भारतीय मानक

कंक्रीट/चिनाई और मिट्टी/रॉकफिल में रिसाव मापने की युक्तियों के संस्थापन, रख-रखाव तथा निरीक्षण की रीति संहिता

Indian Standard

CODE OF PRACTICE FOR INSTALLATION, MAINTENANCE AND OBSERVATION OF SEEPAGE MEASURING DEVICES FOR CONCRETE/MASONRY AND EARTH/ROCKFILL DAMS

ICS 93.160

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 4

Hydraulic Structures Instrumentation Sectional Committee, WRD 16

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Hydraulic Structures Instrumentation Sectional Committee had been approved by the Water Resources Division Council.

Water retaining structures cannot be constructed waterproof. It often happens that a minute quantity of water gets released through various means. This minute quantity of water or seepage through or around a concrete/masonry and earth/rockfill dams is an extremely valuable indicator of the condition and performance of the dam. The quantity of seepage is, normally, directly related to the level of water in the reservoir. Any sudden change in the quantity of seepage without apparent cause, such as a corresponding change in the reservoir levels or a heavy rainfall, could indicate a seepage problem. Similarly, when the seepage water becomes muddy or discoloured, contains increased quantities of sediment, or changes radically in chemical content, a likely serious seepage problem is indicated. Wet spots, moisture or seepage appearing at new or unplanned locations at the abutments or downstream of a concrete dam and on the downstream slope or below an embankment could also indicate a seepage problem.

In order to reduce seepage and uplift pressure under the dam foundation, grout curtain is provided near the underside (u/s) face for a considerable depth below the base of the concrete/masonry dam. This provides a comparatively watertight barrier to percolation from reservoir. A few metre down stream (d/s) of this grout curtain a drainage curtain is provided by drilling a line of holes from the foundation gallery and tunnels in the abutments to intercept any seepage that passes downstream of the grout curtain. Measurement of seepage d/s of the grout curtain provides a direct indication of the adequacy and effectiveness of the grout curtain, drainage curtain and functioning of the drains/holes and helps to decide when and where remedial measures may be required.

Observations of leakage from contraction joints (ungrouted), lift joints and cracks provide a means for judging the quality of workmanship as well as indicate the necessity for corrective measures to preserve the integrity of the structure.

Since all the soil materials used for construction are pervious to varied degree, seepage takes place through earth dams and their foundations. The water seeping under pressure through the soil voids creates mechanical drag on the soil particles. When these forces exceed the resistive forces of the soil grains, the movement of grains may take place. Even a minor washing or removal of grains may lead to progressive decrease in resistance to seepage and culminate in the formation of cavities leading to ultimate collapse of the structure. It is therefore, important to keep down the seepage, not only to keep the water loss well within economic limits but also to take adequate control measures to ensure the safety of the dam against excessive uplift pressure, instability of downstream slope, piping through the embankment and/or foundation and erosion of material by migration into open joints in the foundation and abutments. The purpose of the dam may impose limitations on the quantity of seepage. Thus seepage has to be controlled either by flat slope, embankment zonation or by a system of drains.

Besides the loss of water, the adverse effects of seepage may lead to migration of soil particles resulting in piping failure, and may also contribute to slope failure, or to progressive sloughing. Similarly, excessive pore pressures in the foundations may result in foundation blow out.

Study of seepage and uplift also provide information about the overall state of the grouting, and sudden changes in the recorded trends indicate need for remedial measures in specific areas. Seepage measurements made at various locations in the foundations and abutment may indicate the need for increased drainage facilitiers at some other safe locations to relieve the dam areas of uplift, not caused by the reservoir, but by the underground seepage water.

Results of chemical analysis of water samples collected from drainage holes provide information bout the foundation material wash in the effluent. Presence of material wash could indicate need for appropriate remedial measures in the specific areas.

(*Continued on third cover*)

Indian Standard

CODE OF PRACTICE FOR INSTALLATION, MAINTENANCE AND OBSERVATION OF SEEPAGE MEASURING DEVICES FOR CONCRETE/MASONRY AND EARTH/ROCKFILL DAMS

1 SCOPE

This standard stipulates the provisions for installation, observation and maintenance of seepage measuring devices for concrete/masonry and earth/rockfill dams.

