pipe for Testing Purpose All SWSRP pipes in a single consignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot. The number of test samples to be taken from a lot shall depend on the size of the lot and the inside diameter of the pipes, and shall be in accordance with following Table

Table no :- 10.4. Scale of Sampling for Visual Appearance and Dimensional Requirements. (Reproduced from IS 4985)

Scale of Sampling for Visual Appearance and Dimensional Requirements. (Reproduced from IS 4985)

Number of Pipes in the Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)
Up to 1 000	First	13	13	0	2
	Second	13	26	1	2
1 001 to 3 000	First	20	20	0	2
	Second	20	40	1	2
3 001 to 10 000	First	32	32	0	3
	Second	32	64	3	4
10 001 and above	First	50	50	1	4
	Second	50	100	4	5

Table No.10.5 : Scale of sampling for test other than visual and dimensional requirements (reproduced from IS 16058)

No of pipes in lot	Sample size for ID ≤ 500mm	Sample size for ID ≥ 500mm
Upto 1000	2	1
1001 to 3000	3	2
More than 3000	4	3

Pre Delivery Testing of Pipes

Pipe selected as per sampling criteria mentioned in earlier para are subject to following tests before delivery from factory

1. Dimension: Length, Diameter of pipe & Socket dimensions or Fittings
2. Visual Appearance,
3. Colour of Finished Pipe,
4. Physical Characteristics
5. Mechanical Characteristics. Mechanical Characteristics.

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI. Table No.3 : Scale of sampling for test other than visual and dimensional

These pipes shall be selected at random from the lot and in order to ensure the randomness

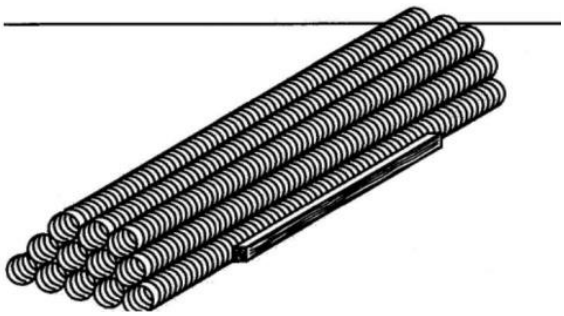
Transportation of Pipes

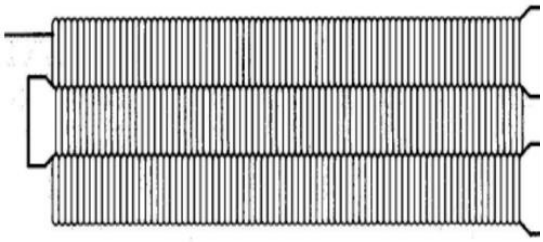
- When transporting pipes, flat bed vehicles should be used. When transporting pipes, flat bed vehicles should be used. The vehicle should be free from nails and other projections. Pipes should rest uniformly on the vehicle over the whole length.

- Loading boom or fork lift should not be used directly on or inside the pipeobo olhould not be used directly on or insi

Stacking Of Pipes at Site

- The area selected for stacking should be plain and care is to be taken to remove any pointed objects / stones f the The area selected for stacking should be plain and care is to be taken to remove any pointed objects / stones from the area.
- Stacking shall done on a flat clear area as shown below
- Stacking shall done on a flat clear area as shown be





StackingSTSTSSS Stacking of pipes **Stacking of socket and coupler ends**

10.1 Stacking of pipes

Laying of Pipes

- The pipe line may be laid along side of the trench and jointed there. There after the jointed pipeline shall be lowered into the trench carefully without causing undue bending. The pipeline shall be laid inside the trench with a slack of up to 2 m/100 m of pipe line.
- Polyethylene pipe requires no special bed preparation for laying the pipe underground, except that there shall be no sharp objects around the pipe. However, while laying in rocky areas suitable sand bedding should be provided around the pipe and compacted. 100 mm compacted fine sand bedding under and around the pipe be provided in rocky areas.

Jointing of Pipes –

It is recommended to use electrofusion joint for pressure application, to ensure robust and leak-proof joint.

It is recommended to use electrofusion joint for pressure application, to ensure robust and leak-proo

Field Testing of Pipeline System

- SWSRP pipelines shall be pressure tested at ambient temperature. After filling with water the pipeline shall be left to stabilize for a period of 1 hour.
- The test pressure shall be 1.5 times the rated pressure of pipes or of the proposed maximum design pressure of the section.
-
- If the pressure remains steady (within 5 percent of the target value) for 1½ h, leakage is not indicated.

10.3 Polyvinyl Chloride Pipe (PVC) :

Introduction - Polyvinyl Chloride (PVC) pipes are made by a continuous extrusion process. These pipes are supplied with plain or with socket-ends.

Raw Materials - Raw material used to manufacture PVC Pipes is polyvinyl chloride

Classification of pipes - The pipe shall be classified by pressure ratings

Table No:- 10.6 Pressure ratings according to class of pipes

Class of pipe	Working pressure (PN)
Class 1	0.25 MPa (2.5 kg/cm^2)
Class 2	0.4 MPa (4.0 kg/cm^2)
Class 3	0.6 MPa (6.0 kg/cm^2)
Class 4	0.8 MPa (8.0 kg/cm^2)
Class 5	1.0 MPa (10.0 kg/cm^2)
Class 6	1.25 MPa (12.5 kg/cm^2)

Sampling criteria for Selection of Pipe for Testing Purpose For ascertaining conformity of the lot to the requirements of this specification, samples shall be selected as per IS 4985

Table No:- 10.7 Scale of Sampling for Visual Appearance and Dimensional Requirements (Reproduced from IS4985)

Number of Pipes in the Lot	Sample Number	Sample Size	Cumula-tive Sample Size	Accept-ance Number
(1)	(2)	(3)	(4)	(5)
Up to 1 000	First	13	13	0
	Second	13	26	1
1 001 to 3 000	First	20	20	0
	Second	20	40	1
3 001 to 10 000	First	32	32	0
	Second	32	64	3
10 001 and above	First	50	50	1
	Second	50	100	4

Pre-Delivery Testing Of Pipes - Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

- Dimensions : Outside diameter, Wall thickness, Length of pipe
- Visual appearance
- Opacity
- Effect on water
- Reversion test,
- Vicat's Softening Test,
- Density,
- Sulphated ash content test
- Resistant to external blows at 0^0 c
- Internal hydrostatic pressure test

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes –

- When transporting pipes, flat bed vehicles should be used. The bed should be free from nails and other projections.
- Mechanical lifting equipment used for lifting pipes and pipe bundles should not damage the pipe. Fork-lift forks should be

flat and protected. Cranes should have spreader bars. No wire ropes, chains or hooks should be used.

Stacking Of Pipes at Site

Pipes should be stacked on a surface flat and free from sharp objects, stones or projections in order to avoid deformation or damage. Ends of pipes should be protected from abrasion and chipping.

- The pipes should be supported evenly over their whole length. The bottom layer of the stack should be supported on wooden battens of unifrom size, at least 50 mm wide and placed not more that 2 m apart.
- Stack height should not exceed 1.5 m in depots and stores or 1 m at construction sites.

Laying of Pipes

- The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipeline. There should be no sharp objects that may cause point loading.
- A minimum bedding thickness of 100 to 150 mm under the pipe shall be provided by watering and compaction
- The pipes shall be preferably laid with the spigots entered into the sockets in the same direction as the intended flow of water.
- To sustain thrust caused by internal pressure, concrete anchor blocks should be provided at all changes of direction.
- Metal marker tape can be laid into the final backfill to enable electronic location of the pipe line.

Jointing of Pipes - Commonly used joints are as follows

a) Solvent welded joints,
b) Integral elastomeric sealing ring joints,
c) Mechanical compression joints,
d) Flanged joints,
e) Screwed or threaded joints,
f) Union coupled joints

Field Testing of Pipeline System

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- The test should confirm to following conditions
  a) be applied for at least 1 h, but not more than 24 h; and
  b) not exceed 1.5 times the maximum rated pressure of the lowest rated component.

10.4 Oriented Unplasticised Polyvinyl Chloride Pipe (PVC-O):

Introduction - Technology for manufacturing pipes, which involves process of controlled circumferential and axial orientation of molecular structure resulting in formation of laminar structure of the material used in the pipe construction, is commonly known as PVC-O (Polyvinyl Chloride - Oriented). Manufacturing of pipes by this technology increases performance and strength of pipes.

Raw Materials - Raw material used to manufacture PVC -O Pipes is polyvinyl chloride.

Classification of pipes - The pipe shall be classified by pressure ratings

Table No:- 10.8 Pressure ratings according to class of pipes

Class of pipe	Working Pressure
PN 10	1.0 Mpa (10 kg/ cm^2)
PN 12.5	1.25 Mpa (1.25 kg/ cm^2)
PN 16	1.6 Mpa (16 kg/ cm^2)
PN 20	2.0 Mpa (20 kg/ cm^2)
PN 25	2.5 Mpa (25 kg/ cm^2)

Sampling criteria for Selection of Pipe for Testing Purpose -For ascertaining conformity of the lot to the requirements of this specification, samples shall be selected as per IS 16647

Table No:- 10.9 Scale of Sampling for Visual Appearance, Colour and Dimensional Requirement (Reproduced from IS 16647)

Sr. No.	Number of Pipes in a Lot	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I	Upto 1000	First	13	13	0	2
		Second	13	26	1	2
II	1000 to 3000	First	20	20	0	2
		Second	20	40	1	2
III	3000 to 10000	First	32	32	0	3
		Second	32	64	3	4
IV	10001 and above	First	50	50	1	4
		Second	50	100	4	5

Table No:- 10.10 Scale of Sampling for Vicat Softening Temperature and Density Test. (Reproduced from IS 16647)

Sr. No.	Number of Pipes in a Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	For nominal outside diameter (d_n) up to and including 110 mm					
	a) Upto 1000	First Second	5 5	5 10	0 1	2 2
	b) 1001 to 3000	First Second	8 8	8 16	0 1	2 2
	c) 3001 to 10000	First Second	13 13	13 26	0 1	2 2
	d) 10001 and above	First Second	20 20	20 40	0 3	3 4
ii)	For d_n above 110 mm					
	a) Upto 3000	First Second	3 3	3 6	0 1	2 2
	b) 3001 to 10000	First Second	5 5	5 10	0 1	2 2
	c) 10001 and above	First Second	8 8	8 16	0 1	2 2

Table No:- 10.11 Scale of Sampling for Resistance to External Blows at 0°C (Reproduced from IS 16647)

Sr No.	Number of Pipes in a Lot	Sample Number	Sample Size	Cumulative Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Upto 3000	First Second	3 3	3 6	0 1	2 2
ii)	3001 to 10000	First Second	5 5	5 10	0 1	2 2
iii)	10001 and above	First Second	8 8	8 16	0 1	2 2
NOTE – The numbers mentioned in col 4 to col 7 represent the number of times the test is to be carried out and do not represent either the number of pipe samples or number of blows or number of failures.						

Table No:- 10.12 Scale of Sampling for Ring Stiffness Test (Reproduced from IS 16647)

Sr. No.	Number of Pipes in a Lot	Sample Size for Sizes Less than or Equal to 500 mm	Sample Size for Sizes Greater than 500 mm
i)	Upto 1000	2	1
ii)	1001 to 3000	3	2
iii)	3001 and above	4	3

Pre-Delivery Testing Of Pipes - Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

1. Dimensions : Outside diameter, Wall thickness, Length of pipe
2. Visual appearance
3. Colour
4. Opacity
5. Resistance to hydrostatic pressure
6. Resistance to external blows at 0^0 c
7. Ring Stiffness
8. Orientation Factor
9. Physical and Chemical Characteristics

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes –

- When transporting pipes, flat bed vehicles should be used. The bed should be free from nails and other projections.
- Mechanical lifting equipment used for lifting pipes and pipe bundles should not damage the pipe. Fork-lift forks should be flat and protected. Cranes should have spreader bars. No wire ropes, chains or hooks should be used.

Stacking Of Pipes at Site

Pipes should be stacked on a surface flat and free from sharp objects, stones or projections in order to avoid deformation or damage. Ends of pipes should be protected from abrasion and chipping.

- Store the pipes horizontally on a flat surface and place supports every 1.5 m to avoid the bending of the pipe.
- Avoid scratches especially in the crest of the socket, due to dragging the pipe on the ground, mainly if the surface is made of stone, concrete or asphalt.
- Do not stack pipes more than 1.5 m height, as this can damage lower pipes or even the upper pipes can fall.
- The sockets should be free, alternating sockets and ends.

- In case of prolonged sun exposure, protect pallets with an opaque material. White colour is preferable because it avoids the over heating of pipes

Laying of Pipes

- The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipeline. There should be no sharp objects that may cause point loading.
- A minimum bedding thickness of 100 to 150 mm under the pipe shall be provided by watering and compaction
- The pipes shall be preferably laid with the spigots entered into the sockets in the same direction as the intended flow of water.
- To sustain thrust caused by internal pressure, concrete anchor blocks should be provided at all changes of direction.
- Metal marker tape can be laid into the final backfill to enable electronic location of the pipe line.

Jointing of Pipes - Commonly used joints are as follows

- Lubricate the chamfer of the spigot and the seal with joint lubricant.
- Line up the pipe as much as possible horizontal and vertically.
- Insert only the chamfer edge of the socket, just to support the pipe but leaving the socket lip free.
- In case of pipes with nominal daimeter ≤ 250 mm, a firm and dry push should be given to seize the momentum produced by the free movement in the lip of the socket and introduce it until the mark is hidden into the socket.

- When installing pipes with diameters > 250 mm, one should use mechanical means to introduce the pipe using materials such as woods, hoists, tackles or slings.

Field Testing of Pipeline System

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- The test should confirm to following conditions
  c) be applied for at least 1 h, but not more than 24 h; and
  d) not exceed 1.5 times the maximum rated pressure of the lowest rated component.

10.5 Glass Fiber Reinforced Plastic Pipe (GRP) :

Introduction - Glass fibre reinforced Plastic (GRP) pipe is a machine made tubular pipe containing glass fibre reinforcements embedded in or surrounded by cured thermosetting resin.

Raw Materials - Raw material use to manufacture the GRP Pipes is Resins, Glass Fiber Reinforcement, Aggregates, Filler and Additives.

Classification Of Pipes - The pipes are classified on the basis of pressure rating & stiffness class.

- Pressure classes of pipes are 5 namely PN3, PN6, PN9, PN12 and PN15 correspond to the working pressure rating of 300, 600, 900, 1200 and 1500 KPa respectively.
- Four Stiffness classes of pipes are 4 namely A,B,C, and D correspond to minimum pipe Stiffness valve of 62,124, 248 and 496 kPa respectively at 5 % deflection

Sampling criteria for Selection of Pipe for Testing Purpose - One pipe selected at random from a lot shall be checked for various tests.

Pre-Delivery Testing Of Pipes - Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

Dimension: Inside diameter, Outside diameter, Length of Pipe, Out of squareness of Pipe, Wall thickness.	Workmanship
Pipe Stiffness	Hydraulic test
Longitudinal Strength Test.	Hoop Tensile Strength Test.
Tests to establish potability of water	

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes -

- The truck used for transportation of the GRP pipes shall be exclusively used for GRP pipes only with no other material loaded – especially no metallic, glass and wooden items. The truck shall not have sharp edges that can damage the Pipe.
- All the pipes and fittings shall be lifted with pliable straps, slings or ropes. These may be canvas or polyester belts with a minimum width of 10 cms or nylon ropes with a minimum diameter of 30 mm. Steel cables or ropes shall not be used for lifting and transportation of pipe.
- Straight continuous lengths of pipe may be lifted at one point. However, owing to its very smooth surface it is usually safer for the pipe to be lifted at two points.

Stacking Of Pipes at Site -

- Pipes and fittings with diameters of less than 1.0 m may be stored directly on sandy soil, the ground should be flat and free from sharp, projection and stones/rocks bigger than 40 mm in diameter.

- Pipes with diameters greater than 1.0 m may be stored on their delivery cradles at a maximum distance of 6 m c/c

Laying of Pipes -

- For a coupling type of joint, two rubber ring gaskets are first fixed into the groove inside the coupling and then the coupling is to be fixed at the coupling area of the pipe and pipe is to be lowered in the trench.
- For socket and spigot type of joint, pass the rubber ring under the pipe until it settles into the groove, then pull it forcibly upwards and follow the ring with the hands so that three quarters of it is positioned in the groove, then lift the ring above the upper generating line of the pipe forcibly and then release it so that it falls into the groove thus being freed of any twists.
- RCC thrust blocks should be provided at bends and at places of reductions in cross section to take care of thrust.
- The pipe should be uniformly and continuously supported throughout its whole length with firm stable bedding material. The bedding material should be placed so as to give complete contact between the bottom of the trench and pipe. The bedding material should be watered and compacted.

Jointing Of Pipes- Commonly used joints are as follows

- Unrestrained Pipe Joint
  a. Spigot and Socket Joint
  b. Double Socket Coupling Joint
- Restrained Pipe Joint
- Butt Joint
- Flanged joint

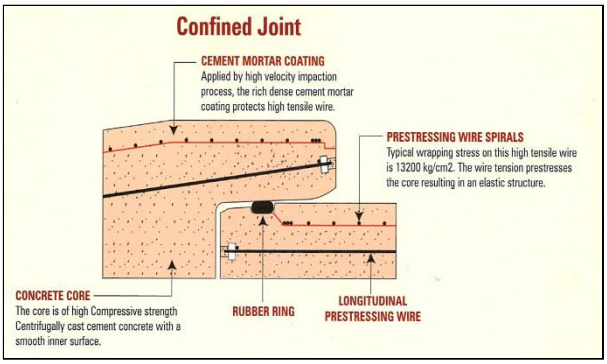
Field Testing Of Pipeline System

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- The test pressure shall be 1.5 times the rated pressure for a given class of pipes or fittings. The test pressure shall be maintained for a period of 24 hours.

10.6 Prestressed Concrete Non-cylinder Pipe (PSC) :

Introduction - Prestressed Concrete Non-Cylinder Pipe is suitably compacted concrete core longitudinally prestressed with pretensioned high tensile steel wire embedded in the concrete, circumferentially prestressed and coated with cement mortar or concrete.

Raw Materials - Raw materials used to manufacture PSC Pipes are cement, aggregates, water, admixture, steel wires, steel for specials, rubber sealing rings.



10.2 Cross Section of PSC Pipe Joint.

Sampling criteria for Selection of Pipe for Testing Purpose

Scale of sampling shall be as given in below Table

Table No:- 10.13 Scale of Sampling and No. of Acceptable defective tests (Reproduced from IS 784)

Number of Pipes in Lot	Hydrostatic Test		Socket and Spigot Dimension		Permeability		Coating Thickness		Dimensional Test		Three Edge Bearing Test Drainage, Sewerage, Culvert Pipes	
	*	**	*	**	*	**	*	**	*	**	*	**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
20 50	All	Nil	All	Nil	3	Nil	3	Nil	3	Nil	2	Nil
51 100	All	Nil	All	Nil	5	Nil	5	Nil	5	Nil	2	Nil
101 300	All	Nil	All	Nil	8	Nil	8	Nil	8	Nil	3	Nil
301 500	All	Nil	All	Nil	13	Nil	13	Nil	13	Nil	4	Nil
501 1 000	All	Nil	All	Nil	26	1	26	1	26	1	5	Nil

* Number of samples

** Number of defectives acceptable

Pre-Delivery Testing Of Pipes

Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

Dimensions - Length, Internal diameter, Core thickness, straightness and finish	Hydrostatic Factory Test
Permeability Test on Coating	Mortar soundness test

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes

- The vehicle shall have side supports approximately spaced 2m apart, and the pipes shall be secured effectively during the transportation. All posts shall be flat with no sharp edges
- All pipes shall be loaded in trucks by mechanical crane/ tripod and unloaded carefully using crane/ tripod

- No unloading using crow bars or on tires will be allowed in any case. Rubber belt may be used instead of crow bars or chains.

Stacking Of Pipes at Site

- Pipes may be placed directly on the ground provided it is reasonably level and free from rocks and other projections.
- Stacking in tiers is permissible provided timber bearers are placed between succeeding tiers.
- Rolling down of the stacked pipes must be avoided by providing wedges wherever required.

Laying of Pipes

- Laying of pipes shall preferably proceed upgrade of a slope.
- When gradient for pipe laying is steeper than 1 in 6, suitable transverse anchor blocks as specified in IS 783 shall be provided for anchoring of pipeline.
- Bedding requirements for this pipe are minimal due to rigid nature of pipe. However, while laying in rocky area, 150 mm compacted fine sand bedding under and around pipe needs to be provided.

Jointing of Pipes - Joint are of two types :

a) **Rigid joints**
   i. Socket and Spigot Joint
   ii. Collar Joint
   iii. Flush Joint

b) **Flexible Joints**
   i. Roll on Joint
   ii. Confined Gasket

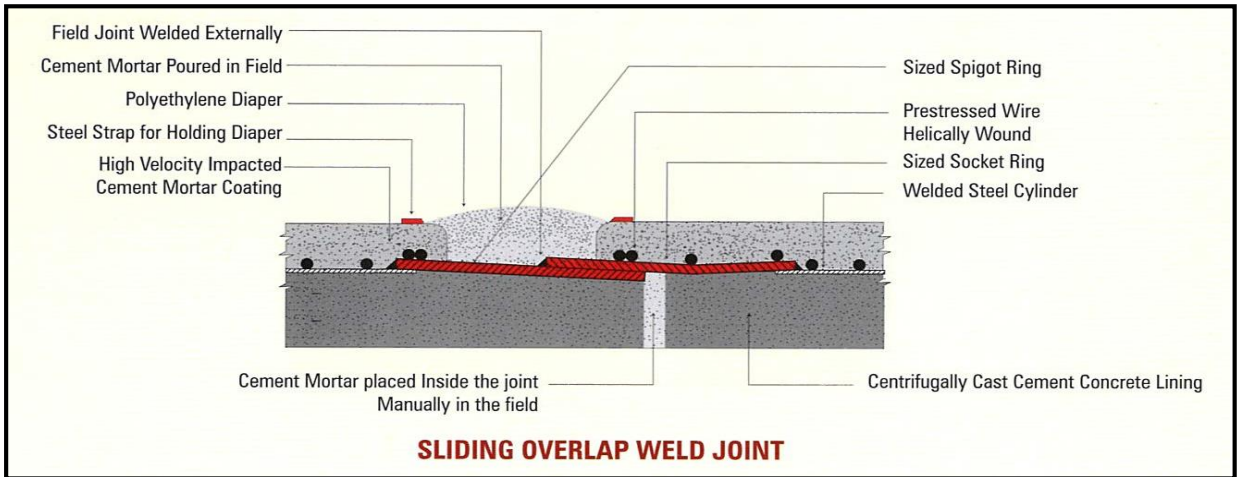
Field Testing of Pipe

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- AS per I.S.784, the test pressure should be 1.5 times design working pressure.
- The generally accepted standard for absorbent pipelines such as PSC pipes is 3 liter per millimeter of pipe diameter per kilometer of pipeline per day for each 30 meter head-of pressure applied.

10.7 Pre-stressed Concrete Cylinder Pipe (PCCP) :

Introduction : The Prestressed Concrete Cylinder Pipe (PCCP) comprises of a welded sheet steel cylinder with steel socket and spigot rings welded to its ends, lined with concrete suitably compacted and circumferentially prestressed .

Raw Materials -Raw materials used to manufacture PCCP Pipes are cement, aggregates, water, admixture, steel reinforcement, steel plates for cylinders, Joint rings and specials.



10.3 Cross Section of PCCP Pipe Joint

Sampling criteria for Selection of Pipe for Testing Purpose

For conformity to the requirements of IS 784, Scale of sampling shall be as given in below Table

Table No:- 10.14 Scale of Sampling and No. of Acceptable defective tests (Reproduced from IS 784)

Number of Pipes in Lot	Hydrostatic Test		Socket and Spigot Dimension		Permeability		Coating Thickness		Dimensional Test		Three Edge Bearing Test Drainage, Sewerage, Culvert Pipes	
	*	**	*	**	*	**	*	**	*	**	*	**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
20 50	All	Nil	All	Nil	3	Nil	3	Nil	3	Nil	2	Nil
51 100	All	Nil	All	Nil	5	Nil	5	Nil	5	Nil	2	Nil
101 300	All	Nil	All	Nil	8	Nil	8	Nil	8	Nil	3	Nil
301 500	All	Nil	All	Nil	13	Nil	13	Nil	13	Nil	4	Nil
501 1 000	All	Nil	All	Nil	26	1	26	1	26	1	5	Nil

* Number of samples

** Number of defectives acceptable

Pre-Delivery Testing Of Pipes

Pipe selected as per sampling criteria mentioned in above para 4.0 are **subject to following tests before delivery from factory.**

Steel cylinder test	Dimensions - Length, Internal diameter, Core thickness, straightness and finish
Hydrostatic Factory Test	Permeability Test on Coating
Mortar soundness test	

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes

- The vehicle shall have side supports approximately spaced 2m apart, and the pipes shall be secured effectively during the transportation. All posts shall be flat with no sharp edges
- All pipes shall be loaded in trucks by mechanical crane/ tripod and unloaded carefully using crane/ tripod.
- No unloading using crow bars or on tires will be allowed in any case. Rubber belt may be used instead of crow bars or chains.

Stacking Of Pipes at Site

- Pipes may be placed directly on the ground provided it is reasonably level and free from rocks and other projections.
- Stacking in tiers is permissible provided timber bearers are placed between succeeding tiers.

Laying of Pipes

- Laying of pipes shall preferably proceed upgrade of a slope.
- When gradient for pipe laying is steeper than 1 in 6, suitable transverse anchor blocks as specified in IS 783 shall be provided for anchoring of pipeline
- Bedding requirements are minimal due to rigid nature of pipe. However, while laying in rocky area, 150 mm compacted fine sand bedding under and around pipe needs to be provided.

Jointing of Pipes - Joint are of two types:

Jointing process of PCCP pipe consist of following steps.

- Aligning of pipes at joint locations.
- Field welding of socket ring at joint externally.
- Fixing of diaper with steel strap at joint location.
- Pouring of cement mortar through diaper at joint location.
- Filling inside of joints by cement mortar.

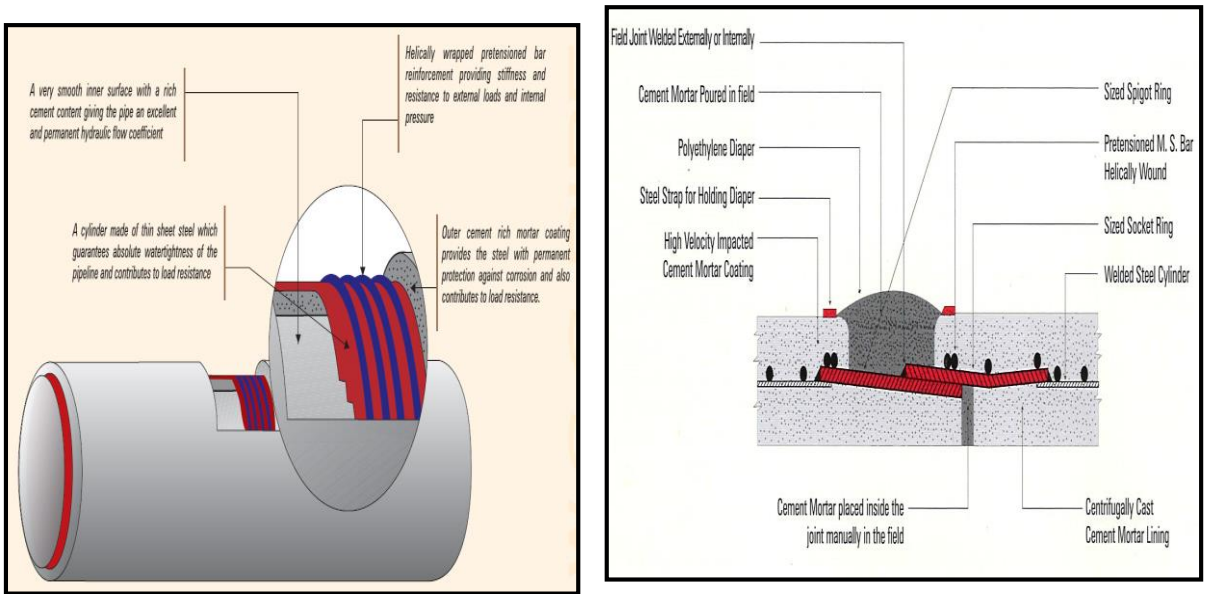
Field Testing of Pipe

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- AS per I.S.784, the test pressure should be 1.5 times design working pressure.
- The generally accepted standard for absorbent pipelines such as PCCP pipes is 3 liter per millimeter of pipe diameter per kilometer of pipeline per day for each 30 meter head-of pressure applied.

10.8 Bar/wire wrapped steel cylinder pipe (BWSC) :

Introduction - Bar/Wire wrapped steel cylinder (BWSC) pipe comprises of a welded steel sheet cylinder with steel socket & spigot rings welded to its ends, lined with centrifugally applied cement mortar within the steel cylinder.

Raw Materials - Raw materials used to manufacture BWSC Pipes are cement, aggregates, water, admixture, steel reinforcement, Steel plates for cylinder, joint rings and specials.



