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Indian Standard

GLOSSARY OF TERMS RELATING TO RIVER VALLEY PROJECTS

PART 3 RIVER AND RIVER TRAINING

(First Revision)

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Indian Standard

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0. FOREWORD

0.1 This Indian Standard (Part 3) (First Revision) was adopted by the Bureau of Indian Standards on 29 January 1988, after the draft finalized by the Terminology Relating to River Valley Projects Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 A number of Indian Standards has already been published covering various aspects of river valley projects and a large number of similar standards are in the process of formulation. These standards include technical terms and precise definitions for such terms are required for avoiding ambiguity in their interpretation. This Part 3 covers definitions of terms relating to types of rivers, river flow behaviour, channel erosion, sediment load and river training.

0.3 In the formulation of this standard, due weightage has been given to international coordination among standards and practices prevailing in different countries, in addition to relating it to the practices in the field in the country. This has been met by deriving considerable assistance, particularly from 'Multilingual technical dictionary on irrigation and drainage' published by the International Commission on Irrigation and Drainage (ICID) and are marked with an asterisk.

0.4 This standard was first published in 1967. The revision of the standard has been taken up in the light of the experience gained during the last few years in the use of this standard. Certain definitions of terms have been added and some of the terms have been modified.

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1. SCOPE

1.1 This standard contains definitions of terms relating to types of river, river flow behaviour, channel erosion, sediment load and river training.

2. TERMS RELATING TO TYPES OF RIVER

2.1 Alluvial River — A river which flows through deposits created by itself and is constantly building its flood plain by overflowing. The sediment that it carries (except for the wash load) is similar to that in its bed and banks.

2.2 Bank — Elevation of land which confine water of a stream to their natural channel in normal course of flow; banks are called right and left, as viewed facing downstream. Banks along a curve are called concave or convex depending on whether the centre of curvature is towards or away from the channel.

2.3 Bank Storage — Water absorbed and stored in bed and banks of stream, lake or reservoir, and returned in whole or in part as level of surface of water falls.

2.4 Bankful Discharge — Discharge at bankful stage.

2.5 Bankful Stage — Stage at which stream just overflows its natural banks.

2.6 Boulder Stage of River — The reach of river when it emerges from the hills with a well defined cross-section and non-submersible banks on either side. In this stage, the rivers are characterized by their steepness and beds with a mixture of boulders, gravels, shingle and sand.

2.7 Briaded River* — A river with an extremely wide and shallow channel, within which the normal river flow passes through a number of smaller interlaced channels separated by bars or shoals. In such rivers, there is often little tendency for the channel as a whole to meander, though local meandering in the minor channel generally occurs.

2.8 Brook — Small shallow stream, usually continuous in its discharge, which flows in somewhat turbulent manner; its channels are usually irregular in shape and have numerous boulders ledges or small drops which cause the turbulent flow.

2.9 Continuous Stream — Stream which flows or contains water throughout its entire course between any two points.

2.10 Creek

a) Small stream which serves as natural outlet for drainage basins of nominal or small size,

b) Inlet of sea coast, and

c) Short arm of stream.

2.11 Delta Stage of River — The reach of a river when it approaches the sea with very gentle slope and velocity, drops down the sediment and divides out into channels on either side of the deposits resulting in the formation of deltas.

2.12 Ephemeral Stream — Stream that flows only in direct response to precipitation, receiving no water from springs, and no long-continued supply from melting snow or other surface source; its channel is at all times above the water-table.

2.13 Flashy Stream — A stream in which transitory flow built up rapidly, and also falls away rapidly due to gorgeous slopes of the catchment and sudden burst or precipitation.

2.14 Graded Stream — Geological term for streams that apparently have, throughout long reaches, an approximate state of equilibrium between rate of sediment transport and rate of sediment supply.

2.15 Incised River — A river which has cut its channel through the bed of the valley floor as opposed to one flowing on a flood plain.

2.16 Influent Stream — Stream from which water is continuously percolating through stream bed to ground water.

2.17 Intermittent Stream — Stream that flows only during wet season and is dry during dry season. The water-table lies at or above the stream bed during wet season but drops below the bed during dry season.

2.18 Mature River — Stream whose slope is so reduced that water velocities are just sufficient to carry debris delivered by the tributaries, which have steeper slopes than the main stream.

2.19 Open Channel — The longitudinal boundary surface consisting of the bed and banks or sides within which the liquid flows with a free surface.