2 SEEPAGE MEASURING DEVICES

Seepage measuring devices are required to be installed to measure quantity of seepage through, around or under dams. Drain outlets are commonly used as seepage measurements points. The seepage water should be tested to determine its chemical composition because chemical changes may indicate progressive dissolution, decay or erosion in the dam body, foundation or abutment. The most common type of seepage measurement devices are weirs, calibrated containers and flowmeters.

2.1 Weirs

2.1.1 *General*

The weir is one of the oldest, simplest and most reliable types of devices used to measure the quantity of flow of water. If sufficient fall is present in the channel and the quantity of water to be measured is relatively small, the weir is very suitable and economical measuring devices, because for weir of specific size and shape, with free flow study stage condition a specific discharge exists for a specific depth of water in the upstream pool. Weirs are of two types:

a) Overflow structure weir; and

b) Submerged orifice weir.

The most common types of weirs under category (1) are rectangular, trapezoidal (Cipolletti) and V-notch weir. A submerged orifice weir, generally not in use, can be used where available head is low and the amount of floating debris are significant.

The shape of the opening determines the type of the weir. For a rectangular or trapezoidal weir, the bottom edge of the opening is called the crest and the side edges are called sides or weir ends. The sheet of water leaving the weir crest is called the nappe. Weirs operate best when they discharge freely into the atmosphere. If the weir is submerged or partially submerged (tail water is high enough to obstruct free discharge into atmosphere), nonstandard negative pressure conditions are created affecting the rate of flow producing error in flow measurement. Thus actual flow may be greater than the computed one. Free flow condition is more desirable. In certain condition, the under-nappe air-space is artificially ventilated to maintain near atmospheric pressure.

The following types of weirs are generally used :

a) Standard contracted rectangular weirs.

b) Standard suppressed rectangular weirs.

c) Standard Cipolletti weirs.

d) Standard 90° V-Notch weirs.

2.1.2 *Standard Contracted Rectangular Weir*

When the distance from the ends or sides of the weir notch to the side of the pool are great enough to allow the water free, unconstrained lateral approach to the crest, the water will flow uniformly and relatively slowly towards the weir ends. As the water from the sides of the channel nears the notch, it accelerates and turns, making a curved flow path or contraction. When approach conditions from the weir pool allow complete contraction at the end and the bottom, the weir is called as contracted weir.

A standard contracted rectangular weir (Fig. 1A) has its crest and sides far enough from the bottom and sides of the weir box or channel in which it is set. Thus a full contraction is developed.

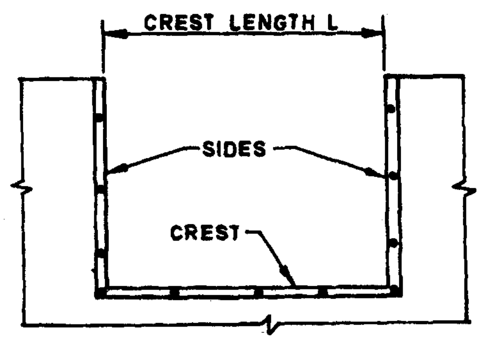

FIG. 1A RECTANGULAR WEIR

2.1.3 *Standard Suppressed Rectangular Weir*

If a rectangular weir is placed in a channel such that sides of the channel acts as the ends of the weir that is there is no side contraction and the nappe has the same width as of channel, the weir is termed as suppressed rectangular weir. A standard suppressed rectangular weir. (Fig. 1B) has its crest far enough from the bottom of the approach channel so that a full crest contraction is developed. Because the sides of the weir coincide with the sides of the approach channel no lateral contraction is possible. In this weir the sides of the approach channel should extend to downstream beyond the crest to prevent lateral expansion of the nappe.

