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Series 157
Série des 157

WITHDRAWAL

October 2011

Selected standards in the series Measurement of liquid flow in open channels

These National Standards of Canada are hereby withdrawn.

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Octobre 2011

Sélection de normes de la série Mesurage du débit des liquides dans les canaux découverts

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CAN/CGSB-157.1-M91

Liquid Flow Measurement in Open Channels — Vocabulary and Symbols (ICS 17.120.20)

CAN/CGSB-157.2-M91/ISO 748 :1979

Liquid Flow Measurement in Open Channels — Velocity-Area Methods (ICS 17.120.20)

CAN/CGSB-157.3-M91

Liquid Flow Measurement in Open Channels — Establishment and Operation of a Gauging Station (ICS 17.120.20)

CAN/CGSB-157.4-M91/ISO 1100-2:1982

Liquid Flow Measurement in Open Channels — Part 2: Determination of Stage-Discharge Relation (ICS 17.120.20)

CAN/CGSB-157.6-M91/ISO 1088:1985

Liquid Flow Measurement in Open Channels — Velocity-Area Methods — Collection and Processing of Data for Determination of Errors in Measurement (ICS 17.120.20)

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CAN/CGSB-157.1-M91

Mesure de débit des liquides dans les canaux découverts — Vocabulaire et symboles (ICS 17.120.20)

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Mesure de débit des liquides dans les canaux découverts — Méthodes d'exploration du champ des vitesses (ICS 17.120.20)

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CAN/CGSB-157.4-M91/ISO 1100-2:1982

Mesure de débit des liquides dans les canaux découverts — Partie 2 : Détermination de la relation hauteur-débit (ICS 17.120.20)

CAN/CGSB-157.6-M91/ISO 1088:1985

Mesure de débit des liquides dans les canaux découverts — Méthodes d'exploration du champ des vitesses — Recueil et traitement des données pour la détermination des erreurs de mesurage (ICS 17.120.20)

NATIONAL STANDARD OF CANADA

CAN/CGSB-157.1-M91

**Liquid Flow Measurement
in Open Channels —
Vocabulary
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LIQUID FLOW MEASUREMENT IN OPEN CHANNELS — VOCABULARY AND SYMBOLS

Prepared by the
Canadian General Standards Board 

Approved by the
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CANADIAN GENERAL STANDARDS BOARD

Preface to the National Standard of Canada

This National Standard defines terms and symbols and establishes terminology used in the field of open-channel hydraulics. It has been prepared by CGSB's Standards Committee on the Measurement of Liquid Flow in Open Channels. It is similar in content and in layout to International Standard ISO 772, Liquid Flow Measurement in Open Channels — Vocabulary and Symbols, published by the International Organization for Standardization (ISO).

ISO 772 was reviewed by the Standards Committee to determine its suitability for Canadian use. An asterisk (*) is used to indicate those sections which differ from ISO 772. In addition, CGSB's committee has made editorial changes to the style of certain sections to make them more comprehensible to Canadian users.

Withdrawn/Retirée

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CANADIAN GENERAL STANDARDS BOARD

LIQUID FLOW MEASUREMENT IN OPEN CHANNELS — VOCABULARY AND SYMBOLS

1. SCOPE

- 1.1 This standard is based on the international standard ISO 772. It defines terms and symbols used in the measurement of liquid flow in open channels. The terms and their definitions are grouped into sections according to the method of measurement or in relation to a particular subject. A list of symbols is given in Appendix A.
- 1.2 The International Organization for Standardization (ISO) adopted three principles in preparing ISO 772. These are:
- To standardize suitable terms and symbols without perpetuating unsuitable ones.
 - To discard any term or symbol that has been used with differing meanings in different countries, or by different people, or by the same person at different times, and to replace that term or symbol by one which has an unequivocal meaning.
 - To exclude terms that are self-evident.

However, ISO recognized that it was not possible to produce a complete set of definitions which are universally acceptable. With this in mind an asterisk (*) is used in this document to indicate terms, definitions and symbols that differ from those in ISO 772.

2. APPLICABLE PUBLICATION

- 2.1 The following publication is applicable to this standard:
- 2.1.1 International Organization for Standardization (ISO)
ISO 772 — Liquid Flow Measurement in Open Channels — Vocabulary and Symbols.
- 2.2 Reference to the above publication is to the latest issue unless otherwise specified by the authority applying this standard. The source for this publication is shown in the Notes section.

3. GENERAL TERMS

- 3.1 **Liquid** — A substance which is neither a solid nor a gas, which is practically incompressible and offers insignificant resistance to change of shape, and flows freely (e.g. water or water with sediment).
- 3.2 **Steady (unsteady) flow** — The condition in which the discharge does not change (changes) in magnitude with respect to time.
- 3.3 **Uniform flow** — Flow in which the depth and velocity remain constant with respect to distance along the channel (Note 1).
- 3.4 **Critical flow** — Flow in which the specific energy (par. 3.46) is a minimum for a given discharge. Under this condition the Froude number will be equal to unity and small surface disturbances cannot travel upstream (see Figure 12).
- *3.5 **Subcritical flow** — Flow in which the Froude number is less than unity and small surface disturbances can travel upstream (see Figure 12).
- 3.6 **Supercritical flow** — Flow in which the Froude number is greater than unity and small surface disturbances cannot travel upstream (see Figure 6 and 12).

Note 1: For uniform flow the velocity vector is constant along every streamline. Uniform flow is possible only in a channel of constant cross section.

- 3.7 **Stratification of flow** — The state of fluid flow that consists of two or more distinct layers arranged according to their density, the least dense layer being on top and densest at the bottom.
- 3.8 **Critical depth** — The depth of a cross section at which the flow is critical.
- 3.9 **Open channel** — The longitudinal boundary surface consisting of the bed and banks or sides within which a liquid flows with a free surface (Note 2).
- 3.10 **Stable (unstable) channel** — A channel whose bed and sides remain stable (unstable) over a substantial period of time and in which scour and deposition during the rising and falling stages are negligible (appreciable).
- *3.11 **Tidal channel; tidal waterway (Note 3)** — A channel whose flow is subject to the movement of tides.
- *3.12 **Estuary** — A partially enclosed body of water in the lower reaches of a river which is freely connected with the sea, which receives fresh water from upland drainage areas and in which fresh and salt water may commingle.
- 3.13 **Stream** — The liquid flowing in an open channel (see also par. 3.15).
- 3.14 **Current** — General term to designate the movement of liquid.
- *3.15 **River** — The stream of water in a large natural open channel.
- 3.16 **Reach** — A length of open channel between two defined cross sections.
- 3.17 **Discharge, Q** — The volume of liquid flowing through a cross section per unit of time (Note 4).
- 3.18 **Stream gauging** — All of the operations necessary for measuring discharge.
- *3.19 **Velocity, v** — Speed of flow in a specified direction.
- 3.20 **Left (right) bank** — The bank to the left (right) of an observer looking downstream.
- *3.21 **Invert** — The lowest part of the cross section of an artificial channel.
- *3.22 **Bed slope; bottom slope, s** — The difference in elevation of the bed per unit distance along its bed measured in the direction of flow (Note 5).
- *3.23 **Bed profile** — The shape of the bed in a vertical plane in the longitudinal direction of a river or channel (see Figure 4).
- *3.24 **Side slope, m** — The tangent of the angle which the side of the open channel makes with the horizontal plane. The tangent of the angle which may also be expressed as the ratio of the horizontal and vertical components of the slope, taking either of them as unity; it should be stated which component is taken as unity. The side slope may also be expressed as a percentage.
- 3.25 **Surface slope, S** — The difference in elevation of the liquid surface of the stream per unit of horizontal distance measured in the direction of flow.
- 3.26 **Surface drawdown** — The local lowering of the water surface in an approach channel caused by the acceleration of the flow passing over an obstacle or through a control.
- 3.27 **Fall** — The difference in elevation of the water surface between the extremities of a defined reach at a given instant of time (e.g. as recorded at a twin-gauge station).

Note 2: The term "channel" generally means the deep part of a river or other waterway, and its meaning is normally made clear by a descriptive term, either stated or implied, such as "low-water" channel, "main" channel, "artificial" channel. For the purposes of this standard, the term "channel" is always assumed to be qualified by the adjective "open."

Note 3: A tidal waterway consists of one or more tidal channels together with the shallows and the banks or sides which set bounds to the water at high water.

Note 4: This term is not synonymous with "flow."

Note 5: This is usually mathematically positive downwards in the direction of the flow.

- *3.28 **Surface width** — The width of a channel, measured in cross section, at the water surface normal to the direction of flow.
- 3.29 **Wetted perimeter, P** — The wetted boundary of an open channel at a cross section.
- *3.30 **Cross section of a stream** — A vertical plane through a stream, normal to the direction of flow, bounded by the wetted perimeter and the free surface.
- 3.31 **Gauging section; measuring section** — The cross section of an open channel in the plane in which measurements of depth and velocity are made.
- 3.32 **Measuring reach** — A reach of open channel selected for the measurement of hydraulic parameters.
- 3.33 **Converging (expanding) reach** — A reach in which the cross section gradually decreases (increases) in the direction of flow.
- 3.34 **Flood mark** — A trace of any kind left by a flood on the banks, obstacles or flood plain (Note 6).
- *3.35 **Established velocity distribution** — The velocity distribution in a straight channel of uniform cross section which is of sufficient length to develop uniform, resistance-controlled flow.
- 3.36 **Surface velocity** — The velocity of a liquid at its surface at a given point.
- 3.37 **Mean velocity depth** — The depth below the surface at which the mean velocity on a vertical occurs.
- 3.38 **Mean velocity at a cross section, $\bar{v}$** — The velocity at a given cross section of a stream, obtained by dividing the discharge by the cross-sectional area of the stream at that section.
- 3.39 **Mean velocity of a reach** — The velocity calculated by dividing the discharge by the average cross-sectional area of the stream along the reach.
- 3.40 **Velocity of approach; approach velocity** — The mean velocity in an open channel at a known distance upstream of a measuring section.
- 3.41 **Velocity head** — The kinetic energy of the flow expressed as the head obtained by dividing the square of the velocity by twice the acceleration due to gravity ($v^2/2g$).
- *3.42 **Total head; energy head, H** — The sum of the elevation (z) of the free surface above a horizontal datum of a section, and the velocity head based on the mean velocity $\bar{v}$ at that section (see Figure 6) (Note 7).

$$H = z + \frac{\bar{v}^2}{2g}$$

- 3.43 **Total head line; energy head line** — A plot of the total (energy) head in the direction of flow (see Figure 6).
- 3.44 **Energy gradient** — The difference in total (energy) head per unit horizontal distance measured in the direction of flow.
- 3.45 **Energy loss; head loss** — The difference in total (energy) head between two cross sections.
- 3.46 **Specific energy** — The sum of the elevation of the free surface above the bed and the velocity head based on the mean velocity at that section (Note 8).
- 3.47 **Stage; gauge height; liquid level** — The elevation of the free surface of a stream, lake or reservoir relative to a gauge datum (see par. 3.71).

Note 6: The flood mark may be used to determine the highest level attained by the water surface during the flood. See par. 7.6.

Note 7: See par. 3.46 and 5.25.

Note 8: See par. 3.42.