NOTE — The term 'channel' generally means the deep part of a river or other waterway, and its meaning is normally made clear by a descriptive adjective term, either stated or implied, such as low water channel, main channel and artificial channel. For the purpose of this glossary, the word 'channel' is always qualified by the adjective 'open'.

2.20 Rocky Stage of River — The reach of a river in the hills with steep slope and high velocity, and the bed is made up of rock or very large boulders.

2.21 Sluggish Stream — Slow moving stream where discharge variations are low in time due to flat slope or due to excessive reduction in flow by withdrawals or by storage upstream and where separation vertices are not conspicuous.

2.22 Stable Stream — A river stream which, on the whole, maintains its slopes, depths and channel dimensions without any significant raising or lowering of its bed. Such a stream may denote a condition that may be temporary from a geological point of view but for practical engineering purposes, may be accepted as one of temporal stability.

2.23 Tidal Reach of River - A reach of river in which flow and water surface slope are affected by tides. In some rivers, the effect may extend a hundred kilometres or more upstream from the mouth, and may be sufficient to reverse temporarily the direction of flow of the stream.

2.24 Torrent — A fast flowing stream in the mountaineous region.

2.25 Tributary — Surface or underground stream which contributes its water, continuously or intermittently, to another large or larger stream.

2.26 Trough Stage of River — The reach of river after it passes on to the alluvial plain created by itself with gentle slope and velocity, and cross-section made-up of alluvial sand and silt, and where the river spreads out over wide areas during high floods.

2.27 Young River* — A river is young when it is actively forming its channel immediately following overland flow.

3. TERMS RELATING TO RIVER FLOW BEHAVIOUR

3.1 Accretion of Level - *See* **3.2.**

3.2 Aggradation of Level* — An increase or rise in specific levels of the bed (the bed level at specific discharge) of a channel at any site. It is the converse of degradation or retrogression of levels. It is also called 'Accretion of Level'. A river in the process of aggradation is called 'Aggrading Type of River'.

3.3 Annual Flood — Highest momentary peak discharge at the respective point of observation which equalled or exceeded once every year.

3.4 Area Curve — Graph in which area is plotted against other variable, such as cross-sectional area of a stream against water surface elevation, or surface area of a reservoir against water surface elevation.

3.5 Area Discharge (Discharge Area) — Area of waterway of channel at discharge section line.

3.6 Avulsion — The breaking through by a river across the narrow neck of a bend or the cut-off of bend in a river or an entire change in the course of a river when it breaks through one of its banks in a deltaic region.

3.7 Axis of Channel* — The line joining the middle points of the water surface of a channel in successive cross-sections.

3.8 Back Water

a) Water held or forced back in consequence of some obstruction, such as a dam or a regulator or the swelling of the river below.

b) A water reserve obtained at high tide to be discharged at a low tide.

3.9 Backwater Curve—Slowly and continuously changing water surface profiles because of disparity between energy slope and bed slope.

3.10 Backwater Effect — Continuous change in water depth of a stream when the flow conditions along a stream are altered by control points.

3.11 Base Flow

a) Sustained flow of stream resulting from outflow of ground water and from drainage of large lakes and swamps.

b) Water sustained in glaciers, snow and other sources, not a result of direct run-off.

3.12 Base Period — When flow of stream exceeds base flow as a result of isolated storm. Also called base length when referring to hydrograph.

3.13 Bottom Contraction — Reduction in area of cross-section of over-flowing water caused by crest of weir contracting the nappe.

3.14 Brackish Water — Water containing halides in solution to a degree of unpalatibility.

3.15 Breathing of Rivers — Fluctuation of water level in a river.

3.16 Bela* — Shoal or island in a river.

3.17 Cascade — Stretch of a stream, where it flows in chutes and pools closely occurring.

3.18 Cataract Action — Digging-back action of rapid current on a river bed.

3.19 Celerity of Wave — Velocity of propagation of a wave through a liquid medium, compared with undisturbed velocity of fluid through which the disturbance is propagated.

3.20 Channel

a) Deep portion of a river or other waterway used by vessels for navigation.

b) Natural or artificial waterway which contains water moving continuously or periodically, or which forms a connecting link between two bodies of water.

3.21 Channel Line — Route of the deepest portion of river, usually coincides or nearly coincides, with the thalweg.

3.22 Channel Storage — Water stored temporarily in channel when flow is greater than related discharge capacity of the channel.