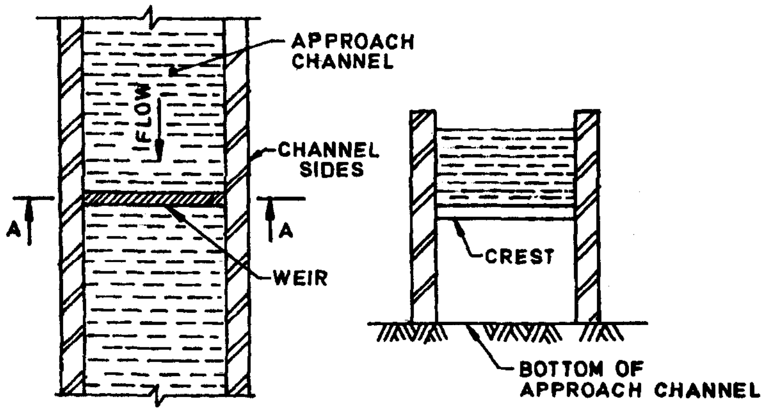

FIG. 1B STANDARD SUPPRESSED RECTANGULAR WEIR

2.1.4 *Standard Cipolletti (Trapezoidal) Weir*

The Cipolletti weir is a contracted trapezoidal weir in which each side of the notch has a slope of 1 horizontal to 4 vertical. It is named after its inventor Cesare Cipolletti, an Italian Engineer. Its popularity rests largely upon the belief that side slopes of 1 to 4 are just sufficient to correct the end contractions of the nappe and that the flow is proportional to the length of the weir crest. It does not require corrections for end contractions. The weir has sharp crest and sharp sides, bevelled from the downstream side only. It is commonly used to measure medium discharges. Standard Cipolletti Weir (Fig. 1C) has its crest and sides far enough from the bottom and sides, respectively, of the approach channel so that full contraction of the nappe occurs. The weir should not be used for heads less than about 0.06 m nor for heads greater than one third the crest length.

2.1.5 *Standard 90° V-Notch Weir*

The triangular or commonly known as V-Notch weir is an accurate flow measuring device particularly suited for small flows. With a low discharge the head over the crest of a rectangular weir is too small to be accurately measured. When the depth of water flowing over the rectangular weir is less than 5 cm triangular weir is preferred, because the discharge over a triangular weir increases more rapidly with the head than in the case of a horizontal rectangular weir. The weir generally used is the 90° V-notch weir shown in (Fig. 2). However, 22.5° and 45° weirs can also be used for comparatively smaller flow/discharge.

2.1.6 *Design Considerations/Installation*

2.1.6.1 *Standard contracted rectangular weir*

The following conditions are necessary to measure flow accurately with the standard contracted rectangular weir:

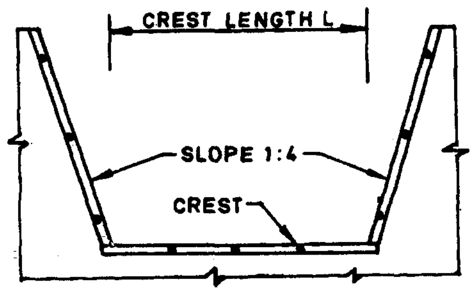

FIG. 1C CIPOLLETTI WEIR

a) The upstream face of the bulkhead and the weir plate should be smooth and in vertical plane perpendicular to the axis of the channel.

b) The entire crest should be horizontal, plane surface that forms a sharp right angle edge where it intersects the upstream face. The thickness of the crest, measured in the direction of flow, should be between 1 to 2 mm. The thickness of the plate should be the same throughout.