- 3.48 **Stage-discharge relation** — A curve, equation or table which expresses the relation between the stage and the discharge in an open channel at a given cross section (Figure 1).

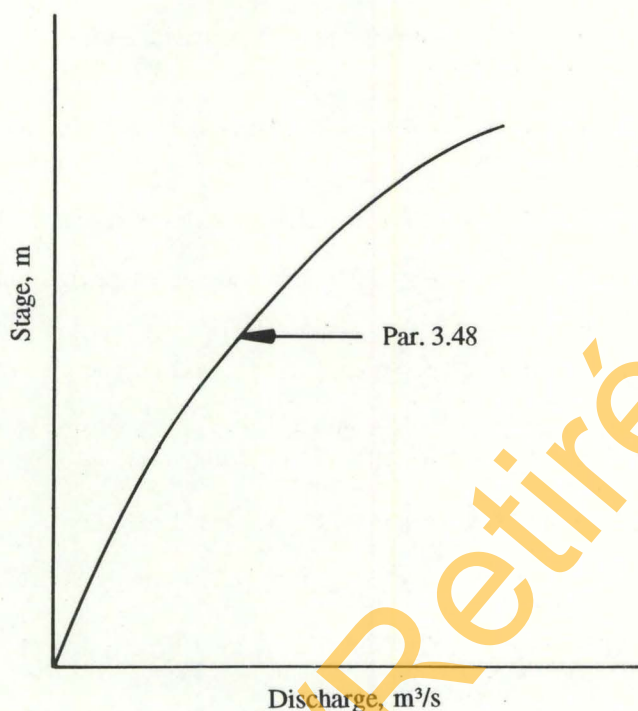


FIGURE 1
A Typical Stage-Discharge Relation

- 3.49 **Stage (discharge) hydrograph** — A graphical representation of changes in stage (discharge) with respect to time.
- 3.50 **Cumulative volume curve; mass discharge curve** — A curve in which the cumulative volume of flow or flow mass is plotted against time.
- 3.51 **Gauging station** — An installation at a measuring site where water level and/or discharge records are regularly obtained.
- 3.52 **Single-gauge station** — A gauging station at which stage records from a single gauge are adequate to establish a stage-discharge relation.
- *3.53 **Twin-gauge station** — A gauging station at which two water-level gauges define a reach for the measurement of water-surface fall or slope. Reach definition is an essential element in establishing a stage-discharge relation.
- *3.54 **Reference system of benchmarks** — The system of benchmarks prevalent in the vicinity of the gauging station, which should be related, where practicable, to a national datum.
- 3.55 **Control; section control** — The physical properties of a cross section or a reach of a natural or artificial channel, which govern the relation between stage and discharge at a location in the channel.
- *3.56 **Rating of a station** — The establishment of a discharge relation with the measured variable(s).
- *3.57 **Backwater** — The rise in water level upstream from a given location on an open channel resulting from impedances offered to the flow (Note 9).

Note 9: It may be caused by channel storage for which the reservoir properties vary with the depth of flow at the given location.

- 3.58 **Backwater curve** — The profile of the liquid surface upstream when its surface slope is less than the bed slope (Note 10).
- 3.59 **Drawdown curve** — The profile of a liquid surface when its surface slope exceeds the bed slope.
- 3.60 **Normal depth** — The depth from the water surface to the bottom grade line of a channel in the case of uniform flow. It is a function of the geometry, slope and roughness of the channel, and of the rate of discharge.
- 3.61 **Frazil ice** — Fine spicules, plates or discoids of ice suspended in water which are generally formed by the supercooling of turbulent water (Note 11).
- 3.62 **Anchor ice** — Submerged ice found attached to the bed, irrespective of the nature of its formation.
- 3.63 **Rime ice** — A white mass of tiny ice crystals or granular ice tufts formed on exposed objects owing to atmospheric moisture.
- 3.64 **Peak stage** — The maximum instantaneous stage during a given period. (see par. 3.34 and 7.6).
- 3.65 **Friction; drag** — The boundary shear resistance which opposes the flow of a liquid.
- 3.66 **Conveyance, K ; conveyance factor (deprecated)** — A measure of the carrying capacity of a channel defined in terms of the discharge, Q and the bed slope, s :
- $$Q = Ks^{1/2}$$
- 3.67 **Hydraulic jump** — The sudden passage of water in an open channel from supercritical depth to subcritical depth, accompanied by energy dissipation (see Figure 6).
- *3.68 **Hydraulic radius; hydraulic mean depth, R_h** — The quotient of the wetted cross-sectional area and the wetted perimeter (Note 12).
- *3.69 **Hydraulic depth; average depth** — The quotient of the wetted cross-sectional area of an open channel and the surface (i.e. top) water width.
- 3.70 **Stage gauge** — A device installed at a gauging station for measuring the level of the surface of the liquid relative to a datum.
- 3.71 **Gauge datum** — The elevation of the zero of the gauge to which the level of the liquid surface is related (Note 13).
- 3.72 **Benchmark** — A permanent mark, the elevation of which should be related, where practicable, to a national datum.
- 3.73 **Stilling well (tube)** — A well (tube) connected with the stream in such a way as to permit the stage to be measured in a relatively still liquid.
- 3.74 **Float well** — A stilling well in which a float device is used.
- 3.75 **Roughness coefficient** — A coefficient which characterizes the condition of the wetted perimeter and which is taken into account when computing head loss.
- 3.76 **Friction coefficient** — A coefficient used to calculate the energy gradient caused by friction.

Note 10: The backwater curve generally occurs upstream of an obstruction or confluence. The term is also used to denote all liquid surface profiles which are non-uniform with respect to distance upstream or downstream. However, this usage is discouraged.

Note 11: Frazil ice may float or accumulate under ice cover or adhere to the stream bed as anchor ice.

Note 12: The term hydraulic mean depth, while not commonly used in Canada, may be used in place of hydraulic radius. It should not be confused with hydraulic depth or average depth (par. 3.69).

Note 13: The gauge datum is related to a benchmark.

- *3.77 **Froude number, Fr** — A dimensionless number expressing the ratio of inertia forces to gravity forces. For open channels, the Froude number is calculated as follows:

$$Fr = \frac{\bar{v}}{\sqrt{gd}}$$

where $\bar{d}$ is the hydraulic depth of the cross section (m), $\bar{v}$ is the mean velocity of flow (m/s), and g is the acceleration due to gravity (m/s^2).

- *3.78 **Reynolds number, Re** — A dimensionless number expressing the ratio of inertia forces to viscous forces. For open channels the Reynolds number is calculated as follows:

$$Re = \frac{\bar{v}R_h}{\nu}$$

where R_h is the hydraulic radius of the cross section (m), $\bar{v}$ is the mean velocity of flow (m/s) and ν is the kinematic viscosity of the liquid (m^2/s) (Note 14).

- *3.79 **Weber number, We** — A dimensionless number expressing the ratio of inertia forces to surface tension forces. For open channels the Weber number is calculated as follows:

$$We = \frac{Q \bar{v}^2 \bar{d}}{\sigma}$$

where $\bar{d}$ is the hydraulic depth of the cross section (m), and $\bar{v}$ is the mean velocity of flow (m/s),

Q is the density of the liquid (kg/m^3) and

σ is the surface tension of the liquid (kg/s^2).

4. VELOCITY-AREA METHODS

- 4.1 **Velocity-area method** — Method of discharge determination based on the area of the cross section bounded by the wetted perimeter and the free surface, and the integration of the component velocities in the cross section.
- 4.2 **Slope-area method** — An indirect method of discharge estimation in a reach based on the surface slope, the reach roughness, the wetted perimeter and flow areas of the various cross sections in the reach.
- *4.3 **Mean direction of flow** — The direction in which the summation of the discharge elements in a cross section is a maximum.
- 4.4 **Vertical** — The vertical line in which velocity measurements or depth measurements are made (see Figure 4).
- *4.5 **Drift (1)** — The distance travelled in a specified direction per unit time.
- 4.6 **Drift (2)** — The distance that a current meter assembly is carried downstream when used with a flexible suspension (see Figure 3).
- 4.7 **Apparent velocity** — Velocity due to drift.
- 4.8 **Measured mean velocity on a vertical** — The velocity obtained by measuring velocity at one or more depths in a vertical and applying a coefficient, either directly or following some averaging process, to derive the mean.
- 4.9 **Mean velocity in a vertical** — Discharge per unit width divided by the depth in the vertical (see Figure 2).

Note 14: For wide channels the hydraulic radius approximates the hydraulic depth.

- *4.10 **Vertical velocity curve; vertical velocity profile; vertical velocity distribution** — A curve showing the relation between depth and horizontal velocity along a vertical line in a specified section of a stream (see Figure 2).

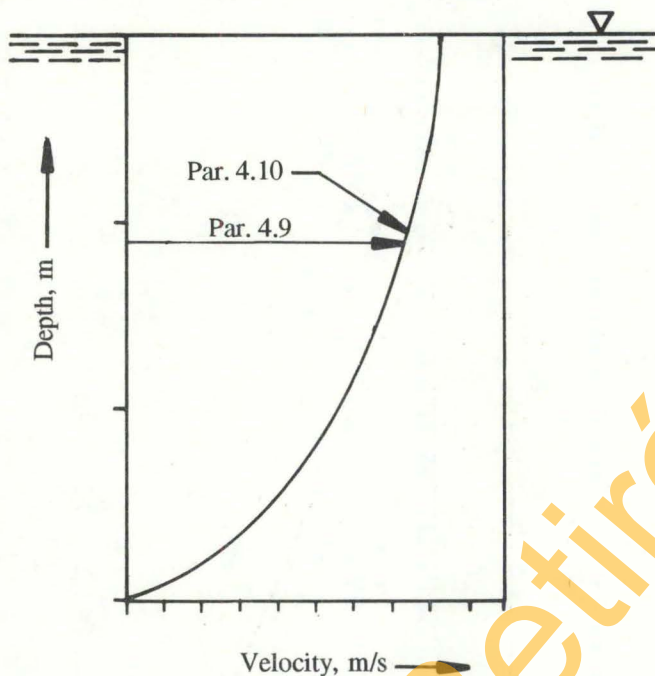


FIGURE 2
Vertical Velocity Curve

- 4.11 **Velocity gradient** — The change in velocity per unit of distance along the vertical velocity curve.
- 4.12 **Vertical velocity coefficient** — The coefficient applied to a single, or an equivalent single, velocity determination at any depth in a vertical to infer the mean velocity on that vertical.
- 4.13 **Sounding** — The operation of measuring the depth from the free surface to the bed.
- 4.14 **Air line correction** — The correction to the sounding line measurement corresponding to that part of the sounding line above the liquid surface (see Figure 3).
- 4.15 **Wet line correction** — The correction to the sounding line measurement corresponding to that part of the sounding line below the liquid surface (see Figure 3).
- *4.16 **Reference gauge** — A stage gauge (par. 3.70) normally linked to a standard system of benchmarks (par. 3.54).
- 4.17 **Reference current meter** — A current meter which is immersed to a fixed position in the cross section during the carrying out of a discharge measurement. For slight changes in discharge during the gauging operation, it is assumed that the change in velocity indicated by the reference current meter is proportional to the change in discharge.
- 4.18 **Standard current meter** — A calibrated current meter used as a basis of comparison for other current meters.
- 4.19 **Integration method (1)** — Method of measuring the velocity in a vertical, involving the raising and lowering of a current meter at a constant rate through the entire depth on the vertical.
- 4.20 **(one-; two-; three-; five-; six-) Point method** — Method of measuring the velocity in a vertical by placing a current meter at a number of designated points in the vertical.
- 4.21 **Float gauging** — Measurement of velocity of a stream by means of a float (par. 7.37).
- 4.22 **Moving boat method** — A method of measuring discharge from a boat by traversing the stream along the measuring section whilst continuously measuring velocity, depth and distance travelled.