10.4 Cross Section of BWSC Pipe and Joint

Sampling criteria for Selection of Pipe for Testing Purpose

For conformity to the requirements of IS 15155, Scale of sampling shall be as given in below Table

Table No:- 10.15 Scale of Sampling and No. of Acceptable defective tests (Reproduced from IS 15155)

No of pipes in lot	Joint rings dimensions		Hydrostatic testing of cylinder		Coating thickness		Hydrostatic test of pipe at factory		Dimensional test (1)		Permeability test	
	*	**	*	**	*	**	*	**	*	**	*	**
Upto 50	All	NIL	All	NIL	3	NIL	1	NIL	3	NIL	3	NIL
51-100	All	NIL	All	NIL	5	NIL	1	NIL	5	NIL	5	NIL
101-300	All	NIL	All	NIL	8	NIL	2	NIL	8	NIL	8	NIL

No of pipes in lot	Joint rings dimensions		Hydrostatic testing of cylinder		Coating thickness		Hydrostatic test of pipe at factory		Dimensional test (1)		Permeability test	
300-500	All	NIL	All	NIL	13	NIL	2	NIL	13	NIL	13	NIL
500-1000	All	Nil	All	Nil	26	1	4	Nil	26	1	26	1

(1)Includes socket and spigot , *Number of samples, * Number of defective samples

Pre-Delivery Testing Of Pipes

Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

Steel cylinder test		Dimensions - Length, Internal diameter, Core thickness, straightness and finish
Hydrostatic Factory Test		Permeability Test on Coating
Mortar soundness test		

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Transportation of Pipes

- All pipes shall be loaded in trucks by mechanical crane/ tripod and unloaded carefully using crane/ tripod.
- No unloading using crow bars or on tires will be allowed in any case. Rubber belt may be used instead of crow bars or chains.

Stacking Of Pipes at Site

- Pipes may be placed directly on the ground provided it is reasonably level and free from rocks and other projections.
- Stacking in tiers is permissible provided timber bearers are placed between succeeding tiers.

Laying of Pipes

- Laying of pipes shall preferably proceed upgrade of a slope.
- When gradient for pipe laying is steeper than 1 in 6, suitable transverse anchor blocks as specified in IS 783 shall be provided for anchoring of pipeline
- Bedding requirements are minimal due to rigid nature of pipe. However, while laying in rocky area, 150 mm compacted fine sand bedding under and around pipe needs to be provided.

Jointing of Pipes -

Jointing process of BWSC pipe consist of following steps.

- Aligning of pipes at joint locations.
- Field welding of socket ring at joint externally.

- Fixing of diaper with steel strap at joint location.
- Pouring of cement mortar through diaper at joint location.
- Filling inside of joints by cement mortar.

Field Testing of Pipe

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- AS per I.S.784, the test pressure should be 1.5 times design working pressure.
- The generally accepted standard for absorbent pipelines such as BWSC pipes is 3 liter per millimeter of pipe diameter per kilometer of pipeline per day for each 30 meter head-of pressure applied.

10.9 Mild steel pipes (M S) :

Introduction - Mild steel Pipes can be manufactured from mild steel produced by the open hearth or electric furnace or one of the basic oxygen processes. The pipes shall be manufactured by either Seamless(S) process or Electric Resistance inducing induction welding (ERW) process or Submerged Arc Welding (SAW) process.

Raw Materials - Raw material use to manufacture the M.S. Pipes (with or without coating) is steel plates, Welding Consumables, Cement, aggregate, water, admixtures, steel reinforcement, primer and red oxide paint.

Classification of Pipes -

The pipes shall be designated by the method of manufacture followed by the grade number corresponding to the minimum specified tensile strength in MPs following the symbol Fe as given in Table 1

Example:

ERW- Fe 410 indicates electric resistance welded or induction welded steel pipe having a minimum tensile strength of 410 MPa

Table No:- 10.16 Designation of the Grades of the pipes

Method of manufacture of Pipe	Reference	Steel Grades Applicable		
(1)	(2)	(3)	(4)	(5)
Seamless	S	Fe 330	Fe 410	Fe 450
Electric resistance including induction welded	ERW	Fe 330	Fe 410	Fe 450
Submerged arc welded (including spirally welded)	SAW	Fe 330	Fe 410	Fe 450

Sampling criteria for Selection of Pipe for Testing Purpose -

The number of pipes to be selected from a lot for checking of dimensional characteristics depends on the size of the lot and shall be taken in accordance with relevant columns of following Table

Table No:- 10.17 Scale of Sampling and Permissible Number of Defectives for Dimensional Characteristics(Reproduced from IS 4711)

Sl No.	Lot	Pipes or Tubes (Outside Dia ≤ 200 mm)		Others	
		Sample	Acceptance	Sample	Acceptance
(1)	(2)	(3)	(4)	(5)	(6)
i)	Up to 100	3	0	2	0
ii)	101-150	5	0	3	0
iii)	151-300	8	0	5	0
iv)	301-500	13	0	8	0
v)	501-1 000	20	1	13	0
vi)	1 001-3 000	32	2	20	1
vii)	3 001-10 000	50	3	32	2
viii)	10 001and above	80	5	50	3

Pre-Delivery Testing Of Pipes

Pipe selected as per sampling criteria mentioned in above para 4.0 are subject to following tests before delivery from factory.

Dimensions- Outside diameter, Wall thickness, Ovality, Straightness		Tensile strength
Flattening test		Guided bend test
Hydraulic pressure test		

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Protective coating for Pipes - Generally pipes are coated internally and externally either by cement mortar mix, epoxy coating or tape coating.

Transportation of Pipes -

- Padding shall be provided between coated pipes and timber skids to avoid damage to the coating.
- All pipes shall be loaded in trucks by mechanical crane/ tripod and unloaded carefully using crane/ tripod.
- No unloading using crow bars or on tires will be allowed in any case. Rubber belt may be used instead of crow bars or chains.

Stacking Of Pipes at Site

- Suitable gap in pipes stacked should be left at intervals to permit access from one side to the other
- Dragging pipes over rough ground should be avoided

- Pipe shall be stacked on reasonable flat surface, free from sharp object, stone or projection likely to deform or damage the pipes

Laying of Pipes

- Before the pipe is lowered, the trench shall be carefully examined to determine that even bedding is provided for the pipeline and that the pipe may be lowered into it without damaging the coating. While laying in rocky areas, 150 mm compacted fine sand bedding under and around pipe needs to be provided.
- In case of coated pipes, extra care shall be taken to preserve the coating while lowering. Slings may be removed progressively without the necessity of digging under the pipe.
- Care shall be taken to see that the longitudinal joints of the consecutive pipes are staggered by at least 30^{o} and should be kept in upper third of the pipeline, if there are two longitudinal joints they should be on the sides.
- The pipe faces shall first be tack-welded alternately at one or more diametrically opposite pairs of points. After completing tack-welding, full welding shall be carried out in suitable runs following a sequence of welding portions of segments diametrically opposite.

Jointing of Pipes: Jointing of Pipes is done by butt wielding

Field Testing of Pipe

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- The field test pressure should not be less than the greatest of the following
  a) 1 times the maximum sustained operating pressure
  b) 1 times the maximum pipeline static pressure, and
  c) Sum of maximum static pressure and surge pressure subjected to the test pressure.
- Where the field test pressure is less than two – thirds the test pressure, the period of test should be at least 24 hours.
- If a drop in pressure occurs, the quantity of water added in order to re-establish the test pressure should be carefully measured. This should not exceed 0.1 lit per mm of pipe dia per km of pipeline per day for each 30 m head of pressure applied.

10.10 Ductile iron pipes (DI) :

Introduction - Ductile iron (DI) pipes are manufactured from ductile iron. Ductile iron is a type of iron in which graphite is present primarily in spherical or nodular form.

Raw Materials - Raw material used in manufacturing of pipes (with or without coating) is ductile iron, cement, sand, water, zinc, bitumen, polyethylene and rubber gasket**.**

Classification of pipes -

- Pipes have been classified as K7,K8,K9, K10, K12,….Depending on service conditions and manufacturing processes

The class designation shall be comprised of

a) prefix K

- A whole number used for thickness, class, designation.
- The value of K will depend on following service conditions.

Table No:- 10.18 Designation of the Grades of the pipes

Nominal dia	Water Main	Sewers	Gas main
80-300	K9-K12	K7-K12	K9-K12
350-600	K8-K10	K7-K10	K9-K10
700-2000	K7-K10	K7-K10	K9-K10

Sampling criteria for Selection of Pipe for Testing Purpose

Numbers of pipes to be selected from the lot for checking dimensional requirements shall be as per following Table

Table No:- 10.19 Scale of sampling and criteria for acceptance for dimensional requirements of pipes (Reproduced from IS 11606

Scale of sampling and criteria for acceptance for dimensional requirements of pipes (Reproduced from IS 11606)		
Lot size	Sample size	Acceptance No.
Upto 50	8	0
51-100	13	1
101-150	20	1
151 -300	32	2
301 & above	50	3

Pre-Delivery Testing Of Pipes

Pipe selected as per sampling criteria mentioned in above para 5.0 are subject to following tests before delivery from factory.

Dimension: Critical dimensions, External diameter, Wall thickness, Length of pipe, ovality, deviation from straight line.	Tensile test
Brinell hardness test	Hydraulic test

These test shall be carried out by the contractor in the presence of representative of Engineer In-charge /WRD/QC/TPI.

Coating on pipes- DI pipes shall normally be coated internally and externally either by zinc coating, bituminous coating or cement mortar lining.

Transportation of Pipes -

- DI pipes are less susceptible to cracking or breaking or impact but precautions should be taken to prevent damage to the protective coating
- The pipes should be loaded on vehicles in pyramid or straight sided formation. The use of straight sided loading is advantageous for utilizing full capacity of the vehicle.
- Cranes should be preferred for off-loading. However, for pipes up to 400 mm nominal bore, skid timbers and ropes may be used.

Stacking of pipes at site -

- The first layer of pipes should be laid on a firm foundation consisting of solid timbers set level on the ground. Subsequent layers should be placed according to the method of stacking adopted. The height of any stack should not exceed 2 m. Stacking of pipes can be either square or parallel or nested .

Laying of Pipes -

- For smaller sizes, up to 250 mm nominal bore, the pipe may be lowered by the use of ropes but for heavier pipes, either a well designed set of shear legs or mobile crane should be used.
- If sheathed pipes are being laid, suitable wide slings or scissor dogs should be used.
- All pipelines having unanchored flexible joints require anchorage at changes of direction and at dead ends to resist the thrusts developed by internal pressure.
- Where pipes are to be bedded directly on the bottom of the trench it should be trimmed & leveled to permit even bedding of the pipe line. However while laying in rocky areas 150 mm compacted fine sand bedding under and around pipe needs to be provided.

Jointing of Pipes: The joints are mainly of two types a) flexible joints b) flanged joints

Field Testing of Pipeline System

- All pipelines should be tested before being brought into service. The test should be a hydrostatic test performed by filling the pipeline with water and raising the pressure to the selected test pressure and maintaining this for a sufficient period to allow for absorption of water by the pipe material.
- The test pressure to be applied should be not less than any of the following:
    a) The maximum sustained operating pressure,
    b) The maximum static pressure plus 5 N/mm^2, and

c) The sum of the maximum sustained operating pressure (or the maximum static pressure) and the maximum calculated surge pressure.

- The pipeline is pressurized up to the full test pressure and the section under test completely closed off. The test should be maintained for a period of not less than 10 minutes to reveal any defects in the pipes, joints or anchorages.

10.11 Common provisions related to all pipe types are as enumerated below:

10.11.1 Marking on Pipes - Each pipe shall be indelibly marked in English language at either end of each pipe. The marking shall show the following

- Manufactures name or trademark
- Grade of raw material
- Pressure rating
- Nominal diameter
- Lot/batch No. of manufacturer
- BIS certification mark
- Third Party Certification mark for each lot
- Name of Department/Project for pipe which pipes are manufactured.
- Any other important matter that the manufacturer or purchaser deems fit to be inscribed.

10.11.2 Post-delivery testing of pipes - After delivery of pipes to worksite, additional test, if desired by Engineer-in-charge, shall be conducted on random samples of pipes collected from site.

10.11.3 Permanent markings of Pipe alignment - The contractor shall establish the sufficient number of reference blocks on the alignment of PDN preferably at the interval of 30m or as suitable on the field boundaries so as they will not be disturbed during the agricultural activities of the farmers.

The Geotagging map showing Latitude and Longitude Value of each apex of laid pipeline shall be submitted to Department and WUA for future refer

10.11.4 Third Party Inspection - Third party Inspection can be done form any one of the following services or from any other mutually agreed agency.

- Engineers India Limited, Mumbai
- S.G.S, Mumbai
- VJTI, Mumbai
- CIPET (Central Institute of Plastics Engineering & Technology)
- CWPRS (Central Water & Power Research Station), Pune
- Vishveshwaraya National Institute of Technology, Nagpur
- R.I.T.E.S. (Rail India Technical Economics Services) Mumbai

10.11.5 Quality Control and Quality assurance

- On award of contract, the Contractors will have to provide adequate quality assurance setup including Quality Assurance Engineer backed with suitable laboratory assistants, labours and well equipped laboratory for taking necessary field test required as per specifications and as per instructions of Engineer in charge.
  Contractor shall provide all test reports of material used in the work as desired from the NABL (National Accreditation Board for Testing & Calibration Laboratories) approved laboratories and from Quality Control, MERI laboratories of the WRD.
- Contractor shall provide periodical quality assurance report (Weekly/fortnightly/monthly) to Engineer in Charge along with proofs in support of quality of material brought for the work the process/ execution of work is as per specification.

10.11.6 Operation, Maintenance and Handing over of the System

- The contractor shall operate and maintain the complete pipe distribution network for the period of 5 (five) years after commissioning. Out of this period, during last two years the operation of the schemes shall be done by the contractor jointly along with WUA. On completion of O & M period, the system shall be handed over to WUA
- During rotation period, once in every year, the Contractor shall perform hydraulic test to the satisfaction of Engineer In-charge to verify the flow of designed discharge, detect or confirm any leakage in the system and rectify at his own cost. The testing shall preferably be conducted jointly with members of WUA/representative of Engineer In-charge, technical representative of contractor and any other stake holder.

10.11.7 **Backfilling of Pipe Trenches**

- The backfill material shall be placed carefully and spread in uniform layers of not more than 15cm thickness, with the first layer watered and compacted by stamping or by mechanical means. The backfill shall be brought up as uniformly as practicable on both sides of pipe to prevent unequal loading.
- Only soft earth and gravel of good quality free from boulder, roots, vegetable matters etc. shall be used for refilling of trench upto 300mm above the top of the pipe. Remaining trench can be filled with available material.

Comparison of various pipe materials as given in CWC Guidelines for PDN are reproduced for ready reference as per attached **Volume II**

CHAPTER - XI

OPERATION, MAINTENANCE AND REPAIRS

11.1 INTRODUCTION

11.1.1 Objectives of Operation, Maintenance And Repairs

The objective of an efficient operation and maintenance of a Irrigation Pipe Distribution Network System is to provide water as per designed quantity, with adequate pressure at convenient location and time at competitive cost on a sustainable basis

"Operation refers to timely and daily operation of the components of a Irrigation Pipe Distribution Network System such as headwork's, machinery and equipment, conveying mains, and distribution system etc., effectively by various technical personnel, as a routine function."

"Maintenance is defined as the act of keeping the structures, plants, machinery and equipment and other facilities in an optimum working order. Maintenance includes preventive /routine maintenance and also breakdown maintenance. However, replacements, correction of defects etc. are considered as actions excluded from preventive maintenance.

When any system goes wrong or partially damaged, it requires repairs. Repairs requires detail analysis of problem and evaluation of extent of damage. The estimate of repairs requires careful consideration and particularly rate analysis should be realistic and rational.

11.1.2 Necessity

The Guideline for Operation and Maintenance is a long felt need of the Irrigation Pipe Distribution Network System. At present, there is no technical manual on this subject to benefit the field personnel and to help the O& M authorities to prepare their own specific manuals suitable for organization.

11.2 STRATEGY

The activities which are required for good operation and maintenance (O&M) are as follow.

11.2.1. Development of Individual Plan for O&M

The individual plan must be prepared scheme wise for all units and all pieces of equipment. Each unit must have a plan to fix responsibility, timing of action, and ways and means. Generally actions recommended by the manufacturer or by the site engineer in charge who has installed the equipment or who has supervised the installation can be included.

Often the contractor's recommended operation and maintenance procedures at the time of design/ construction will be a good starting point for preparing a sound program. This plan has to be followed by the O&M staff and also will be the basis for supervision/ inspection. It also may be used for evaluation of the O&M status and the delivery of designed outcome.

The agency in-charge for O&M of Irrigation Pipe Distribution Network System shall become service oriented. It is essential that the organization responsible for O&M has well qualified, trained, experienced motivated and efficient staff to perform better.

11.2.2 **Plan for providing spares and tools**

It is essential to ensure the availability of spare parts like stand by pump-sets, minimum numbers of different sizes of jointing materials assessed on the basis of lengths of pipe lines, all sizes of nuts and bolts, Bearings, pipe pieces of different sizes & materials, electric spares like MCBs, Relay etc.

The availability of spare parts for repairs and replacements is to be ensured by ordering and delivery of spare parts by organizing an inventory system. The list of spare parts to be procured can be drafted on the basis of manufacturer's recommendations / consumption of material in previous years. The spare parts procured should be of BIS standard, with proper quality check.

11.2.3. **Plan for water audit and leakage control**

The availability of water (underground and surface) is very limited, there are considerable losses in the water produced and distributed through leakages in pipelines, valves, public taps un authorized service connection etc. the percentage of unaccounted for water **(UFW/NRW)** ranges from 30 to 55 %. Thus, huge quantum of water is being wasted which also leads to reduction in water as well as revenue losses. Therefore, it become essential to plan the conservative use of water i.e. water auditing/ leakage control through metering, improved O & M practices and awareness intervention.

11.2.4. **Reports and Record Keeping**

A Reports and Record Keeping system shall be enforced to list all the basic data of each piece of equipment and the history of the equipment. A reporting system shall be provided for the operator to inform the supervisor /manager about the problems of each equipment requiring the attention to repair and replacement crew or other specialized service personal.

The success of operation and maintenance program should result in decline of frequency of shutdowns, and emergency repairs. Improved O&M may result increased availability water supply to farmers and more revenue, Further, the cost of repairs may also reduce with the increase of equipment's life owing to the implementation of the maintenance program.

11.3 TRANSMISSION SYSTEM

11.3.1 General-Objective of Transmission System

The overall objective of a transmission system is to deliver raw water from the source to Delivery Chamber for supply into distribution networks. Transmission of raw water can be either by canals or by pipes. Transmission through pipes can be either by gravity flow or by pumping.

The objective of O&M of transmission system is to achieve optimum utilization of the installed capacity of the transmission system with minimum transmission losses and at minimum cost. To attain this objective the agency has to evolve operation procedures to ensure that the system can operate satisfactorily, function efficiently and continuously, and last as long as possible at lowest cost.

11.3.2. Transmission by gravity through channels or canals

11.3.2.1 Maintenance of Delivery Chamber Transmitting Water

Silt deposited should be removed. Flow meters should be installed at the head and tail of canals at important points in between. The reading should be observed and recorded daily. Both edges of the bank especially the inner one should be neatly aligned and should be free from holes, weeds. Ensure there is no Seepage through the banks

11.3.2.2. Maintenance of Lined Canals Transmitting Raw Water

Cavity or pockets or any activity detected behind the lining should be carefully packed with sand or other suitable material. Care should be taken to ensure that the lining does not get damaged or displaced

Damaged portion of lining should be removed and replaced with fresh lining of good quality by preparing a thoroughly compacted sub-grade before laying fresh sub-grade. The cracks in the lining should be filled with standard sealing compound. An effective sealing may be obtained by cutting 'V' groove along the face of the cracks before filing with sealing compound. Packing with powdered clay upstream of the cracks a seal minor crack on the lining. Displaced portion of the joint filter should be removed and fresh filter material may be packed. The chocked pressure release pipes should be cleaned by intermittent application of air and water by rodding.

Subsoil water level should be observed regularly especially after rainy season. If there is rise, adequacy of the pressure release system or other

remedial measures like humps, regulators etc. provided for the safety of the lining should be reviewed.
Seepage through embankments if any should be observed from time to time and remedial measure should be taken. Silt deposition if any noticed should be flushed out during non-Monsoon period when the water is silt free.
Aquatic weed growth if observed below the supply level should be removed. Land weed growing over the free board should also be controlled. Canal banks should be inspected for seepage condition at the outer slope and for some distance beyond the toe especially in high fill reaches.

11.3.3 **Transmission through Pipes**

All valves Installed in the transmission main should be inspected daily to ensure that there is no leakage otherwise leakage should be attended. If attending leakage requires stoppage of flow through pipes the same can be attended on a pre-fixed monthly shutdown day.

11.3.3.1 **Types of Pipes which are generally used in Water Supply System**

The various make of pipes are generally used for Pipe Distribution Network System for Irrigation Sector. The selection and Specification of pipes should be based on field conditions and used as per the *State Pipe Policy* and *BIS specification*.

11.3.3.2 **Problems in Transmission Mains**

(i) Leakage

Water is often wasted through leaking pipes, joints, valves and fittings of the transmission system either due to bad quality of materials used, poor workmanship, and corrosion, age of the installations or through vandalism. This leads to reduced supply and loss of pressure. Review of flow meter data will indicate possible leakages. The leakages can be either visible or invisible. In the case of invisible leaks sections of pipeline can be isolated and search carried out for location of leaks.

Most common leaks are through the glands of sluice valves. Leaks also occur through expansion joints where the bolts have become loose and gland packing is not in position. Leaks through air valves occur due to improperly seated ball either due to the damage of the gasket or due to abrasion of the ball, through the gland of the isolating sluice valve or through the small orifice.

(ii)Air Entrapment

Air in free form in rising main collects at the top of the pipeline and then goes up to higher points. Here, it either escapes through air valves or forms an air pocket which in turn, results into an increase or head loss. Other problems associated with air entrainment are: surging, corrosion, reduced pump efficiency and malfunctioning of valves or vibration. In rare cases bursting of pipes also is likely to occur due to air entrainment.

There should always be air valve chamber with cover slabs for the protection of the air valve and it should always be kept leakage free and dry. Frequent inspection should be conducted to check, whether Air valves are functioning properly and to ensure that there is no leakage through air valve.

(iii) Water Hammer

The pressure rise due to water hammer may have sufficient magnitude to rupture the transmission pipe or damage the valves fixed on the pipeline. Water hammer in Pipe Distribution Network System in case of direct connection of Pipe Distribution Network System to pumps of lift irrigation schemes occurs due to rapid closure of valves and sudden shut off or unexpected failure of power supply to the pumps. The care should be taken to open and close sluice valves gradually.

11.3.4. **O & M Activities**

11.3.4**.1 Operation Schedule**

Mapping and inventory of pipes and fitting: An updated transmission system map with location of valves, flow meters and pressure gauges is the foremost requirement of operation schedule. The valves indicated in the map should contain direction to open; number of turn to open, make of valve and date of fixing etc. the hydraulic gradient lines are to be marked to indicate the pressure in the transmission system. They can be used for identifying high pressure or problem areas with low pressure.

System pressure: It is essential to maintain a continuous positive pressure in the main at the time of transmission of water in the pipeline. Low pressure locations have to be investigated if necessary by measuring pressure with pressure gauge.

System Surveillance: The maintenance staff of the Department/ Water User Association (WUA)should go along the transmission line frequently so as to accomplish the following objectives.

- To detect and correct any deterioration of the transmission system.
- To detect if there is encroachment of transmission system failures
- To detect and correct if there is any unauthorized tapping of water
- To detect and correct if there is damage to the system by vandalism.

11.3.4.2 **Maintenance Schedule**

A maintenance schedule is required to be prepared to improve the level of maintenance of water Transmission system through improved co-ordination and planning of administrative and fieldwork and through the use of adequate techniques, equipment and materials for field maintenance. The schedule has to be flexible so that it can achieve team action with the available vehicles and tools. Co-ordination of activities is required for spares and fittings, quality control of materials used and services rendered. Training of maintenance staff shall, apart from the technical skills, include training to achieve better public relations with farmers.

11.3.4.3 **Activities of Maintenance Schedule**

Following activities are to be included in the schedule:

- Develop and conduct a surveillance programme for leaks in pipelines, pipe joints and valves.
- Develop and conduct a water quantity surveillance programme.
- Develop and conduct a programme for locating and repairing
- leaks including rectifying cross connections if any, arrange for flushing, cleaning the mains,
- Establish procedures for setting up maintenance schedules and obtain and process the information provided by the public and the maintenance teams about the pipeline leaks,
- Establish repair procedures for standard services and with provision for continuous training of the team members
- Procure appropriate machinery, equipment and tools for repair of leaks and replacement of pipes and valves,
- Allocate suitable transport, tools and equipment to each maintenance team
- Establish time, labour and material requirement and output expected, time required and other standards for each maintenance task, and
- Arrange for monitoring the productivity of each maintenance team

A preventive maintenance schedule has to be prepared for:

Maintenance of the pipelines with particulars of the tasks to be undertaken, works not completed, and works completed, Servicing of valves, expansion joints etc .Maintenance of valve chambers Maintenance of record of tools, materials, labour, and Costs required carrying out each task.

Activities for Preventive Maintenance

a) **Servicing of valves:** Periodical servicing is required for valves, expansion joints flow meter and pressure gauges. Corrosion of valves is the main problem in some areas and can cause failure of bonnet and gland bolts. Leaks from spindle rods occur and bonnet separates from the body. Stainless steel bolts can be used for replacement and the valve can be wrapped in polythene wrap to prevent corrosion. Manufacturer's catalogues may be referred and servicing procedure should be prepared for the periodical servicing.

b)**List of spare** **:** List of spares procured for the transmission system shall be prepared and the spares shall be procured and kept for use. The spares may include check nut, spindle rods, bolt and nuts are flanged joints, gaskets for flanged joints for all sizes of sluice valves, consumables like gland rope, grease, cotton waste, jointing materials like rubber gaskets, spun yarn, pig-lead and lead wool etc.

c) List of tools: The maintenance staff shall be provided with necessary tools/equipment's for attending to the repairs in the transmission system. These tools may include key rods for operation of sluice valves, hooks for lifting manhole covers, pipe wrench, DE spanner set, ring spanner set, screw drivers, pliers, hammers, chisels, caulking tools, crow bars, spades, dewatering pumps

11.3.4.4 Maintenance of Pipelines

Pipeline bursts/main breaks can occur at any time and the O & M agencies shall have a plan for attending to such events. This plan must be written down, disseminated to all concerned and the agency must always be in readiness to implement the plan immediately after the pipe breaks reported. After a pipe break is located, determine which valve is to be closed to isolate the section where the break has occurred.

After the closure of the valve the dewatering/mud pumps are used to drain the pipe breakpoints. The sides of trenches have to be properly protected before the workers enter the pit. The damaged pipe is removed, and the accumulated silt is removed from inside the pipe and the damaged pipe is replaced and the line is disinfected before bringing into use. A report shall be prepared following every pipe break about the cause of such break, the resource required

11.3.4.4.1 **Scouring of pipeline**

Scouring is done to clean the transmission lines by removing the impurities or sediment that may be present in the pipe

11.3.4.4.2. **Leakage control**

Visible and Non visible leaks identified and appropriate correct measures have to be implemented. Lead detection equipment have to be procured for detection of non-visible leak

11.3.4.4.3 **Telemetary and Scada System**

Manual collection of data and analyzing may not be helpful in large undertaking if water utilities have to aim at enhanced customer service by improving water quantity and service level with reduced cost. The substitution for manual system is adaptation of Telemetary and Scada.

11.3.5**.Engaging Contractors for Maintenance**

Due to inadequate trained O&M staff in line department/ WUA , the operation and maintenance of transmission system and other components of the scheme, if required, may be done by out sourcing/awarding Contracts for Comprehensive Annual Maintenance for any specified period e.g. 5 -10 years.

11.3.6**. Records and Reports**

Updated transmission system maps with alignment plans. Longitudinal sectional plans, Record of daily readings of flow meter at upstream and downstream end of pipeline, Record of water level of reservoir at both upstream and downstream end of transmission system.

- Pressure reading of the transmission system.
- Identification of persistent low pressure location along the pipeline.
- Record of age of pipes.
- Identify pipelines to be replaced.
- Identify source of leaks.
- Record of Bulk meter/water meter reading .
- Record on when the pipeline leaks were repaired or pipe changed and the cost of materials and labour cost thereof.

11.4 DISTRIBUTION SYSTEM

The overall objective of a distribution system is to deliver water to the consumer at adequate residual pressure in sufficient quantity at convenient points and achieve continuity and maximum coverage at affordable cost.

Normally, the operations are intended to maintain the required supply and pressure throughout the distribution system. Critical points are selected in a given distribution system for monitoring of pressures by installation of pressure recorders and gauges.

11.4.1 **Issues Causing Problems in the Distribution System**

(a)Leakage of Water

Large quantity of water is wasted through leaking pipes, joints, valves and fittings of the distribution systems either due to bad quality of materials used, poor workmanship, and corrosion, age of the installations or through vandalism. This leads to reduced supply, loss of pressure. Maintenance of appropriate positive pressure at all times to all outlet is the main concern of O&M. Negative pressure and very high pressure damages the pipelines. Low pressure may be avoided by taking the following steps.

- Purposefully or accidently a line valve is left closed or partly closed or blockage due to any material causing loss of pressure.
- Too high velocities in small pipelines
- Failure of pumps/Booster pumps (either due to power failure or mechanical (failure)feeding the system directly.

b) Age of the System

With age there is considerable reduction in carrying capacity of the pipelines due to incrustation, particularly unlined CI, MS and GI pipes. In most of the places the HDPE/ PVC pipes get brittle and leaks occur resulting in loss of water with reduced pressure .

11.4.**2. Routine Operations of the Pipe Distribution Network System**

The efficiency and effectiveness of a Pipe Distribution Network System depends on the operating personnel's knowledge of the variables that affect the continuity, reliability, and quantity of water supplied to consumers. The operational staff should be able to carry out changes in the hydraulic status of the system as required depending on those variables promptly and effectively. Routine operations shall be specified which are activities for adjusting the valves and operation of contain procedures for operating the distribution system. It should contain procedures to obtain, process, and analyze the variables related to water flows, pressures and levels as well as the consequences of manipulating control devices, such as operation of valves and or pumps so that the hydraulic status of the system can match the demand for water. When operators change their shifts information on valve closure and opening must be exchanged.

11.4.**2.1 Measurement of Flows, Pressures and Levels**

It will be necessary to monitor regularly operational data concerning flows, pressures and levels to assess whether the system is functioning as per requirements. Analysis of data may reveal over drawl of water to some reservoirs and or bulk consumers. At such places appropriate flow control devices may be introduced to limit the supplies to the required quantity.