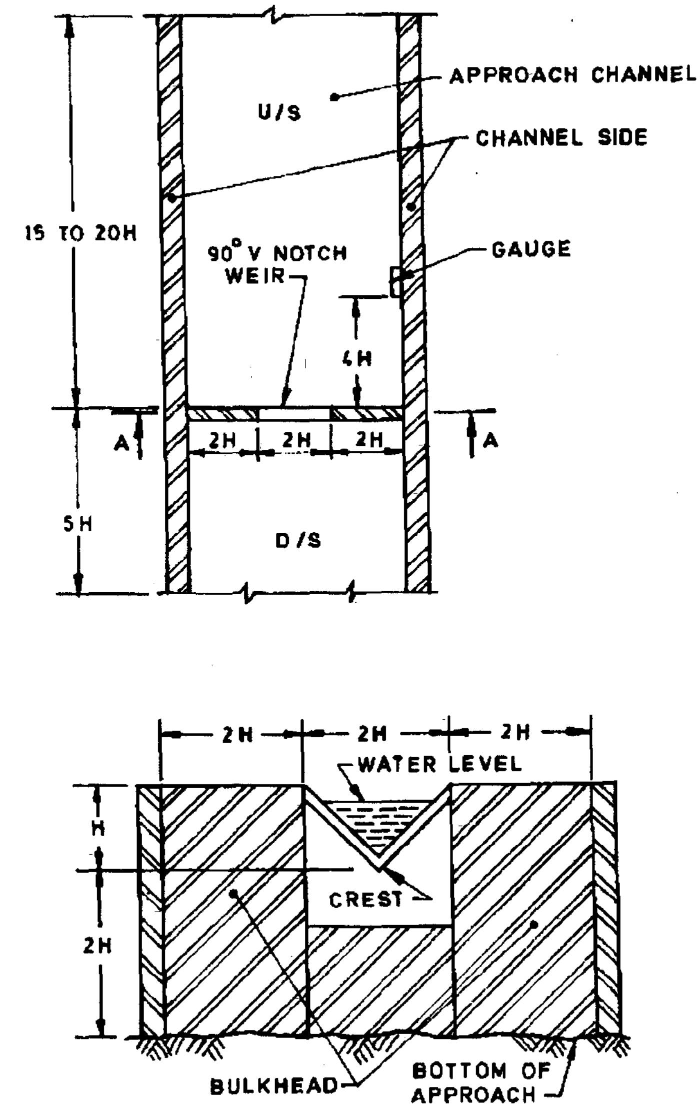

FIG. 2 TYPICAL DETAIL OF SEEPAGE MEASUREMENT INSTALLATION (V-NOTCH WEIR)

c) The upstream edge of the notch should be machined or filed perpendicular to the upstream face of the weir and should be free of burrs or scratches. Material of the weir should be hard enough and unscratchable by abrasive cloth or paper during cleaning. Knife edges are not desirable and should be avoided because they are difficult to maintain and do not allow the nappe to develop properly.

d) The downstream edges of the notch should be chamfered if the plate is thicker than the prescribed crest width. This chamfer should be at an angle of 45° or more to the surface of the crest.

e) The distance from the bottom of the approach channel to the crest should preferably be at least twice the depth of water above the crest, but not less than 0.3 m.

f) The distance from the sides of the weir to the sides of the approach channel should preferably be at least twice the depth of water above the crest, but not less than 0.3 m.

g) The overflow sheet should touch only the upstream edges of the crest and sides.

h) The maximum downstream pool level should be at least 0.6 m below crest elevation.

j) The head on the weir should be taken as the difference in elevation between the crest and the water surface at a point upstream from the weir a distance of four times the maximum head on the crest.

k) The cross sectional area of the approach channel should be at least 8 times that of the nappe at the crest for a distance upstream from 15 to 20 times and downstream preferably 5 times the depth of the nappe, if the approach channel is smaller than that defined the velocity of approach may be too high and the staff gauge reading too low.

m) The depth of water flowing over the rectangular weir should not be less than about 5 cm and not more than about two-thirds the crest width.

2.1.6.2 *Standard suppressed rectangular weir*

The conditions for accurate measurement with the standard suppressed rectangular weir are identical with those of the standard contracted rectangular weir except the side contraction. In the suppressed weir, the sides of the approach channel should coincide with the sides of the weir and should extend downstream beyond the crest to prevent lateral expansion of the nappe. The vents may be placed on both sides of the weir box under the nappe to secure proper aeration beneath the nappe at the crest.

2.1.6.3 *Standard Cipolletti (trapezoidal) weir*

The sides of the weir incline outward at a slope of one horizontal to four vertical. The Cipolletti weir is a contracted weir, and should be installed accordingly. In this weir the end contraction are suppressed but the contractions are compensated by the outward slope of the weir sides.

All conditions for accurate measurements stated for the standard contracted rectangular weir apply to the Cipolletti weir. The weir should not be used for heads less than 0.06 m nor for heads greater than one-third the crest length.