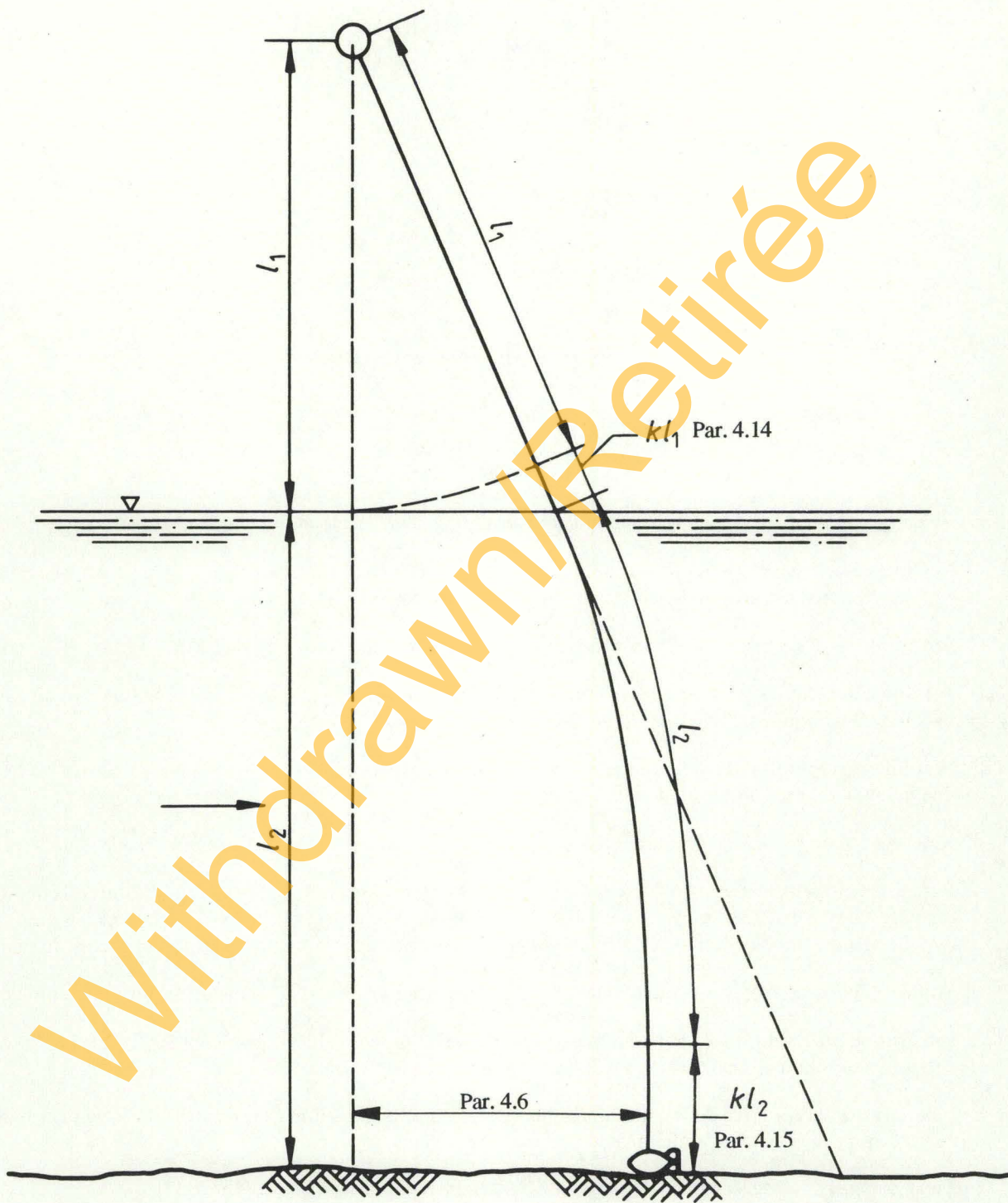


FIGURE 3
Sounding Line Corrections

- 4.23 **Channel storage** — In general, the volume of liquid contained in an open channel at a given instant of time. In specific terms, the volume contained in a defined reach at a given instant and represented by the mean depth of flow in the reach.
- 4.24 **Segment (1) (mean section)** — The area bounded by two consecutive verticals in a cross section, the bed of the open channel and the water surface (see Figure 4).
- 4.25 **Segment (2) (mid-section)** — The area at a vertical defined by the depth at that vertical multiplied by one-half of the distance between the preceding and the succeeding verticals (see Figure 4).

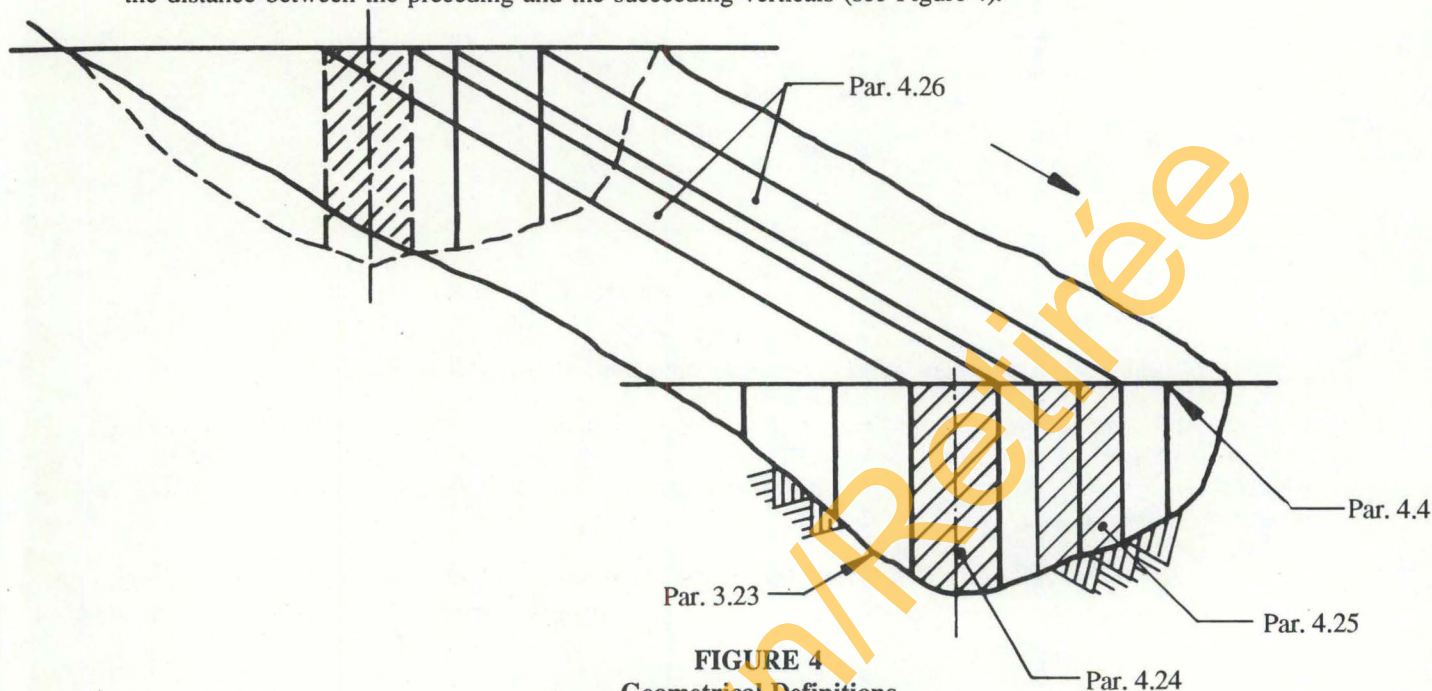


FIGURE 4
Geometrical Definitions

- 4.26 **Panel** — That part of the surface of the stream enclosed between the corresponding traces of segments in adjacent cross sections (see Figure 4).
- *4.27 **Storage curve** — A curve depicting the volume of stored water against stage.
- 4.28 **Cubature** — A numerical technique of computing discharges in a tidal channel at a cross section from the rates of change in volume of water up to the tidal limit, with algebraic allowance for the freshwater discharges entering the channel (Note 15).
- 4.29 **Looped stage-discharge relation; hysteresis of the stage-discharge relation** — The stage-discharge relation at a gauging station where, for the same stage, the discharge on the rising stage is different from that on the falling stage (see Figure 5).
- 4.30 **Sensitivity of the stage-discharge relation** — A measure of the change in stage at a gauging station due to a change in discharge (Note 16).
- 4.31 **Stilling-well lag** — During conditions of rising or falling stage in a channel, the difference at a given time instant between the channel stage and the stilling-well stage.
- 4.32 **Normal fall stage-discharge relation; normal fall method** — The relationship between stage and discharge established graphically from a number of distinct sets of measurements of stage, discharge and fall recorded at a gauging station subject to variable slope, so as to define the condition of minimum backwater in terms of the upstream gauge.

Note 15: The maximum volume is usually that occurring at high water of spring tide.

Note 16: When a small increase in discharge produces a relatively large increase in stage, the relation is said to be sensitive. When a large increase in discharge produces a relatively small increase in stage, the relation is said to be insensitive.

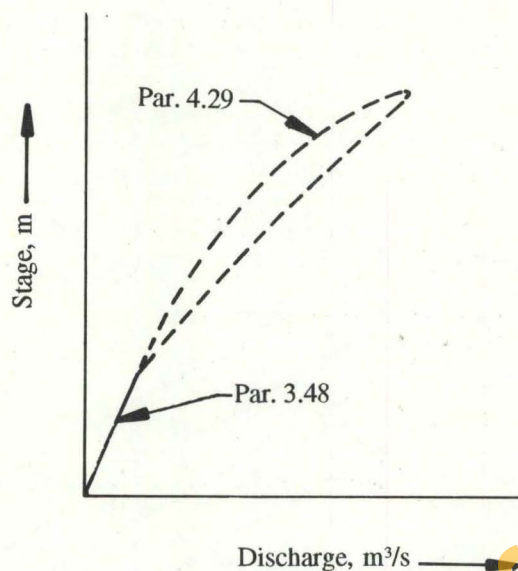


FIGURE 5
A Typical Looped Stage-Discharge Relation

- 4.33 **Constant fall stage-discharge relation; constant fall method** — The relationship established by graphical interpolation between a number of distinct sets of measurements of stage, discharge, and fall, recorded at a gauging station subject to variable slope, so as to define those pairs of stage and discharge measurements for which the measured fall has the same value.
- 4.34 **Fall-stage-discharge relation; slope-stage-discharge relation** — A family of curves which expresses the relationship between water surface slope, stage and discharge in an open channel in a given reach subject to variable backwater.
- *4.35 **Tide** — The periodic rise and fall of water level in a water body due to the gravitational attraction of the sun, moon and earth.
- 4.36 **Ebb tide** — The occurrence of a falling water surface of a tide.
- 4.37 **Ebb current** — The seaward movement of water along a tidal channel.
- 4.38 **Flood tide** — The occurrence of a rising water surface of a tide.
- 4.39 **Flood current** — The landward movement of water along a tidal channel.
- *4.40 **Spring tide** — Tide of greatest amplitude occurring twice during the lunar month when the resultant gravitational force of the sun and the moon acting upon the earth is at a maximum.
- *4.41 **Neap tide** — Tide of smallest amplitude occurring twice during a lunar month, near the time of quadrature of the moon with the sun, i.e., when the resultant gravitational force acting upon the earth is at a minimum.
- 4.42 **High (low) water** — The state of the tide when water is highest (lowest) for any given tidal cycle.
- 4.43 **Ebb (flood) volume** — The total discharge of an ebb (flood) tide.
- 4.44 **Tidal amplitude; tide amplitude** — One half of the difference in height between consecutive high water and low water, hence half the tide range.
- 4.45 **Tidal cycle; tide cycle** — A period which includes a complete set of tide conditions or characteristics, such as a tidal day.
- 4.46 **Tidal day** — The interval between two upper transits of the moon over a local meridian, approximately equal to 24.84 h.