A list of priority points in Pipe Distribution Network System have to be identified such as installation of meters to measure flows, pressures and levels. A detailed map showing location or each measuring point has also

to be prepared. The degree of sophistication of the devices used at each measuring point with regard to indication, integration, recording, transmission and reception of data depends mainly on the skills of the O&M personnel available with the agency and affordability of the agency.

11.4.3 **Management in Times of Water Shortage**

The objective of developing a programme for managing in times of shortage of water is to reduce the excessive use of water particularly when the source is limited due to adverse seasonal conditions. Basically it involves that a water conservation policy is developed and implemented among water consumers. The following activities can be considered while formulating such a water management project:

- Installation of accurate water meters and establishment of a realistic tariff structure to encourage water conservation and prevent wastage of water.
- Introduction of restrictions Water use by farmers to flood irrigation technique.
- Development and implementation of farmers education programmes to encourage water conservation.

11.4.**4 System Surveillance**

- Surveillance of distribution system is done to detect and correct.
- Deterioration of distribution system facilities, [to detect].
- Encroachment of distribution system facilities by other utilities such as sewer and storm water lines, power cables, telecom cables etc. and
- Damages of the system facilities by vandalism. [Detecting and correcting].

11.4.**5 Maintenance Schedule**

A maintenance schedule is required to be prepared to improve the level of maintenance of water distribution networks through improved co-ordination and planning of administrative and field work and through the use of adequate techniques, equipment and materials for field maintenance.

The schedule has to be flexible so that it can achieve team action with the available vehicles and tools. Co-ordination of activities is required for spares and fittings, quality control of materials used and services rendered. Training of maintenance staff shall include training to achieve better public relations with consumers apart from the technical skills.

11.4.**6 Activities in Maintenance Schedule**

Following activities are to be included in the schedule:

- Establishment of procedures for setting up maintenance schedules and obtaining and processing the information provided by the farmers and the maintenance teams.

- Formation of maintenance teams for each type of service with provision for
  continuous training.

- Establishment of repair procedures for standard services.
- Specification of appropriate tools.
- Allocation of suitable transport, tools and equipment to each team.
- Establishment of time, labour and material requirement and output expected; time
- required and other standards for each maintenance task, and
- Monitoring the productivity of each team.

11.4.**7 Preventive Maintenance Schedule**

A preventive maintenance schedule for Servicing of Valves and Maintenance of Valve Chambers, Maintenance of the pipelines: may include the tasks, set priorities, issue of work orders for tasks to be performed, list of scheduled tasks not completed, record of when the tasks are completed and maintaining a record of tools, materials, labour and costs required. to complete each task.

11.4.**8 Leakage Control**

Wastage of water in the system and distribution network occurs by way of leakage from pipes, joints & fittings, Delivery Chember and overflow from Delivery Chember. The objective of leakage control programme is to reduce the wastage to a minimum and minimize the time that elapses between the occurrence of a leak and its repair. The volume of water lost through each leak should be reduced by taking whatever action is technically and economically feasible to ensure that the leak is repaired as quickly as possible. To achieve this, the organization shall prescribe procedures for identifying, reporting, repairing and accounting for all visible leaks.

It will be beneficial for the agency if the procedures involve the conscious and active participation of the farmers served by the agency apart from its own staff. The Management has to process the data and evaluate the work on detection and location of leaks and for dissemination of the results and initiate actions to control the overall problem of water loss. Interim measures for reduction/control of leakage can be initiated by controlling pressures in the water distribution system where feasible.

11.4.**8.1 Procedures for detecting Visible Leaks**

The water agency has to establish procedures whereby the Farmers served by the agency can notifies the visible leaks. The agency staff can also report visible leaks found by them while carrying out other works on the Pipe Distribution Network System .

Pipe Distribution Network System agency has to establish procedures for prompt repair of leaks and for attending efficiently and accurately to the

leak. Critical areas where leaks often occur have to be identified and appropriate corrective measures have to be implemented.

11.4.**8.**2 **Procedures for Detecting Invisible Leaks**

Establishment of procedures for detecting and locating non-visible leaks shall be compatible with the technological, operational and financial capability of the agency. Selection and procurement of equipment for detection and location of leaks must take into account the cost-effectiveness and the financial capability of the organization.

11.4.**9**. **Cross Connections**

The various types of material of pipe &specials are being used in distribution system, namely CI,GI, DI,MS,PVC, HDPE, GRP RCC, AC, etc. and specific requirement of maintenance are to be followed as per the CPHEEO Manual/ Manufacturer's recommendations.

11.5 PUMPING MACHINERY

(For Pressuresed Pipe Distribution Network System For Irrigation Sector)

11.5.1. General

Pumping machinery and pumping station are very important components in case of Pressuresed Pipe Distribution Network irrigation System . Pumping machinery is subjected to wear, tear, erosion and corrosion due to their nature of functioning and therefore is vulnerable for failures. Generally, more number of failures or interruptions in water supply is attributed to pumping machinery than any other component.

Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance to ensure uninterrupted Pipe Distribution Network System for irrigation. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast moving spare parts. Efficiency of pumping machinery reduces due to normal wear and tear. Timely action for restoration of efficiency can keep energy bill within reasonable optimum limit.

In case of depletion of sources during summer/ monsoon failure, the schemes can be operated partially without throttling of pumps. While replacement of motors/ pumps is done, it may be insisted to provide star rated motors to have energy savings. Generally, as the pumps are scheme specific, (i.e. Discharge & head fixed depending upon the requirement) the question of standardization with regard to minimizing the inventory does not arise. To ensure better performance/ for effective cost savings energy audit and water audit need to be done for every scheme.

Annual monitoring of handed over schemes must be done by the department who executed the scheme. Proper record keeping is also very important.

A log book should be maintained covering the following items.

- Timings when the pumps are started, operated and stopped during 24 hours
- Voltage in all three phases
- Current drawn by each pump-motor set and total current drawn at the installation Frequency
- Readings of vacuum and pressure gauges
- Motor winding temperature
- Bearing temperature for pump and motor
- Water level in intake/sump
- Flow meter reading
- Daily PF over 24 hours duration
- Any specific problem or event in the pumping installation or pumping system e.g. burst in pipeline, tripping or fault, power failure.

11.5.2COMPONENTS IN PUMPING STATIONS

11.5.2.1Important Points for Operation of the Pumps

Various types of pumps are in use and the specification of O&M schedule provided by manufacturers shall be followed.

However, the following points shall be observed while operating the pumps:

1. Dry running of the pumps should be avoided.
2. Centrifugal pumps have to be primed before starting.
3. Pumps should be operated only within the recommended range on the head-discharge Characteristics of the pump.

4. If pump is operated at point away from duty point, the pump efficiency normally reduce.
5. Operation near the shut off should be avoided, as the operation near the `shut off causes substantial recirculation within the pump, resulting in overheating of water in the casing and consequently, overheating of the pump.
6. Voltage during operation of pump-motor set should be within + 10% of rated voltage. Similarly, current should be below the rated current as per name plate on the motor.
7. Whether the delivery valve should be opened or closed at the time of starting should be decided by examining shape of the power-discharge characteristic of the pump. Pump of low and medium specific speeds draw lesser power at shut off head and power required increases from shut off to normal operating point. Hence in order to reduce starting load on motor, a pump of low or medium specific speed is started against closed delivery

valve. Normally the pumps used in water supply schemes are of low and medium specific speeds. Hence, such pumps need to be started against closed delivery valve. The pumps of high

8. specific speed draws more power at shut off. Such pumps should be started with the delivery valve open.
9. The delivery valve should be operated gradually to avoid sudden change in flow velocity which can cause water hammer pressures. It is also necessary to control opening of delivery valve during pipeline - filling period so that the head on the pump is within its operating range to avoid operation on low head and consequent overloading. This is particularly important during charging of the pumping main initially or after shutdown. As head increases the valve shall be gradually opened.
10. When the pumps are to be operated in parallel, the pumps should be started and stopped with a time lag between two pumps to restrict change of flow velocity to minimum and to restrict the dip in voltage in incoming feeder. The time lag should be adequate to allow stabilizing the head on the pump, as indicated by a pressure gauge.
11. When the pumps are to be operated in series, they should be started and stopped sequentially, but with minimum time lag. Any pump, next in sequence should be started immediately after the delivery valve of the previous pump is even partly opened. Due care should be taken to keep the air vent of the pump next in sequence open, before starting that pump.
12. The stuffing box should let a drip of leakage to ensure that no air is passing into the pump and that the packing is getting adequate water for cooling and lubrication. When the stuffing box is grease sealed, adequate refill of the grease should be maintained.
13. The running of the duty pumps and the standby should be scheduled so that no pump remains idle for long period and all pumps are in ready-to run condition.

    Similarly unequal running should be ensured so that all pumps do not wear equally and become due for overhaul simultaneously. If any undue vibration or noise is noticed, the pump should be stopped immediately and cause for vibration or noise be checked and rectified.
14. Bypass valves of all reflux valve, sluice valve and butterfly valve shall be kept in closed position during normal operation of the pumps.
15. Frequent starting and stopping should be avoided as each start causes overloading of motor, starter, contactor and contacts. Though overloading lasts for a few seconds, it reduces life of the equipment.

Additional Points for Operation of the Pumps

(a)Submersible pumps:

Correct rotations Pump is below static water level before starting, and continues to be below draw down level throughout the operation.

(b)Centrifugal pumps:

Correct rotations Pump is properly primed before starting if pump suction is negative.

(c)Vertical turbine pumps

- Pumps properly primed before starting
- Air vent to be fully opened before starting
- Correct rotation of pump.
- Pump should not be operated, if ratchet pins are missing
- Bowl assembly is completely submit

10.5.3. **Undesirable Operations**

Following undesirable operations should be avoided:

- Operation at Higher Head-The pump should never be operated at head higher than maximum recommended. Such operation results in excessive recirculation in the pump, overheating of the water and the pump. Another problem, which arises if pump is operated at a head higher than the recommended maximum head, is that the radial reaction on the pump shaft increases causing excessive unbalanced forces on the shaft which may cause failure of the pump shaft. As a useful guide, appropriate marking on pressure gauge be made. Such operation is also inefficient as efficiency at higher head is normally low.
- Operation at Lower Head-If pump is operated at lower head than recommended minimum head, radial reaction on the pump shaft increases causing excessive unbalanced forces on shaft which may cause failure of the pump shaft. As useful guide, appropriate markings on both pressure gauge and ammeter are made. Such operation is also inefficient as efficiency at lower head is normally low.
- Operation on Higher Suction Lift-If pump is operated on higher suction lift than permissible value, pressure at the eye of impeller and suction side falls below vapour pressure. This results in flashing of water into vapour. These vapour bubbles during passage collapse resulting in cavitation in the pump, pitting on suction side of impeller and casing and excessive vibrations. In addition to mechanical damage due to pitting, discharge of the pump also reduces drastically.
- Throttled operation-At times if motor is continuously overloaded, the delivery valve is throttled to increase head on the pump and reduce power drawn from motor. Such operation results in inefficient running as energy is wasted in throttling. In such cases, it is preferable to reduce diameter of impeller which will reduce power drawn from motor. Installation of variable voltage &variable frequency (VVVF) drive as a remedial measure is recommended
- Operation with Strainer/Foot Valve Clogged-If the strainer or foot valve is clogged, the friction loss in strainer increases to high magnitude which may result in pressure at the eye of the impeller falling below water vapor pressure, causing cavitation’s and pitting similar to operation on higher suction lift. The strainers and foot valves should be periodically cleaned particularly during monsoon.

- Operation with Occurrence of Vortices-If vibration continues even after taking all precautions, vortex may be the cause. All parameters necessary for vortex-free operation should be checked.

11.5.4. **Stopping the Pump**

(a) Stopping the Pump under Normal Condition

Steps to be followed for stopping a pump of low and medium specific speed are as follows:

- Close the delivery valve gradually (sudden or fast closing should not be resorted
- to which can give rise to water hammer pressures
- Switch off the motor.
- Open the air vent in case of V.T. and submersible pump.
- Stop lubricating oil or clear water supply in case of oil lubricated or clear water lubricated VT pump as applicable.

(b)Stopping after Power Failure/Tripping

If power supply to the pumping station fails or trips, actions stated below should be immediately taken to ensure that the pumps do not restart automatically on resumption of power supply. Though no-volt release or under volt relay is provided in starter and breaker, possibility of its malfunctioning and failure to open the circuit cannot be ruled out.

In such eventuality, if the pumps start automatically on resumption of power supply, there will be sudden increase in flow velocity in the pumping main causing sudden rise in pressure due to water hammer which may prove disastrous to the pumping main. Secondly, due to sudden acceleration of flow in the pumping main from no-flow situation, acceleration head will be very high and the pumps shall operate near shut off region during acceleration period which may last for few minutes for long pumping main and cause overheating of the pump. Restarting of all pumps simultaneously shall also cause overloading of electrical system. Hence, precautions are necessary to prevent auto-restarting on resumption on power.

Following procedure should be followed.

- Close all delivery valves on delivery piping of pumps if necessary, manually as actuators cannot be operated due to non-availability of power.
- Check and ensure that all breakers and starters are in open condition i.e. off-position.
- All switches and breakers shall be operated to open i.e. off-position.
- Open air vent in case of V.T. or submersible pump and close lubricating oil or clear water supply in case of oil lubricated or clear water lubricated V.T. pump. Information about power failure should be given to all concerned, particularly to upstream pumping station to stop pumping so as to prevent overflow.

11.5.5. **Pumping Machinery Maintenances**

(a) Daily

- Clean the pump, motor and other accessories.
- Check coupling bushes/rubber spider.
- Check stuffing box, gland etc.

(i) Routine observations of irregularities

The pump operator should be watchful and should take appropriate action on any irregularity noticed in the operation of the pumps. Particular attention should be paid to following irregularities.

- Changes in sound of running pump and motor
- Abrupt changes in bearing temperature.
- Oil leakage from bearings
- Leakage from stuffing box or mechanical seal
- Changes in voltage
- Changes in current
- Changes in vacuum gauge and pressure gauge readings
- Sparks or leakage current in motor, starter, switch-gears, cable etc
- Overheating of motor, starter, switch gear, cable etc.
-

(II) Record of operations and observations

A log book should be maintained to record the observations, which should cover the following items

- Timings when the pumps are started operated and stopped during 24 hours.
- Voltage in all three phases.
- Current drawn by each pump-motor set and total current drawn at the installation.
- Frequency.
- Readings of vacuum and pressure gauges.
- Motor winding temperature.
- Bearing temperature for pump and motor.
- Water level in intake/sump.
- Flow meter reading.
- Daily PF over 24 hour's duration.
- Any specific problem or event in the pumping installation or pumping system e.g. burst in pipeline, tripping or fault, power failure.

(b) Monthly Maintenance

- Check free movement of the gland of the stuffing box; check gland packing and replace if necessary. Clean and apply oil to the gland bolts.
- Inspect the mechanical seal for wear and replacement if necessary. Check condition of bearing oil and replace or top up if necessary.

(c) Quarterly Maintenance

- Check alignment of the pump and the drive. The pump and motor shall be decoupled while correcting alignment, and both pump and motor shafts shall be pushed to either side to eliminate effect of end play in bearings.
- Clean oil lubricated bearings and replenish with fresh oil. If bearings are grease lubricated, the condition of the grease should be checked and replaced/replenished to the correct quantity.
- An anti-friction bearing should have its housing so packed with grease that the void space in the bearing housing should be between one third to half. A fully packed housing will overheat the bearing and will result in reduction of life of the bearing.
- Tighten the foundation bolts and holding down bolts of pump and motor mounting on base plate or frame.
- Check vibration level with instruments if available; otherwise by observation.
- Clean flow indicator, other instruments and appurtenances in the pump house.

(d)Annual Inspections and Maintenance

A very thorough, critical inspection and maintenance should be performed by trained operator/Engineer once in a year.

Following items should be specifically attended.

- Clean and flush bearings with kerosene and examine for flaws developed, if any, e.g. corrosion, wear and scratches. Check end play. Immediately after cleaning, the bearings should be coated with oil or grease to prevent ingress of dirt or moisture.
- Clean bearing housing and examine for flaws, e.g. wear, grooving etc. Change oil or grease in bearing housing.
- Examine shaft sleeves for wear or scour and necessary rectification. If shaft sleeves are not used, shaft at gland packing's should be examined for wear.
- Check stuffing box, glands, lantern ring, and mechanical seal and rectify if necessary.
- Check clearances in wearing ring.
- Check impeller hubs and vane tips for any pitting or erosion.
- Check interior of volute, casing and diffuser for pitting, erosion, and rough surface.
- All vital instruments i.e. pressure gauge, vacuum gauge, ammeter, voltmeter,
- Check performance test of the pump for discharge, head efficiency.

11.5.6. **MAINTENANCE SCHEDULE FOR MOTORS**

(a) Daily

- Clean external surface of motor.
- Examine earth connections and motor leads.
- Check temperature of motor and check whether overheated. The permissible maximum temperature is above the level which can be comfortably felt by hand. Hence temperature observation should be taken with RTD or thermometer. (Note: In order to avoid opening up motors, a good practice is to observe the stator temperature under normal working conditions. Any increase not accounted for, by seasonal increase in ambient temperature, should be suspected).
  In case of oil ring lubricated bearing.
- Examine bearings to check whether oil rings are working.
- Note bearing temperature.
- Add oil if necessary.
- Check for any abnormal Bearing noise.

(b) Monthly

- Check belt tension. In case where this is excessive it should immediately be reduced.
- Blow dust from the motor.
- Examine oil in oil lubricated bearing for contamination by dust, grit, etc. (this can be judged from the colour of the oil).
- Check functioning and connections of anti-condensation heater (space heater).
- Check insulation resistance by mongering.

(c) Quarterly

- Clean oil lubricated bearings and replenishes fresh oil. If bearings are grease lubricated, the condition of the grease should be checked and replaced/replenished.
- Anti-friction bearing should have its housing so packed with grease that the void space in the bearing housing should be between one third to half. A fully packed housing will overheat the bearing and will result in reduction of life of the bearing.
- Wipe brush holders and check contact faces of brushes of slip-ring motors. If contact face is not smooth or is irregular, file it for proper and full contact over slip rings.
- Check insulation resistance of the motor.
- Check tightness of cable gland, lug and connecting bolts.
- Check and tighten foundation bolts and holding down bolts between motor and frame.
- Check vibration level with instrument if available; otherwise by observation.

(d) Half Yearly

- Clean winding of motor, bake and varnish if necessary.
- In case of slip ring motors, check slip-rings for grooving or unusual wear, and polish with smooth polish paper if necessary.

(e) Annual Inspections and Maintenance

- Clean and flush bearings with kerosene and examine for flaws developed, if any, e.g. wear and scratches. Check end-play. Immediately after cleaning, the bearings should be coated with oil or grease to prevent ingress of dirt or moisture.
- Clean bearing housing and examine for flaws, e.g. wear, grooving etc. Change oil or grease in bearing housing.
- Blow out dust from windings of motors thoroughly with clean dry air. Make sure that the pressure is not so high as to damage the insulation

- Clean and varnish dirty and oily windings. Re-varnish motors subjected to severe operating and environmental conditions e.g., operation in dust-laden environment, polluted atmosphere etc.
- Check condition of stator, stamping, insulation, terminal box, fan etc.
- Check insulation resistance to earth and between phases of motors windings, control gear and wiring.
- Check air gaps.
- Check resistance of earth connections.

11.5.7. **History Sheet**

Similar to history sheet of pump, history sheet of motor should be maintained. The history sheet should contain all important particulars, records of periodical maintenance, repairs, Inspections and tests. It shall generally include the following

- Details of motor, rating, model, class of duty, class of insulation, efficiency curve, type test result and type test certificate etc.
- Date of installation and commissioning.
- Addresses of manufacturer & dealer with phone & fax number and e-mail addresses.
- Brief details of monthly, quarterly, half yearly and annual maintenance and observations of inspections about insulation level, air gap etc.
- Details of breakdown, repairs with fault diagnosis.
- Running hours at the time of major repairs.

11.6. WATER METERS, INSTRUMENTATION TELEMETRY & SCADA

10.6.1. Repairs, Maintenance &Trouble Shooting of Water Meters

The water meters are mechanical devices, which normally deteriorate in performance over time. The fact that a meter does not show outward signs of any damage and has a register that appears to be turning does not mean that the meter is performing in a satisfactory way.

It is necessary to ascertain the following preventive cares for water meter after proper installation:

Breakdown maintenance:-

Replacement of broken glass, lid and fallen wiper wherever provided: - These are the only basic breakdowns observed during periodical inspection. If a meter found not working, then it shall be removed immediately and sent to meter service workshop. In meter workshops normally following steps are performed to carry out the repairs:

- Disassembling of water meters including strainer, measuring unit, regulator, registering device, etc.
- Clean all disassembled spare parts in detergent solution in warm water.
- Inspect the cleaned parts and replace worn parts and gaskets, if any.
- Inspect the meter body spur threads and cover threads.
- Inspect the sealing surface on meter body and paint the meter body, if necessary.
- Inspect the vane wheel shaft pinion, bearing & pivot.
- Inspect the vane wheel chamber.
- Reassemble the water meter properly after reconditioning.
- Calibrate & test the repaired water meter for leakage & accuracy as per IS 678410. Make entry in the life register of that water meter for keeping history record.

11.6.1.1. Prevention of Tampering Of Water Meters

In order to prevent tampering, following precautions should be taken:

- The water meters, shall be installed properly in the chamber with lock and key or in the C.I. covers with lock and key in order to avoid tampering.
- The water meters must be sealed properly.
- The water meters shall not allow reversible flow; it should register flow in forward directions only.
- The water meter dials should be easily readable without confusions.
- The lid, glass of water meters must be made up of tough materials as per IS 779 and shall be replaced timely.
- The wiper or dial as far as possible is avoided.
- In case of magnetically coupled meters, the proper material to shield magnets must be provided in order to avoid the tampering of such meter by outside magnets in the vicinity of meter.
- Periodical inspection/checking at site is essential to ensure the proper working of meter.
- Special sealing arrangements may be necessary and provided for bulk meters where by unauthorized removal of the meter from the connection can be detected. In addition to the above, to tackle the problems of tampering suitable penalty provisions/clauses shall be there in the rules or the water supply agreement with the consumer. This will also discourage the consumer tendencies of neglecting water meter safety.

11.6.1.2. Automatic Water Metering Systems

Water meter is a cash register of a WUA. Consumption based water rates require periodic reading of meters except in remote or automated meter reading of meters. Except in remote or automated meter reading these readings are usually done by meter readers visiting consumers premises one by one and noting down the indicator reading by the meter.

These readings are recorded manually in books or on cards and later keyed in manually to a customer accounting or billing system. In some cases, meter readers use Hand held Data Entry Terminals to record meter readings. Data from these devices are transferred electronically to a billing system. In other cases, key entry has been replaced by mark-sense card readers or optical scanners.

The environment of meter reading usually is not favorable to the meter reader as most of the water meters are installed in underground chamber; these chambers are filled in many cases with water, reptiles or insects.

The data can be captured by the meter readers from the meter in one of the following ways.

- Manual entry into meter books.
- Manual entry into portable hand held entry terminals or recorders.
- Direct electronic entry from meter registers either into portable data terminals or display units from which readings are transcribed in the field.
- Telemetry link through radio, telephone.

11.6.2. Instrumentation

Presently there is a lack of instrumentation in Pipe Distribution Network system of Irrigation sector but in future more instrumentation is expected to be practiced in the following areas:

11.6.2.1 Pressure Measurement

In Pipe Distribution Network system network pressure parameter plays very important role in order to get sufficient water to the consumers. Similarly, in flow measurement by differential pressure type flow meter, differential pressure measurement across the primary element is the main physical parameter to inter link with flowing fluid. This pressure or differential pressure measurement is accomplished with the help of following methods in water works:

- Manometers
- Elastic Pressure Transducer
- Electrical Pressure Transducer

11.6.**3 Operation and Maintenance of Capacitors**

The supply voltage at the capacitor bus should always be near about the rated voltage. The fluctuations should not exceed + 10% of the rated voltage of the capacitor.
Frequent switching of the capacitor should be avoided. There should always be an interval of about 60 seconds between any two switching operations.
The discharge resistance efficiency should be assessed periodically by sensing, if shorting is required to discharge the capacitor even after one minute of switching off. If the discharge resistance fails to bring down the voltage to 50V in one minute, it needs to be replaced.
Leakage or breakage should be rectified immediately. Care should be taken that no appreciable quantity of imp- regnant has leaked out.
Before physically handling the capacitor, the capacitor terminals shall be shorted one minute after disconnection from the supply to ensure total discharging of the capacitor.
Replace capacitor if bulging is observed.

11.6.3.1General guidelines for maintenance of different types of water hammer control devices as follows

(1)Surge Tank and One-Way Surge Tank

Quarterly:

Water level gauge or sight tube provided shall be inspected, any jam rectified, all cocks and sight tube flushed and cleaned.

Yearly:

The tank shall be drained and cleaned once in a year or earlier if frequency of ingress of foreign matter is high.

Valve maintenance:

Maintenance of butterfly valve, sluice valve and reflux valve shall be attended

Painting: Painting of tanks shall be carried out once in 2 years.

Air-Vessel
Daily:

- Check air-water interface level in sight glass tube.
- The air water level should be within range marked by upper and lower levels and shall be preferably at middle.
- Check pressure in air receiver at interval of every 2 hours.

Quarterly:

- Sight glass tube and cock shall be flushed.
- All wiring connections shall be checked and properly reconnected.

- Contacts of level control system and pressure switches in air supply system shall be cleaned.

  Yearly:

- The air vessel and air receiver shall be drained, cleaned and dried.
- Internal surface shall be examined for any corrosion etc. and any such spot cleaned by rough polish paper and spot-painted.
- Probe heads of level control system shall be thoroughly checked and cleaned a*ccessories :*
- Maintenance of panel, valves and air compressor etc. shall be carried out as specified for respective appurtenances.

  Zero-Velocity Valves and Air Cushion Valve

  Foreign matters entangled in valve shall be removed by opening all hand holes and internal components of the valves including ports, disk, stem, springs, passages, seat faces etc. should be thoroughly cleaned and checked once in 6 months for raw water and once in a year for clear water application.

11.6.4. **Telemetry and SCADA Systems**

11.6.4**.1 Manual Monitoring**

Normally the Managers of O&M of water scheme monitor levels in Delivery Chamber pressures and flows in a distribution system and on operation of pumps such as hours of pumping and failure of pumps and monitor water quality by measuring residual chlorine. The line department usually uses the telephone line or wireless unit to gather the data, uses his discretion gained with experience and takes decisions to ensure that the system is operating with required efficiency. Manual collection of data and analysis may not be helpful in large undertakings if water utilities have to aim at enhanced customer service by improving water quality and service level with reduced costs. This is possible if the management acquires operational data at a very high cost.

11.6.4**.2 Telemetry**

The inspection, monitoring and control of O&M of a water can be automated partially through telemetry. Telemetry enables regular monitoring of the above data on real time basis and the data is provided to anyone in the organization who can review the data and take decision. In Telemetry system probes/sensors will be used which will sense and generate signals for the level, pressure and flow in a given unit and transmit the signals by radio/by Telephone. Normally radio link is used and telephone line with modem is used as spare communication. Microwave satellite or fiber- optic transmission systems are also used for data transmission. The water pumping stations may communicate via a cable buried with the pipe. However, there may be locations where the main power may not be available and hence solar panels with a battery charger are used to power the remote terminal unit (RTU) and the radio.

In urban areas RTU s can communicate on cell phones and or packed radio networks. For remote locations satellite technology is also available.

(i)Data for collection by telemetry

The data includes levels in Service reservoirs, pressures and flows in a distribution system, Flows/quantity of delivered into a SR and data on operation of pumps such as Voltage, amperes, energy consumed, operating times and down times of pumps and chlorine residuals. In a telemetry system up-to the minute real time information is gathered from remote terminal unit located at the water treatment plant, reservoir, flow meter, pumping station etc. and transmitted to a central control station where the information is updated, displayed and stored manually or automatically.

(ii) Processing data from telemetry

The meter readings from reservoirs are useful information for managing the distribution system and helps in preventing overflow from reservoirs. However the effectiveness of Telemetry in pumping operations is dependent on reliability of instrumentation for measuring flows, pressures, KWh meters, etc. Standard practice is to calculate pump efficiency and water audit calculations on a monthly basis. Telemetry can also be used to supervise water hammer protection system wherein the pump failures are linked to initiate measures to prevent occurrence of water hammer.

(iii)SCADA Systems (Supervisory Control and Data Acquisition)

Supervisory Control and Data Acquisition (SCADA) systems provide control functionality and alarms at Pipe Distribution Network system scheme sites which in many cases are very remote. These systems were often used to solve single problems such as reducing power cost, or improving control of a particularly complex operation. The installation of SCADA has subsequently been seen as a means to satisfy a variety of increasing pressures such as farmers demands, regulatory requirements, and to also satisfy the need to reduce operational costs. The deployment of SCADA systems has been extended to cover large rural water supply schemes and has been found very effective.

An important challenge to the commercial success of the organization is to harness the data collection power of the SCADA systems to provide a wealth of operational information to all levels of the organization. Past systems that have been installed in some of the water treatment plants have failed to meet expectations regarding data availability. This has primarily been attributed to difficulties associated with merging traditional engineering and new IT methodology, and a lack of system openness in data interconnectivity and communications.

(iv) Remote Terminal Units (RTU)

A Remote Terminal Unit (RTU) is a microprocessor-controlled electronic device that interfaces objects in the physical world to a SCADA (supervisory control and data acquisition system) by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system. Modern RTUs are usually capable of executing simple programs autonomously without involving the host computers of SCADA system to simplify deployment, and to provide redundancy for safety reasons.