2.1.6.4 *Standard 90° V-notch weir*

The crest of the standard 90°V-Notch weir consists of a thin plate set on the sides of the notch which are inclined 45° from the vertical. This weir operates as a contracted weir, and all conditions for accuracy stated for the standard contracted rectangular weir apply. The distance from the sides of the weir to the sides of the channel should be at least twice the head on the weir. The minimum distance from the crest to the pool bottom should be measured from the vertex of the notch to the channel floor and should not be less than 0.3 m.

Because the V-Notch weir has no crest length and due to its shape a small flow has greater head than that of other types of weirs. This is an advantage for small discharges because the nappe will spring free of the crest, whereas, it would cling to the crest of another type of weir and make the measurement worthless. The 45° and 22.5° weirs are even more accurate for smaller flows than the 90° V-Notch weirs.

2.1.7 *Selection of Weir Types*

Each of the weir has its own characteristics that make it suitable for particular operating condition. Experience shows that a rectangular suppressed weir or a 90° V-Notch weir provides the most accurate measurement than others. Usually the range of flows to be measured by a weir can bet fairly well estimated in advance. With this range in mind, the following points may be considered while selecting the types of weir.

The 90° V-Notch weir is preferred for measuring discharges between 0.015 m^3/sec to 0.03 m^3/sec. It can also work fairly well and is as accurate as other types of weirs for flow from 0.03 to 0.28 m^3/sec. For flows less than 0.015 m^3/s, the 22.5° or 45° V-notch weir is preferred.

2.1.8 *Discharge Measurement*

The rate of flow or discharge in litres per second over the crest of a standard contracted rectangular weir, standard suppressed rectangular weir or standard Cipolletti weir is determined by the head H in cm. and by the crest length L in cms. The discharge of the standard 90° V-Notch weir is determined directly by the head on the bottom of the V-Notch. As the stream passes over the weir, the top surface curves downward. This curved surface, or draw down, extends upstream a short distance from the weir notch. The head shall be measured at a point on the water surface in the weir pond beyond the effect of the draw down. This distance should be at least four times the maximum head on the weir, and the same gauge point should be used for lesser discharges. A staff gauge having a graduated scale with the zero placed at the same elevation as the weir crest is usually provided for the head measurements. The staff should be placed upstream of the draw down at a distance of 4 times the maximum weir head, and close enough to the bank for easy reading.

After the head is determined, the rate of flow or discharge may be found by referring to the tables as described in the following paras. These tables are for free-flow conditions and are applicable only to weirs installed in accordance with the requirements for standard contracted weirs.

2.1.9 *Discharge Formulas*

2.1.9.1 *Standard contracted rectangular weir*

The discharge through the standard contracted rectangular weirs may be computed by the Francis formula stated below:

$$Q = 0.018\,4\,(L - .2\,H)\,H^{3/2}$$

where

Q = Discharge, litres/second;

L = Length of crest, cm; and

H = Head over the weir, cm.

Table 1 presents the value of discharge through contracted rectangular weirs (assuming end contractions at both ends of the weir) under different widths and operating heads.

Table 1 Discharge Through Contracted Rectangular Weirs, Litres per Second

Head Over Weir	Width of Weir			
cm	30 cm	40 cm	50 cm	60 cm
(1)	(2)	(3)	(4)	(5)
5.0	5.97	8.0	10.1	12.2
5.5	6.9	9.3	11.6	14.0
6.0	7.8	10.5	13.1	15.0
6.5	8.4	11.8	14.9	17.9
7.0	9.7	13.2	16.6	20.0
7.5	10.7	14.5	18.3	22.1
8.0	11.8	16.0	20.1	24.3
8.5	12.9	17.6	22.1	26.7
9.0	14.0	19.0	24.0	28.9
9.5	15.2	20.7	26.0	31.2
10.0	16.3	22.2	28.0	33.8
10.5	17.5	23.7	30.0	36.2
11.0	18.7	25.3	33.0	37.7
11.5	19.9	27.1	34.3	41.4
12.0	21.3	29.0	36.7	44.4
12.5	22.5	30.7	39.0	47.1
13.0	23.7	32.3	40.9	49.5
13.5	24.8	34.0	43.0	52.2
14.0	26.2	35.8	45.4	55.2
14.5	27.7	37.9	48.2	58.5
15.0	28.8	39.5	50.3	60.9
16.0	31.6	43.3	55.2	67.0
17.0	34.3	47.2	60.1	73.0
18.0	37.0	51.0	65.3	79.0
19.0	39.8	55.0	70.2	85.3
20.0	42.8	59.3	75.8	88.8
21.0	45.7	63.3	81.0	99.0
22.0	48.7	67.5	86.7	105.7
23.0	51.3	71.7	92.2	112.3
24.0	54.7	76.5	94.8	120.0
25.0	57.0	79.8	102.7	125.8
26.0	60.0	84.6	109.0	133.3
27.0	63.5	89.2	115.0	140.8
28.0	66.5	93.7	122.2	148.3
29.0	69.5	93.3	127.0	155.7
30.0	72.5	102.7	133.0	163.3