- 4.47 **Duration of tide** — The time required for one tidal cycle, usually 12.42 h for a semi-diurnal tide or 24.84 h for a diurnal tide.
- *4.48 **Tidal prism** — The difference between the mean high-water volume and the mean low-water volume of an estuary, excluding any upland discharges.
- 4.49 **Tide (tidal) range** — The difference in level between high water and low water of a tide. The range is specific to a particular tide if consecutive high and low water are used. Otherwise, the range can refer to extremes of high and low water over any specified period of time.
- 4.50 **Diurnal inequality (1)** — The difference in heights and durations of two successive high waters or of two successive low waters of each day.
- 4.51 **Diurnal inequality (2)** — The difference in speed and direction of the two flood currents or the two ebb currents of each day.
- 4.52 **Seiche** — An oscillation of the surface of a liquid caused mainly by winds and variations in atmospheric pressure.
- 4.53 **Density current** — The phenomenon of gravity flow of a liquid relative to another liquid, or of relative flow within a liquid medium due to difference in density (see par. 4.54).
- 4.54 **Saltwater wedge** — The wedge-like intrusion of a large mass of salt water flowing in from the sea under the freshwater in a tidal waterway.

5. NOTCHES, WEIRS AND FLUMES

- 5.1 **Approach channel** — The reach of the channel upstream of the gauging structure in which suitable flow conditions have been established to ensure correct gauging.
- 5.2 **Guide vane** — A device placed in the approach channel to improve flow conditions (see par. 5.21).
- 5.3 **Weir** — An overflow structure which may be used for controlling upstream surface level or for measuring discharge, or for both (see Figure 6).

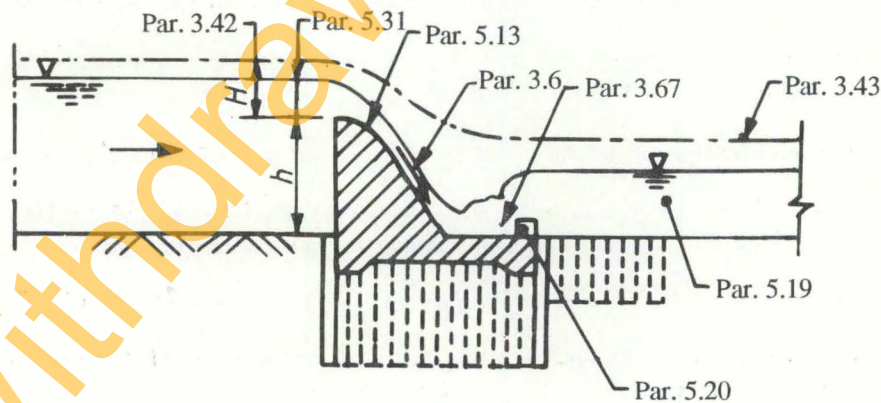


FIGURE 6
Weir

- 5.4 **Thin-plate weir** — A weir constructed of a vertical thin plate, in such a manner that the nappe (par. 5.26) springs clear of the crest (see Figure 7).
- 5.5 **Thin-plate notch weir** — A weir whose crest is a notch cut in a thin plate (see Figure 8).
- 5.6 **Long-based weir** — A weir of such dimensions that a section through the block forming it has a horizontal longitudinal dimension at the bed level of the weir equal to or greater than the maximum operating head.

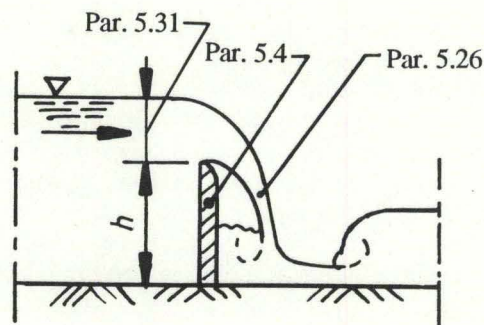


FIGURE 7
Thin-Plate Weir

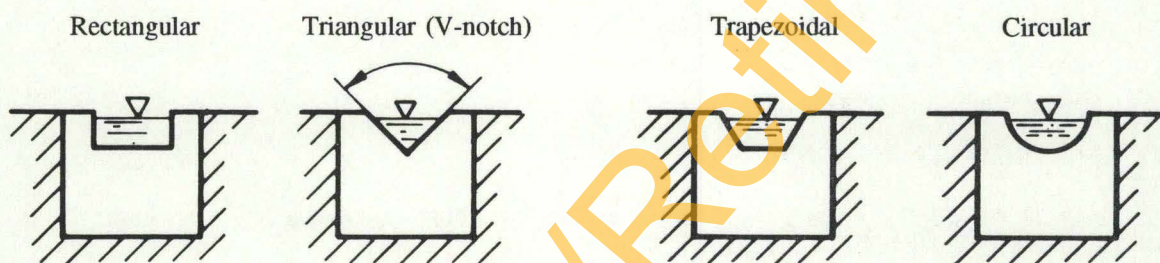


FIGURE 8
Thin-Plate Notch Weirs

- 5.7 **Short-crested weir** — A weir of such dimensions that a section through the block forming it has a horizontal longitudinal dimension at bed level equal to or smaller than the maximum operating head.
- 5.8 **Broad-crested weir** — A weir of such crest length in the direction of flow that critical flow occurs on the crest of the weir (see Figure 9).
- 5.9 **Triangular-profile weir** — A long-based weir having a triangular longitudinal profile (see Figure 10).
- 5.10 **Flat-V weir** — A long-based weir with a triangular longitudinal profile. The height of the triangle increases linearly from the middle of the channel to the abutment of the weir (see Figure 11).
- 5.11 **Compound weir** — A weir containing two or more sections, which may be of different types and/or dimensions.
- 5.12 **Full-width weir; suppressed weir (deprecated)** — A weir whose crest fills the full width of the channel in which it is placed, thus eliminating side contraction of the stream.
- 5.13 **Weir block; weir body** — The part of a weir lying between the abutments and over which the water flows (see Figure 6).
- 5.14 **Weir abutment; abutment; wing wall** — A wall at the side of a channel, in general normal to the axis of the weir, against which a weir terminates.
- 5.15 **Flume** — An artificial open channel with a clearly specified shape and dimensions which may be used for measurement of flow.
- 5.16 **Venturi flume (subcritical flow)** — A flume containing a contraction such that, in principle, a measurement of two water levels, upstream from and either at or downstream from the constriction, allows a calculation of the discharge (see Figure 12).