3.23 Control Section — Natural or artificially created section of an open channel or conduit, or channel of stream where conditions, such as dam or stretch of rapids, make the water-level above it a fairly stable index, at some or all stages of the discharge. Control may be complete or partial; complete control exists if elevation of water surface above the control is entirely independent of fluctuations of water level downstream; partial control, if downstream fluctuations have some effect upon upstream water level.

3.24 Creep — Movement of water under or around structure built on permeable foundations.

3.25 Critical Depth — Depth in a channel for a given discharge at which the specific energy of flow is minimum.

3.26 Critical Flow

a) The flow in which the specific energy head is minimum for a given discharge; under this condition, the Froude number will be equal to unity and surface disturbances will not just travel upstream.

b) A condition of flow where the mean velocity is at one of the critical values, ordinarily at Belanger's critical velocity. An other important usage in reference to Reynold's critical velocity at which the flow changes from stream line or non-turbulent or turbulent flow.

3.26.1 *Belanger's Critical Flow* — That flow in open channel at which the specific energy content of the flowing liquid is minimum.

3.26.2 *Reynold's Critical Flow* — Flow at that velocity which distinguishes turbulent motion from viscous motion.

3.27 Critical Tractive Force — Tractive force which starts general movement of bed material.

3.28 Critical Velocity

3.28.1 *Belanger's Critical Velocity* — The velocity in a channel at which the specific energy content of the flowing liquid is minimum.

3.28.2 *Lower Critical Velocity* — The velocity at which eddies in the flow die out.

3.28.3 *Reynold's Critical Velocity* — The velocity in a conduit or channel at which flow changes from laminar to turbulent flow.

3.28.4 *Upper Critical Velocity* — The velocity at which eddy formation is first noted. Also called upper critical velocity.

3.29 Cross-Over —Portion of river between bends where river bed is relatively high. Also called crossing.

3.30 Current

a) Flowing water.

b) Portion of stream of water which is moving with velocity much greater than average or in which progress of water is principally concentrated.

3.31 Cut-Off — A process by which an alluvial river flowing along curves or bends, abandons a particular bend and establishes its main flow along a comparatively straighter and shorter channel.

3.32 Cut-Off Ratio* — The ratio of the length of arc to chord of a meander at which the cut-off generally takes place.

3.33 Degradation, Degradation of Levels or Retrogression of Levels* — The lowering of specific bed levels of a channel. It is the converse of aggradation. A river in the process of degradation is called 'Degrading Type of River'.

3.34 Degree of Sinuosity — *See* **3.70.1**.

3.35 Depletion — Continuous or sporadic withdrawal of water from a surface stream of ground water, or reservoir or basin at a rate greater than the rate of replenishment (filling).

3.36 Direct Run-Off

a) Portion of precipitation from a given area that travels over ground as surface flow or through ground as interflow before joining a stream. Also called run-off.

b) That portion of run-off directly associated with causative rainfall or snow melt.

3.37 Discharge — Volume of water which flows past cross-section of a stream, channel or conduit in a unit of time; also called rate of flow.

3.38 Dominant Discharge — Discharge at which equilibrium is most closely approached, associated with a dominant silt charge slope; the discharge which determines the meander length.

3.39 Dominant Formative Discharge

a) The discharge which is large enough in magnitude and is of sufficient frequency, of occurrence to have a dominating effect in determining the size and characteristics of the river course, channel section and bed.

b) The discharge of a natural channel which determines the characteristics and principal dimensions of the channel. It depends on the maximum and mean discharge, duration of flow and flood frequency. It generally corresponds to bankful discharge.

3.40 Drop-Down Curve — Curved profile assumed by water surface in waterway or conduit along longitudinal profile, upstream from point where a sudden fall occurs.

3.41 Dry Weather Flow — Flow of water in a stream during lean season.

3.42 Ebb Current — Movement of tide or tidal current away from shore or down the tidal stream to the sea contrast 'flood current' which flows in the opposite direction from the sea towards the land.

3.43 Eddy — A whirling current within the main stream due to local pressure gradient or due to local bed changes, an eddy is called a confined eddy, when it retains contact with the solid boundary, and free or detached eddy, when it looses such contact and does not have contact with any solid part of the boundary.