2.1.9.2 *Standard suppressed rectangular weir*

Following Francis formula is used for computing the discharge through standard suppressed rectangular weir. Velocity of approach is not considered.

$$Q = 0.0184 \ L \ H^{3/2}$$

where

Q = Discharge, litres/sec;

L = Length of crest, cm; and

H = Head over the weir, cm.

2.1.9.3 *Standard Cipolletti (trapezoidal) weir*

Cipolletti provided a formula for the reduced discharge caused by the end contractions. This is accomplished by sloping the sides of the weir sufficiently to overcome the effect of contraction. The formula for calculating the discharge through Cipolletti weir, in which the Francis coefficient is increased by 1 percent and neglecting the velocity of approach, is

$$Q = 0.0186 \ L \ H^{3/2}$$

where

Q = Discharge, litres/sec;
L = Length of crest, cm; and
H = Head over the weir crest, cm.

2.1.9.4 *Standard 90° V-notch weir*

The 90° V-Notch weir is commonly used to measure small and medium size streams. The advantage of the V-Notch weir is its ability to measure small flows accurately. The weir has both its sides sharp, bevelled from the downstream side only. The discharge through a 90° V-Notch weir may be computed by the following formula:

$$Q = 0.0138 \ H^{5/2}$$

where

Q = Discharge, litres/sec; and
H = Head, cm.

Table 2 presents the values of discharge through 90° V-Notch weir.

Table 2 Discharge Through 90° V-Notes Weirs, Litres per Second

Height of Water Over V-Notch cm	Discharge litres/sec	Height of Water Over V-Notch cm	Discharge litres/sec	Height of Water Over V-Notch cm	Discharge litres/sec
(1)	(2)	(3)	(4)	(5)	(6)
4.0	0.45	13.0	8.6	22.0	31.0
4.5	0.60	13.5	9.5	22.5	34.0
5.0	0.80	14.0	10.5	23.0	35.7
5.5	1.0	14.5	11.3	23.5	38.2
6.0	1.0	15.0	12.3	24.0	40.0
6.5	1.5	15.5	13.3	24.5	42.7
7.0	1.8	16.0	14.5	25.0	44.5
7.5	2.2	16.5	15.6	25.5	46.7
8.0	2.5	17.0	16.7	26.0	48.8
8.5	2.8	17.5	18.3	26.5	51.0
9.0	3.4	18.0	19.4	27.0	53.8
9.5	3.9	18.5	21.7	27.5	56.3
10.0	4.5	19.0	22.3	28.0	58.7
10.5	5.1	19.5	23.5	28.5	61.5
11.0	5.7	20.0	25.5	29.0	64.5
11.5	6.3	20.5	27.0	29.5	66.8
12.0	7.1	21.0	28.3	30.0	69.4
12.5	7.8	21.5	30.3		

2.1.10 *Maintenance*

For best operating conditions, the weir structure should be set in a straight reach of the channel and perpendicular to the line of flow. The weir crest shall be horizontal and the bulkhead plumb.

The weir and weir pool should be maintained free of weeds and trash and the weir pool should be cleaned of sediment as it accumulates.

The level of the crest should be checked periodically, and should also be checked with reference to the elevation of the zero of staff gauge. Inspection should also be made to determine whether there is leakage around the weir and, if such leakage exists, necessary arrangements may be made to stop the leakage.