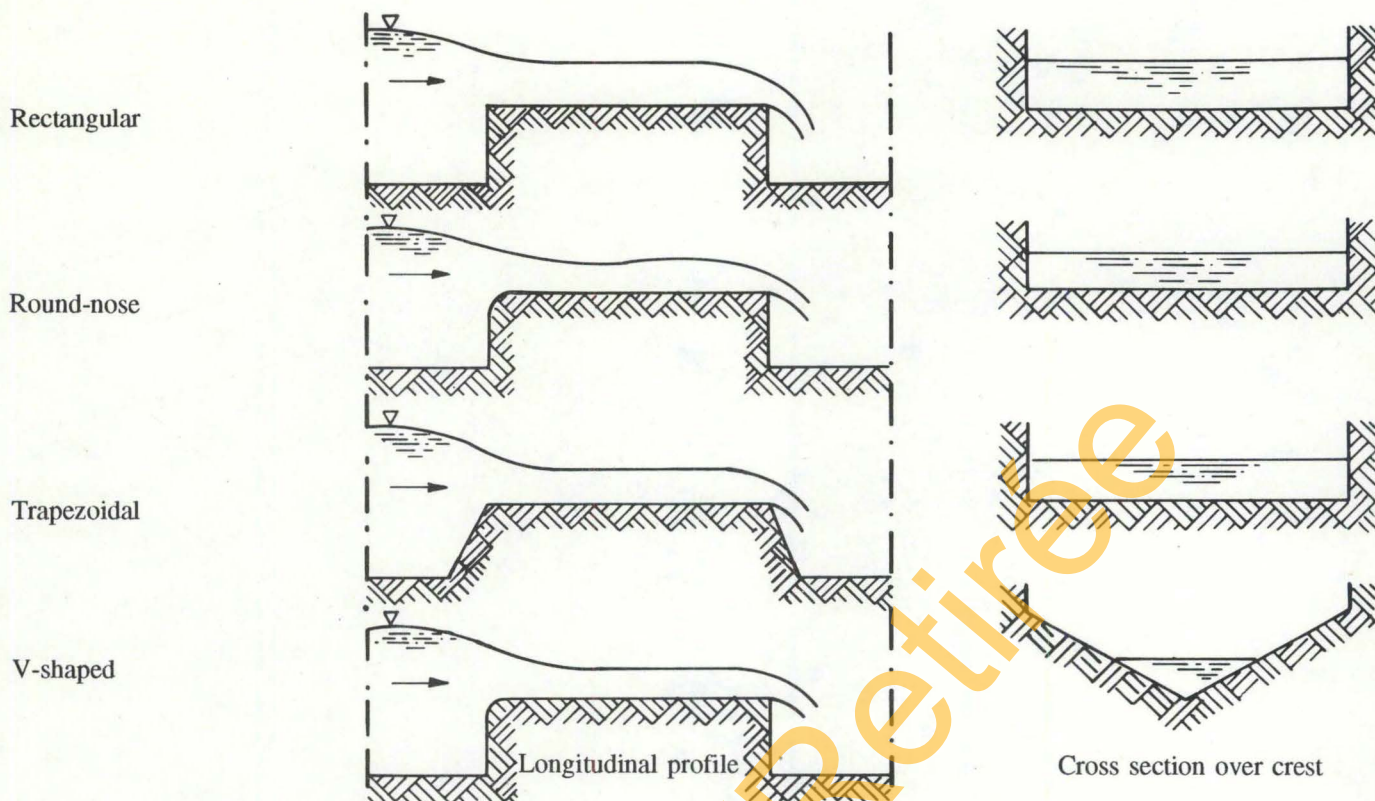


FIGURE 9
Broad-Crested Weirs

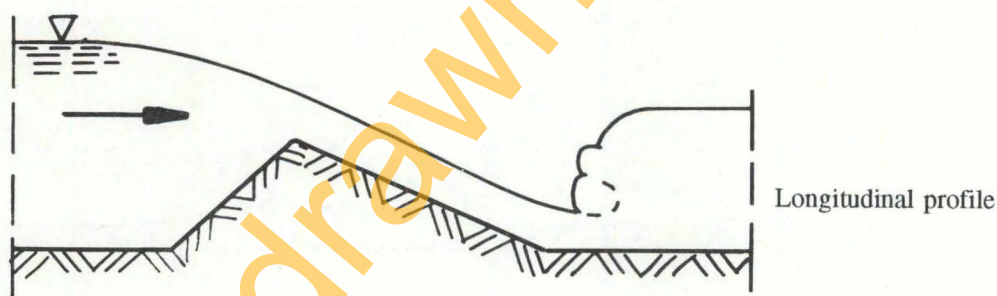


FIGURE 10
Triangular-Profile Weir

- 5.17 **Critical-depth flume; standing-wave flume** — A venturi flume in which the flow changes from subcritical upstream to supercritical downstream and in which the measurement of one water level, the upstream water level, allows for a calculation of the discharge.
- 5.18 **Throat** — The minimum cross-sectional area within a flume. The throat may be rectangular, trapezoidal, U-shaped or of any other specially designed shape.
- 5.19 **Stilling basin** — A pool downstream of a structure in which the velocity and the energy of the flow are reduced (see Figure 6).
- 5.20 **Control blocks, baffle piers, baffle blocks** — Blocks placed downstream of the weir in the stilling basin to dissipate energy (see Figure 6).
- 5.21 **Baffle** — A wall or blocks placed in a stream to dissipate energy or to cause improved velocity distribution.
- 5.22 **Free flow** — A flow which is not influenced by the level of water downstream of the measuring device.

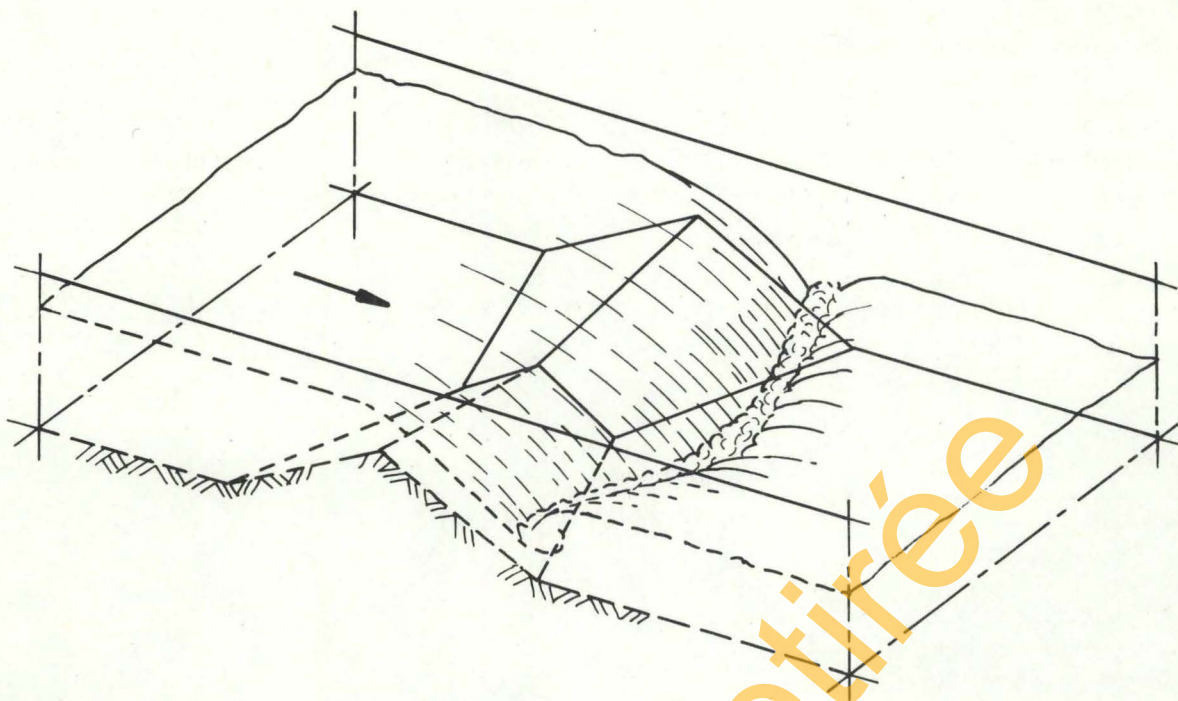


FIGURE 11
Flat-V Weir

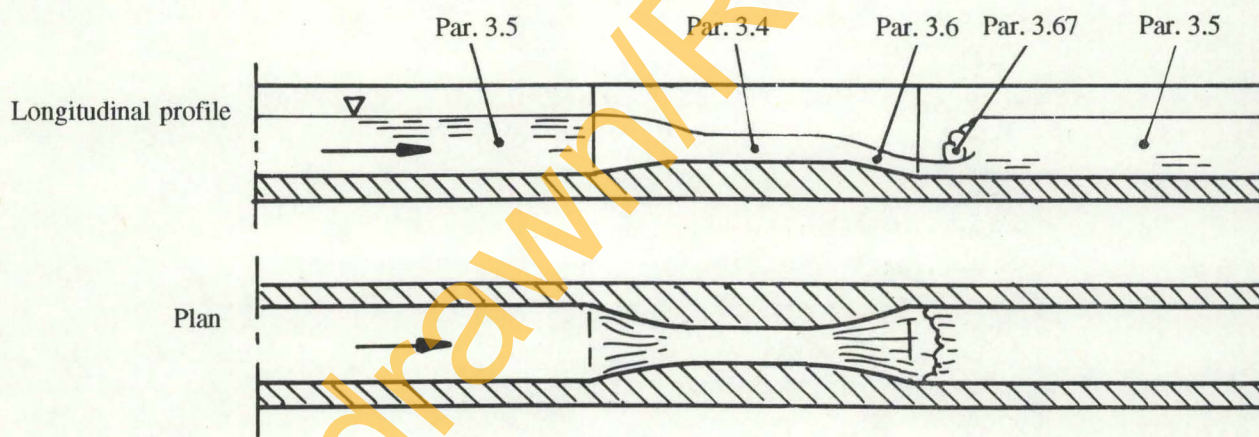


FIGURE 12
Venturi Flume

- 5.23 **Point of incipient submergence** — The condition of flow where a rising downstream level just begins to affect the discharge.
- 5.24 **Drowned flow; submerged flow** — A flow which is influenced by the water level downstream of the measuring structure.
- 5.25 **Submergence ratio** — The ratio of the downstream measured head to the upstream total head over a weir, the crest being taken as the datum (see par. 3.43 and 3.46).
- 5.26 **Nappe** — The jet formed by the flow over a weir (see Figure 7).
- 5.27 **Clinging nappe** — A nappe which maintains contact with the downstream face of a weir.
- 5.28 **Fully ventilated nappe; fully aerated nappe** — A nappe springing clear of the downstream face of the weir, with atmospheric pressure on the underside of the nappe.

- 5.29 **Fully developed contraction of a nappe** — The contraction which occurs when a further increase in the depth or width of the approach channel no longer affects the nappe.
- 5.30 **Control section (of a weir or flume)** — The section at which the discharge is uniquely related to the depth of flow.
- 5.31 **Head on (over) the weir** — Elevation of the water above the lowest point of the crest of a weir, measured at a point upstream. The distance upstream to the point of measurement depends on the type of weir used but is upstream of the transition zone from subcritical to supercritical flow at full weir flow (see Figures 6 and 7).
- 5.32 **Discharge coefficient** — A coefficient in the discharge equation, in general relating the actual discharge to a theoretical discharge.

6. DILUTION METHODS

- 6.1 **Tracer** — An ion, compound or radionuclide introduced into a flow system to follow the behaviour of some component of that system; it is necessary for the tracer, which can be observed, to behave in exactly the same fashion as the component to be followed, the behaviour of which cannot easily be observed.
- 6.2 **Dilution method** — A method in which the discharge is deduced from the determination of the ratio of the concentration of the tracer injected to that of the tracer at the sampling cross section (see par. 6.10).
- 6.3 **Constant-rate injection method** — A method of measuring discharge in which a tracer of known concentration is injected at a constant and known rate at one cross section and its dilution is measured at another section downstream where complete mixing has taken place.
- 6.4 **Integration method** — A method of measuring discharge in which a known quantity of a tracer is injected over a short time at one cross section and its dilution is measured at another cross section downstream where complete mixing has taken place; the measurement period shall be sufficient to allow all the tracer to pass that cross section so that the mean concentration of tracer during the sampling time can be determined.
- 6.5 **Multiple injection** — Simultaneous injection of tracer at several points in the injection cross section, with the aim of improving transverse mixing in a given measuring reach.
- 6.6 **Constant-level tank** — Equipment for the injection of the concentrated solution at a constant rate. With the help of an overflow weir, a constant head is maintained above a selected nozzle or orifice.
- 6.7 **Mariotte vessel** — Equipment for the injection of the concentrated solution at a constant rate. The constant-rate injection is achieved by means of an airtight vessel provided with an orifice plate or nozzle at its bottom portion. The liquid flows through the restriction and air enters the vessel through a tube which emerges at a set height above the restriction, maintaining atmospheric pressure at the lower end of the tube. The head on the restriction and, consequently, the injection rate remain constant, independently of the level in the vessel.
- 6.8 **Floating siphon** — Equipment for the injection of the concentrated solution at a constant rate. The solution is taken from a vessel by means of a siphon which is fixed on a float. The lower end of the siphon is fitted with an orifice plate or nozzle. The head on the restriction and, consequently, the injection rate, remain constant independently of the level in the vessel.
- *6.9 **Mixing reach (length) for complete mixing** — For the constant-rate injection method, the minimum length of the reach between the injection cross section and cross sections where the steady tracer concentration does not vary spatially in the section. For the integration method, it is the minimum length of the reach between the injection cross section and the cross section where transverse mixing is such that the integral of the tracer concentration versus time relationship does not vary spatially in the section.
- 6.10 **Dilution ratio, $N(1)$; dilution factor (1)** — In the constant-rate injection method, the ratio between the concentration of the injected tracer solution and the concentration of added tracer detected at the sampling cross section when steady conditions have been reached.
- 6.11 **Dilution ratio, $N(2)$; dilution factor (2)** — In the integration method, the ratio between the concentration of the injected tracer solution and the mean, over the sampling period, of the concentration of added tracer detected at the sampling cross section.