An RTU in a modern water management system will typically have code to modify its behavior when physical override switches on the RTU are toggled during maintenance by maintenance personnel. This is done for safety reasons; a. miscommunication between the system operators and the maintenance personnel could cause system operators to mistakenly enable power to a water pump when it is being replaced, for example.

Further the following preferences relevant national & International Standards on meters are available:

- IS 779-1994: Water meters (Domestic type) – Specification (Sixth revision).
- IS 2373-1981: Specifications for water meters (Bulk type) (Third revision)
- IS: 6784: Testing of Water meter4.
- BS: 5728: Measurement of water flow in close conduits,
- Part-I: Specifications for meters for cold potable Water
- Part – II : Specification for installation requirements for meters
- Part – III: Methods for determining principal characteristics of meters.
- ISO: 4064: Measurement of water flow in close conduits,
- Part-I-Specification for meters for cold potable Water.
- Part – II : Installation requirement
- Part – III: Test methods and equipment

11.7 Repairs of Pipe Distribution System

It is one of the most important responsibilities of a Water Undertaking to properly maintain the transmission and distribution mains in order to prevent waste and provide a constant pressurized flow of water to the farmers. It is equally important to prevent damage to the public property which could arise for not properly repairing a defective pipe. Proper planning and implementation of remedial measures will avoid leakages and breakdowns.

When any system goes wrong or partially damaged, it requires repairs. Repairs requires detail analysis of problem and evaluation extent of damage. The estimate of repairs requires careful consideration and particularly rate analysis should be realistic and rational.

11.7.1. CAUSES OF FAILURE IN PIPELINE

For proper planning for the operation of the repair work it is necessary to assess the probable causes of failure. Following guidelines outline some of the factors to be duly considered to ensure protection of pipes from damage/failure.

11.7.1.1 HANDLING AND STORAGE OF PIPES

1. Damage during transport of the piping material.
2. Defective stacking and storage.
3. Damage to the pipe wall and coating.
4. Cracks in pipe during careless unloading and pipes striking against each other.
5. Weathering effect due to unfavorable environment.
6. Mixing up of different classes of pipes and their jointing materials.

11.7.1.2 LAYING OF PIPELINE

1. Deviation from proper laying procedures.
2. Improper bedding
3. Loss of support of bedding after laying.
4. Slipping of trench sides.
5. Sinking of soil after laying.
6. Poor quality of backfill material.
7. Improper compaction of trench backfill and its subsequent settling.
8. Excessive overburden on piping trenches, not taken care of during the design of pipeline.
9. Point loads coming on the pipe through the backfill.
10. Excessive vibrations due to traffic during the laying of pipeline

11.7.1.3 JOINTING OF PIPES

1. Defective jointing material.
2. Direct strike on the body of the pipe with any sharp edge, while jointing.
3. Slipping of jointing material like rubber ring or lead etc.

11.7.2. SPECIAL OBSERVATIONS ON FAILURE OF PIPES

11.7.2.1 PIPE BARREL

Certain failures connected with the deterioration of the barrels of pipe are given below.

11.7.2.1.1 Brittle type fractures

These may be found in rigid and semi-rigid materials such as cast iron, asbestos cement and PVC.

These are characterized by relatively clean, sharp-edged splits or cracks.

These may occur as circumferential breaks or longitudinal cracks which may run straight but more often irregularly curved along the pipe barrel.

11.7.2.1.2. Ductile type failures

These occur in polyethylene and ductile iron. These are usually found as relatively short splits or tears with irregular edges which are often associated with some local swelling around the break.

11.7.2.1.3. C Blow Outs

These are localized failures which only occasionally occur and are usually associated with high pressure, e.g. pumping surges in weakened brittle materials.

11.7.2.1.4. Pinholes

These may be caused by an impurity or inclusion in the wall of the pipe wall or, more often, by localized chemically or electrically induced corrosion which thins and weakens the pipe wall until a small plug is blown out by internal pressure. Pinholes often enlarge quite quickly due to erosion around the edges of the hole. Pin holes are frequently found within the metallic group of pipes.

11.7.2.1.5. Generalized Deterioration

More generalized deterioration of pipe barrel may be due to a manufacturing defects but is usually the result of some form of chemical attack. The overall effect is reduction in wall strength depending on the material group. Some of the examples are the graphitization of iron mains, sulphate attacks on AC and concrete, lime leaching from cement lining by soft waters and solvent attacks on the polymeric group of materials leading to softening or delamination of composites such as GRP.

11.7.2.2. FAILURE AT PIPE JOINTS

Some of the points for consideration are given below:

11.7.2.2.1 General

1. Failures may occur due to originally careless installation practices causing displacements of the seal and/or eventual separation of the mating surfaces.
2. Stress cracking of pipe material around the joint.
3. Biodegradation of the sealing components.

11.7.2.2.2 Flanged connections

Stress cracking of the flange can occur due to unequally tightened bolts. Such a situation arises during ground movement or the forceful activation of a valve or hydrant.

11.7.2.2.3. Crushing of pipe ends

Cracking may occur due to crushing of pipe ends when they touch or bind and are then subjected to high compressional or bending forces.

11.7.2.2.4 Lead joints

Hardening of lead in association with joint movement may lead to 'weeping' which gradually develops into a more serious leak.

11.7.2.2.5 Sealing rings or gaskets

Many mechanical joint designs rely upon the compression of sealing rings or gaskets which have varying compositions and different resiliences. The physical breakdown (e.g. biodegradation) or change of resilience with time can lead to leaking joints. The loss of compression combined with corrosion of pressure rings or collars or the bolts may aggravate the breakdown.

11.7.3. REPAIR ACTION PLAN

GENERAL PROCEDURE

Following procedure may be followed:

1. Internal mobilization.
2. Detection of pipe failure: Inspection of site
3. Notification of interruption in water supply and related issues.
4. Location and demarcation
5. Repair planning
6. Repair work: Selection of most appropriate method for repair.
7. Testing of 'dry' repair.
8. Restoration
9. Completion
10. Hygiene
11. Notice of restoration and completion

The typical Repair Estimate of Pipe Line is Given **Annexure No 7 To 9**

CHAPTER - XII

ESTIMATE PREPARATION GUIDLINES.

Guidelines for Estimation of Pipe Distribution Network.

12.1 Preamble :

The Govt. Vide GR dtd. 9.6.2016, has declared the PDN policy. Then the Govt. vide GR dtd. 13.1.2017 and 2.2.2017, issued the guidelines regarding PDN policy. The Govt. vide GR dtd. 2.5.2017, issued the policy to finalize the distribution system by keeping in mind the ultimate target of micro irrigation system by providing/using decentralized storages in the command area as far as possible.

Preparation of detail estimates of PDN system involves various activities of estimation of survey, design, PDN Network and maintenance etc.

Following methodology shall be necessary for proper estimation of various activities for PDN work.

12.2 Estimation of Detailed Survey, Alignment, Design and Approval of Pipe Distribution Network.

12.2.1 Estimate for Command Area :

The Detailed Command area survey shall be carried out at contour interval of 0.2 to 1 m. There shall be provision of super imposition on village map and details of all types of water storages like Water Tank, K.T. Weirs, Cement Nalla Bandhs, Wells, Farm Ponds and Nallas etc. in the estimate. Provision in the estimate of survey shall also include identification and markings of Forest Area, Residential area, existing roads, Horticultural farms, Electric Poles, village boundary etc. The list of benefitted farmers clearly showing individual G.C.A., C.C.A. and I.C.A. should be prepared.
The digitization of all types of above maps shall be included in the estimate.
The Rate shall be worked out according to above listed activities on C.C.A. by Ha. Basis

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12.2.2 Item of Alignment survey :

As per detailed survey of Command area, provision of PDN alignment survey shall be in the estimate. Provision of Alignment survey, marking on ground, geo mapping on ground, alignment finalisation shall be in the estimate.

12.2.3 Item of Detail design of PDN :

Provision of detail design based on various guidelines shall be on the basis of CCA Ha area of PDN.

12.2.4 Items to be covered in the Detailed Estimate of PDN :
The estimate should be comprising of
1) Head Regulator, 2) Delivery Chamber, 3) Valve Cabin, 4) PDN System and 5) Handing over the scheme to WUA and Commissioning, Running and Maintenance of entire PDN system for five years

- **Head Regulator :**

Head regulator is the important flow controlling structure in PDN. The detailed estimate along with trash rack and M.S. Service gate on the basis of design should be prepared.

- **Delivery Chamber**

For delivering water through PDN at required level, the structure is necessary. The detailed estimate along with M. S. Ladder on the basis of design should be prepared.

- **Valve Cabin :**

Size of Valve Cabin should be sufficient to accommodate flow meter and Sluice Valves. The detailed estimate should be prepared and provision should be made accordingly.

- **Pipe Distribution Network :**

1. Excavation of Trench of pipes in all strata – Excavation quantities for soil, hard murum, soft rock and hard rock etc. Should be calculated separately and clubbed together in the name of Excavation in all strata for all leads and lifts. Additional 10% quantity of excavation should be considered for profile correction of trench. Minimum bottom width of excavation trench should be 1.5 times outer dia. Of pipe in mm + 300 mm. In no case, bottom width should be less than 600 mm. Sufficient bed width should be provided at places where shoring and strutting is necessary. If depth of excavation is more than 3 m, then berm of minimum width 3.0 m on one side shall be provided. If necessary, the provision for dewatering should be made.
2. Murum/Sand Bedding for laying of pipe as per strata classification – Murum bedding should be of depth 20 Cms for full width of trench. When the excavation for pipe trench is in Hard Strata and in more depth, sufficient quantity of murum may not be available for filling. Provision of murum from quarry (Borrow Area) shall be made if proper murum for bedding is not available. Where, the sand is available by cheaper rate, sand bedding can also be made.
3. Providing, lowering, laying and jointing of Pipes – According to the sanctioned design, necessary provision for various types and dia. Of pipes should be made.
4. Provision for Specials with X-Ray Testing – For short pipes, bends etc. necessary provision should be made.
5. Provision of various types of valves, viz. Kinetic Air Valve, NRV, Scour Valves, Sluice Valves etc.- The locations of Various types of Valves are

finalised during the sanction of design. Accordingly, necessary provision should be made in the estimate.

6. Provision for shaft – According to the no. Of Kinetic Air Valves, the provision for shaft should be made.

7. Provision for thrust blocks/ Anchor block etc – When the alignment is passing on the ridge, for passing the thrust, necessary thrust blocks should be provided and the provision for the same should be made.

8. Hydraulic Testing of Pipe – After the work of laying of pipe line is completed and before putting it into commission, the pipe line is to be tested in the field for its designed pressure and leakage. Necessary provision for the same should be made.

9. Back Filling with available and borrow material and disposal of Excess Excavated Material - When the excavation for pipe trench is in Hard Strata and in more depth, sufficient quantity of murum may not be available for filling. Provision of murum from quarry (Borrow Area) shall be made if proper murum for back filling is not available. After back filling, any excess material likely to be piled on trench shall be disposed off at suitable locations. So, provision for excess material after backfilling shall be done in the estimate.

10. Outlet Chambers - According to the sanctioned design, necessary provision for outlet chambers should be made. They should be in concrete. Sluice Valve along with M.S. Manifold should be provided for each outlet.

11. Provision for Pipe Pushing for various crossings – If the alignment crosses roads, railway line, then necessary provision should be made in the estimate.

12. Flow Meter – It is essential for volumetric supply of water. Necessary provision for the same is essential.

- **Handing over the scheme to WUA and Commissioning, Running and Maintenance of entire PDN system for five years :**

This is classified under 3 different works viz. Repairs, Operation and Maintenance.

Repair Works :

The repair work of PDN consists of all kinds of major and minor repairs to system to work done by Contractor.

Operation :

It consists of providing supervisory staff and unskilled labor for distribution of water. Watch and guard of Valves, PDN system and other structures on PDN and all concern work of irrigation management etc.

Maintenance :

The maintenance of PDN network consists all kind of maintenance required to run the scheme satisfactorily for five years.

Necessary provision under this item should be as under :

Work Cost up to Rs. 10.00 Cr.	**-**	**0.8%/per year**
Work Cost between Rs. 10 & 25 Cr.	**-**	**0.6%/per year**
Work Cost beyond Rs. 25 Cr.	**-**	**0.4%/per year**

Provision of various taxes to be made in the estimate :

The rates of all items are exclusive of G.S.T. Therefore necessary provision for G.S.T. should be made in the Recapitulation Sheet of the estimate. Necessary provision for Royalty Charges and Insurance Charges wherever applicable should be made in the Recapitulation Sheet of the estimate.

CHAPTER - XIII

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ANNEXURES

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ANNEXURE I

LIST OF PDN HANDBOOK COMMITTEE MEMBERS
(Maharashtra Government Water Resources Department)
Miscellaneous-2019/ (Case No:-3/2019)/ Date-12/02/2019

SR. NO.	NAME	ORGANIZATION
1	Shri. N. V. Shinde.	Director General Maharashtra Engineering research institute
2	Shri. A.P. Kohirkar.	Chief Engineer Water Resources Department, Aurangabad.
3	Shri. A.P. Awhad.	Chief Engineer Water Resources Department, Aurangabad.
4	Shri. R.R. Shaha.	Chief Engineer (Civil), Hydropower Project & Quality Control Pune.
5	Shri. A. R. Kamble.	Chief Engineer Gosikhurd Project Circle, Nagpur
6	Shri. G. M. Shaikh..	Chief Engineer Gosikhurd Project Circle, Nagpur
7	Shri. D. R. Mohite.	Chief Engineer Water Resources Department, Pune.
8	Shri. S. D. Kulkarni.	Chief Engineer Water Resources Department, Konkan Region, Mumbai.
9	Shri. S. D. Kulkarni.	Chief Engineer Tapi Irrigation Development coporation, Jalgaon.
10	Shri.R. E. Upasani.	Chief Engineer Central Designs Organization, Nashik.
11	Shri. P. G. Mandade.	Chief Engineer Central Designs Organization, Nashik.

Special Invitee

SR. NO.	NAME	ORGANIZATION
1	Shri. R. P. Landekar.	Chief Engineer Water Resources Department, Amaravati
2	Shri. C. N. Mali	Superitending Engineer (canals), Central Designs Organization, Nashik.
3	Shri. S. N. Kulkarni	Executive Engineer Canal design Division No- 04, Central Designs Organization, Nashik.

Vote of Thanks

SR. NO.	NAME	ORGANIZATION
1	Miss. P. S. Dongre.	Assistant Engineer, Grade II, Canal Design Division No. 04, Central Designs Organization, Nashik.
2	Miss. P.D. Bawage.	Junior Engineer, Canal Design Division No. 04, Central Designs Organization, Nashik.
3	Shri. K. Sawant	Assistant Engineer, Grade II, Quality Control Circle, Aurangabad
4	Shri. S. Shaikh	Technical Assistant, Quality Control Circle, Aurangabad
5	Mrs. M. S. Tejale	Assistant Engineer, Grade I, Chief Engineer, Hydropower Project, Pune.
6	Shri. A. Kulkarni	Assistant Engineer, Grade II, Chief Engineer, Hydropower Project, Pune.
7	Shri. V. R. Muntode	Junior Clerk. Canal Design Division No. 04, Central Designs Organization, Nashik.

ANNEXURE II

Proforma for Limits of Operational Parameters

Sr. No.	Parameters	Specification	Max. Limit	Min. Limit
1	HT AC Voltage –			
2	Frequency			
3	Motor Current – Without capacitor - with Capacitor - Nodal			
4	DC Voltage			
5	Auxilary Transformer LV side AC Voltage			
6	Pump Cooling Pressure			
7	Motor / Thrust Bearing			

ANNEXURE III

Proforma fortechnical information of pumping machinery

(To be submitted by Field Office)

A	**Pumps**	
	Pump type/ Make	
1	Pump Hp / Nos.	-
2	Duty head (m)	-
3	Duty dischange (m/sec) per pump	-
4	Pump rpm	-
5	Bkw duty paint	-
B	**Motor**	
1	Motor Type / make	-
2	Motor kw	-
3	Voltage Rating (KV)	-
4	Full load curent (A)	
	1) With capacitor	-
	2) Without capacitor	-
	3) No load	-
C	**Valves**	
a)	NRV	
	1) Type / Make	-
	2) Dia (mm) /PN rating	-
b)	BFV	
	1) Make	-
	2) Dia (mm) /PN rating	-
c)	KAV	
	1) Make	-
	2) Dia (mm) /PN rating	-
D	**H.T. switch**	
1	Rating / Make	-
2	Feeder details	-
	a) Incomer – 1 No	-
	b) Outgoving Moter feeder- 5 Nos.	-
	c) Copacitor – 1 No	-
	d) Anx. Transformer	-
E	**L.T. Switch Gear Panel**	
	1) Make	-
	2) Feeders	-
F	**Capacitor**	
	1) Rating / Make - 4 Nos.	-
G	**Soft Starter**	-
H	**EOT Crane –**	
	Make / Capacity	-

	Span	
K	**Axillary equipments used**	
1	R.C. Desk	-
2	Temp Scanner	-
3	Water Level Indicater	-
4	DCDB	-
5	Batteries (55 Nos, 110 V)	-
6	Battery charger	-
7	HT/LT Cables	-
8	Forced water Lubrication system	-
J	**Axu. Transformer**	-
	Rating/ Type /Make/Type	

ANNEXURE IV								
..... LIFT IRRIGATION SCHEME - STAGE -								
Pump Set Status Report (To be filled & submitted by field officer)								
Component ⇒ / Status ⇓	Pumping Machinery				Electrical system			Remarks
	Pump	HOPD	REJ	KAV	H.T. Motor	Motor Feeder	Capacitor	
Pumpset 1								
Pumpset 2								
Pumpset 3								
Pumpset 4								
Pumpset 5								
Pumpset 6								
Pumpset 7								
Pumpset 8								
Pumpset 9								
Pumpset 10								
Pumpset 11								
Pumpset 12								
Pumpset 13								
Pumpset 14								
Pumpset 15								
Pumpset 16								

ANNEXURE V

Check List of HT Panel

Sr. No.	Description	Incomer	M/F 1	M/F 2	M/F 3	M/F 4	M/F (Spare)	C/F	T/F	Remarks
1	Checking of VCB Rack 'IN' & Rack 'OUT' operation									
2	Checking of ON/OFF operation of VCB (Electrical)									
3	Checking of ON/OFF operation of VCB (Mechanical)									
4	Checking of Indications									
5	Checking of Trippings									
6	Tightening of HT Cables									
7	Checking of Control cable Termination									
8	Checking of TNC/Local/Remote Switch.									
9	Tripping with Electrical Emergency Push button									
10	HV/IR testing									

ANNEXURE VI

Check List of Remote Control Panel

Sr. No.	Description	Incomer	M/F 1	M/F 2	M/F 3	M/F 4	M/F (Spare)	C/F	T/F	Remarks
1	Checking annunciation									
2	Checking of valve Open/Close operation									
3	Checking of valve Stop operation									
4	Checking of Indications									
5	Checking of ON/OFF operation of Booster Pump									
6	Checking of Pump operation with logic									
7	Checking of Pump operation without logic									
8	Checking of Control cable Termination									
9	Checking of TNC/Local/Remote Switch.									

ANNEXURE VII

Inspection check list for Pump and Valves

Sr. No.	Description	Pump No. 1	Pump No. 2	Pump No. 3	Pump No. 4	Pump No. 5	Pump No. 6	Pump No. 6	Pump No. 7	Remarks
Pump										
1	Checking Foundation bolts of Stool and Motor									
2	Checking Pump Motor Coupling Bolts									
3	Checking of Oil Level Indicator availability and operation									
4	Checking Manual Spinning									
5	Checking of Stuffing Box, Gland packing and lock plate									
6	Checking information of last rotation (working/non working)									
7	Checking of Cooling system along with all valves, joints and fittings									
8	Checking of Pressure Gauge with Isolation Valve (working/non working)									
9	Checking of Air Vent Drain pipe									
10	Checking of Thrust Rod with all bolts									

Stage -

BFV										
Sr.No.	**Description**	**Pump No. 1**	**Pump No. 2**	**Pump No. 3**	**Pump No. 4**	**Pump No. 5**	**Pump No. 6**	**Pump No. 6**	**Pump No. 7**	**Remarks**
1	Checking Valve Body, bolts & gasket									
2	Checking Actuator (working/non working)									
3	Checking Manual Operation									
4	Checking Actuator Operation									
5	Checking for stucking of valve at any position (top, intermediate, bottom)									
6	Checking for leakages in valve seat ring									
7	Checking for leakages in DE & NDE shaft seals									

NRV										
Sr. No.	**Description**	**Pump No. 1**	**Pump No. 2**	**Pump No. 3**	**Pump No. 4**	**Pump No. 5**	**Pump No. 6**	**Pump No. 6**	**Pump No. 7**	**Remarks**
1	Checking Valve Body, bolts & gasket									
2	Checking By pass arrangement (working/non working)									
3	Checking for stucking of valve at any position (top, intermediate, bottom)									
4	Checking for leakages in valve seat ring									
5	Checking for leakages in DE & NDE shaft seals									

KAV										
Sr. No.	**Description**	**Pump No. 1**	**Pump No. 2**	**Pump No. 3**	**Pump No. 4**	**Pump No. 5**	**Pump No. 6**	**Pump No. 6**	**Pump No. 7**	**Remarks**
1	Checking Riser pipe for corrosion and punctures									
2	Checking operation of Isolating Sluice valve (working/non working)									
3	Checking for leakages from gasket									
4	Checking for nut bolts									
5	Checking for orifice & timber balls									

Delivery pipe										
Sr. No.	**Description**	**Pump No. 1**	**Pump No. 2**	**Pump No. 3**	**Pump No. 4**	**Pump No. 5**	**Pump No. 6**	**Pump No. 6**	**Pump No. 7**	**Remarks**
1	Checking Delivery pipe for corrosion and punctures									
2	Checking leakages									
3	Checking Saddles & supports									
4	Visual Checking of welding joints									

Typical Repair ,Estimate ,Abstract For REPLACEMENT OF AIR VALVE FOR P/W RISING MAIN				
	ABSTRACT			
QTY	**ITEM No 1**	**RATE**	**UNIT**	**AMOUNT**
	Providing & fixing in positin air valve shaft including Providing & fixing GI medium class or 6 mm thick MS pipe shaft 2.70 m long over branch flange of air valve tee,providing PCC block of M-150 concrete 150 mm thick around the air valve tee including encasing of vertical shaft in PCC M-150 as shown in type design together with providing & making flanged joint wherever required and fixing of air valve over the shaft excluding cost of air valve & branch flanged air valve tee etc. complete as per type design and as directed by Engineer-in-charge for following diameters of pipe lines(type design attached)			
10	foundation in BC soil 200 to 400 mm dia	6917.4	No	69174
	Rs. 6588 + 5 % sugarcane Ara			
	(MJP, DSR 2018-19 P N241/17)			
	ITEM No 2			
	Providing & supplying Kinetic Double Orifies type Air Valve as per MJP's standard specifications combined with screw down isolating valve , small orifies elastic ball resting on a gun metel orifies nopple, large orifies vulcanite ball seating on moulded seat ring, inlet face and drilled, including all taxes (Central and Local), insurance ,third party inspection charges, loading ,unloading,transportation upto departmental stores /site etc.omplete.			
13	100 mm Kinetic Air Valve Double ball flanged type PN-1.6	13916	No	180908
	(MJP, DSR 2018-19 P N 235/9 b)			
	ITEM No 3			
	Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in C.M. 1:5 Proportion precast RCC frame and cover, etc. complete as directed by Engineer-in-charge.			
3	For existing Sluice Valve 90 x 90 cm internal size and depth upto 1.2 m	10045.4	No	30136.05
	Rs.9567 + 5 % Sugarcane charges			
	(MJP, DSR 2018-19 P N 69/4/14)			
	ITEM No 4			

	Providing & fixing in position M.S. Air boxes fabricated with 2 mm thick M.S, plate 30 x30 x 3 mm size MS angle frame ,concreting in M-150 for fixing the box in position , applying two coats of oil painting , painting changes ,locking arrangement etc. comp. as directed by Engineer-in-charge.			
10	For Double ball air valve	2764.65	No	27646.5
	Rs. 2633 +5 % sugarcane Area			
	(MJP, DSR 2018-19 P N 69/5/14)			
	Total RS			**307864.55**
	Add 5 % Contengencies Charges Rs.			**15393.23**
	Add 2 % W.C. Charges Rs.			**6157.29**
	Total RS			**329415.07**
	Say Rs			**329415.00**

ANNEXURE VIII

Estimate for Removing Leakage of Air Valves & Pipe Lines

ABSTRACT

Quantity	Description of Item	Rate	Unit	Amount
	Item No.1:- Repairs of 457 mm dia M.S. Pipe & expansion joint including necessary excavation cutting M.S. Pipe welding new M S plate at leakage portion, including cost of welding rod hire charges of welding machine cable rubber rings labour charges and refilling the trenches after water tightness test including opening and closing scour valve for emptying the section and dewatering if required etc. complete…			
12.00	a) Repairs of 457 mm dia M.S. Rising Main (Rate as per Rate Analysis)	13401.00	No	160812.00
15.00	b) Maintenance & Repairs 457 mm dia expansion joints	14600.00	No	219000.00
	(Rate as per Rate Analysis)			
	Item No. 2:- Repairs of following dia P.S.C. Leading Main of Leakages and Soket and Circumferencial Crack including necessary excavation Cost of araldite hardner and M Seal Filter sand, rubber rings including Labour charges for putting rubber rings in proper Position including applying cost of araldite hardner and M Seal including, providing & fixing M.S. Jacket including nut and bolts required for fixing including filling the portion between pipe and jacket by C M 1:1 including dewatering wherever necessary etc. complete as directed by the Engineer in charge			
45				987300.00
	For 470, 400, 350mm dia P.S.C. Leading Main	21940.00	No	
	(Rate as per Rate Analysis)			
	Item No. 3 :- Repairs of following D. I. pipe line including necessary			

5.00	A) For 400 mm, dia D. I. K-9 Rising Main / Gravity Mains	17445.00	No.	87225.00
2.00	B) For 450 mm, dia D. I. K-9 Rising Main / Gravity Mains **(Rate as per Rate Analysis)**	18189.00	No.	36378.00
	Item No. 4:- Repairs of following dia and class P.V.C. Leading Main			
15	a) For 90 mm dia P.V.C. 6kg/cm^2	10290	No.	154350.00
15	b) For 140 mm dia P.V.C. 6kg/cm^2	12579	No.	188685.00
18	c) For 160 mm dia P.V.C. 6kg/cm^2	15206	No.	273708.00
11	d) For 200, 180 mm dia P.V.C. 6kg/cm^2	18-555	No.	204105.00
	(Rate as per Rate Analysis)			
	Item No.5 :- Repairs of following dia and class. Air valves including cost of material with all taxes rubber packing nut bolts where required etc. complete labour charges and dewatering if required will be done by departmentaly.			
28.00		4967.00	No.	139076.00
22.00	100 mm dia kinetic Air valves 50 mm dia D/B Air valves	4302.00	No.	94644.00
	(Rate as per Rate Analysis)			
	Item No. 6 :- Providing, supplying ND Fixing Kinetic Double Orifice type Air Valves confirming to IS 14845 as per N4 JP's standard specifications having small orifice elastic ball resting on a gun metal orifice nipple, large orifice vulcanite ball seating on a molded seat ring, with BulGin Kinetic features, isolating sluice valve mounted in a horizontal position and operated by wheel gearing, inlet face and drilled, including insurance, third party inspection charges, loading, unloading, transportation upto departmental stores, excluding GST levied by GOI & GOM in all respect etc. complete.			
10.00	100 mm dia kinetic Air valves PN-1.6(13916 + 416) (DSR 2018-19 P.No.144 I. no.9 & P.No.236 I. no. 10b)	14332.00	No.	143320.00
	Item No. 6A:- Providing, supplying and Fixing Kinetic Double Orifice type Air Valves confirming to IS 14845 as per MJP's standard specifications combined with screw down isolating			

5.00	valve small orifice elastic ball resting on a gun metal orifice nipple, large orifice vulcanite ball seating on a molded seat ring, inlet face and drilled, including insurance, third party inspection charges, loading, unloading, transportation upto departmental stores, excluding GST levied by GOI & GOM in all respect etc. complete. 50 mm dia PN-1.6 (10881+315)	11196.00	No.	55980.00
	(DSR 2018-19 P.No.144 I. no.8 & P.No. 236 I. no. 10b)			
	Item No.7 :- Repairs of following dia and class. Sluice valves including cost of material with all taxes rubber packing nut bolts where required etc. complete. Labour charges and dewatering if required will be done by departmentaly.			
1	450 mm dia sluice valves – Lump sum Provision market rate	5000.00	No.	5000.00
1	400 mm dia sluice valves – Lump sum Provision market rate	12000.00	No.	12000.00
1	350 mm dia sluice valves – Lump sum Provision market rate	10000.00	No.	10000.00
10	200 mm to 80 mm dia sluice valves – Lump sum Provision market rate	3000.00	No.	90000.00
		Total		2861583.00
		12% GST		343390
		Total		3204973.00
		5% contingencies		160249
		2% W.C.		64098
				3429321.00
				3429321
				3429321

Rate analysis for Removing leakage on 457 mm dia M S Rising main				
Abstract				
QTY	Description of Item	Rate	Unit	Amount
1	2	4	7	8
	Item of work : Removing leakage on 457 mm dia M S Rising main			
2.00	Item No.1 :- Hire charges of welding set with Generator set etc. complete	2472	Day	4944
	MJP DSR 18-19 P No.21 I No.10			
2.00	Item No.2:- Carting charges for welding machine by truck to site work upto 20 Kms & taking back from site of work etc. complete	2000	Day	4000
	MJP DSR 18-19 P No.21 I.No.16			
	Item No.3:- Labour charges for welding to M S Pipe line for removing leakages as per direction of Engineer in charge etc. complete			
1.00	Welder	472	Day	472
	MJP DSR 18-19 P No.20 I.No.35			
10.00	Mazdoor (male)	341	Day	3410
	MJP DSR 18-19 P No.20 I.No.20			
0.50	Item No.4 :- Supply of welding rod etc. complete	1149	Box	574.5
	MJP DSR 18-19 P No.20 I.No.20			
			Total Rs.	13400.5
			Say Rs.	13401

ANNEXURE IX

Rate Analysis for Removing Leakage on 350 mm dia/400 mm dia/470 mm dia PSC Gravity Main

ABSTRACT

QTY	Particulars	Rate	Per	Amount
1	2	3	4	5
	Item No.1:- Excavation for pipe trenches in Slush Muddy/Marshy/Slushy/Soil including use of Poclain, labour for dewatering during execution including removing the excavated material upto a distance of 50 meters and lift as below stacking and spreading as directed preparing the bed by cleaning item but excluding backfilling etc. comp. Providing and fixing shuttering shall be paid separately.			
17.52	Lift 0 TO 1.50 m	339	Cu. M	5940.34
	MJP DSR 18-19 P No. 51 I. No. 8			
	Item No. 2:- Providing and supplying following materials for PSC Pipe circumference crack refilling and stop water leakage from pipe line etc. comp.			
8	A) Supply of M Seal	240.00	Kg	1920
	As per market rate			
8.00	B) Lead Wool	270.00	Kg	2160
	As per market rate			
	Item No. 3 :- Labour charges for fixing PSC pipe crack groove, cleaning fixing , spunnyarn, M seal cement, Rubber sheet and MS clamp fixing etc. comp as per direction of Engineer – in – charge.			
1	Fitter	449.00	No.	449.00
5	Mazdoor (Heavy)	341.00	No.	1705.00
	MJP DSR 18-19P No. 20 I. No. 12& 20			
	Item No. 4 :- Providing and laying in situ cement concrete of trap Granite/gneiss metal for PCC work below foundation and footing including normal dewatering plywood formwork compaction finishing and curing etc. comp.			
1.54	PCC 1:2:4	3682.00	Cu. M	5670.28
	MJP DSR 18-19P. No. 56 I. No. 1(2)			
	Item no.5 :- Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads and lifts including consolidation surcharging etc. comp.			