Care must be taken to avoid damaging the weir notch itself. Small nicks and dents can reduce the accuracy of a good weir installation. Any nicks and dents that do occur should be carefully dressed with a fine-cut file or stone, storking only in the plane of the weir upstream faces, plane of the weir, crest or sides, or plane of the chamfers. Under no circumstances should the upstream corner of the notch be rounded or chamfered, nor should any attempt be made to remove completely an imperfection that would change the shape of the weir opening. Instead, only those portions of the metal that protrude above the normal surface should be removed. The entire stretch of the channel both downstream and upstream of the notch must be periodically cleared of weeds, mud, etc, in order to ensure that the flow is smooth and measurements are accurately done.

2.2 Flow Meters

2.2.1 *General*

Many types of flow meters/velocity meters are available. Their method of operation vary from the pitot type principal to propeller-type devices, accoustic flow meters and electro-magnetic current indicators. Most of these devices can be used for measuring flow in open channels. A relatively new device is the portable velocity meter, which can be used for measuring water velocity.

2.2.2 *Description of Device*

The portable velocity meter probe operates on electro-magnetic principles. A conductor moving through a magnetic field will have an induced voltage. In the velocity meter a signal is generated and sent to an electromagnet within the probe, which creates a magnetic field. The conductor is the water into which the probe is immersed.

As water flows through the magnetic field, a voltage is generated in the water in the vicinity of the electrodes which sense the voltage. The sensed voltage is then transmitted through the cable to the surface unit which amplifies and conditions the signal, and displays the results as a velocity measurement. The polarity and magnitude of this signal is directly proportional to the direction and velocity of the water. By knowing the channel dimensions and depth of flow, the quantity of flow can be computed.

The device consists of a probe, extension rods and a surface read out unit. All these are connected by a cable. The unit is battery powered, light weight and easily portable. The device has an accuracy within 5 percent at low flows of about 0.003 m^3/sec and within one percent at higher flows of about 0.06 m^3/sec.

2.2.3 *Installation of Devices*

No installation is required for the portable velocity meter. The velocity meter is lowered into the flowing water with the device switches set at "Normal" and "on" and readings taken for the meter velocity. The observation should be taken by skilled staff.

2.2.4 *Monitoring Procedures*

The velocity meter is lowered into the flowing water. The water velocity is read directly from the meter. Open channel flow may be determined by measuring the velocity and computing the cross-sectional area of the channel to the depth of flow. Then the flow may be computed by multiplying the measured water velocity and the area of the channel.

2.3 Calibrated Container Devices

This method is generally used for relatively low flow condition and is most suitable for monitoring quantity of flow from drains. The method consists of catching a known quantity of water in a calibrated container and measuring the amount of time required to do so. Rate of flow can easily be computed by dividing the time to the quantity of water catched. This method requires that the drain water be either flowing through a pipe with an exposed end or the channel with a vertical drop and an overhang. Such requirements are necessary so that the container can be placed in a position to catch the water. Calibrated containers may be of any size. Commonly used sizes are 1,2,5 or 10 litres in capacity for convenience of handling. When catching the water, the container is held in a position so as to catch the total flow, and the time in minutes, required to fill the container is noted:

Rate of flow can be computed as follows:

$$\text{Rate of flow} = \frac{\text{Quantity of water caught (Litres)}}{\text{Time taken in minutes}}$$

3 SELECTION OF SEEPAGE MEASURING DEVICES

3.1 Weir

The weir is preferred if sufficient fall is present in the channel and the quantity of water to be measured is small. The weirs are located in the drainage gallery to measure the drain flow or internal seepage. These are also used to measure the overall seepage through the dam.

3.2 Flow Meters

The flow/velocity meters are preferred when the quantity of water to be measured is comparatively large. The device may be used in a straight reach of the open channel. The observations should be taken by skilled staff only.

3.3 Calibrated Container Devices

This method is preferred when the quantity of water to be measured is relatively very small. The device is used to measure the quantity of flow from drains. The device is particularly suitable for measuring the block-wise or reach-wise seepage from the dam.

(Continued from second cover)

Study of quantum of seepage, under varying reservoir level with the expected seepage, aids in assessing the influence of the geological formations below the dam and the reservoir.

For arresting seepage through the body, around or under the dam proper arrangements may be made during construction stage itself.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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