- 6.12 **Sampling cross section; sampling station** — A cross section of an open channel downstream of the injection cross section, at which samples are taken or in which the concentration is directly measured.
- 6.13 **Standard solution** — A reference solution containing a selected concentration of a dissolved substance.
- 6.14 **Conductivity method** — A technique for determining the concentration of the tracer by means of its electrical conductivity.
- *6.15 **Transit time method** — A method of determining the mean velocity by measuring the time taken for the centroid of a cloud of injected liquid to travel between two cross sections or two points in the stream that are a known measured distance apart.
- 6.16 **Carrier** — A non-radioactive isotope of the radioactive tracer element usually added to radioactive solutions when the concentration of the radioactive isotope of the element is so small that there is a danger of loss by adsorption on the walls of the recipient container.
- 6.17 **Geometric efficiency** — The ratio of the number of particles or photons which enter the sensitive volume of a detector to the total number of particles or photons emitted by a radioactive source.
- 6.18 **Half-life** — The time taken for the activity of a radioactive substance to decrease by one-half. Each radionuclide has a unique half-life.
- 6.19 **Volumetric activity** — The activity per unit volume of a given radioactive material, expressed in a becquerel per cubic metre.

7. INSTRUMENTS AND EQUIPMENT

- 7.1 **Vertical gauge; staff gauge** — A fixed vertical graduated scale on which the level of a liquid surface relative to a datum may be read.
- 7.2 **Inclined gauge; ramp gauge** — A gauge on a slope, generally graduated directly to indicate vertical heights.
- 7.3 **Float gauge** — A gauge consisting essentially of a float which rides on the liquid surface and rises or falls with it, its movement being transmitted to a recording or indicating device.
- 7.4 **Point gauge** — A gauge whose essential element is a pointed rod which is lowered until it just touches the water surface (see Figure 13). The moment when the point touches the water surface is often indicated by an electrical device.

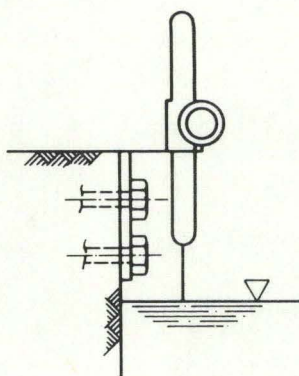


FIGURE 13
Point Gauge

- 7.5 **Hook gauge** — A gauge whose essential element is a pointed hook which, after immersion, is raised until it touches the surface (see Figure 14).

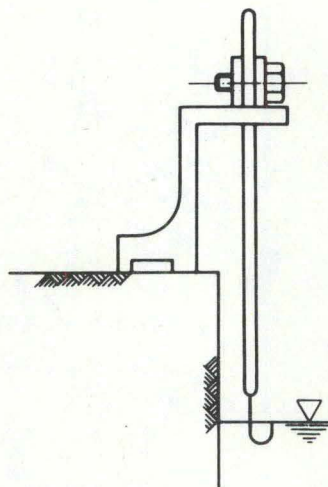


FIGURE 14
Hook Gauge

- 7.6 **Crest stage gauge** — A gauge, usually vertical, used to indicate peak stage (see par. 3.64).
- 7.7 **Wire weight gauge** — A gauge consisting essentially of a graduated wire or chain, weighted and lowered to make contact with the surface of the liquid. Contact with the liquid is determined visually.
- 7.8 **Servo-manometer; servo-beam-balance** — Two types of sensors of liquid head which incorporate a servo-system to convert a detected liquid pressure into a record or an indication of the liquid level.
- 7.9 **Elastic pressure bulb** — A device, operating on a closed gas system, used to transmit liquid pressure to a sensor. It normally consists of a short, cast, hollow cylinder with an open end, sealed with a slack, highly flexible, diaphragm, connected to the sensor by means of suitable tubing.
- 7.10 **Gas purge (bubbler) technique** — A method of transmitting liquid pressure in which a small discharge of non-corrosive gas or compressed air is allowed to bleed through a tube to an immersed fixed orifice. The measured pressure, detected by a pressure sensor, is directly proportional to the liquid head.
- 7.11 **Instrumental hysteresis** — The difference between the movement of the input mechanism and the associated movement of the stylus, lost as a result of the mechanical linkage.
- 7.12 **Stage recorder** — A device which automatically records, either continuously or at selected time intervals, the liquid level as detected by a sensor.
- *7.13 **Sensor** — A device which responds to the absolute value of or change in a physical or chemical stimulus (see par. 7.39).
- 7.14 **Rotating-element current meter** — A device fitted with a rotor, whose rotational frequency responds to and is a function of the local velocity of the surrounding liquid.
- 7.15 **Cup-type current meter** — A current meter whose rotor is a wheel fitted with cups turning on a vertical axis, perpendicular to the flow (see Figures 15, 17 and 18).
- 7.16 **Propeller-type current meter** — A current meter whose rotor is a propeller rotating around an axis parallel to the flow (see Figures 16, 17 and 18).
- 7.17 **Component propeller-type current meter** — A propeller-type current meter whose rotor is designed to provide a cosine response, (i.e. angular flow components are resolved on an axis parallel to the axis of the meter).

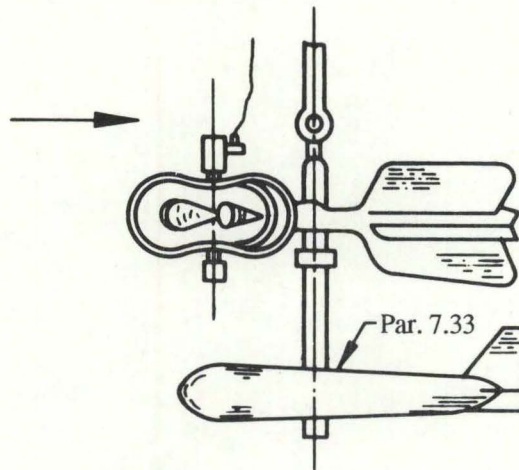


FIGURE 15
Cup-Type Current Meter

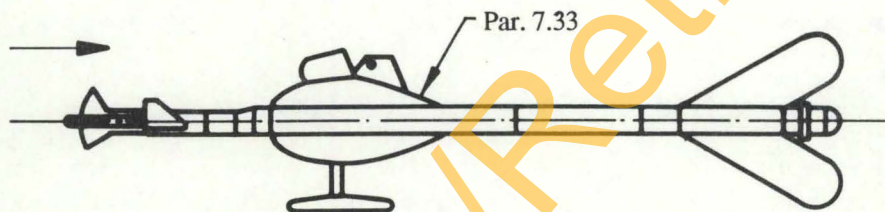


FIGURE 16
Propeller-Type Current Meter

- 7.18 **Pitch of the rotor (propeller)** — The degree of inclination or slope of the blade, or the distance which a given rotor (propeller) would advance in one revolution.
- 7.19 **Spin test** — A test in which the rotor of a current meter is spun either with the fingers or by blowing into the cup or into the propeller to check that it rotates freely and uniformly.
- 7.20 **Minimum speed of response** — The lowest velocity of the liquid relative to the rotor of a current meter at which the rotor gradually attains continuous and uniform angular motion.
- 7.21 **Calibration (rating) tank; towing tank** — A tank containing still liquid through which the current meter is moved at a constant velocity in order to calibrate the meter.
- 7.22 **Epper effect** — The effect produced by the Epper phenomenon, in which the wave crest produced by a current meter and its suspension, moving, causes an increase in the height of the wetted cross section and a consequential reduction in the relative velocity.
- 7.23 **Cableway system; cableway** — An assembly of cables and a carriage, often incorporating a winch, used for placing, measuring or sampling instruments at any desired point in the cross section.
- 7.24 **Main cable** — The anchored cable in a cableway system along which the instrument or personnel carriage travels (see Figures 17 and 18).
- 7.25 **Suspension equipment** — The cables, cables and winches or rigid rods to which hydrometric instruments may be attached for suspension in a channel.
- 7.26 **Anchorage** — The cableway fixtures to which the (main cable) track and stay lines are attached (see Figures 17 and 18).

- 7.27 **Stay lines** — The cables placed between the towers (pier posts) and anchorages of a cableway system to ensure the stability of the towers (pier posts) (see Figures 17 and 18).
- 7.28 **Suspension cable** — The wire from which the current meter is suspended, possibly incorporating an electrically insulated core and controlled by the winch (see Figures 17 and 18).
- 7.29 **Tow (traversing) cable** — A moving cable by means of which an instrument carriage is positioned from the bank. This cable is controlled by a winch (See Figure 17).
- 7.30 **Hand-held suspension** — Suspension of the current meter by a hand-held suspension cable, used for gauging from bridges or similar structures.
- 7.31 **Winch** — A drum-type, hand- or machine-operated winch, around whose drum is wound a hydrometric instrument suspension cable, incorporating a means of measuring the vertical distance which the instrument has travelled from a fixed point.
- 7.32 **Double-drum winch** — A winch with two drums, one of which controls and measures the vertical displacement of hydrometric instruments while the other controls and measures the horizontal displacement of an unmanned cableway carriage (see Figure 17).
- 7.33 **Sounding weight; sinker** — A streamlined weight attached to a sounding line or to the suspension of a current meter when recording depths or velocities in streams (see Figures 15, 16, 17 and 18).
- 7.34 **Sounding rod; sounding line** — A graduated, rigid rod or a chain or cable, usually with a weight attached to its lower end, used for determining depth.
- 7.35 **Wading rod** — A light, hand-held, graduated, rigid rod, for sounding the depth and positioning the current meter in order to measure the velocity in shallow streams suitable for wading (see Figure 19). This instrument may also be used from boats or ice cover, at shallow depths.
- 7.36 **Pendant wire; tag-line** — The wire or cord marking the measuring section and carrying pendants or markers to indicate the position of the observation points, but not used for suspending apparatus.
- 7.37 **Float** — Any natural or artificial body which is supported by buoyancy (Archimedian) forces (see Figure 20). Several types of float are possible:
- 7.37.1 **Surface float** — A float whose greatest drag is near the surface for measuring surface velocities.
- 7.37.2 **Subsurface float** — A float whose greatest drag is below the surface for measuring subsurface velocities.
- 7.37.3 **Double float** — A body of slightly negative buoyancy which moves with the stream at a known depth and whose position is indicated by a small surface float from which it is suspended.
- 7.37.4 **Velocity rod; rod-float** — A floating rod weighted at the base so that it travels in a stream in an almost vertical position; the immersed portion may be adjustable.
- 7.38 **Echo sounder** — An instrument using the reflection of an acoustic signal from the stream bed to determine the depth.
- 7.39 **Transducer** — A device that converts energy in one form into energy in a second form (see par. 7.13).
- 7.40 **Pulse** — A controlled transient increase or decrease in transmitted energy.
- 7.41 **Bit** — A binary digit; a digit (1 or 0) in the representation of a number in binary notation.
- 7.42 **Byte** — A sequence of adjacent binary digits operated on by a computer as a unit.
- 7.43 **Baud** — A unit of measure of data flow on a communication path, equivalent to one bit per second.
- 7.44 **Hydrometric instrument** — Equipment used to measure liquid characteristics (e.g. flow, suspended sediment concentration, velocity, depth, etc.) in an open channel.