15.55	MJP DSR 18-19P. No. 52 I. No. 15	64.00	Cu. M	995.20
50	Item No.6 :- Dewatering the excavated trenches and pools of water in the building trenches / pipeline trenches , well work by using pumps and other devices including disposing of water to safe distance as directed by Engineer-in-charge (including cost of machinery labour fuel) etc. complete	62.00	BHP/ Hr	3100.00
	MJP DSR 18-19P. No. 51 I. No. 14			
			Total Rs.	21939.82
			Say Rs.	21940.00

ANNEXURE X

Estimate for Operation and Maintenance of the Scheme

RATE ANALYSIS FOR AIR VALVE

1)	100 mm Dia air Valve			Per	Amount
i	Air Valve ball Market rate	2 Nos	200	Nos	400.00
ii	Rubber gasket MJP DSR 18-19 P.No.17 I. No. 44	2 Kg	74	Nos	148.00
iii	Nut bolt MJP DSR 18-19 P.No.16 I. No. 33	0.8 Kg	71	Kg	56.80
iv	Filter MJP DSR 18-19 P.No.18 I. No. 11	1 No	449	Day	449.00
v	Labour (Mazdoor , Heavy) MJP DSR 18-19 P.No.18 I. No. 20	2 No	341	Day	682.00
vi	Welder MJP DSR 18-19 P.No.18 I. No. 35	1 No	472	Day	472.00
vii	Rent for welding set with generator set MJP DSR 18-19 P.No.19 I. No. 10	1 Day	2472	Day	2472.00
viii	Welding additional rods to all sides of M S Cage MJP DSR 18-19 P.No.17 I. No. 58	0.25 Box	1149	Box	287.25
				Total Rs.	4967.00
				Say Rs.	4967.00
2)	50 mm Dia Air Valve				Amount
i	Air Valve ball Market rate	1 Nos	150	Nos	150.00
ii	Rubber gasket MJP DSR 18-19 P.No.17 I. No. 44	1 Kg	74	Nos	74.00
iii	Nut bolt MJP DSR 18-19 P.No.16 I. No. 33	0.8 Kg	71	Kg	56.80
iv	Filter MJP DSR 18-19 P.No.18 I. No. 11	1 No.	449	Day	449.00
v	Labour (Mazdoor, Heavy) MJP DSR 18-19 P.No.18 I. No. 20	1 No.	341	Day	341.00
vi	Welder MJP DSR 18-19 P.No.18 I. No. 35	1 No.	472	Day	472.00
vii	Rent for welding set with generator set MJP DSR 18-19 P.No.19 I. No. 10	1 Day	2472	Day	2472.00

viii	Welding additional rods to all sides of M S cage MJP DSR 18-19 P.No.17 I. No. 58	0.25 Box	1149	Box	287.25
			Total Rs.		4302.05
			Say Rs.		4302.00

ANNEXURE XI
List of Figures

ANNEXURE XII
List of Table

ANNEXURE XIII

LIST OF RELEVANT GOVERNMENT RESOLUTIONS

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र. सिंचन २०१५/प्र.क्र.२४ /२०१५/जसं (धोरण)
मंत्रालय, मुंबई-४०० ०३२.
दिनांक :- ०९ जून, २०१६.

वाचावे : महाराष्ट्र शासन, जलसंपदा विभाग, शा.नि. क्र.मजनिप्रा-२०११/(२४/२०११) / जसं (आस्था.), दिनांक १० जून, २०१३.

प्रस्तावना :-

केंद्र शासनाने सन २०१७ पर्यंत पाणी वापराच्या कार्यक्षमतेत २० टक्क्यांनी वाढ करण्याचे उद्दिष्ट ठेवले आहे व त्या अनुषंगाने उपाययोजना करण्याचे राज्य शासनास आव्हान केलेले आहे. कृषी क्षेत्रातील पाणी वापर हा लक्षणीय असल्याने कृषी क्षेत्रातील पाणी वापराची कार्यक्षमता वाढविण्यास प्राधान्य देणे गरजेचे आहे. तसेच महाराष्ट्र जलसंपत्ती नियमन प्राधिकरणाच्या (MWRRA) दि. १२.६.२०१५ रोजीच्या अधिसूचनेनुसार सन २०१९ पासून बारमाही पिकांना सुक्ष्म सिंचनाद्वारे पाणी देणे अनिवार्य केलेले आहे.

महाराष्ट्र जल व सिंचन आयोगाने अंदाजित केल्यानुसार राज्याचे लागवडीलायक क्षेत्र सुमारे २२५ लक्ष हेक्टर आहे. राज्यातील भूपृष्ठावरील व भूजलाची उपलब्धता विचारात घेता भूपृष्ठावरील पाण्यातून सुमारे ८५ लक्ष हेक्टर व भूजलाव्दारे ४१ लक्ष हेक्टर असे एकूण १२६ लक्ष हेक्टर म्हणजेच लागवडीलायक क्षेत्राच्या ५६ टक्के इतकेच क्षेत्र अंतिमत: सिंचनाखाली येऊ शकते. वाढत्या नागरीकरणामुळे व औद्योगिकरणामुळे बिगर सिंचन पाणी वापरात वाढ होत आहे. त्यामुळे सिंचनासाठी उपलब्ध होणाऱ्या पाण्यात घट झाली आहे व ही घट भविष्यात वाढतच जाणार आहे. सदर वस्तुस्थिती विचारात घेऊन सिंचनासाठी उपलब्ध होणाऱ्या पाण्याचा इष्टतम वापर करुन जास्तीत जास्त क्षेत्र सिंचनाखाली आणणे गरजेचे आहे. यासाठी पारंपारीक वितरण प्रणाली व सिंचन पध्दतीत सुधारणा करण्याची गरज निर्माण झाली आहे.

पारंपारिक वितरण प्रणालीत कालवे, वितरिका, लघुकालवे व शेतचाऱ्यांची आखणी कालव्याच्या प्रवाहासाठी जमीनीची आवश्यक पातळी विचारात घेऊनच करावी लागते. यामध्ये काही विशिष्ठ शेतकऱ्यांची जास्त जमीन जाते.

कालवे बांधावरुन घ्यावेत, सर्वाची जमीन समप्रमाणात घ्यावी, अशा सूचना करुन शेतकरी वितरण प्रणालीस विरोध करतात. शेतकऱ्यांचा विशेषत: अल्प भूधारक शेतकऱ्यांचा विचार करता त्यांची भूमिका योग्यही असते. मात्र पारंपारिक कालवा वितरण प्रणाली संकल्पित करताना तांत्रिक अपरिहार्यतेमुळे या सूचना मान्य करता येत नाहीत. त्यामुळे शेतकऱ्यांचा विरोध कायम राहतो व वितरण व्यवस्थेची कामे वर्षानुवर्षे रेंगाळतात.

कालव्याच्या मुखाकडील शेतकरी थेट कालव्यावर पंप बसवून पाणी घेतात. त्यामुळे मुखाकडील भागात पाण्याचा जादा पाणी वापर होतो. मात्र पुच्छ भागातील शेतकरी सिंचनाच्या लाभापासून वंचित राहतात. काही प्रकरणी उपरोक्त कारणांमुळे वितरण व्यवस्थेअभावी धरणात पाणीसाठा होऊनही त्याचा वापर होत नाही व आर्थिक गुंतवणूक फलद्रुप होत नाही. अशा प्रकरणी सिंचनाचे लाभ लवकर मिळण्यासाठी नलिका वितरण हा एक पर्याय होऊ शकतो.

गेल्या नजिकच्या कालावधीत जमिनीच्या किंमती मोठ्या प्रमाणावर वाढल्या आहेत.

भू-संपादनासह कालव्याचे मातीकाम, बांधकामे विचारात घेऊन त्यावरील एकूण भांडवली गुंतवणूकीचा व आवर्ती खर्चाचा एकत्रित विचार केल्यास बऱ्याच प्रकरणी नलिका वितरण

आर्थिकदृष्टया किफायतशीर ठरु शकते. कोकणासारख्या जास्त चढउतार असणाऱ्या लाभक्षेत्रातील वितरण प्रणालीवरील बांधकामांची संख्या जास्त राहते. अशा परिस्थितीत पाईप वितरण प्रणालीचा अवलंब केल्यास बांधकामाची संख्या कमी होते व खर्चात बचत होते. त्याचप्रमाणे काळया मातीतील कालव्यावरील बांधकामाचा खर्च खोल पायामुळे जास्त येतो. अशा प्रकरणी सुध्दा नलिका वितरण प्रणाली किफायतशीर ठरु शकते.

त्याचप्रमाणे जमिनीत आवश्यकतेपेक्षा जास्त ओलावा निर्माण झाल्यास संत्रा पिकाचे व फळ बागांच्या उत्पादनात घट होते. याउलट नलिका वितरण प्रणालीद्वारे आवश्यकतेनुसार नियंत्रित पाणी पुरवठा करता येत असल्याने विशेष करुन संत्रा व इतर फळबागा असणाऱ्या प्रकल्प लाभक्षेत्रात तसेच पश्चिम विदर्भातील खारपाण पट्टयात पारंपारिक वितरण प्रणालीस शेतकऱ्यांचा विरोध आहे. नलिका वितरण प्रणालीसाठी शेतकरी आग्रही आहेत.

नलिका प्रणालीमुळे भूसंपादनाची गरज राहत नाही. तसेच मशागतीस कोणताही अडथळा येत नाही. नलिका वितरणाद्वारे समन्यायी पाण्याचे वाटप करणेही सुलभ होते. नलिका वितरण प्रणालीचा देखभाल-दुरुस्ती व परिचलनाचा खर्चही तुलनेने कमी राहतो. डोंगर उतारावरील, खोल खोदाईतील व काळ्या मातीतील कालव्यावर तुलनेने देखभाल-दुरुस्तीचा खर्च जास्त राहतो.

वरीलप्रमाणे विविध स्थानिक परिस्थितीमध्ये नलिका वितरण हे पारंपारिक कालवा वितरणापेक्षा सरस ठरु शकते. मात्र शासनाच्या असे निदर्शनास आले आहे की, संदर्भिय शासन निर्णयातील तरतुदीनुसार केवळ प्रशासकीय मान्यता प्राप्त प्रकल्प अहवालात पारंपारिक वितरण प्रणालीची तरतूद असल्याने सुधारित प्रशासकीय मान्यता घेतल्याशिवाय नलिका वितरण प्रणालीचा अवलंब करता येत नाही. त्यामुळे नलिका वितरण प्रणाली बाबत स्वतंत्र धोरण स्वीकारण्याचे शासनाच्या विचाराधीन होते. या पार्श्वभूमीवर शासनाने पुढीलप्रमाणे निर्णय घेतला आहे :-

<u>शासन निर्णय :-</u>

प्रशासकीय मान्यता प्राप्त प्रकल्प अहवालात पारंपारिक कालवा वितरण व्यवस्थेची तरतूद असताना केवळ योजनेच्या पूर्ण किंवा काही भागात नलिका वितरण प्रणाली प्रस्तावित करताना यापुढे संदर्भिय शासन निर्णयातील परिच्छेद ४ नुसार संपूर्ण प्रकल्प अहवालास सुधारित प्रशासकीय मान्यता घेण्याची गरज राहणार नाही. मात्र नलिका वितरणाचा प्रस्ताव शासन निर्गमित करेल अशा मार्गदर्शक सूचनांशी सुसंगत असावा.

२. ज्या प्रकल्पांना पारंपारीक कालवा वितरण प्रणाली गृहीत धरुन प्रशासकीय मान्यता देण्यात आली आहे, अशा प्रकल्पांवर संपूर्ण वितरण प्रणालीसाठी किंवा तिच्या भागासाठी नलिका वितरण प्रणाली राबविण्याचा प्रस्ताव सादर करावयाचा झाल्यास अशा प्रस्तावाची तांत्रिक व आर्थिक व्यवहार्यता तपासण्याची जबाबदारी संबंधित क्षेत्रिय मुख्य अभियंता यांची राहील. तसेच आर्थिक व्यवहार्यता पडताळण्याची जबाबदारी कार्यकारी संचालकांची राहील.

३. वरीलप्रमाणे तांत्रिक व आर्थिक व्यवहार्यता प्रमाणित करुन तसेच नलिका वितरण प्रस्तावित करण्यामागची सविस्तर कारणमिमांसा विषद करुन शासन मान्यता आवश्यक असलेले प्रस्ताव शासनास मान्यतेस्तव सादर करण्यात यावा.

४. नलिका वितरण प्रणालीच्या प्रस्तावास मान्यता देण्याचे अधिकार पुढीलप्रमाणे राहतील :-

(अ) प्रकल्पाच्या अद्ययावत किंमतीनुसार पारंपारिक वितरण प्रणालीच्या तुलनेत नलिका वितरण प्रणाली खर्चिक नसल्यास अशा प्रस्तावास मान्यता देण्यास जलसंपदा विभाग सक्षम असेल.

(ब) शासन निर्गमित करेल अशा मार्गदर्शक सूचनाशी सुसंगत रु. ५ कोटी किंमतीपर्यंतच्या आणि पारंपारिक वितरण प्रणालीच्या तुलनेत कमी खर्चिक नलिका वितरण प्रणालीच्या प्रस्तावास मान्यता देण्याचे अधिकार संबंधित पाटबंधारे विकास महामंडळांच्या कार्यकारी संचालकांना राहतील.

सदर रु.५ कोटी ही मर्यादा संपूर्ण प्रकल्पासाठी आहे. एकाच प्रकल्पातील नलिका वितरण प्रणालीचे रु.५ कोटी किंमतीचे भाग पाडून अशी मान्यता कार्यकारी संचालकांना देता येणार नाही. रु.५ कोटी पेक्षा अधिक किंमतीचे प्रस्ताव मान्यतेसाठी शासनास सादर करावेत. अशा प्रस्तावांना मान्यता देण्याचे अधिकार जलसंपदा विभागास असतील.

(क) मात्र पारंपारिक वितरण प्रणालीच्या तुलनेत नलिका वितरण प्रणाली खर्चिक असूनही भौगोलिक परिस्थितीनुसार तिचा अवलंब करणे अनिवार्य असल्यास अशा प्रकरणी सुधारित प्रशासकीय मान्यता देण्यास सक्षम प्राधिकरणाची पूर्वसहमती आवश्यक राहील.

(ड) प्रकल्पात नलिका वितरण प्रणालीचा समावेश करत असताना नलिका वितरण प्रणालीसह प्रकल्पाची अद्ययावत किंमत रु.२५ कोटी पेक्षा जास्त होत असल्यास नलिका वितरण प्रणालीचा प्रस्ताव राज्य तांत्रिक सल्लागार समितीच्या अभिप्रायांसह शासनाच्या मान्यतेसाठी सादर करण्यात यावा.

वरील सर्व प्रकरणी वितरण प्रणालीचा तौलनिक अभ्यास करताना प्रचलित दरसूची व भू-संपादनाची प्रचलित नियमांनुसार वाजवी किंमत विचारात घेण्यात यावी.

५. नलिका वितरण प्रणालीमुळे होणाऱ्या पाण्याच्या बचतीचा उपयोग लाभक्षेत्रातील लागवडीयोग्य क्षेत्र व नियोजित सिंचनक्षेत्रातील तफावत दूर करण्यासाठी व बिगर सिंचन आरक्षणामुळे झालेल्या सिंचन कपातीची पूनर्स्थापना करण्यासाठी करावा.

६. नलिका वितरण प्रणालीसह प्रकल्पीय सिंचन क्षमतेत १० टक्क्यांपेक्षा जास्त वाढ होत असल्यास असे प्रस्ताव संदर्भाधीन शासन निर्णयामधील यथास्थिती परिच्छेद २.१ अथवा २.२ नुसार प्रथम महाराष्ट्र जलसंपत्ती नियोजन प्राधिकरणाकडे महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण अधिनियम, २००५ मधील कलम ११ (च) अंतर्गत आढावा व मान्यतेसाठी सादर करावेत व प्राधिकरणाच्या मान्यतेनंतरच शासनास सादर करावेत.

७. नलिका वितरण प्रणालीचा प्रस्ताव हा संपूर्ण लाभक्षेत्राच्या सविस्तर सर्वेक्षणावर व सविस्तर संकल्पचित्रावर आधारित असावा. लाभक्षेत्रामध्ये महाराष्ट्र सिंचन पध्दतीचे शेतकऱ्यांकडून व्यवस्थापन अधिनियम, २००५ (MMISF ACT, 2005) व महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण अधिनियम, २००५ (MWRRA ACT, 2005) मधील तरतुदीनुसार सर्व लाभार्थींमध्ये हक्कदारीनुसार व समन्यायी पध्दतीने पाणी वाटप करणे शक्य होईल, या दृष्टीने नलिका वितरण प्रणालीचे संकल्पन व आराखडा तयार करावा. त्यामध्ये लाभक्षेत्रातील भूपृष्ठजल, भूजल व कालव्याच्या पाण्याचा संयुक्त वापर शेतकऱ्यांना त्यांच्या गरजेनुसार प्रवाही सिंचनाबरोबरच सुक्ष्मसिंचन पध्दतीने करणे शक्य होईल, ही बाब विचारात घ्यावी.

८. नलिका वितरण प्रणाली प्रस्तावित करण्यापुर्वी नियोजित लाभक्षेत्रामध्ये MMISF ACT, 2005 नुसार पाणी वापर संस्था निर्माण करावी व संस्थेच्या व्यवस्थापन समितीच्या सल्ल्यानुसार नलिका

वितरण प्रणालीचा आराखडा व त्याचे बांधकाम करावे. नलिका वितरण प्रणालीचे काम पूर्ण झाल्यावर व्यवस्थापनासाठी व देखभाल दुरुस्तीसाठी हस्तांतरीत करुन घेण्याची पाणी वापर संस्थेची लेखी सहमती अनिवार्य राहील. तसेच काम पूर्ण झाल्यानंतर वितरण प्रणाली व्यवस्थापनासाठी व देखभाल दुरुस्तीसाठी पाणी वापर संस्थेस हस्तांतरीत करावी.

९. नलिका वितरण प्रणाली धोरण म्हणून स्वीकारताना विभागाकडे याबाबतचे संकल्पन करणारी स्वतंत्र यंत्रणा उपलब्ध असणे गरजेचे आहे. उपलब्ध आस्थापनेतून अशी यंत्रणा जलसंपदा विभागाने निर्माण करावी.

१०. नलिकेची उभारणी जमिनीखाली अशा खोलीवर करावी की नलिकेच्या माथ्यावर १.२ मी. चा भराव राहील, जेणेकरुन शेतीच्या अवजारामुळे नलिकेस बाधा पोहोचणार नाही .

नलिका जोडणी पिके निघून गेल्यानंतर करण्याचे नियोजन करावे. यासाठी पिक नुकसान भरपाईची तरतूद करु नये.

११. नलिकांचा पुरवठा व जोडणी व पहिल्या ३ वर्षासाठी देखभाल दुरुस्तीचा अंतर्भाव असलेली एकत्रित निविदा काढावी. फक्त पुरवठ्यासाठी देयक अदायगी करु नये.

एका पाणी वापर संस्थेच्या संपूर्ण कार्यक्षेत्रातील नलिका वितरणाचे काम पूर्ण झाल्यानंतर अंशत: अदायगी व उर्वरित रक्कम टप्या-टप्याने यशस्वी चाचणी व Defect Liability Period संपल्यावर करावी. यासाठी व्यवहार्य रक्कम रोखून ठेवण्यात यावी.

Defect Liability Period ५ वर्षे असावा. त्यापैकी ३ वर्षे देखभाल, दुरुस्ती व सिंचन व्यवस्थापनाची जबाबदारी ठेकेदारावर ठेवावी.

१२. नलिका वितरण प्रणाली बाबतचे सविस्तर निकष / मार्गदर्शक सूचना जलसंपदा विभागाने तांत्रिक परिपत्रकाव्दारे निर्गमित कराव्यात.

सदर शासन निर्णय नियोजन विभागाने अनौपचारिक सं.क्र.१/का.१४३४, दि.०६.०१.२०१६ व वित्त विभागाने अनौपचारिक सं.क्र.३२/२०१६,दि.०४.०२.२०१६ आणि महाराष्ट्र जलसंपत्ती नियमन प्राधिकरणाने संदर्भ पत्र क्र.५८१, दि.३०.०९.२०१५ अन्वये दिलेल्या सहमतीने निर्गमित करण्यात येत आहे.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करुन देण्यात आला असून त्याचा संकेतांक क्र. २०१६०६०९१८०२०२४५२७ असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

Rajnish Ramkishor Shukla

Digitally signed by Rajnish Ramkishor Shukla
DN: c=IN, o=Government Of Maharashtra, ou=Water Resources, postalCode=400032, st=Maharashtra, 2.5.4.20=d37cbfb080a0bc996a710b3c0aeea737985dac09cb66bbff878f42ad4e77a606, serialNumber=293016b5f13cd03f75c9f34c66d956309c8b3cd5faf07931d817577e6116e436, cn=Rajnish Ramkishor Shukla
Date: 2016.06.09 18:16:22 +05'30'

(र.रा.शुक्ला)
शासनाचे उप सचिव

प्रत,

१. मा.राज्यपाल यांचे सचिव, राजभवन, मुंबई
२. मा.मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई
३. मा.मंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई
४. मा.राज्यमंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई

५. सर्व विधानसभा सदस्य / विधान परिषद सदस्य
६. मा.मुख्य सचिव, मंत्रालय, मुंबई.
७. प्रधान सचिव, सामान्य प्रशासन विभाग, मंत्रालय, मुंबई
८. प्रधान सचिव, वित्त विभाग, मंत्रालय, मुंबई
९. प्रधान सचिव, नियोजन विभाग, मंत्रालय, मुंबई
१०. प्रधान सचिव (जसं), जलसंपदा विभाग, मंत्रालय, मुंबई
११. सचिव (लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई
१२. सचिव, महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण,मुंबई.
१३. महालेखापाल, महाराष्ट्र, मुंबई / नागपूर
१४. महासंचालक, मेरी, नाशिक
१५. महासंचालक, वाल्मी, औरंगाबाद
१६. कार्यकारी संचालक, महाराष्ट्र कृष्णा खोरे विकास महामंडळ, पुणे
१७. कार्यकारी संचालक, कोकण पाटबंधारे विकास महामंडळ, ठाणे
१८. कार्यकारी संचालक, तापी पाटबंधारे विकास महामंडळ, जळगाव
१९. कार्यकारी संचालक, गोदावरी मराठवाडा पाटबंधारे विकास महामंडळ, औरंगाबाद
२०. कार्यकारी संचालक, विदर्भ पाटबंधारे विकास महामंडळ, नागपूर
२१. मुख्य अभियंता, जलविज्ञान प्रकल्प, नाशिक
२२. मुख्य अभियंता, यांत्रिकी, जलसंपदा विभाग, नाशिक
२३. मुख्य अभियंता, जलविद्यूत प्रकल्प (विद्यूत), मुंबई
२४. मुख्य अभियंता, जलसंपदा विभाग, औरंगाबाद /नागपूर /अमरावती / पुणे / कोकण विभाग / मुंबई / उत्तर महाराष्ट्र विभाग, नाशिक / तापी पाटबंधारे विभाग, जळगांव
२५. मुख्य अभियंता, लाभक्षेत्र विकास, औरंगाबाद
२६. मुख्य अभियंता, महाराष्ट्र जल विकास केंद्र, औरंगाबाद
२७. मुख्य अभियंता, गोसीखुर्द प्रकल्प, जलसंपदा विभाग, नागपूर
२८. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, अमरावती
२९. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, पुणे
३०. मुख्य अभियंता (द व प्र) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३१. मुख्य अभियंता (पा) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३२. मुख्य अभियंता (कृपातंल) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३३. मुख्य अभियंता (जसं) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३४. मुख्य अभियंता, संकलन, प्रशिक्षण, संशोधन व सुरक्षितता, मेरी, नाशिक.
३५. मुख्य अभियंता (स्थापत्य), जलविद्युत, पुणे.
३६. सह सचिव (सेवा), जलसंपदा विभाग, मंत्रालय, मुंबई
३७. आंतरवित्त सल्लागार व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३८. अधीक्षक अभियंता, पाटबंधारे संशोधन व विकास संचालनालय, पुणे
३९. अधीक्षक अभियंता, (माती धरण), मध्यवर्ती संकल्पचित्र संघटना (सीडीओ), नाशिक.
४०. अधीक्षक अभियंता, महाराष्ट्र अभियांत्रिकी संशोधन संस्था, नाशिक.

४१. अधीक्षक अभियंता, (व्दारे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४२. अधीक्षक अभियंता, (दगडी धरण), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४३. अधीक्षक अभियंता, (विदयुत गृहे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४४. कोयना संकल्पचित्र मंडळ, पुणे.
४५. कोयना (वि.व.यां) संकल्पचित्र मंडळ, पुणे
४६. महाराष्ट्र अभियांत्रिकी प्रशिक्षण प्रबोधिनी, नाशिक.
४७. अधीक्षक अभियंता, धरण सुरक्षितता संघटना, (DSO) नाशिक.
४८. जलनियोजन विभाग, मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४९. जलगती संशोधन विभाग क्र.१, नाशिक
५०. भुकंप उपकरणे कक्ष व भुकंप आधार सामुग्री पृथःकरण कक्ष, नाशिक.
५१. संरचनात्मक संशोधन व पदार्थ विज्ञान विभाग, नाशिक.
५२. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, पुणे
५३. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, नागपूर.
५४. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, औरंगाबाद.
५५. गाळ सर्वेक्षण विभाग, नाशिक.
५६. सुदूर संवेदन व भूमाहिती शास्त्र विभाग, नाशिक.
५७. सामुग्री चाचणी विभाग व मृदू चाचणी विभाग, मेरी, नाशिक.
५८. भुकंप आधार सामुग्री पृथःकरण विभाग, मेरी, नाशिक.
५९. उपकरणे संशोधन विभाग, मेरी, नाशिक
६०. अधीक्षक अभियंता, आधार सामुग्री (पृथःकरण) मंडळ,नाशिक
६१. सर्व उप सचिव / अवर सचिव / कक्ष अधिकारी, जलसंपदा विभाग, मंत्रालय, मुंबई.
६२. जलसंपदा (धोरण) कार्यासन (संग्रहार्थ).

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र. सिंचन २०१५/प्र.क्र.२४ /२०१५/जसं (धोरण)
मंत्रालय, मुंबई-४०० ०३२.
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२) महाराष्ट्र शासन, जलसंपदा विभाग, शा.नि. क्र. संकीर्ण २०१५/(४२५/२०१५)/ मध्यम प्रकल्प, दि. १६ नोव्हेंबर, २०१६.

प्रस्तावना :-

केंद्र शासनाने सन २०१७ पर्यंत पाणी वापराच्या कार्यक्षमतेत २० टक्क्यांनी वाढ करण्याचे उद्दिष्ट ठेवले आहे व त्या अनुषंगाने उपाययोजना करण्याचे राज्य शासनास आव्हान केलेले आहे. कृषी क्षेत्रातील पाणी वापर हा लक्षणीय असल्याने कृषी क्षेत्रातील पाणी वापराची कार्यक्षमता वाढविण्यास प्राधान्य देणे गरजेचे आहे. तसेच महाराष्ट्र जलसंपत्ती नियमन प्राधिकरणाच्या (MWRRA) दि. १२.६.२०१५ रोजीच्या अधिसूचनेनुसार सन २०१९ पासून बारमाही पिकांना सुक्ष्म सिंचनाद्वारे पाणी देणे अनिवार्य केलेले आहे.