3.44 Effluent

a) Stream flowing out of another stream or lake.

b) Liquid which flows out of containing space.

c) Stream fed by ground water.

3.45 Embayment*

a) The area within the swing of the bend of a river.

b) A local recession of a river bank due to erosion, that is, a bite taken out of a river bank.

3.46 Energy Line — Joins elevations of energy heads along a stream; lies above hydraulic gradient line at a height equivalent to velocity head at all sections along the stream.

3.47 Equilibrium* — An ideal condition towards which a channel is ever tending to develop. A channel is in equilibrium when the energy available due to the discharge and slope is just sufficient to carry the sediment charge without any tendency for the stream or channel to change its shape or slope; this entails every part of the cross-section being in equilibrium. In nature, this is never fully attained.

3.48 Extreme Limits of Oscillation* — The width within which a river has ranged within historic times.

3.49 Fall

a) The difference between the upstream and downstream total energy lines at a fall structure in a channel.

b) A fall structure is a structure designed to secure the lowering of the water surface in a channel in a short distance.

3.50 Flood Current — In tidal flow, the flow of tide or inland movement from the sea to landwards.

3.51 Flood Stage

a) Elevation or stage at which river overflows its natural banks.

b) Elevation established at salient points on rivers, indicating stage above which river is considered to be in flood.

3.52 Flood Wave — It is a translatory water surface profile caused by routing of the flood through the reaches of a river.

3.53 Flow — Quantity of water carried by a stream or conduit expressed in volume per unit of time.

3.54 Fore Shore* — The portion of a bank or shore lying adjacent to and sloping gradually to water.

3.55 Gauge Correlation — Empirical curve relating discharge (or stage) of stream at a downstream point to the simultaneous discharge (or stage) at one or more upstream points.

3.56 Gauging Station — Selected site on stream equipped and operated to furnish data on stream flow. Also called gauge and discharge site.

3.57 Horseshoe Bend* — A river bend such that only a neck of land is left between two parts of the stream. The river may cut through leaving a crescent-shaped lake (*see* Fig. 1).

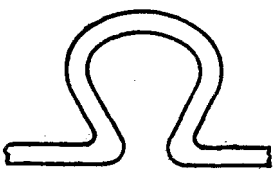


FIG. 1 A TYPICAL HORSESHOE BEND

3.58 Hydraulic Friction — A force resisting flow which is exerted on contact surface between a stream and its containing channel. It usually includes the normal eddies and cross currents, normally dependent upon turbulent flow, occasioned by roughness characteristics of the boundary surface, moderate curvature and normal channel variations.

3.59 Hydraulic Gradient — The energy gradient which sustains the water flow in an open channel or pipe or through the body of a structure. It is denoted:

a) in closed conduit by the gradient of the line joining the levels to which water will rise in manometer tubes attached to the conduit at specified locations;

b) in open channels by the gradient of the free water surface; and

c) in dikes, embankments, earth dams and other water retaining structures, the gradient of the saturation line, neglecting the effect of capillary rise, if any.

3.60 Hydraulic Jump — The phenomenon of abrupt rise in the surface of a stream accompanied by great deal of turbulence in the process when the flowing water in the stream passes from super-critical flow to sub-critical flow.

3.61 Hydraulic Mean Depth — Area of cross-section of the flowing water divided by its wetted perimeter, also called hydraulic radius.

3.62 Hydrograph — Graph showing the stage discharge, velocity or other feature of a water stream across a defined cross-section with respect to time.

3.63 Inter Flow — Portion of precipitation that travels through the upper horizons of the soil but does not join the water table.

3.64 Island* — Piece of land surrounded by the flowing water in the stream channel itself.

3.65 Local Inflow — Water that enters a stream between two stream gauging stations.

3.66 Loss of Head — A part of energy of given flow that is lost.

3.67 Mean Depth — Average depth of water in channel of stream or conduit, equal to cross-sectional area divided by surface width.

3.68 Mean Velocity

a) Velocity at given section of stream obtained by dividing discharge of stream by cross-sectional area at that section.

b) For a reach of stream, discharge divided by average area of the reach.

3.69 Meander — Deviations in the channel of stream maintaining, however, a general direction of the channel on the whole.

3.70 Meander or Full Meander — A meander in a river consists of two consecutive loops, one flowing clockwise, the other anticlockwise (*see* Fig. 2).