Cableway System: Unmanned Instrument Carriage

FIGURE 17

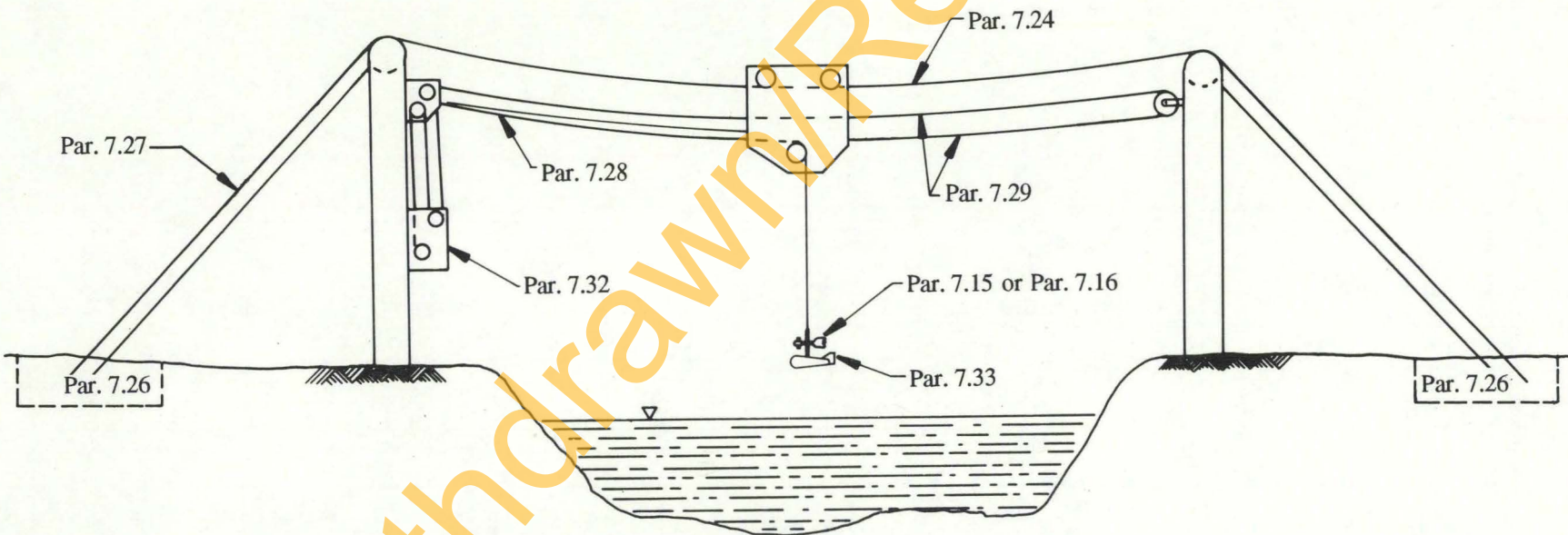
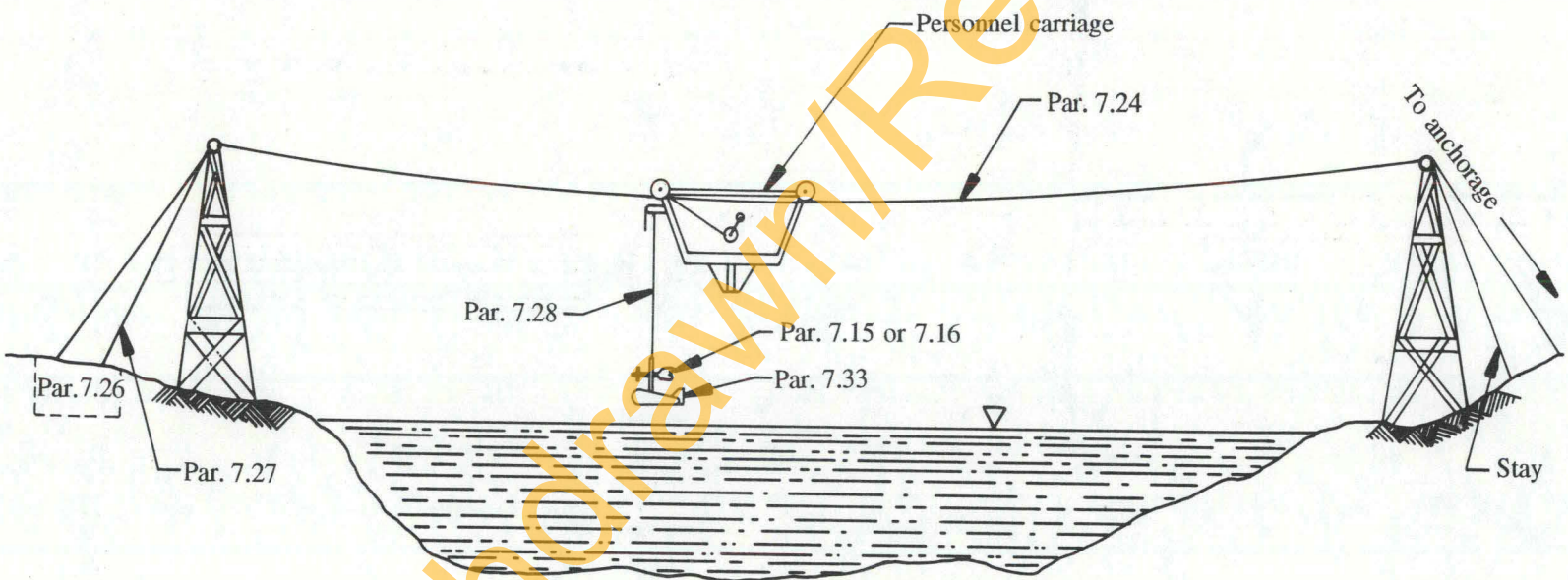


FIGURE 18
Cableway System: Manned Instrument Carriage



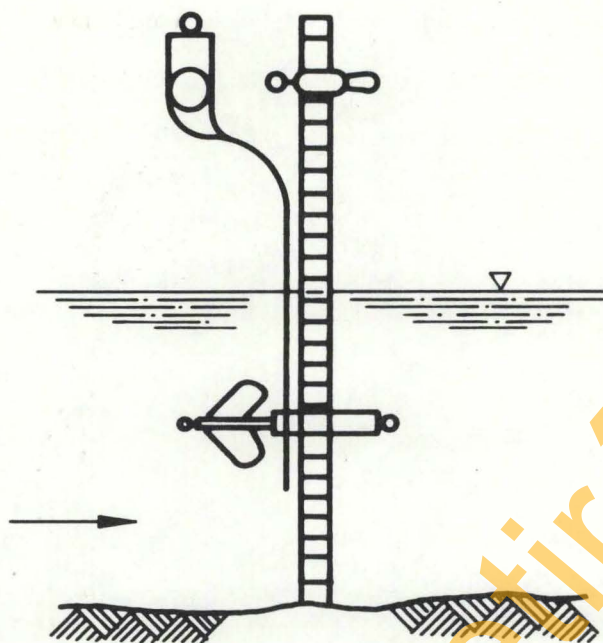


FIGURE 19
Wading Rod

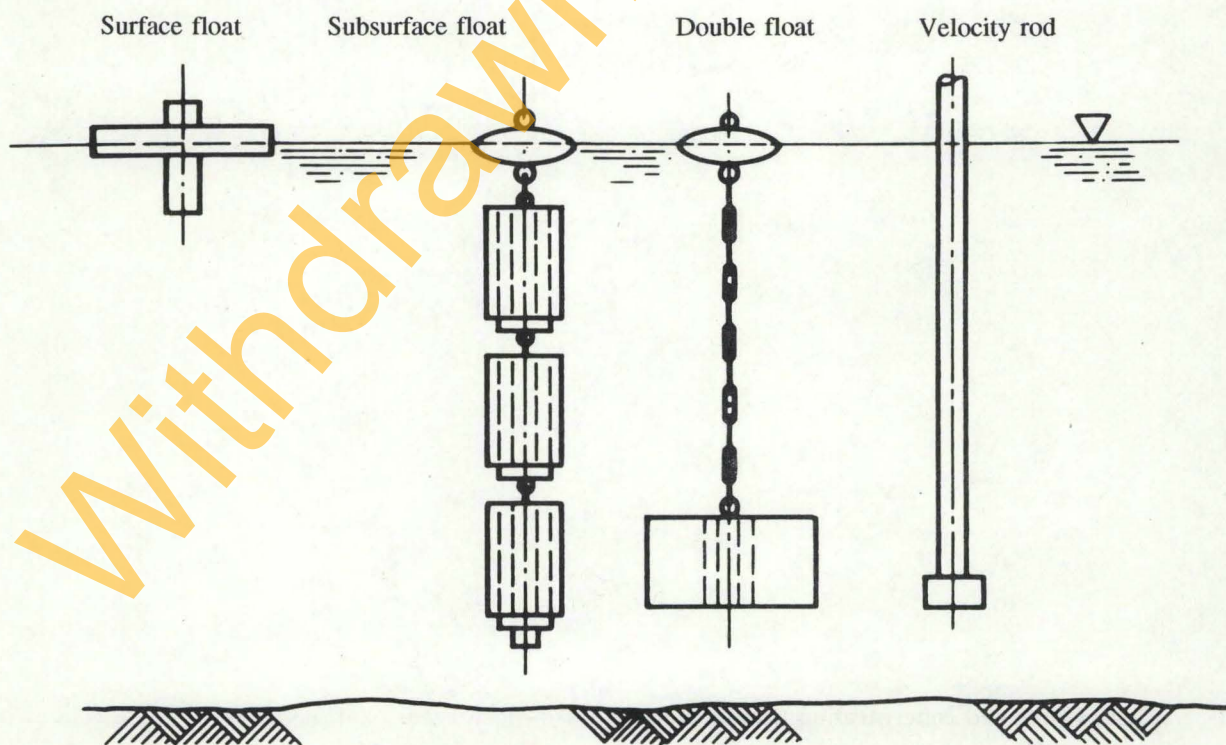


FIGURE 20
Types of Float

8. SEDIMENT TRANSPORT

- 8.1 **Sediment** — Solid particles formed as a result of erosion which are or have been transported by liquid flow.
- 8.2 **Sediment transport** — The movement of solids transported in any way by a flowing liquid.
- 8.3 **Total load** — The sum of the bed material load (par. 8.5) and the wash load (par. 8.8) (see Figure 21).
- *8.4 **Bed material** — The material whose particle sizes are found in measurable quantities in that part of the bed affected by transport.
- *8.5 **Bed material load** — Transported material which is derived from the bed of the channel and which includes both suspended load and bed load, but excludes wash load (see Figure 21).
- 8.6 **Suspended load** — That part of the total sediment transported which is maintained in suspension by turbulence in the flowing water for considerable periods of time without contact with the stream bed. It moves with practically the same velocity as that of the flowing water; it is generally expressed as a mass or volume per unit time (see Figure 21).
- 8.7 **Bed load** — The sediment in almost continuous contact with the bed, carried forward by rolling, sliding or hopping (see Figure 21).
- 8.8 **Wash load** — That part of the suspended load which is composed of particle sizes smaller than those found in appreciable quantities in the bed material. It is in near-permanent suspension and therefore, is transported through the stream without deposition. The discharge of the wash load through a reach only depends on the rate with which these particles become available in the catchment and not on the transport capacity of flow. It is generally expressed in mass or volume per unit of time (see Figure 21).