महाराष्ट्र जल व सिंचन आयोगाने अंदाजित केल्यानुसार राज्याचे लागवडीलायक क्षेत्र सुमारे २२५ लक्ष हेक्टर आहे. राज्यातील भूपृष्ठावरील व भूजलाची उपलब्धता विचारात घेता भूपृष्ठावरील पाण्यातून सुमारे ८५ लक्ष हेक्टर व भूजलाव्दारे ४१ लक्ष हेक्टर असे एकूण १२६ लक्ष हेक्टर म्हणजेच लागवडीलायक क्षेत्राच्या ५६ टक्के इतकेच क्षेत्र अंतिमत: सिंचनाखाली येऊ शकते. वाढत्या नागरीकरणामुळे व औद्योगिकरणामुळे बिगर सिंचन पाणी वापरात वाढ होत आहे. त्यामुळे सिंचनासाठी उपलब्ध होणाऱ्या पाण्यात घट झाली आहे व ही घट भविष्यात वाढतच जाणार आहे. सदर वस्तुस्थिती विचारात घेऊन सिंचनासाठी उपलब्ध होणाऱ्या पाण्याचा इष्टतम वापर करुन जास्तीत जास्त क्षेत्र सिंचनाखाली आणणे गरजेचे आहे. यासाठी पारंपारीक वितरण प्रणाली व सिंचन पध्दतीत सुधारणा करण्याची गरज निर्माण झाली आहे.

पारंपारिक वितरण प्रणालीत कालवे, वितरिका, लघुकालवे व शेतचाऱ्यांची आखणी कालव्याच्या प्रवाहासाठी जमीनीची आवश्यक पातळी विचारात घेऊनच करावी लागते. यामध्ये काही विशिष्ठ शेतकऱ्यांची जास्त जमीन जाते.

कालवे बांधावरुन घ्यावेत, सर्वाची जमीन समप्रमाणात घ्यावी, अशा सूचना करुन शेतकरी वितरण प्रणालीस विरोध करतात. शेतकऱ्यांचा विशेषत: अल्प भूधारक शेतकऱ्यांचा विचार करता त्यांची भूमिका योग्यही असते. मात्र पारंपारिक कालवा वितरण प्रणाली संकल्पित करताना तांत्रिक अपरिहार्यतेमुळे या सूचना मान्य करता येत नाहीत. त्यामुळे शेतकऱ्यांचा विरोध कायम राहतो व वितरण व्यवस्थेची कामे वर्षानुवर्षे रेंगाळतात.

कालव्याच्या मुखाकडील शेतकरी थेट कालव्यावर पंप बसवून पाणी घेतात. त्यामुळे मुखाकडील भागात पाण्याचा जादा पाणी वापर होतो. मात्र पुच्छ भागातील शेतकरी सिंचनाच्या लाभापासून वंचित राहतात. काही प्रकरणी उपरोक्त कारणांमुळे वितरण व्यवस्थेअभावी धरणात पाणीसाठा होऊनही त्याचा वापर होत नाही व आर्थिक गुंतवणूक फलद्रुप होत नाही. अशा प्रकरणी सिंचनाचे लाभ लवकर मिळण्यासाठी नलिका वितरण हा एक पर्याय होऊ शकतो.

गेल्या नजिकच्या कालावधीत जमिनीच्या किंमती मोठ्या प्रमाणावर वाढल्या आहेत.

भू-संपादनासह कालव्याचे मातीकाम, बांधकामे विचारात घेऊन त्यावरील एकूण भांडवली गुंतवणूकीचा व आवर्ती खर्चाचा एकत्रित विचार केल्यास बऱ्याच प्रकरणी नलिका वितरण आर्थिकदृष्टया किफायतशीर ठरु शकते. कोकणासारख्या जास्त चढउतार असणाऱ्या लाभक्षेत्रातील वितरण प्रणालीवरील बांधकामांची संख्या जास्त राहते. अशा परिस्थितीत पाईप वितरण प्रणालीचा अवलंब केल्यास बांधकामाची संख्या कमी होते व खर्चात बचत होते. त्याचप्रमाणे काळया मातीतील कालव्यावरील बांधकामाचा खर्च खोल पायामुळे जास्त येतो. अशा प्रकरणी सुध्दा नलिका वितरण प्रणाली किफायतशीर ठरु शकते.

त्याचप्रमाणे जमिनीत आवश्यकतेपेक्षा जास्त ओलावा निर्माण झाल्यास संत्रा पिकाचे व फळ बागांच्या उत्पादनात घट होते. याउलट नलिका वितरण प्रणालीद्वारे आवश्यकतेनुसार नियंत्रित पाणी पुरवठा करता येत असल्याने विशेष करुन संत्रा व इतर फळबागा असणाऱ्या प्रकल्प लाभक्षेत्रात तसेच पश्चिम विदर्भातील खारपाण पट्टयात पारंपारिक वितरण प्रणालीस शेतकऱ्यांचा विरोध आहे. नलिका वितरण प्रणालीसाठी शेतकरी आग्रही आहेत.

नलिका प्रणालीमुळे भूसंपादनाची गरज राहत नाही. तसेच मशागतीस कोणताही अडथळा येत नाही. नलिका वितरणाद्वारे समन्यायी पाण्याचे वाटप करणेही सुलभ होते. नलिका वितरण प्रणालीचा देखभाल-दुरुस्ती व परिचलनाचा खर्चही तुलनेने कमी राहतो. डोंगर उतारावरील, खोल खोदाईतील व काळ्या मातीतील कालव्यावर तुलनेने देखभाल-दुरुस्तीचा खर्च जास्त राहतो.

वरीलप्रमाणे विविध स्थानिक परिस्थितीमध्ये नलिका वितरण हे पारंपारिक कालवा वितरणापेक्षा सरस ठरु शकते. मात्र शासनाच्या असे निदर्शनास आले आहे की, महाराष्ट्र शासन, जलसंपदा विभाग, शासन निर्णय क्र. मजनिप्रा-२०११/(२४/२०११)/जसं (आस्था.), दि. १० जून २०१३ मधील तरतुदीनुसार केवळ प्रशासकीय मान्यता प्राप्त प्रकल्प अहवालात पारंपारिक वितरण प्रणालीची तरतूद असल्याने सुधारित प्रशासकीय मान्यता घेतल्याशिवाय नलिका वितरण प्रणालीचा अवलंब करता येत नाही. त्यामुळे नलिका वितरण प्रणाली बाबत स्वतंत्र धोरण संदर्भ क्र.१ येथील दिनांक ०९ जुन २०१६ च्या शासन निर्णयानुसार जाहिर करण्यात आले. सदर नलिकेव्दारे सिंचन वितरण धोरणाच्या अनुषंगाने राज्यासाठी नलिकाव्दारे सिंचन वितरण प्रणालीच्या जलदपणे व कार्यक्षम अंमलबजावणीसाठी सर्व पाटबंधारे विकास महामंडळाचे कार्यकारी संचालक, मुख्य अभियंता, अधिक्षक अभियंता व संबंधित कार्यकारी अभियंता यांची दिनांक १३ जुलै २०१६ रोजी वाल्मी, औरंगाबाद येथे कार्यशाळा घेण्यात आली. सदर कार्यशाळेत केंद्र शासनाच्या PMKSY योजने अंतर्गतचे सिंचन प्रकल्प तसेच भूसंपादनाच्या अडचणीमुळे काही ठिकाणी कालव्याची कामे पूर्ण न झाल्यामुळे संपुर्ण वितरण प्रणालीमध्ये सलगता नाही, अशा प्रकल्पांमध्ये नलिका वितरण प्रणाली जलदगतीने घेण्यासाठी दिनांक ०९.०६.२०१६ च्या शासन निर्णयामध्ये काही सुधारणा करणे आवश्यक असल्याबाबतच्या शिफारशी करण्यात आल्या. पारंपारिक वितरण प्रणाली ऐवजी नलिका वितरण प्रणाली अवलंबताना कालपव्यय टाळून अंमलबजावणी जलदगतीने होण्यासाठी दिनांक १३.०७.२०१६ रोजीच्या कार्यशाळेतील शिफारशींनुसार दिनांक ०९.०६.२०१६ च्या शासन निर्णयात बदल करणे आवश्यक आहे. तसेच दरम्यानच्या काळात संदर्भ २ मधील शासन निर्णय निर्गमित झाला आहे.

या पार्श्वभूमिवर संदर्भ क्र.१ येथील दिनांक ०९.०६.२०१६ रोजीचा शासन निर्णय अधिक्रमित करण्यात येत असून शासनाने पुढीलप्रमाणे निर्णय घेतला आहे.

शासन निर्णय :-

प्रशासकीय मान्यता प्राप्त प्रकल्प अहवालात पारंपारिक कालवा वितरण व्यवस्थेची तरतूद असताना केवळ योजनेच्या काही भागात नलिका वितरण प्रणाली प्रस्तावित करताना संपूर्ण प्रकल्प अहवालास सुधारित प्रशासकीय मान्यता घेण्याची गरज राहणार नाही. मात्र नलिका वितरणाचा प्रस्ताव शासन निर्गमित करेल अशा मार्गदर्शक सूचनांशी सुसंगत असावा.

२. नलिका वितरण प्रणाली वापरण्यासाठी शासन स्तरावरुन कोणत्याही स्वतंत्र मान्यतेची आवश्यकता राहणार नाही. महाराष्ट्र सार्वजनिक बांधकाम नियमावली परिच्छेद १३४ व १३५ व परिशिष्ठ-४२, (महाराष्ट्र शासन, सार्वजनिक बांधकाम विभाग, शासन निर्णय विअसु २०१५/प्र.क्र.२१८/इमारती-२, दि.१६ डिसेंबर २०१५ नुसार सुधारित केल्याप्रमाणे) नुसार तांत्रिक मान्यतेस मुख्य अभियंता यांना पूर्ण अधिकार, अधीक्षक अभियंता यांना रु. २.५ कोटी पर्यन्त व कार्यकारी अभियंता यांना १.० कोटी पर्यंत अधिकार आहेत. याच मर्यादेत संकल्पचित्र मंजूरीचे अधिकार सबंधित क्षेत्रिय अधिकाऱ्यांना आहेत. मुख्य अभियंता यांना संकल्पचित्र मान्यतेबाबत ही पूर्ण अधिकार आहेत. सदर प्रदान केलेल्या अधिकाराचा वापर करुन प्रकल्पाच्या / प्रकल्प घटकाच्या पाईप वितरण प्रणालीच्या अंदाजपत्रकास सक्षम स्तरावरुन तांत्रिक मान्यता देण्यात यावी. तत्पुर्वी नलिका वितरण प्रणालीचा प्रस्ताव शासन निर्गमित करेल अशा मार्गदर्शक सूचनांशी सुसंगत आहे याची खात्री करण्यात यावी. तसेच तांत्रिक मान्यता देण्यास सक्षम अधिकाऱ्याने नलिका वितरण आराखडयास व संकल्पचित्रास मान्यता द्यावी. प्रस्तावाची आर्थिक व्यवहार्यता तपासून संबधित कार्यकारी संचालकांनी प्रस्तावास मान्यता द्यावी.

३. नलिका वितरण प्रणालीचा प्रस्ताव हा आवश्यक सर्वेक्षणावर व सविस्तर संकल्पचित्रावर आधारित असावा. लाभक्षेत्रामध्ये महाराष्ट्र सिंचन पध्दतीचे शेतकऱ्यांकडून व्यवस्थापन अधिनियम, २००५ (MMISF ACT, २००५) व महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण अधिनियम, २००५ (MWRRA ACT, २००५) मधील तरतुदीनुसार सर्व लाभार्थींमध्ये हक्कदारीनुसार व समन्यायी पध्दतीने पाणी वाटप करणे शक्य होईल, या दृष्टीने नलिका वितरण प्रणालीचे संकल्पन व आराखडा तयार करावा. नलिका वितरण प्रणाली आराखडा तयार करताना लाभक्षेत्रातील भूपृष्ठजल, भूजल व कालव्याच्या पाण्याचा संयुक्त वापर शेतकऱ्यांना त्यांच्या गरजेनुसार प्रवाही सिंचनाबरोबरच सुक्ष्मसिंचन पध्दतीने करणे शक्य होईल, ही बाब विचारात घ्यावी.

४. नलिका वितरण प्रणालीमुळे होणाऱ्या पाण्याच्या बचतीचा उपयोग लाभक्षेत्रातील लागवडीयोग्य क्षेत्र व नियोजित सिंचनक्षेत्रातील तफावत दूर करण्यासाठी व बिगर सिंचन आरक्षणामुळे झालेल्या सिंचन कपातीची पूनर्स्थापना करण्यासाठी करावा.

५. नलिका वितरण प्रणालीमुळे संदर्भ २ मधील शासन निर्णयातील परिच्छेद २ नुसार व्याप्ती बदल होत असल्यास या शासन निर्णयातील नमुद परिच्छेद ४ नुसार सुधारित प्रशासकीय मान्यता घेण्याबाबतची कार्यवाही करावी.

६. नलिका वितरण प्रणाली प्रस्तावित करण्यापुर्वी नियोजित लाभक्षेत्रामध्ये MMISF ACT, २००५ नुसार निर्माण करावयाच्या पाणी वापर संस्थांबाबतचे नियोजन व आराखडा तयार करावा तसेच नियोजनामध्ये लाभधारकांचा सहभाग घेण्यात यावा. नलिका वितरण प्रणालीचे काम सुरु होईपर्यंत महाराष्ट्र सिंचन प्रणालीचे शेतकऱ्याकडून व्यवस्थापन अधिनियम २००५ कलम १ (३) व २ ची अधिसूचना काढण्यात यावी. नलिका वितरण प्रणालीचे काम संपेपर्यंत उक्त अधिनियमातील कलम ५, ६, ७ नुसार अधिसूचना ३ काढण्यात यावी. काम पूर्ण

झाल्यानंतर व पहिली ३ वर्षे परिचलन झाल्यानंतर वितरण प्रणाली व्यवस्थापनासाठी पाणीवापर संस्थेस हस्तांतरीत करावी.

७. नलिका जोडणी शक्यतो पिके निघून गेल्यानंतर करण्याचे नियोजन करावे, मात्र आवश्यकतेनुसार पिक नुकसान भरपाईची तरतूद करण्यात यावी.

८. नलिका वितरण प्रणाली धोरण म्हणून स्वीकारताना विभागाकडे याबाबतचे संकल्पन करणारी स्वतंत्र यंत्रणा उपलब्ध असणे गरजेचे आहे. उपलब्ध आस्थापनेतून अशी यंत्रणा जलसंपदा विभागाने निर्माण करावी व ती दोन वर्षात सक्षम करावी.

उपरोक्त स्वतंत्र यंत्रणा सक्षमतेने कार्यरत होईपर्यंत सविस्तर संकल्पनाची पर्यायी व्यवस्था विभागांतर्गत किंवा खाजगी सल्लागारामार्फत करण्यात यावी तसेच संकल्पचित्रासह योजना कार्यान्वयीत करण्याबाबतच्या निविदा काढण्याचा पर्याय निवडावा, मात्र संबधित मुख्य अभियंत्याने सदर संकल्पचित्रास मान्यता द्यावी.

९. निविदा मधील देखभाल दुरुस्ती कालावधी ५ वर्षे ठेवण्यात यावा. त्यापैकी शेवटच्या २ वर्षात पाणी वापर संस्थेसोबत ठेकेदाराने संयुक्त कार्यवाही करावी. एका पाणी वापर संस्थेच्या संपूर्ण कार्यक्षेत्रातील नलिका वितरणाचे काम पूर्ण झाल्यानंतर झालेल्या त्या पाणीवापर संस्थेच्या कार्यक्षेत्रातील कामाच्या पूर्ण किंमतीच्या ८०% रक्कम अदा करावी व उर्वरित रकमेपैकी १०% रक्कम यशस्वी चाचण्यानंतर व १०% रक्कम Defect Liability Period साठी रोखून ठेवण्यात यावी. Defect Liability Period ५ वर्षाचा असावा. Defect Liability साठी राखून ठेवलेली १०% रक्कम Defect आढळल्यास ते ज्या त्या वेळी कंत्राटदाराकडून दूर करुन घेऊन दरवर्षी २% प्रमाणे अदा करावी, असे सर्वसाधारणपणे धोरण राहील. तथापि अनुभवाअंती प्रकल्पसापेक्ष विशेषता विचारात घेऊन बदल करण्याचे अधिकार मुख्य अभियंता यांना राहतील.

१०. नलिका वितरण प्रणाली बाबतचे सविस्तर निकष / मार्गदर्शक सूचना जलसंपदा विभागाने तांत्रिक परिपत्रकाव्दारे निर्गमित कराव्यात.

सदर शासन निर्णय संदर्भ - २ मधील शासन निर्णय अधिक्रमित करुन तसेच नियोजन विभागाने अनौपचारिक सं.क्र.१६३ /१४३३ /२०१६, दि.०१.०९.२०१६ व वित्त विभागाने अनौपचारिक सं.क्र. २६७/२०१६, दि. २३.११.२०१६ अन्वये दिलेल्या सहमतीने निर्गमित करण्यात येत आहे.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करुन देण्यात आला असून त्याचा संकेतांक क्र. २०१७०११३१७०१३३५४२७ असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

Rajnish Ramkishor Shukla

Digitally signed by Rajnish Ramkishor Shukla
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(र.रा.शुक्ला)
शासनाचे उप सचिव

प्रत,

१. मा.राज्यपाल यांचे सचिव, राजभवन, मुंबई
२. मा.मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई
३. मा.मंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई

४. मा.राज्यमंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई
५. सर्व विधानसभा सदस्य / विधान परिषद सदस्य
६. मा.मुख्य सचिव, मंत्रालय, मुंबई.
७. प्रधान सचिव, सामान्य प्रशासन विभाग, मंत्रालय, मुंबई
८. प्रधान सचिव, वित्त विभाग, मंत्रालय, मुंबई
९. प्रधान सचिव, नियोजन विभाग, मंत्रालय, मुंबई
१०. प्रधान सचिव (जसं), जलसंपदा विभाग, मंत्रालय, मुंबई
११. सचिव (लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई
१२. सचिव (प्रस), जलसंपदा विभाग, मंत्रालय, मुंबई
१३. सचिव, महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण,मुंबई.
१४. महालेखापाल, महाराष्ट्र, मुंबई / नागपूर
१५. महासंचालक, मेरी, नाशिक
१६. महासंचालक, वाल्मी, औरंगाबाद
१७. कार्यकारी संचालक, महाराष्ट्र कृष्णा खोरे विकास महामंडळ, पुणे
१८. कार्यकारी संचालक, कोकण पाटबंधारे विकास महामंडळ, ठाणे
१९. कार्यकारी संचालक, तापी पाटबंधारे विकास महामंडळ, जळगाव
२०. कार्यकारी संचालक, गोदावरी मराठवाडा पाटबंधारे विकास महामंडळ, औरंगाबाद
२१. कार्यकारी संचालक, विदर्भ पाटबंधारे विकास महामंडळ, नागपूर
२२. मुख्य अभियंता, जलविज्ञान प्रकल्प, नाशिक
२३. मुख्य अभियंता, यांत्रिकी, जलसंपदा विभाग, नाशिक
२४. मुख्य अभियंता, जलविद्युत प्रकल्प (विद्युत), मुंबई
२५. मुख्य अभियंता, जलसंपदा विभाग, औरंगाबाद /नागपूर /अमरावती / पुणे / कोकण विभाग / मुंबई / उत्तर महाराष्ट्र विभाग, नाशिक / तापी पाटबंधारे विभाग, जळगांव
२६. मुख्य अभियंता, लाभक्षेत्र विकास, औरंगाबाद
२७. मुख्य अभियंता, महाराष्ट्र जल विकास केंद्र, औरंगाबाद
२८. मुख्य अभियंता, गोसीखुर्द प्रकल्प, जलसंपदा विभाग, नागपूर
२९. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, अमरावती
३०. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, पुणे
३१. मुख्य अभियंता (द व प्र) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३२. मुख्य अभियंता (पा) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३३. मुख्य अभियंता (कृपातंल) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३४. मुख्य अभियंता (जसं) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३५. मुख्य अभियंता, संकलन, प्रशिक्षण, संशोधन व सुरक्षितता, मेरी, नाशिक.
३६. मुख्य अभियंता (स्थापत्य), जलविद्युत, पुणे.
३७. सह सचिव (सेवा), जलसंपदा विभाग, मंत्रालय, मुंबई
३८. आंतरवित्त सल्लागार व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३९. अधीक्षक अभियंता, पाटबंधारे संशोधन व विकास संचालनालय, पुणे

४०. अधीक्षक अभियंता, (माती धरण), मध्यवर्ती संकल्पचित्र संघटना (सीडीओ), नाशिक.
४१. अधीक्षक अभियंता, महाराष्ट्र अभियांत्रिकी संशोधन संस्था, नाशिक.
४२. अधीक्षक अभियंता, (व्दारे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४३. अधीक्षक अभियंता, (दगडी धरण), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४४. अधीक्षक अभियंता, (विदयुत गृहे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४५. कोयना संकल्पचित्र मंडळ, पुणे.
४६. कोयना (वि.व.यां) संकल्पचित्र मंडळ, पुणे
४७. महाराष्ट्र अभियांत्रिकी प्रशिक्षण प्रबोधिनी, नाशिक.
४८. अधीक्षक अभियंता, धरण सुरक्षितता संघटना, (DSO) नाशिक.
४९. जलनियोजन विभाग, मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
५०. जलगती संशोधन विभाग क्र.१, नाशिक
५१. भुकंप उपकरणे कक्ष व भुकंप आधार सामुग्री पृथ:करण कक्ष, नाशिक.
५२. संरचनात्मक संशोधन व पदार्थ विज्ञान विभाग, नाशिक.
५३. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, पुणे.
५४. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, नागपूर.
५५. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, औरंगाबाद.
५६. गाळ सर्वेक्षण विभाग, नाशिक.
५७. सुदूर संवेदन व भूमाहिती शास्त्र विभाग, नाशिक.
५८. सामुग्री चाचणी विभाग व मृदू चाचणी विभाग, मेरी, नाशिक.
५९. भुकंप आधार सामुग्री पृथ:करण विभाग, मेरी, नाशिक.
६०. उपकरणे संशोधन विभाग, मेरी, नाशिक
६१. अधीक्षक अभियंता, आधार सामुग्री (पृथ:करण) मंडळ,नाशिक
६२. सर्व उप सचिव / अवर सचिव / कक्ष अधिकारी, जलसंपदा विभाग, मंत्रालय, मुंबई.
६३. जलसंपदा (धोरण) कार्यासन (संग्रहार्थ).

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र. सिंचन २०१५/प्र.क्र.२४ /२०१५/जसं (धोरण)
मंत्रालय, मुंबई-४०० ०३२.
दिनांक :- १८ जानेवारी, २०१७.

संदर्भ : महाराष्ट्र शासन, जलसंपदा विभाग, शा.नि. क्र. सिंचन २०१५/प्र.क्र.२४ /२०१५/ जसं (धोरण), दिनांक १३ जानेवारी, २०१७.

शासन शुध्दीपत्रक :-

संदर्भाधिन शासन निर्णयातील पृ.क्र.४ वरील परिच्छेद १० नंतरचा परिच्छेद

" सदर शासन निर्णय संदर्भ - २ मधील शासन निर्णय अधिक्रमित करुन तसेच नियोजन विभागाने अनौपचारिक सं.क्र.१६३ / १४३३ /२०१६, दि.०१.०९.२०१६ व वित्त विभागाने अनौपचारिक सं.क्र. २६७/२०१६, दि. २३.११.२०१६ अन्वये दिलेल्या सहमतीने निर्गमित करण्यात येत आहे."

या वाक्याऐवजी

" सदर शासन निर्णय **संदर्भ - १** मधील शासन निर्णय अधिक्रमित करुन तसेच नियोजन विभागाने अनौपचारिक सं.क्र.१६३ / १४३३ /२०१६, **दि.२५.१०.२०१६** व वित्त विभागाने अनौपचारिक सं.क्र. २६७/२०१६, दि. २३.११.२०१६ अन्वये दिलेल्या सहमतीने निर्गमित करण्यात येत आहे."

असे वाचावे.

सदर शासन शुध्दीपत्रक महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करुन देण्यात आला असून त्याचा संकेतांक क्र. २०१७०११८१६५२२१७१२७ असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांचे आदेशानुसार व नावाने.

Rajnish Ramkishor Shukla

Digitally signed by Rajnish Ramkishor Shukla
DN: c=IN, o=Government Of Maharashtra, ou=Water Resources, postalCode=400032, st=Maharashtra, 2.5.4.20=d37cbfb080a0bc996a710b3c0aeea737985dac09cb66bbff878f42ad4e77a606, serialNumber=293016b5f13cd03f75c9f34c66d956309c8b3cd5faf07931d817577e6116e436, cn=Rajnish Ramkishor Shukla
Date: 2017.01.18 16:57:48 +05'30'

(र.रा.शुक्ला)
शासनाचे उप सचिव

प्रत,

१. मा.राज्यपाल यांचे सचिव, राजभवन, मुंबई
२. मा.मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई
३. मा.मंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई
४. मा.राज्यमंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई
५. सर्व विधानसभा सदस्य / विधान परिषद सदस्य
६. मा.मुख्य सचिव, मंत्रालय, मुंबई.
७. प्रधान सचिव, सामान्य प्रशासन विभाग, मंत्रालय, मुंबई
८. प्रधान सचिव, वित्त विभाग, मंत्रालय, मुंबई
९. प्रधान सचिव, नियोजन विभाग, मंत्रालय, मुंबई
१०. प्रधान सचिव (जसं), जलसंपदा विभाग, मंत्रालय, मुंबई
११. सचिव (लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई
१२. सचिव (प्रस), जलसंपदा विभाग, मंत्रालय, मुंबई

१३. सचिव, महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण,मुंबई.
१४. महालेखापाल, महाराष्ट्र, मुंबई / नागपूर
१५. महासंचालक, मेरी, नाशिक
१६. महासंचालक, वाल्मी, औरंगाबाद
१७. कार्यकारी संचालक, महाराष्ट्र कृष्णा खोरे विकास महामंडळ, पुणे
१८. कार्यकारी संचालक, कोकण पाटबंधारे विकास महामंडळ, ठाणे
१९. कार्यकारी संचालक, तापी पाटबंधारे विकास महामंडळ, जळगाव
२०. कार्यकारी संचालक, गोदावरी मराठवाडा पाटबंधारे विकास महामंडळ, औरंगाबाद
२१. कार्यकारी संचालक, विदर्भ पाटबंधारे विकास महामंडळ, नागपूर
२२. मुख्य अभियंता, जलविज्ञान प्रकल्प, नाशिक
२३. मुख्य अभियंता, यांत्रिकी, जलसंपदा विभाग, नाशिक
२४. मुख्य अभियंता, जलविद्यूत प्रकल्प (विद्यूत), मुंबई
२५. मुख्य अभियंता, जलसंपदा विभाग, औरंगाबाद /नागपूर /अमरावती / पुणे / कोकण विभाग / मुंबई / उत्तर महाराष्ट्र विभाग, नाशिक / तापी पाटबंधारे विभाग, जळगांव
२६. मुख्य अभियंता, लाभक्षेत्र विकास, औरंगाबाद
२७. मुख्य अभियंता, महाराष्ट्र जल विकास केंद्र, औरंगाबाद
२८. मुख्य अभियंता, गोसीखुर्द प्रकल्प, जलसंपदा विभाग, नागपूर
२९. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, अमरावती
३०. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, पुणे
३१. मुख्य अभियंता (द व प्र) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३२. मुख्य अभियंता (पा) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३३. मुख्य अभियंता (कृपातंल) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३४. मुख्य अभियंता (जसं) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३५. मुख्य अभियंता, संकलन, प्रशिक्षण, संशोधन व सुरक्षितता, मेरी, नाशिक.
३६. मुख्य अभियंता (स्थापत्य), जलविद्युत, पुणे.
३७. सह सचिव (सेवा), जलसंपदा विभाग, मंत्रालय, मुंबई
३८. आंतरवित्त सल्लागार व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई
३९. अधीक्षक अभियंता, पाटबंधारे संशोधन व विकास संचालनालय, पुणे
४०. अधीक्षक अभियंता, (माती धरण), मध्यवर्ती संकल्पचित्र संघटना (सीडीओ), नाशिक.
४१. अधीक्षक अभियंता, महाराष्ट्र अभियांत्रिकी संशोधन संस्था, नाशिक.
४२. अधीक्षक अभियंता, (व्दारे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४३. अधीक्षक अभियंता, (दगडी धरण), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४४. अधीक्षक अभियंता, (विदयुत गृहे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४५. कोयना संकल्पचित्र मंडळ, पुणे.
४६. कोयना (वि.व.यां) संकल्पचित्र मंडळ, पुणे
४७. महाराष्ट्र अभियांत्रिकी प्रशिक्षण प्रबोधिनी, नाशिक.
४८. अधीक्षक अभियंता, धरण सुरक्षितता संघटना, (DSO) नाशिक.
४९. जलनियोजन विभाग, मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
५०. जलगती संशोधन विभाग क्र.१, नाशिक
५१. भुकंप उपकरणे कक्ष व भुकंप आधार सामुग्री पृथःकरण कक्ष, नाशिक.

पृष्ठ **३** पैकी **२**

५२. संरचनात्मक संशोधन व पदार्थ विज्ञान विभाग, नाशिक.
५३. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, पुणे.
५४. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, नागपूर.
५५. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, औरंगाबाद.
५६. गाळ सर्वेक्षण विभाग, नाशिक.
५७. सुदूर संवेदन व भूमाहिती शास्त्र विभाग, नाशिक.
५८. सामुग्री चाचणी विभाग व मृदू चाचणी विभाग, मेरी, नाशिक.
५९. भुकंप आधार सामुग्री पृथःकरण विभाग, मेरी, नाशिक.
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६३. जलसंपदा (धोरण) कार्यासन (संग्रहार्थ).

नलिकेव्दारे वितरण प्रणाली धोरणाबाबत
मार्गदर्शक सूचना.

महाराष्ट्र शासन
जलसंपदा विभाग
शासन परिपत्रक क्र. सिंचन २०१५/प्र.क्र.२४ /(भाग-२)/२०१५/जसं (धोरण)
मंत्रालय, मुंबई-४०० ०३२.
दिनांक :- ०२ फेब्रुवारी, २०१७.