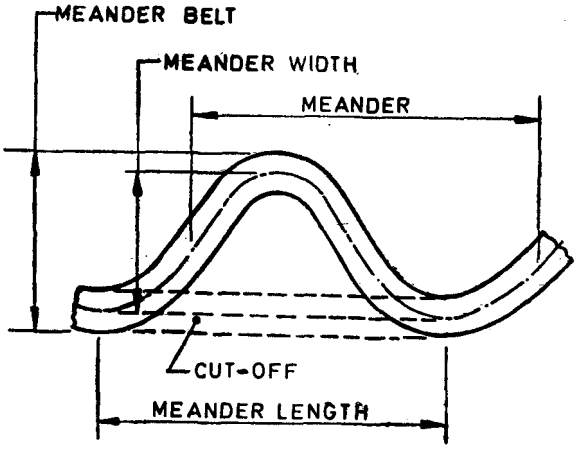


FIG. 2 MEANDERING RIVER

3.70.1 *Degree of Sinuosity* — The ratio of the meander belt (*see* **3.70.2**) and meander length (*see* **3.70.3**) of a meandering type river (*see* **3.70.6** and Fig. 2).

3.70.2 *Meander Belt** — The distance between lines drawn tangential to the extreme limits of successive fully developed meanders (*see* Fig. 2).

3.70.3 *Meander Length* — The air distance along a meandering type river, measured from the tangent point of one curve to the tangent point of the next similar curve (*see* Fig. 2).

3.70.4 *Meander Width** — The amplitude of swing of a fully developed meander, measured from midstream to midstream (*see* Fig. 2).

3.70.5 *Meander Ratio** — The ratio of meander width to meander length.

3.70.6 *Meander River* — A river in alluvial plans to which flows in consecutive curves of reverse orientation order connected with their straight reaches called crossings. The pattern of meandering may change whenever there is a change in discharge or the material transported by the stream (*see* Fig. 2).

3.71 Mid-channel — The line following the deepest part of the bed or channel of a river.

3.72 Normal Depth — It is the depth of flow in open channel where the bed slope and energy slope is exactly balanced. It is the function of discharge, cross-section, bed slope and friction factor.

3.73 Oxbow — The abandoned bow-shaped or horseshoe-shaped part of a former meander, left when the stream cut a new shorter channel across the narrow neck between two closely approaching bends of the meander. The abandoned channel, after being separated from the new main channel by deposition of silt, may contain standing water. Occasionally and locally the term oxbow has been applied to the closely looping meander itself, before the new shorter channel was cut through.

3.74 Rapid* — A part or reach of a stream with swift and turbulent flow without pronounced falls.

3.75 Rating Curve — A curve which expresses graphically the relationship between the discharge and the corresponding elevation of liquid surface in a channel or connduit at a given section.

3.76 Reach — Length of channel between two stipulated sections of the river.

3.77 Recession Curve — Falling arm of discharge hydrograph after a flood event representing withdrawal of water from storage in valley and stream of channel, also from subsurface run-off; that is, the part of the descending arm, from point of inflextion to point when direct run-off has ceased.

3.78 Regime

a) Equilibrium condition of stream or its channel in respect of its stability over a period of time.

b) Condition of river or canal if its channel has a stable form as a result of its flow characteristics.

c) In climatology, character of seasonal distribution of rainfall or of some other climatologic factor.

3.79 Regulated Flow — Flow releases in a stream regulated by upstream controls.

3.80 Riparian — Pertaining to banks of a stream or body of water, for example, 'riparian rights' are natural rights due to proprietor of lands along the river banks.

3.81 Reparian Land — Land to which abuts upon banks of a river of natural body of water. According to the concept of riparian rights, owners of the reparian land are entitled to receive the full natural flow of water or full compliment of water from the water bodies on which their lands abut undiminished in quantity and quality.

3.82 Ripples or Riffles

a) Shallow ridges in an open stream, where the water surface is broken into waves by obstructions, wholly or partly submerged.

b) Undulating ridges and furrows or crests and troughs in very small dimension formed by action of flow on the bed of the channel.

3.83 Retrogression of Levels* — A drop in specific discharge gauge reading, that is, a lowering of water level for the same discharge. Retrogression of levels is also applicable to retrogression of bed levels.

3.84 River — Large running stream of water which serves as natural drainage outlet for a drainage area or basin of considerable extent.