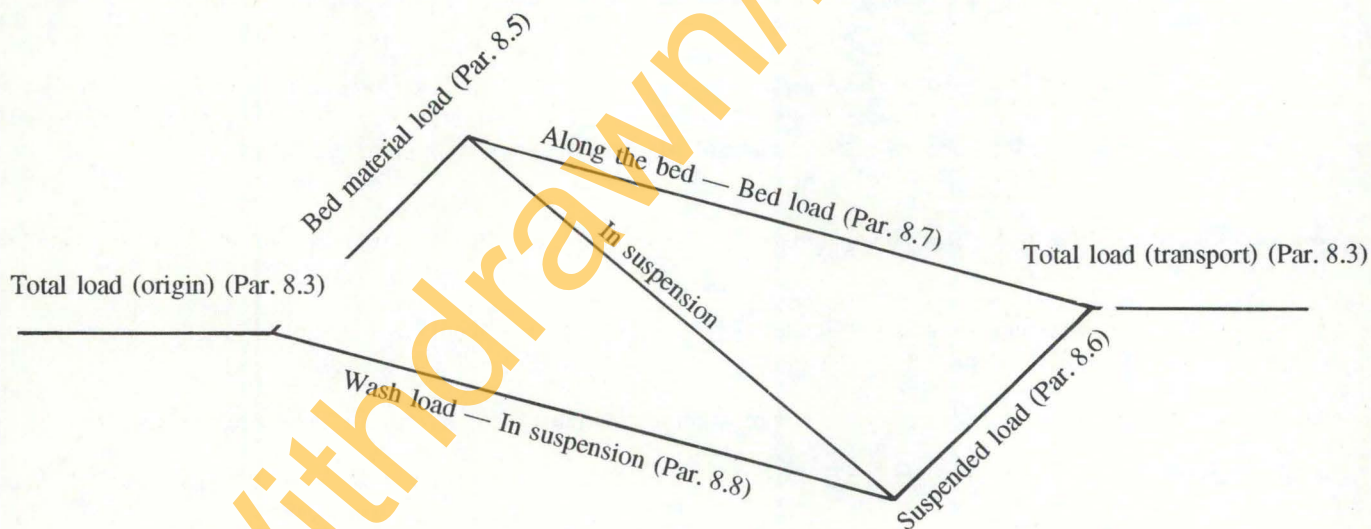


FIGURE 21
Definition Sketch

- *8.9 **Sediment concentration** — The ratio of the mass of the dry sediment in a water/sediment mixture to the total volume of the suspension.
- 8.10 **Mean suspended concentration (time); time-weighted mean suspended sediment concentration** — The time-average sediment concentration.
- 8.11 **Average suspended concentration (space)** — The average of the mean suspended concentration (time) over the entire contributing area to a particular station.

- 8.12 **Specific mass; relative density; specific gravity (deprecated)** — The ratio of the mass of a given volume of the sediment to the mass of an equal volume of water.
- 8.13 **Bulk density (of deposited sediment)** — The total dry mass of a unit volume (including pores) of undisturbed deposit.
- 8.14 **Oden theory** — In a uniformly dispersed sediment system, the principle which postulates that the sediment concentration at any level remains constant until the largest particle in suspension has had time to settle from the surface to the level in question.
- 8.15 **Depth-integrated method** — A method of sampling suspended sediment in which, by traversing the depth of the stream at a uniform speed, the sampler takes, at every point in the vertical, a small specimen of the water/sediment mixture, each increment of which is proportional to the local sediment discharge.
- 8.16 **Direct method of measurement** — A method in which, with the aid of one device, the time-averaged suspended sediment load at a point is measured directly.
- 8.17 **Indirect method of measurement** — A method in which the time-averaged concentration of the sediment and the time-averaged current velocity at a point are measured practically simultaneously with the aid of separate devices and multiplied to obtain the sediment load.
- 8.18 **Decantation-evaporation method** — A method of obtaining the sediment concentration in a sample containing suspended sediment by letting the sample stand undisturbed so that the sediment will settle out of suspension, then successively decanting the sediment-free liquid and generally subjecting the sample to the processes of evaporation.
- 8.19 **Filtration method** — The process of passing a liquid through a filtering paper or other medium to remove suspended or colloidal matter.
- 8.20 **Hydrometer method** — A method of estimating the total concentration of suspended load and dissolved matter from the density given by a hydrometer.
- 8.21 **Gravimetric method** — A method of estimating total sediment by allowing the sediment to settle in a container, with a suitable additive to quicken settlement, siphoning off supernatant water and carefully transferring all the sediment from the container to a beaker and from the beaker onto a filter paper, then finally drying the sample and determining the mass of total sediment.
- 8.22 **Pipette method** — The analysis of fine particles of sediment, less than 0.062 mm in diameter, by taking samples by means of a pipette.
- 8.23 **Fall velocity; settling velocity** — The limiting velocity reached asymptotically by a particle falling under the action of gravity in still water.
- 8.24 **Size distribution** — A numerical or graphical representation of the results of a particle size analysis.
- 8.25 **Particle size distribution; grain size distribution** — Proportion by mass of each particle size present in a given sediment sample.
- 8.26 **Hydrometer** — A floating instrument used for determining the relative density of liquids.
- 8.27 **Siltometer** — An instrument which separates into different sizes the particles of a sample of sediment, either by deposition through a water column or by means of an air current, and which measures the volume or mass of the different grades thus separated.
- 8.28 **Bottom withdrawal tube** — An instrument for analysis of sediment particles less than 0.5 mm in diameter based on the principle that in a uniformly dispersed suspension, such as is used in the bottom withdrawal tube, the sediment concentration at any level remains constant until the largest particle has had time to settle from the surface to the level in question (see par. 8.14).
- 8.29 **Sedimentation tube** — A basic component of many items of equipment, through which particles settle in a column of liquid, usually water.

- 8.30 **Pycnometer** — An instrument for measuring density and relative density of liquids and solids.
- 8.31 **Depth-integrating sampler** — An instrument which obtains a sample of the sediment/water mixture while it is moved at a uniform rate vertically through a given distance.
- 8.32 **Instantaneous sampler** — An instrument which attempts to trap instantaneously a sample of sediment/water mixture.
- 8.33 **Point-integrating sampler** — An instrument which obtains a sample of sediment/water mixture at a given point over a fixed period of time.
- 8.34 **Pumping sampler** — An instrument which consists of a pumping system with the intake facing perpendicular to the stream flow and the outlet discharging to a container or a flushing system.
- 8.35 **Particle size; grain size** — A dimension which is representative of the size of an individual particle.
- 8.36 **Mean particle diameter, $\bar{D}$** — The arithmetic mean of the individual particle diameters.
- 8.37 **Median particle diameter, D_{50}** — The particle size dividing a given sample into two equal masses.
- 8.38 **Geometric mean particle diameter, $\bar{D}_g$** — That diameter, whose logarithm is the mean of the logarithms of the individual particle diameters; or, when reckoned in terms of the probability of the mass of the sample, p_i , and the algebraic mid-value, D_i , of the class interval of the particle diameters, the geometric mean diameter is given by the formula:

$$\log \bar{D}_g = \frac{\sum (p_i \log D_i)}{\sum p_i}$$

- 8.39 **Nominal diameter** — The diameter of a sphere of the same volume as the given particle.
- 8.40 **Projected diameter** — The diameter of a circle which just encloses the projected image of the particle when viewed in the plane of maximum stability.
- 8.41 **Sedimentation diameter** — The diameter of a sphere having the same specific mass and the same terminal settling velocity as a given particle in the same sedimentation fluid.
- 8.42 **Sieve diameter** — The length of the side of the smallest square opening through which the particles will just pass.

9. NOTES

- 9.1 **Source of Referenced Publications** — The publication referred to in par. 2.1.1 may be obtained from the Standards Council of Canada, Standards Sales Branch, 350 Sparks Street, Suite 1200, Ottawa, Ontario K1P 6N7.

SYMBOLS

Parameter	Symbol	Dimensions	SI unit
Area	A	L^2	m^2
Breadth (width) of the channel	B	L	m
Chezy coefficient	C	$L^{1/2}T^{-1}$	$m^{1/2}/s$
Diameter	D	L	m
Force, pull or thrust (tension)	F	MLT^{-2}	N
Total (energy) head	H	L	m
Conveyance	K	L^3T^{-1}	m^3/s
Length	L	L	m
Measured value	M	1)	1)
Dilution ratio	N		
Wetted perimeter	P	L	m
Discharge	Q	L^3T^{-1}	m^3/s
Electrical resistance	R	$ML^2T^{-3}I^{-2}$	Ω
Surface slope	S		
Transmissivity	T	L^2T^{-1}	m^2/s
Volume	V	L^3	m^3
Weight	W	MLT^{-2}	N
Sub-area	a	L^2	m^2
(Partial) breadth (or width)	b	L	m
Concentration	c	ML^{-3}	mg/L
Depth	d	L	m
Function factor	f		
Frequency	f	T^{-1}	Hz
Acceleration due to gravity	g	LT^{-2}	m/s^2
Head of liquid level (gauged, geometrical or measured)	h	L	m
Effective roughness height	k	L	m
Number of sources of error in a result	k		
(Partial) length	l	L	m
Side slope	m		
Manning's coefficient	n	$L^{-1/3}T$	$s/m^{1/3}$
Height of weir	h	L	m
Height of flume invert	p	L	m
Pressure	p	$ML^{-1}T^{-2}$	Pa
Unit discharge	q	L^2T^{-1}	m^2/s
Rate of injection of tracer (chemical)	q	L^3T^{-1}	L/s

Parameter	Symbol	Dimensions	SI unit
Radius	r	L	m
Bed slope; bottom slope	s		
Time	t	T	s
Student's t	t		
Velocity	v	LT^{-1}	m/s
x axis velocity component	v_x	LT^{-1}	m/s
y axis velocity component	v_y	LT^{-1}	m/s
z axis velocity component	v_z	LT^{-1}	m/s
Coordinates	x, y, z	L	m
Stage (elevation)	z	L	m
Difference between two values of the same quantity	Δ	1)	1)
Thermodynamic temperature	Θ	Θ	K
Radian measure	π		rad
Summation	Σ	1)	1)
Angle	α		rad
Boundary layer displacement thickness	δ	L	m
Uncertainty	ϵ	1)	1)
Efficiency	η		
Celsius temperature	θ	Θ	$^{\circ}\text{C}$
Wavelength	λ	L	m
Dynamic viscosity	μ	$ML^{-1}T^{-1}$	$\text{Pa}\cdot\text{s}$
Kinematic viscosity	ν	L^2T^{-1}	m^2/s
Head loss per unit length	ξ		
Mass per unit volume (density)	ρ	ML^{-3}	kg/m^3
Standard deviation	σ	1)	1)
Shear stress	τ	$ML^{-1}T^{-2}$	Pa
Thompson's τ	τ		
Froude number	Fr		
Equivalent sand roughness	K_s	L	m
Reynolds number	Re		
Hydraulic radius (hydraulic mean depth)	R_h	L	m
Water surface, water table	∇		
Weber number	We		

L=length, M=mass, T=time, I=electric current, Θ =thermodynamic temperature

1) Dimensional order would depend on its meaning.

Note: Unless otherwise stated, the symbols above are indicated in their most general form. For any specific use, such symbols may be qualified by a subscript, where necessary, and explained to indicate its exact meaning. A horizontal bar over a symbol indicates a mean value.

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Withdrawn/Retirée