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प्रस्तावना :-

उपलब्ध पाण्याचा शेतीसाठी इष्टतम वापर करण्याचे शासनाचे धोरण आहे. त्यामुळे सुक्ष्म सिंचनास प्राधान्य आहे. संदर्भीय शासन निर्णयाव्दारे निश्चित केलेले धोरण हे नलिकाव्दारे वितरण प्रणालीचे आहे. यामध्ये विचारात घेतलेली नलिका वितरण प्रणाली ही Pressurized असली तरीही पाण्याचा दाब हा गुरुत्वाकर्षणीय उर्जेव्दारे अभिप्रेत आहे. विमोचका खालील नलिकेव्दारे सुक्ष्म सिंचनाचे धोरणाची आखणी स्वतंत्ररित्या करण्यात येणार आहे. यासाठी विद्युत किंवा डिझेल पंपाव्दारे बाहय उर्जेचा वापर अनिवार्य आहे. तत्पुर्वी लाभक्षेत्रात विकेंद्रित साठे निर्माण करण्याचे धोरण निश्चित होणे गरजेचे आहे. ही प्रक्रिया सद्या शासनाच्या विचाराधीन आहे.

वितरण प्रणाली व सिंचन प्रणाली या दोन भिन्न बाबी आहेत. वितरण प्रणालीव्दारे धरणातील जलाशयातील / नदीतील पाणी, पाणीवापर संस्थेच्या कार्यक्षेत्रापर्यंत पोहचवणे अभिप्रेत आहे. हे वितरण project specific / canal specific बांधकामाची स्थिती (construction stage), भूसंपादनाची सद्य: स्थिती, भूस्तर, भौगोलीक स्थिती, पिकरचना विचारात घेऊन प्रवाही कालवे, नलिका किंवा दोन्हीचे मिश्रण(Combination of both) वापरुन करणे अभिप्रेत आहे. पारंपारिक पाटचाऱ्या व्दारे (flow irrigation पध्दतीने), तुषार किंवा ठिंबक असे सिंचनाचे वेगवेगळे प्रकार आहेत. हे पाणी वापर संस्थेच्या कार्यक्षेत्रात कार्यान्वित करावयाचे आहेत.

नलिका वितरण स्विकारले तरीही सिंचनाची कोणतीही पध्दत अवलंबता येते. मात्र राज्यातील उपलब्ध पाणी व लागवडी लायक क्षेत्र विचारात घेता संपुर्ण लाभक्षेत्रात सुक्ष्म सिंचन हे जलसंपदा विभागाचे दूरगामी (Long-term) उद्दीष्ट राहील. हे साध्य करणेचे दृष्टीने वितरण व्यवस्था निर्माण करणे किंवा सद्याची वितरण व्यवस्था सुक्ष्म सिंचनास पुरक अशी रुपांतरीत करणे आवश्यक आहे.

नलिकाव्दारे सिंचन वितरण धोरणाबाबतचा शासन निर्णय क्रमांक सिंचन २०१५/प्र.क्र.२४ / २०१५/जसं (धोरण), दिनांक १३ जानेवारी, २०१७ रोजी निर्गमित करण्यात आला आहे. सदर शासन निर्णयाच्या परिच्छेद क्रमांक १० अन्वये नलिका वितरण प्रणालीबाबतचे सविस्तर निकष / मार्गदर्शक सूचना जलसंपदा विभागाने तांत्रिक परिपत्रकाव्दारे निर्गमित कराव्यात, असे सूचित करण्यात आले आहे.

त्यामुळे नलिका वितरण प्रणालीबाबतचे सविस्तर निकष / मार्गदर्शक सूचना तयार करण्याचे शासनाच्या विचाराधीन होते. सदर शासन निर्णयात नमुद केल्यानुसार नलिका वितरण धोरणाच्या अंमलबजावणीसाठी सविस्तर निकष / मार्गदर्शक सूचना खालीलप्रमाणे आहेत.

निकष / मार्गदर्शक सूचना :-

सिंचन प्रकल्पांच्या वितरण व्यवस्थेत संपूर्ण अथवा अंशत: नलिका वितरण प्रणालीचा अवलंब करण्यासाठी खालील निकष / मार्गदर्शक सूचना विचारात घ्याव्यात.

१.० नलिकेव्दारे वितरणाचा पर्याय निवडताना त्या मागचा उद्देश स्पष्ट असावा. खालीलपैकी कोणत्या क्षेत्रिय परिस्थितीत नलिका वितरणाचा पर्याय निवडण्यात येत आहे. त्यामुळे कोणते लाभ अपेक्षित आहेत, याचा सविस्तर परामर्श घेऊन त्या बाबतची स्वयंस्पष्ट नोंद तांत्रिक मान्यता प्रस्तावात करावी.

(१.१) लाभक्षेत्रातील जमीनीचा उतार तीव्र असल्यास कालव्यावर /वितरिकेवर / लघु कालव्यावर उपलब्ध अतिरिक्त उर्जेचा व्यय करण्यासाठी धबधब्याची (Series of Fall Structures) श्रृंखला बांधावी लागते . अशा परिस्थितीत उपलब्ध उर्जेचा व्यय / नाश करण्यासाठी धबधबे बांधणीवर खर्च करण्यापेक्षा या उर्जेचा वापर करुन तुलनेने कमी खर्चात नलिका वितरण प्रणाली संकल्पित करण्यास वाव असतो. सर्वसाधारणपणे जमिनीचा उतार १:५०० पेक्षा तीव्र असल्यास गुरुत्वाकर्षणान्वये उर्जेव्दारे नलिका वितरण व्यवहार्य ठरते.

(१.२) त्याचप्रमाणे लाभक्षेत्रातील जमिनीस मोठ्या प्रमाणावर चढ-उतार असल्यास कालवा बांधकामाचा खर्च वाढतो. तसेच शेतचाऱ्यांवरील धबधब्यांचा खर्च वाढतो .अशा प्रकरणीही बंदीस्त नलिका वितरण व्यवहार्य ठरु शकते.

(१.३) संत्रा व अन्य फळबागांसाठी तसेच पश्चिम विदर्भातील खारपाण पट्ट्यात अत्यंत नियंत्रित सिंचनाची गरज आहे. जास्त पाण्यामुळे फळबागांची उत्पादकता (Productivity) कमी होते. अशा लाभक्षेत्रासाठी बंदिस्त नलिका वितरण प्रणालीचा पर्याय अन्य निकषांच्या आधारे तपासून स्वीकारता येईल.

(१.४) नवीन प्रकल्पांच्या बाबतीत ज्या प्रकरणी पारंपारिक कालवा वितरण प्रणाली भू-संपादनाच्या खर्चामुळे अधिक महाग ठरते , अशा प्रकरणी अन्य अभियांत्रिकी निकषांनुसार नलिका वितरण तांत्रिक व आर्थिकदृष्टया व्यवहार्य ठरत असल्यास अशा ठिकाणीही नलिका वितरण व्यवस्था स्वीकारता येईल.

(१.५) नलिका वितरणामुळे वहनव्ययाची बचत होते. पाणी वापराची कार्यक्षमता वाढते. त्यामुळे उपसा सिंचन योजनेमधील शीर्षकामाच्या भांडवली गुंतवणुकीत तसेच वीज देयकाच्या

आवर्ती खर्चात बचत संभवते. त्यामुळे नवीन उपसा सिंचन योजनांमध्ये संकल्पनाच्या टप्यावरच बंदिस्त नलिका वितरणाचा व पारंपारिक कालवा वितरण प्रणालीचा तौलनिक अभ्यास करुन प्रकल्प अहवालामध्ये तरतूदी कराव्यात व त्यानुसार वितरण प्रणालीसाठीच्या भू- संपादनाची तरतूद करावी.

(१.६) काळया मातीच्या लाभक्षेत्रात पाया खोल असल्याने कालव्यावरील बांधकामाचा भांडवली खर्च जास्त येतो. तसेच मुरुम जवळपास उपलब्ध नसल्यास मुरुम लादी भरावासह (CNS Bedding) संधानकातील अस्तरीकरणाच्या तुलनेत नलिका वितरण किफायतशीर ठरु शकते .अशा प्रदेशात तांत्रिक निकषांनुसार नलिका वितरण प्रणाली स्वीकारता येईल.

(१.७) ज्या वितरण प्रणालीच्या बाबतीत सुरुवातीच्या काही भागातील भूधारकांच्या विरोधामुळे सिंचनाचे लाभ मिळण्यास अडचण झाली असेल, अशा प्रकरणी वितरण व्यवस्थेची सलगता निर्माण करुन (Bridging the gaps in the distribution system) सिंचनाचे लाभ सुरु करण्याच्या दृष्टीने वितरण प्रणालीचे अंशत: बांधकाम नलिका वितरणाद्वारे करता येईल.

(१.८) बंदिस्त नलिका वितरणामुळे पाणी बचत होते. या बचतीतून उपलब्ध पाण्यातून जास्तीचे सिंचन क्षेत्र निर्माण होऊ शकते. त्यामुळे पूर्ण झालेल्या प्रकल्पातील सिंचनासाठी नियोजित केलेले पाणी बिगर सिंचन प्रयोजनार्थ वर्ग झाले असल्यास, अशा प्रकरणी जेव्हा वितरण प्रणालीच्या पुन:र्स्थापनेचे काम विचाराधीन असेल तेव्हा, कपात केलेल्या सिंचनक्षेत्राची पुन:र्स्थापना करण्यासाठी नलिका वितरणाचा पर्याय अन्य अभियांत्रिकी व आर्थिक निकषांच्या चौकटीत तपासून स्वीकारता येईल.

(१.९) राज्यातील सिंचन प्रकल्पांचे लाभक्षेत्र ठरविताना लागवडीयोग्य क्षेत्र (CCA) व नियोजित सिंचनक्षेत्र (ICA) या दोन संज्ञा विचारात घेतल्या जातात. सर्वसाधारणपणे ICA हा CCA च्या ७० ते ८० टक्के असतो. त्यामुळे उपलब्ध पाण्याच्या तुलनेत प्रत्यक्षात लाभक्षेत्रात लागवडीलायक क्षेत्र जास्त असते. या जास्तीच्या क्षेत्रास पाणी घेण्यास शेतकऱ्यांना प्रतिबंध करणे शक्य नसते .तसेच जलाशयावरुन व कालव्यावरुन अनुज्ञेय मर्यादेत दिल्या जाणाऱ्या खाजगी उपसा क्षेत्राची तरतूद प्रकल्प संकल्पनात केलेली नसते. त्याचप्रमाणे वाढत्या नागरीकरणामुळे व औद्योगिकरणामुळे प्रकल्पीय तरतूदींच्या तुलनेत जास्तीचे पाणी बिगरसिंचन प्रयोजनार्थ वेळोवेळी वर्ग केले जाते. त्यामुळे राज्यातील बहुतेक प्रकल्पांच्या जलनियोजनावर व सिंचन व्यवस्थेवर मोठ्या प्रमाणावर ताण निर्माण

झाला आहे .नलिका वितरणामुळे बचत झालेल्या पाण्यातून मूळ घोषित लाभक्षेत्रात निर्माण झालेली तूट भरुन काढणे आणि CCA व ICA मधील तफावत दूर करणे हा उद्देश असावा. मात्र नलिका वितरण प्रस्तावित करुन पाणी बचत दर्शवून प्रकल्पाच्या मंजूर लाभक्षेत्राबाहेरील वाढीव सिंचनक्षेत्र शासन पूर्वमान्यतेखेरीज प्रस्तावित करु नये.

२.०० सर्वसाधारणपणे मोठया व मध्यम प्रकल्पामध्ये वितरीका / लघु वितरीका साठी व लघु प्रकल्पामध्ये संपुर्ण वितरण व्यवस्थेसाठी नलिका वितरणाचा अवलंब करावा.

३.०० ज्या प्रकरणी सुक्ष्म सिंचनाचा भविष्यात अवलंब करणे प्रस्तावित आहे. अशा ठिकाणी लघु कालव्याचे विमोचकाचे खाली नलिका वितरण प्रणाली कायान्वित करु नये. जलाशय ते लघु कालव्याच्या मुखापर्यंतच नलिका वितरण मयादित करावे. विमोचका खालील / विकेंद्रित पाणी साठयाखालील सुक्ष्म सिंचन प्रणाली कृषी विभागाचे अर्थसाहाय्याचे मदतीने लाभार्थीच्या पाणीवापर संस्थेने करणे अभिप्रेत आहे.

४.०० भूसंपदानाचा खर्च धरुन नलिका वितरण व्यवस्था पारंपारिक कालवा वितरणापेक्षा अधिक खर्चिक ठरते. त्यामुळे ज्या प्रकरणी पारंपारिक वितरण प्रणाली गृहीत धरुन भू-संपादन झाले आहे, अशा ठिकाणी नलिका वितरणाचा विचार करु नये.

५.०० नलिकाची निवड :

संकल्पित विसर्ग, त्यासाठी लागणारा नलिकाचा व्यास, पाण्याचा दाब, नलिकाच्या प्रकारानुसार अपेक्षित आयुष्यमान व टिकाऊपणा, किंमत, हाताळणीतील सुलभता/अडचणी, जोडाईची सुलभता, जोडाचा टिकाऊपणा, अन्य फायदे, तोटे व पूर्वअनुभव विचारात घेऊन नलिकाचा प्रकार समंजसपणे (Judiciously) निवडण्याचे स्वातंत्र्य मुख्य अभियंता यांना राहील.

६.०० जलशास्त्रीय संकल्पन :

(६.१) प्रकल्पीय पीक रचनेनुसार पंधरवडयातील जास्तीत जास्त पाणी गरज विचारात घेऊन वितरण प्रणालीचे संकल्पन करावे.

(६.२) Field Application Efficiency ७५ टक्के व वहनव्यय ५ टक्के विचारात घ्यावा.

(६.३) पंधरवडयातील १२ दिवस मुख्य वाहिनी प्रवाही राहील असे गृहीत धरावे. विमोचके २४ तास चालतील असे गृहीत धरावे. मात्र अस्तित्वात असलेल्या वितरण प्रणालीचे scheduling वेगळे असल्यास त्या scheduling शी मेळ बसेल असे किफायतशीर जलशास्त्रीय संकल्पन करावे.

७.०० जलवाहिन्याचे आरेखन (Pipe Layout) :

(७.१) नलिका वितरण प्रणालीचे नियोजनात "चक" चे नियोजन हा महत्वाचा घटक आहे. सर्वेक्षणाअंती सर्वसाधारणपणे ५ ते १२ हेक्टर आकाराचे चक नियोजन करावे. मात्र प्रकल्प सापेक्ष यात बदल करता येईल.

(७.२) Nearly equitable water distribution to all outlets and optimum cost ही दोन उद्दीष्टे ठेऊन Network architecture अंतिम करावे.

(७.३) सर्वसाधारण रचनेमध्ये मुख्य वाहिनी ही कमीत कमी लांबीची असावी.

(७.४) मुख्य वाहिनी प्रमाणेच उपवाहिन्याची आखणी करताना कमीत कमी लांबीत जास्तीत जास्त लाभक्षेत्रास लाभ देता येईल हा निकष ठेवावा. प्रत्येक चक साठी स्वतंत्र उपवाहिनी (Lateral) असावी. चक चा size व shape विचारात घेऊन आवश्यकतेनुसार sub-lateral प्रस्तावित करावेत.

(७.५) Operational Scheduling हे आर्थिकदृष्टया किफायतशीर व सिंचन व्यवस्थापनाच्या दृष्टीने सुटसुटीत असावे.

Layout व Operational Scheduling बाबत designer ने त्याचे कौशल्य वापरणे अभिप्रेत आहे व याबाबतची खातरजमा मुख्य अभियंता यांनी मान्यता देताना करणे अभिप्रेत आहे.

८.०० संकल्पनाबाबत इतर मार्गदर्शक सूचना :

(८.१) प्रवाहाचा वेग :- नलिकेमधील प्रवाहाचा वेग कमी राहिल्यास नलिकेमध्ये गाळ साठण्याचा संभव असतो. त्यामुळे संपूर्ण वितरण प्रणालीमध्ये प्रवाहाचा वेग सर्वसाधारणपणे १ मी./सेकंद इतका असावा. (०.८ मी./सेकंद ते १.२ मी./सेकंद) अपवादात्मक परिस्थितीत कमी लांबीत प्रवाहाचा वेग ०.६ मी./सेकंद पर्यंत स्विकारता येईल. मात्र प्रवाहाचा वेग ०.६ मी./सेकंद पेक्षा कुठेही कमी नसावा. तसेच प्रवाहाचा वेग १.५ मी./सेकंद पेक्षा जास्त नसावा. मात्र नलिका वाहिनी लोखंडी, पीएससी किंवा एचडीपीई नलिकाची प्रस्तावित असल्यास खर्चातील बचतीसाठी प्रवाहाची कमाल मर्यादा १.८ मी./सेकंद पर्यंत वाढवता येईल. मात्र असे करताना नलिका रेटींग किमान ४ kg/cm^2 इतके असावे. ज्या लांबीत प्रवाहाचा वेग ०.६ मी./से. पेक्षा कमी राहण्याची शक्यता आहे त्या लांबीत Scouring arrangement प्रस्तावित करावी.

(८.२) नलिका वितरण प्रणालीचे संकल्पन करताना नलिकेचा व्यास असा असावा कि नलिका व्दारे संकल्पित विसर्ग शाश्वतपणे उपलब्ध होईल. नलिकेचा व्यास गरजेपेक्षा कमी राहिल्यास संबंधित क्षेत्रास पुरेसा पाणी पुरवठा होत नाही याउलट नलिकेचा व्यास

गरजेपेक्षा जास्त ठेवल्यास त्या क्षेत्रास जास्त पाणी पुरवठा होतो व अन्य क्षेत्रावर त्याचा विपरीत परिणाम होतो.

(८.३) बंदीस्त नलिकेमधून पाण्याच्या प्रवाहाचे नियंत्रण Hydraulic Gradient व्दारे होते. संकल्पन करताना Hydraulic Gradient बाबत खालील मार्गदर्शक सूचना विचारात घ्याव्यात.

(अ) मुख्य वाहिनीच्या सुरुवातीस adequate pressure व full flow condition ensure करण्यासाठी इंनटेक चेंबर च्या जागी किमान १.२ मी. चे चलन शिर्ष (Driving Head) असावे. Intake chamber सर्वसाधारणपणे नलिका व्यासाच्या दुप्पट व्यासाची असावी.

(ब) तसेच वाहिनीवर किमान effective head (HGL- crown elevation) ०.६ मी. असावे. अपवादात्मक ठिकाणी हा निकष ०.३ मी. पर्यंत शिथील करता येईल.

(क) प्रत्येक विमोचकाच्या ठिकाणी Residual head जवळ जवळ सारखे असावे.

(ड) Low Lying Area मध्ये उपलब्ध Hydraulic Gradient जास्त असल्यास नलिकाचा व्यास कमी करुन किंवा Valve चा वापर करुन विसर्ग मर्यादित करावा.

(८.४) नलिकाचे संकल्पन करताना सर्वसाधारणपणे Modified Hazen Williams Formula वापरण्यात यावा.

Modified Hazen Williams Formula

$$V = 143.534\ CR \times r^{0.6575} \times s^{0.5525}$$

$$h = \frac{L \times [Q / CR]^{1.81}}{994.62 \times D^{4.81}}$$

In which

V = velocity of flow in m / sec.
CR = Pipe roughness coefficient
r = hydraulic radius in m. (for circular pipe, r = internal radius)
S = frictions slope (i.e. slope of HGL line)
D = Internal diameter of pipe in m.
h = friction head loss in m.
L = Length of pipe in m.
Q = Flow of pipe in m^3 / sec.

विविक्षित कारणास्तव यापेक्षा वेगळा Formula किंवा त्यावर आधारित संगणक प्रणाली किंवा monogram वापरावयाचे असल्यास त्याचे स्वातंत्र्य मुख्य अभियंताना राहील. मात्र याबाबतची कारण मिमांसा अभिलेख्यात नमुद करावी.

जेव्हा isolation मध्ये bridging the left over canal lengths साठी नलिका वापरली जाते त्यावेळी manually संकल्पन करण्यात यावे. मात्र संपुर्ण Network साठी संगणक प्रणालीचा वापर करावा.

(८.५) संकल्पनासाठी विचारात घेतलेल्या Pipe segment मधील Bends / Tees इत्यादींच्या minor losses साठी विचाराधीन लांबीतील friction losses च्या १० % losses ची तरतूद करावी.

(८.६) जलवाहिनीच्या स्थिरतेच्या दृष्टीने मुख्य वाहिनी व उपवाहिनी वर change in alignment च्या ठिकाणी Thrust Blocks संकल्पीत करावेत. तसेच सरळ लांबीत मातीचे swelling pressure विचारात घेऊन ठराविक अंतरावर Anchor Block प्रस्तावित करावेत. Thrust block व Anchor block P.C.C.मध्ये असावेत.

(८.७) परिरक्षणाच्या सोयीच्या दृष्टीने प्रत्येक उपवाहिनीचे सुरुवातीस Sluice valve ची तरतूद करावी. तसेच Lowest Elevation च्या ठिकाणी / नाल्याजवळच्या ठिकाणी drain valve प्रस्तावित करावेत.

(८.८) Summit locations च्या जागी Air Vaccum Relief Valves ची तरतूद करावी. तसेच सर्वसाधारणपणे ३०० मी. अंतरावर Air Vent ची तरतूद करावी. Air Vent HGL चे वर ०.६ मी. पर्यंत extend करावेत. Air Valves चा व्यास सर्वसाधारणपणे वाहिनीच्या व्यासाच्या किमान १० टक्के इतका असावा.

९.०० पुढील आदेशापर्यंत अंदाजपत्रक तयार करण्यासाठी ज्या बाबीचे दर (उदा.पाईप) जलसंपदा विभागाच्या दरसूचीत नाहीत ते महाराष्ट्र जीवन प्राधिकरण (म.जी.प्रा.) ची दरसूचीनुसार वापरण्यात यावेत. मात्र असे करताना पाईप, व्हॉल्व इत्यादीच्या पुरवठा किमतीवर विशिष्ट क्षेत्रासाठीच्या (जनजाती / विशेष कृती कार्यक्रम ईत्यादी) वाढी विचारात घेण्यात येऊ नयेत. जलसंपदा विभागाचे दरसूचीतील टीप क्र. ९ लागू करताना सुध्दा अनुज्ञेय वाढ म.जी.प्रा. दरसूचीतील साहित्याच्या किमतीवर विचारात घेऊ नये. कंत्राट व्यवस्थापनेच्या दृष्टीने शक्य असेल तेथे प्रारुप निविदेत प्रति हेक्टरी दर नमुद करण्याच्या पर्यायाचा विचार करावा.

१०.०० जुना अनुभव विचारात घेता बंदीस्त नलिका वितरण प्रणाली राबवताना खालील बाबी कटाक्षाने विचारात घ्याव्यात:-

(१०.१) Inlet chamber मध्ये sand / silt trap तसेच debris ची entry टाळण्यासाठी Trash screen ची तरतूद करावी.

(१०.२) आर.सी.सी. नलिका चे जोड (Joints) Male - Female Joint सह व Rubber Packing सह पूर्णत: Water tight असावेत, अन्यथा झाडांची मुळे सदर नलिकेच्या सांध्यातून नलिकेत प्रवेश करुन नलिकेच्या प्रवाहात अडथळे निर्माण करतात.

(१०.३) पी.व्ही.सी. नलिका हे जास्त काळ सूर्यप्रकाशाच्या संपर्कात राहिल्यास U V degradation मुळे Brittle होतात. निविदेत पुरवठा व जोडणी या दोन स्वतंत्र बाबी ठेवल्यास कंत्राटदाराचा पुरवठ्यावर भर राहतो. कार्यक्षेत्रावरील अडचणींमुळे नलिका जोडणी लांबणीवर पडल्यास नलिका खराब(Brittle) होतात. तसेच कंत्राटदाराचीही जोडणी कामास टाळाटाळ / विलंब करण्याची प्रवृत्ती दिसून येते. त्यामुळे या कामाच्या निविदेमध्ये पुरवठ्याची बाब असु नये. तसेच नलिका कार्यक्षेत्रावर आणल्या बरोबर त्याची जोडणी करावी व joint set झाल्याबरोबर नलिकेच्या बाजूने व वरती पुनर्भराव (Refilling) आवश्यक दबाईसह करावे. जेणेकरुन seepage मुळे नलिका वर येणार नाहीत (Floating action). पुनर्भराव करताना नलिकेच्या दोन्ही बाजूने uniformly पुनर्भराव करावा.

(१०.४) जमिनीखाली नलिकेची उभारणी अशा खोलीवर करावी की, नलिकेच्या माथ्यावर १.२ मी. चा भराव राहील, जेणेकरुन शेतीच्या अवजारामुळे नलिकेस बाधा पोहोचणार नाही.

(१०.५) अंदाजपत्रकात नलिकासाठी चारी खोदाईस बाजूचे उतार विचारात घेऊ नयेत. तसेच खोदाईसाठी बाजूचे उतार देय राहणार नाहीत याची स्पष्ट तरतूद प्रारुप निविदेत करावी. चारीच्या तळातील खोदाई रुंदी ही १.५ पट बाहय व्यास + ३०० मी.मी. किंवा किमान ५० सें.मी. इतकी घ्यावी.

११.०० नलिका वितरण योजना पाणी वापर संस्थेस हस्तांतरीत करताना Operation Manual हस्तांतरीत करणे गरजेचे आहे. Operational Manual आवश्यक प्रतीत उपलब्ध करुन देण्याची अट निविदेत अंतर्भूत असावी. या Operational Manual मध्ये किमान खालील बाबींचा अंतर्भाव असावा.

(११.१) संकल्पचित्रातील गृहितके (विशेषत: scheduling बाबतची).

(११.२) पाणी वितरण स्टाफ च्या जबाबदाऱ्या .

(११.३) संभाव्य अडचणी (आपत्कालीन परिस्थिती), त्यावेळी करावयाच्या उपाययोजना व त्यासंबंधी सुचना.

(११.४) संपुर्ण नलिका प्रणालीच्या नकाशा (Plan) व लंबछेद नकाशामध्ये विविध प्रकारच्या Valve ची तसेच Thrust block / Anchor block ची ठिकाणे सा.क्र. सह दर्शवावीत.

(११.५) Standard specification ची यादी.

(११.६) Specification & Rating of valves, निर्मिती / पुरवठा / दुरुस्ती करणाऱ्या अभिकरणांचा संपर्क तपशील.

Operational manual मधील सदर बाबी या उदाहरणादखल येथे नमुद केलेल्या आहेत. Operational manual हे समग्र स्वरुपाचे असावे.

सदर शासन परिपत्रक महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करुन देण्यात आला असून त्याचा संकेतांक क्र. २०१७०२०२१३२४५१२२२७ असा आहे. हे परिपत्रक डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांचे आदेशानुसार व नावाने.

Rajnish Ramkishor Shukla

Digitally signed by Rajnish Ramkishor Shukla
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Date: 2017.02.02 13:33:32 +05'30'

(र.रा.शुक्ला)

शासनाचे उप सचिव

प्रत,

१. मा.राज्यपाल यांचे सचिव, राजभवन, मुंबई.
२. मा.मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई.
३. मा.मंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई .
४. मा.राज्यमंत्री, जलसंपदा यांचे स्वीय सहायक, मंत्रालय, मुंबई .
५. सर्व विधानसभा सदस्य / विधान परिषद सदस्य.
६. मा.मुख्य सचिव, मंत्रालय, मुंबई.
७. प्रधान सचिव, सामान्य प्रशासन विभाग, मंत्रालय, मुंबई.
८. प्रधान सचिव, वित्त विभाग, मंत्रालय, मुंबई.
९. प्रधान सचिव, नियोजन विभाग, मंत्रालय, मुंबई.
१०. प्रधान सचिव (जसं), जलसंपदा विभाग, मंत्रालय, मुंबई.
११. सचिव (लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई.
१२. सचिव (प्रस), जलसंपदा विभाग, मंत्रालय, मुंबई.
१३. सचिव, महाराष्ट्र जलसंपत्ती नियमन प्राधिकरण,मुंबई.

१४. महालेखापाल, महाराष्ट्र, मुंबई / नागपूर.
१५. महासंचालक, मेरी, नाशिक.
१६. महासंचालक, वाल्मी, औरंगाबाद .
१७. कार्यकारी संचालक, महाराष्ट्र कृष्णा खोरे विकास महामंडळ, पुणे.
१८. कार्यकारी संचालक, कोकण पाटबंधारे विकास महामंडळ, ठाणे.
१९. कार्यकारी संचालक, तापी पाटबंधारे विकास महामंडळ, जळगाव.
२०. कार्यकारी संचालक, गोदावरी मराठवाडा पाटबंधारे विकास महामंडळ, औरंगाबाद.
२१. कार्यकारी संचालक, विदर्भ पाटबंधारे विकास महामंडळ, नागपूर.
२२. मुख्य अभियंता, जलविज्ञान प्रकल्प, नाशिक.
२३. मुख्य अभियंता, यांत्रिकी, जलसंपदा विभाग, नाशिक.
२४. मुख्य अभियंता, जलविद्यूत प्रकल्प (विद्यूत), मुंबई.
२५. मुख्य अभियंता, जलसंपदा विभाग, औरंगाबाद /नागपूर /अमरावती / पुणे / कोकण विभाग / मुंबई / उत्तर महाराष्ट्र विभाग, नाशिक / तापी पाटबंधारे विभाग, जळगांव.
२६. मुख्य अभियंता, लाभक्षेत्र विकास, औरंगाबाद.
२७. मुख्य अभियंता, महाराष्ट्र जल विकास केंद्र, औरंगाबाद.
२८. मुख्य अभियंता, गोसीखुर्द प्रकल्प, जलसंपदा विभाग, नागपूर.
२९. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, अमरावती.
३०. मुख्य अभियंता (वि.प्र.), जलसंपदा विभाग, पुणे.
३१. मुख्य अभियंता (द. व प्र.) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३२. मुख्य अभियंता (पां.) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३३. मुख्य अभियंता (जसं.) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३४. मुख्य अभियंता, मध्यवर्ती संकल्पचित्र संघटना,(सिडीओ) नाशिक.
३५. मुख्य अभियंता (स्थापत्य), जलविद्युत, पुणे.
३६. सह सचिव (सेवा), जलसंपदा विभाग, मंत्रालय, मुंबई.
३७. आंतरवित्त सल्लागार व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
३८. अधीक्षक अभियंता, पाटबंधारे संशोधन व विकास संचालनालय, पुणे.
३९. अधीक्षक अभियंता, (माती धरण), मध्यवर्ती संकल्पचित्र संघटना (सीडीओ), नाशिक.
४०. अधीक्षक अभियंता, महाराष्ट्र अभियांत्रिकी संशोधन संस्था, नाशिक.
४१. अधीक्षक अभियंता, (व्दारे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.
४२. अधीक्षक अभियंता, (दगडी धरण), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.

४३. अधीक्षक अभियंता , (कालवे) मध्यवर्ती संकल्पचित्र संघटना, नाशिक.

४४. अधीक्षक अभियंता, (विदयुत गृहे), मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.

४५. कोयना संकल्पचित्र मंडळ, पुणे.

४६. कोयना (वि.व.यां) संकल्पचित्र मंडळ, पुणे.

४७. महाराष्ट्र अभियांत्रिकी प्रशिक्षण प्रबोधिनी, नाशिक.

४८. अधीक्षक अभियंता, धरण सुरक्षितता संघटना, (DSO) नाशिक.

४९. जलनियोजन विभाग, मध्यवर्ती संकल्पचित्र संघटना (सिडिओ), नाशिक.

५०. जलगती संशोधन विभाग क्र.१, नाशिक.

५१. भुकंप उपकरणे कक्ष व भुकंप आधार सामुग्री पृथ:करण कक्ष, नाशिक.

५२. संरचनात्मक संशोधन व पदार्थ विज्ञान विभाग, नाशिक.

५३. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, पुणे.

५४. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, नागपूर.

५५. अधीक्षक अभियंता, गुण नियंत्रण मंडळ, औरंगाबाद.

५६. गाळ सर्वेक्षण विभाग, नाशिक.

५७. सुदूर संवेदन व भूमाहिती शास्त्र विभाग, नाशिक.

५८. सामुग्री चाचणी विभाग व मृदू चाचणी विभाग, मेरी, नाशिक.

५९. भुकंप आधार सामुग्री पृथ:करण विभाग, मेरी, नाशिक.

६०. उपकरणे संशोधन विभाग, मेरी, नाशिक.

६१. अधीक्षक अभियंता, आधार सामुग्री (पृथ:करण) मंडळ,नाशिक.

६२. सर्व उप सचिव / अवर सचिव / कक्ष अधिकारी, जलसंपदा विभाग, मंत्रालय, मुंबई.

६३. जलसंपदा (धोरण) कार्यासन (संग्रहार्थ).

सिंचन प्रकल्पांच्या लाभक्षेत्रात सुक्ष्म सिंचनाचे अंतिम उद्दिष्ट ठेवून वितरण व्यवस्था करण्याचे धोरण.

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्रमांक : संकीर्ण २०१५/(५५०/४/१५)/सिं.व्य.(धोरण)
मंत्रालय, मुंबई ४०० ०३२.
दिनांक - ०२ मे, २०१७

१.० प्रस्तावना–

राज्यातील वापरायोग्य पाणी मर्यादित असून सिंचनासाठी उपलब्ध होणाऱ्या पाण्यातून सिंचन प्रकल्पाद्वारे प्रवाही पध्दतीने जास्तीत जास्त ८५ लक्ष हेक्टर इतके म्हणजे एकूण लागवडी योग्य क्षेत्राच्या ३७.३७% एवढेच सिंचन क्षेत्र निर्माण होऊ शकेल असा अंदाज आहे. याशिवाय भूजलामधून जलसंधारण, स्थानिक स्तर व कृषि विभागाच्या कार्यक्रमाद्वारे प्रकल्पांतून ४१ लक्ष हेक्टर निर्माण होईल असे अपेक्षित आहे. म्हणजे सर्व स्त्रोतांमधून राज्यात जास्तीत जास्त १२६ लक्ष हेक्टर म्हणजे एकूण लागवडी योग्य क्षेत्राच्या ५६% इतके सिंचन क्षेत्र निर्माण होऊ शकणार आहे.

भारतातील सिंचन क्षमतेची राष्ट्रीय सरासरी ७६.४४% असून किमान त्यापर्यंत जाण्यासाठी राज्यातील कृषी/सिंचन क्षेत्रातील पाणी वापराची कार्यक्षमता वाढविण्याशिवाय पर्याय नाही. यासाठी संपुर्ण सुक्ष्म सिंचनाचे दिर्घकालीन उद्दिष्ट ठेऊन सध्याचे प्रवाही सिंचन पध्दतीचे परिवर्तन टप्प्याटप्प्याने सुक्ष्म सिंचनात करणे, तसेच बांधकामाधीन व भविष्यकालीन सिंचन प्रकल्पांची वितरण व्यवस्था सुक्ष्मसिंचन पध्दत विचारात घेऊन संकल्पित करणे अनिवार्य आहे.

सध्या सिंचन प्रकल्पातून शेतीसाठी प्रवाही सिंचन पध्दतीने पाणी पूरविण्याचे धोरण असून त्यादृष्टीने लाभक्षेत्रात वितरण व्यवस्था निर्माण केली जाते. प्रवाही सिंचन पध्दतीमध्ये कालव्यांचे संकल्पन ३० ते ४० दिवसाच्या कालांतराचे आवर्तन विचारात घेऊन केले जाते. सुक्ष्म सिंचन पध्दतीस प्रोत्साहन देणेसाठी दररोज शाश्वत पाणी उपलब्ध करुन देणे गरजेचे आहे. पारंपारिक सिंचन प्रकल्पांचे कालवे प्रवाही सिंचन पध्दतीने पाणी वितरणासाठी संकल्पित केलेले असल्याने त्यामधून सुक्ष्म सिंचनासाठी दररोज पाणी उपलब्ध करणे तांत्रिकदृष्टया शक्य होत नाही.

महाराष्ट्र जलसंपत्ती नियमन प्राधिकरणाने अधिनियमातील कलम १४(४) नुसार जून २०१९ पासून पुढे राज्यातील बारमाही पिकांना सुक्ष्मसिंचनाद्वारे पाणी पुरवठा करणे बंधनकारक केलेले आहे. त्याची अंमलबजावणी करण्यासाठी सिंचन प्रकल्पांच्या पारंपरिक वितरण पध्दतीमध्ये सुधारणा करुन सुक्ष्म सिंचनासाठी लाभक्षेत्रात जागोजागी विकेंद्रीत जलसाठे निर्माण करुन त्याद्वारे शाश्वत पाणी उपलब्ध करुन देणे आवश्यक आहे.

वरील बाबी विचारात घेऊन सिंचन प्रकल्पांची वितरण व्यवस्था सुक्ष्म सिंचन पध्दतीस पूरक करणेबाबतचा धोरणात्मक निर्णय दिनांक ०९.०३.२०१७ रोजीच्या मा.मंत्रीमंडळ बैठकीत शासनाने घेतला आहे. त्यानूसार लाभक्षेत्रामध्ये सुक्ष्मसिंचनास प्रोत्साहन देण्यासाठी जागोजागी विकेंद्रीत जलसाठे (decentralised storages) निर्माण करून त्याव्दारे सुक्ष्मसिंचनास गरजेनूसार पाणी उपलब्ध करून देण्याची शाश्वत व्यवस्था निर्माण करण्याचे धोरण आहे. विकेंद्रीत जलसाठ्यामधून लाभार्थींनी स्वत:च्या यंत्रणेव्दारे/ पंपाव्दारे पाणी उपसा करून त्यांच्या शेतातील शेततळे/ विहीरी मध्ये साठवावे व सुक्ष्मसिंचन संचाव्दारे पिकांना पाणी पूरवठा करावा. वितरण व्यवस्थेचे नविन धोरण हे लवचिक असून त्यामुळे लाभधारकांना त्यांच्या नियोजनानूसार पिकांचे नियोजन करणे शक्य

होईल, महाराष्ट्र सिंचन पध्दतीचे शेतकऱ्यांकडून व्यवस्थापन कायद्याव्दारे पाणीवापर संस्था निर्माण करणे व सिंचन व्यवस्थापनामध्ये लाभधारकांचा सक्रिय सहभाग वाढविणे , प्रकल्पांचे लाभ जनतेला लवकर देणे व सिंचन व्यवस्थापनामधील शासन यंत्रणेचा हस्तक्षेप कमी करणे इत्यादी महत्वाची उद्दीष्टे साध्य होऊ शकतील.

शासन निर्णय–

१.० राज्यात सिंचन प्रकल्पाच्या लाभक्षेत्रात सुक्ष्मसिंचन पध्दत राबविणे हे शासनाचे अंतिम उद्दिष्ट असून, ते साध्य करण्यासाठी सुक्ष्म सिंचनास पुरक वितरण व्यवस्था निर्माण करण्याचा शासनाने निर्णय घेतलेला आहे.

१.१ सुक्ष्म सिंचनास शाश्वत पाणी उपलब्ध करुन देण्यासाठी लाभक्षेत्रात जागोजागी सर्वसाधारणपणे १०० हेक्टरचे चक (Block) करुन त्या क्षेत्रास किमान १५ दिवस पुरेल इतक्या क्षमतेचे विकेंद्रीत जलसाठे निर्माण करावेत.

१.२ प्रकल्पाच्या लाभक्षेत्रामध्ये, जलसंपदा विभाग, जलसंधारण, स्थानिक स्तर व कृषी विभागामार्फत पूर्ण झालेले व यापुढे पूर्ण होणारे लघु पाटबंधारे तलाव, पाझर तलाव, गांव तलाव, बंधारे इत्यादींचा उपयोग विकेंद्रीत जलसाठे म्हणून प्राधान्याने करावा. या जलसाठ्यात पाणी भरण्यासाठी नैसर्गिक नाल्यांचा उपयोग पोहच कालवे (Feeder Canal) म्हणुन करावा.

जलसाठ्यांच्या साठवण क्षमतेनुसार त्यांचे लाभक्षेत्र व ते भरुन देण्याची वारंवारता निश्चित करावी. उर्वरीत लाभक्षेत्रासाठी आवश्यकतेनुसार नविन विकेंद्रीत जलसाठे निर्माण करावेत. कालव्याद्वारे प्रवाही पध्दतीने विकेंद्रीत जलसाठे भरुन देणे शक्य होईल, याद्दष्टीने विकेंद्रीत जलसाठयाचे ठिकाण निश्चित करावे. तांत्रिक द्दष्टया शक्य असेल तेथे विकेंद्रीत जलसाठे भरुन देण्यासाठी पाईप लाईनचा वापर करावा.

१.३ नव्याने निर्माण करावयाच्या विकेंद्रीत साठ्यासाठी सुयोग्य शासकीय जमीन उपलब्ध असल्यास ती प्रधान्याने वापरावी अन्यथा आवश्यक खाजगी जमिनीचे संपादन प्रकल्प खर्चातून करावे.

१.४ लाभक्षेत्रातील पूर्ण व बांधकामाधीन असलेले लघु पाटबंधारे तलाव, पाझर तलाव, गांव तलाव, बंधारे हे ज्या नैसर्गिक नाल्यावर बांधलेले आहेत, तो नाला मुख्य कालव्यास /शाखा कालव्यास वरील भागात ज्या ठिकाणी छेदतो, तेथे शिर्ष विमोचकाद्वारे घनमापन पध्दतीने मोजून नाल्यात पाणी सोडण्याची व्यवस्था करावी. नाल्यात सोडलेले पाणी लघु पाटबंधारे तलाव, बंधारे, गांव तलाव, पाझर तलाव यामध्ये आवश्यक विसर्गाने पोचविण्यासाठी नाला रुंदीकरण व इतर कामे संकल्पनानुसार शक्यतो जलसंधारण/ जलयुक्त शिवार कार्यक्रमातून करावीत व ते शक्य नसेल तरच प्रकल्प खर्चाने करण्याचा निर्णय महामंडळस्तरावर घ्यावा.

१.५ राज्यात अतिपावसाच्या प्रदेशात, विशेषत: जेथे भाताचे पिक घेतले जाते तेथील सिंचन प्रकल्पावर पारंपरिक वितरण प्रणाली अथवा सुक्ष्म सिंचन वितरण प्रणाली बांधण्याबाबतचा निर्णय स्थानिक लोकप्रतिनिधी व लाभधारकांबरोबर विचार विनिमय करुन महामंडळस्तरावर घ्यावा. त्यामध्ये सध्याची व भविष्यातील पिकरचना आणि शेतीच्या तंत्रज्ञानामध्ये भविष्यात होणारे बदल याचा विचार करावा.

२.० बांधकामाधीन प्रकल्पांच्या बाबतीत वितरण व्यवस्थेची सद्यस्थिती, झालेले भू-संपादन तसेच अस्तीत्वात असलेले करार या सर्वाचा परामर्श घेऊन तसेच लाभार्थींशी विचार विनिमय करुन संपूर्ण सुक्ष्मसिंचनाचे दिर्घकालीन उद्दिष्ट ठेऊन वितरण व्यवस्थेच्या आराखडयात आवश्यक बदल करावेत. याबाबतचा निर्णय कालव्याची संरेखा मंजूर करण्यास सक्षम अधिकाऱ्याने घ्यावा. असे करतांना झालेल्या कामाचा व संपादित जमिनीचा इष्टतम वापर होईल हे पहावे.

३.० प्रवाही सिंचन क्षमता निर्माण झालेल्या पूर्ण व बांधकामाधीन प्रकल्पाच्या लाभक्षेत्रातील प्रवाही वितरण व्यवस्थेचे रुपांतरण सुक्ष्म सिंचनासाठी पूरक व्यवस्थेमध्ये स्थानिक परिस्थिती विचारात घेऊन टप्प्याटप्प्याने करावे. त्यासाठी लाभक्षेत्रातील पाणी वापर संस्था व वैयक्तीक लाभधारकांच्या एकत्रित बैठका घेऊन सर्वसहमतीने रुपांतराचा बृहत आराखडा तयार करावा. अशा प्रकारच्या रुपांतरणाच्या प्रकल्पनिहाय बृहत आराखडयास महामंडळस्तरावर मान्यता द्यावी.

४.० लेखे चालू असलेल्या बांधकामाधीन प्रकल्पांवर, वितरण प्रणाली रुपांतराचे काम प्रकल्पाच्या खर्चातून करावे. पूर्ण झालेल्या प्रवाही वितरण व्यवस्थेचे रुपांतरण सुक्ष्म सिंचन वितरण प्रणालीमध्ये करण्यासाठी येणाऱ्या खर्चाचे स्वतंत्र अंदाजपत्रक करुन त्यास महामंडळस्तरावरुन मान्यता देण्यात यावी. आवश्यकतेनुसार या तरतुदीसह प्रकल्पास सुधारित प्रशासकीय मान्यता घेण्यात यावी.

लेखे बंद झालेल्या पूर्ण प्रकल्पाच्या रुपांतराचा खर्च महामंडळास उपलब्ध होणाऱ्या योजनांतर्गत निधीतून स्वतंत्र लेखाशिर्ष निर्माण करुन प्रचलित पध्दती अनुसरुन रुपांतराच्या कामास प्रशासकीय मान्यता घेऊन करावा.

५.० महाराष्ट्र सिंचन पध्दतीचे शेतकऱ्यांकडून व्यवस्थापन अधिनियम २००५ कलम ७ नुसार विकेंद्रीत जलसाठयाच्या लाभक्षेत्रावर पाणी वापर संस्था स्थापन कराव्यात. लाभक्षेत्रातील नाल्यावर एकापेक्षा जास्त विकेंद्रीत जलसाठे असल्यास नाल्याच्या संपूर्ण पाणलोट क्षेत्रासाठी (सर्व विकेंद्रीत जलसाठयासाठी) एकच पाणी वापर संस्था स्थापन करावी. वरीलपेक्षा वेगळी स्थानिक परिस्थिती असल्यास पाणी वापर संस्थांचे कार्यक्षेत्र सरमिसळ होणार नाही यादृष्टीने पाणी वापर संस्था स्थापन कराव्यात. मात्र, याबाबतचा निर्णय लाभार्थींशी विचार विनिमय करुन घ्यावा.

६.० राज्यातील सिंचन हे सूक्ष्मसिंचन पध्दतीने करणे व राज्याचे सिंचन क्षेत्र भारताच्या राष्ट्रीय सरासरी पर्यंत (७६.४४%) वाढविणे हे शासनाचे अंतिम उद्दिष्ट आहे. त्यासाठी प्रकल्पांच्या लाभक्षेत्रात उपलब्ध होणारे कालव्याचे पाणी, पावसाचे पाणी व भूजलाच्या एकात्मीक वापराचे नियोजन करावे (Integrated Water Use).

७.० सिंचन प्रकल्पांच्या लाभक्षेत्रात जलसंधारण, स्थानिकस्तर व कृषी विभागामार्फत पूर्ण झालेले लघु पाटबंधारे तलाव, गांव तलाव, पाझर तलाव व बंधारे संबंधित विभागांनी सिंचन व्यवस्थापनासाठी जलसंपदा विभागाकडे हस्तांतरीत करावेत.

८.० विकेंद्रीत जलसाठयामध्ये घनमापन पध्दतीने पाणी भरुन देण्याची व्यवस्था झाल्यानंतर व तेथे पाणी वापर संस्था स्थापन झाल्यावर, विकेंद्रीत जलसाठयावरील लाभक्षेत्राइतकी सिंचन क्षमता निर्माण झाल्याचे घोषीत करावे व प्रकल्पाची व्याप्ती विकेंद्रीत जलसाठया मध्ये पाणी

उपलब्ध करून देण्यापर्यंत मर्यादीत करावी. विकेंद्रीत जलसाठ्यामधून पाणी वापर संस्थेच्या सभासदांनी स्वत:च्या यंत्रणेव्दारे / पंपाव्दारे पाणी उपसा करून पिकांच्या गरजेनूसार वापर करावा.

सदर शासन निर्णय ग्राम विकास व जलसंधारण विभाग, कृषि विभाग, नियोजन व वित्त विभागाच्या सहमतीने निर्गमित करण्यात येत आहे.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करण्यात आला असून त्याचा संकेताक २०१७०५०२१६३४५६५६२७ असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

S M Upase

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(शि. मा. उपासे)

सचिव (लाक्षेवि), महाराष्ट्र शासन

प्रति,

१) मा.राज्यपाल यांचे सचिव
२) मा.मुख्यमंत्री यांचे सचिव
३) मा.अध्यक्ष/उपाध्यक्ष, विधानसभा, विधान भवन, मुंबई
४) मा.अध्यक्ष/उपाध्यक्ष, विधानपरिषद, विधान भवन, मुंबई
५) मा. विरोधी पक्षनेते, विधानसभा, मुंबई यांचे कार्यालय, विधानभवन, मुंबई
६) मा. विरोधी पक्षनेते, विधानपरिषद, मुंबई यांचे कार्यालय, विधानभवन, मुंबई
७) सर्व मा. मंत्री यांचे खाजगी सचिव
८) सर्व मा. राज्यमंत्री यांचे खाजगी सचिव.
९) महालेखापाल १/२ (लेखा व अनुज्ञेयता), महाराष्ट्र राज्य, मुंबई /नागपूर
१०) महालेखापाल १/२ (लेखा परीक्षा), महाराष्ट्र राज्य, मुंबई /नागपूर
११) प्रधान सचिव, वित्त विभाग /नियोजन विभाग/ ग्राम विकास व जलसंधारण विभाग/ कृषी विभाग
१२) स्वीय सहायक, प्रधानसचिव (जसंप्र व वि), जलसंपदा विभाग, मंत्रालय, मुंबई.
१३) स्वीय सहायक,सचिव (जसंव्य व लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई.
१४) सचिव (प्रकल्प समन्वय), जलसंपदा विभाग, मंत्रालय, मुंबई.
१५) सर्व कार्यकारी संचालक, जलसंपदा विभाग
१६) मुख्य अभियंता (पा) व सह सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
१७) सर्व मुख्य अभियंते, जलसंपदा विभाग.
१८) उप सचिव (सिंव्य) जलसंपदा विभाग, मंत्रालय, मुंबई.
१९) सर्व अधीक्षक अभियंता, जलसंपदा विभाग.

२०) सर्व कार्यकारी अभियंते, जलसंपदा विभाग.
२१) सर्व तांत्रिक कार्यासन, जलसंपदा विभाग
२२) संचालक, माहिती व जनसंपर्क संचालनालय, मंत्रालय, मुंबई.
२३) निवडनस्ती कार्यासन सिं.व्य. (धोरण).

उपसा सिंचन योजनेच्या संकल्पनासंबंधी मार्गदर्शक तत्वे व योजनांचे आराखडे तयार करणे.

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय, क्रमांक मंसस १०१४/ (प्र.क्र. ३३७/१४)/ मोप्र-१
मंत्रालय, मुंबई ४०० ०३२.
दिनांक :- ३० सप्टेंबर, २०२०

वाचा : १) जलसंपदा विभाग,शासन निर्णय, क्र. मंसस १०१४/ (प्र.क्र. ३३७/१४)/ मोप्र-१, दि. २०/११/२०१४.
२) जलसंपदा विभाग, शासन निर्णय क्र. सिंचन २०१५/प्र.क्र. २४/२०१५/जसं(धोरण), दिनांक १३/०१/२०१७ व १८/०१/२०१७
३) जलसंपदा विभाग, शासन निर्णय क्र. सिंचन २०१५/प्र.क्र. २४/(भाग-२)/२०१५/जसं(धोरण), दिनांक ०२/०२/२०१७
४)जलसंपदा विभाग, परिपत्रक क्र. मसंसं ०२०८/(८३/२००८)/मोप्र-१, दि. २४/०३/२००८.
५) जलसंपदा विभाग, परिपत्रक क्र. उसिंयो ०६०९/(३६६/२००९)/मोप्र-१, दि.०६/०७/२००९.

प्रस्तावना :-

"उपसा सिंचन योजनेच्या संकल्पनासंबंधी मार्गदर्शक तत्वे व योजनांचे आराखडे तयार करणे" या विषयावरील संदर्भ क्र. १ वरील शासन निर्णय मधील परिच्छेद क्र.५ मध्ये उपसा सिंचन योजना संकल्पन संबंधी मार्गदर्शक सूचना निर्गमित केल्या आहेत. त्यानुसार सर्व प्रकारच्या उपसा सिंचन योजनांच्या मान्यता प्राप्त लाभक्षेत्रासाठी संकल्पित विसर्ग हा सुधारित पेनमन पध्दतीनुसार (१२ दिवस वहन कालावधी व दोन दिवस बंद धरुन) येणा-या महत्तम पंधरवाडी पाण्याच्या मागणीवर आधारित विसर्गाच्या ७० टक्के इतका घेण्यात यावा, असे निर्देश आहेत. सदर सूचना हया प्रामुख्याने मुख्य शिर्ष उदा. पंपगृह, उर्ध्वगामी नलिका इ. कामासाठी लागू असून वितरण व्यवस्था ही त्या-त्या वितरिका/ लघुवितरिका इ. वरचे प्रत्यक्ष I.C.A. साठी सिंचन वेळापत्रकानुसारच संकल्पित केल्या जातात.

शासनाने नलिकाव्दारे सिंचन वितरण धोरणाबाबतचा संदर्भ क्र. २ वरील शासन निर्णय निर्गमित केला आहे. तसेच नलिकेव्दारे वितरण प्रणाली धोरणाबाबत मार्गदर्शक सूचना संदर्भ क्र. ३ वरील शासन परिपत्रकान्वये निर्गमित केल्या आहेत. सदर परिपत्रकातील परिच्छेद क्र. ६.० मध्ये " प्रकल्पीय पीक रचनेनुसार पंधरवडयातील जास्तीत जास्त पाणी गरज विचारात घेऊन वितरण प्रणालीचे संकल्पन करावे" असे निर्देशित आहे.

तसेच संदर्भ क्र. ४ व ५ वरील शासन परिपत्रकानुसार पंपगृहाची क्षमता Peak Discharge च्या ७०% विसर्गासाठी संकल्पित करण्याच्या सूचना हया वितरण कुंडाच्या खालील पारंपारीक वितरण प्रणाली वापरण्याच्या संदर्भातील असल्यामुळे त्या बंदिस्त नलिका वितरण प्रणालीला लागू करावे किंवा

कसे याबाबत संदिग्धता आहे. ही संदिग्धता दूर करण्यासाठी पारंपारिक वितरण प्रणाली तसेच नलिका वितरण प्रणाली असणा-या उपसा सिंचन योजनांसाठी एकत्रित मार्गदर्शन सूचना निर्गमित करणे शासनाच्या विचाराधीन होते.

शासन निर्णय:

उपरोक्त संदर्भ क्र. ४ व ५ येथील शासन परिपत्रके तसेच संदर्भ क्र. १ येथील शासन निर्णयातील परिच्छेद क्र. ५.० अधिक्रमित करुन खालील प्रमाणे सुधारित मार्गदर्शक सूचना देण्यात येत आहेत:

उपसा सिंचन योजना तांत्रिक दृष्टया किफायतशीर, सामाजिक दृष्टया स्वीकृत व पर्यावरणांच्या दृष्टीने टिकाऊ होण्यासाठी तसेच नियोजन व संकल्पनाबाबत एकसूत्रीपणा येण्यासाठी खालील मार्गदर्शक सूचनांचे काटेकोरपणे पालन करण्यात यावे.

क) १२ दिवस वहन कालावधी व ०२ दिवस बंद अशा पध्दतीची खुल्या कालव्याची वितरण व्यवस्था असणा-या उपसा सिंचन योजनांच्या पंपगृहासाठी संकल्पित विसर्ग हा सुधारित पेनमन पध्दतीनुसार येणा-या महत्तम १४ दिवसांच्या पाण्याच्या मागणीवर आधारित विसर्गाच्या ७० टक्के इतका घेण्यात यावा.

ख) १२ दिवस वहन कालावधी व ०२ दिवस बंद अशा पध्दतीची बंदिस्त नलिका पध्दतीची वितरण व्यवस्था असणा-या उपसा सिंचन योजनांच्या पंपगृहासाठी संकल्पित विसर्ग हा सुधारित पेनमन पध्दतीनुसार येणा-या महत्तम १४ दिवसांच्या पाण्याच्या मागणीवर आधारित विसर्गाच्या ८५ टक्के इतका घेण्यात यावा.

ग) आवर्तनातील पूर्ण १४ दिवस वहन कालावधी आणि बंदिस्त नलिका पध्दतीची वितरण व्यवस्था असणा-या उपसा सिंचन योजनांच्या पंपगृहासाठी संकल्पित विसर्ग सुधारित पेनमन पध्दतीनुसार येणा-या महत्तम १४ दिवसांच्या पाण्याच्या मागणीवर आधारित विसर्गा एवढा घेण्यात यावा.

घ) बंदिस्त नलिका पध्दतीची वितरण व्यवस्था असणाऱ्या उपसा सिंचन योजनामध्ये वितरण प्रणालीची विसर्ग क्षमता पंपगृहाच्या विसर्ग क्षमतेशी सुसंगत असावी.

च) आर्वतन कालावधी हा १४ दिवस व २४ तास पंपीग असा धरण्यात यावा.

छ) अतिरिक्त पंपाची तरतूद करण्यात येऊ नये.

झ) सर्व नियोजनाधीन उपसा सिंचन योजनांचे सर्वसाधारण आराखडे तांत्रिक व्यवहार्यतेच्या दृष्टीने मध्यवर्ती संकल्पचित्र संघटनेकडून तपासणी झाल्यानंतरच सक्षम स्तरावर मान्यता देण्यात यावी.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in वेबसाईटवर प्रसिध्द करण्यात आला असून त्याचा सांकेतांक क्र. २०२००९३०१६३१४०८७२७ आहे. हे आदेश डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेश व नावाने.

Atul Ashok Kapole

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Date: 2020.09.30 16:34:02 +05'30'

(अ.अ.कपोले)

मुख्य अभियंता, (द.व.प्र) व स.स.

प्रत-

१) मा.मंत्री (जलसंपदा) यांचे खाजगी सचिव मंत्रालय मंत्रालय मुंबई
२) मा.राज्यमंत्री (जलसंपदा) यांचे खाजगी सचिव मंत्रालय मंत्रालय मुंबई
३) स्वीय सहायक, प्रधान सचिव(जलसंपदा), जलसंपदा विभाग, मंत्रालय, मुंबई.
४) स्वीय सहायक, सचिव(लाक्षेवि), जलसंपदा विभाग, मंत्रालय, मुंबई.
५) स्वीय सहायक, सचिव(प्रकल्प समन्वय), जलसंपदा विभाग, मंत्रालय, मुंबई.
६) महासंचालक, संकल्पन व संशोधन, महाराष्ट्र अभियांत्रिकी संशोधन संस्था, नाशिक.
७) कार्यकारी संचालक, (सर्व)
८) स्वीय सहायक,सर्व मुख्य अभियंता व सह सचिव, जलंसपदा विभाग,मंत्रालय, मुंबई
९) सर्व मुख्य अभियंता (स्थापत्य), जलंसपदा विभाग,मंत्रालय, मुंबई
१०) मुख्य अभियंता (यांत्रिकी), जलसंपदा विभाग, नाशिक.
११) मुख्य अभियंता (विद्युत), जलसंपदा विभाग, मुंबई
१२) स्वीय सहायक, सर्व उप सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
१३) सर्व अधीक्षक अभियंता, (स्थापत्य, यांत्रिकी व जलविद्युत) जलसंपदा विभाग.
१४) सर्व अवर सचिव, जलसंपदा विभाग, मंत्रालय, मुंबई.
१५) सर्व कार्यकारी अभियंता (स्थापत्य, यांत्रिकी व जलविद्युत) जलसंपदा विभाग.
१६) जलसंपदा विभागातील सर्व तांत्रिक अधिकारी व तांत्रिक कार्यासने.

प्रत मोप्र-१ कार्यासन संग्रहार्थ.