3.85 River Capture — Process by which a river having more rapid power of erosion than another cuts into the headwaters of the latter and takes over certain of its tributaries.

3.86 River Forecasting — Forecasting river stage and discharge.

3.87 River Stage — Height of water surface referred to a given datum.

3.88 Roughness Coefficient — It is the coefficient reflecting the effects of roughness of the wetted perimeter. Also called coefficient of rugosity or rugosity.

3.89 Run-Off Percentages — Amount of run-off, expressed in percentage of total precipitation from drainage area or basin.

3.90 Shooting Flow — Flow in open channel in which Froude number is greater than unity, or velocity is greater than celerity of gravity wave. Also called rapid flow.

3.91 Sinuosity — Ratio between thalweg length and straight line distance between two points on a river.

3.92 Slack Water — State of current when its velocity is negligible.

3.93 Slope — Inclination or gradient of a line or surface; most frequently expressed as difference in elevation of two points, divided by their horizontal distance.

3.94 Sounding — Depth of water in stream as measured from water surface to bed at one or several points.

3.95 Specific Energy — Energy of flow in an open channel, measured from bottom of channel as base, expressed as energy head above bottom of channel and not above any other datum.

3.96 Stage — Elevation of water surface, relative to established datum or plane of reference.

3.97 Stage Discharge Relationship — A curve or table which expresses the relation between the stage and the discharge in an open channel at a given cross-section for a given condition of flow, that is, steady, rising or falling.

3.98 Stability of Channel — Channel is stable when, though it may change slightly at different times of year, there is no appreciable change from year to year, that is, when accretion balances scour over the year.

3.99 Static Head — Head produced by static pressure of water, equal to pressure divided by unit weight of water.

3.100 Steady Flow

a) Flow in which velocity vector does not change in either magnitude or direction with respect to time at any point or section.

b) Condition in which rate of flow or quantity of water passing a given section per unit time remains constant.

3.101 Storm Flow — Excess water that flows off, at or near surface of ground, directly into creeks and rivers.

3.102 Stream

a) General term for liquid flowing in a channel or conduit.

b) Term usually applied to water flowing in a natural surface channel, but is also applicable to water flowing in an open or closed conduit, and to a jet of water issuing from an opening.

3.103 Stream Gauging — Measuring velocity of stream of water in stream channel of open conduit and area of cross-section of the water to determine discharge.

3.104 Stream Line — Line which lies in direction of flow at every point at a given instant. Hence, at any point, velocity vector and stream line passing through that point shall be tangential to each other, while velocity component normal to the line at the point of tangency must necessarily have zero magnitude.

3.105 Sub-critical Flow — Flow at velocities of less than one of recognized critical values.

3.106 Sub-meander — Small meander contained within banks of perennial channel of river, caused by relatively low discharges after flood has subsided.

3.107 Super Critical Flow — Flow at velocities higher than that corresponding to the critical depth and in which the Froude number is greater than unity and any surface disturbances cannot travel upstream.

3.108 Surge — Sudden change in discharge resulting from opening or closing of a gate controlling the flow in a channel, or by sudden introduction of additional water into the channel.

3.109 Swirl* — Term applied to moving eddies, the digging effect of which is naturally limited.

3.110 Time Lag

a) Referring to discharge or water level; time elapsing between occurrence of corresponding changes in discharge or water level at two points in a river. The difference in time by which one observation lags behind (is later than) another. Contrast with 'time lead'.

b) Referring to run-off from rain fall, time between centre of mass (or beginning of rain fall) to peak (or centre of mass) of run-off.

c) Referring to snow melting, time between beginning of snow melt and start of resulting run-off.

3.111 Time of Travel — Time elapsing between passage of flood wave down an open channel between a given point and another point downstream.

3.112 Turbulence — State of flow wherein small elements of a fluid travel in irregular paths, in contrast to stream-line or laminar flow, it exists when Reynolds number exceeds a certain value. Turbulence also refers to disturbances of the entire flow pattern by disturbances caused by eddies generated in the initial zone of instability which thereafter spreads rapidly through the fluid.

3.113 Turbulent Flow — A state of flow of liquid in which fluctuations (mixing or eddying motion) are super-imposed on the main stream. It is an irregular motion in which a time averaged quantities can be defined only in a statistical sense.

3.114 Warp* — Bend in a river imposed by external restraint.

3.115 Water Stage Recorder — Device for obtaining continuous record of stage at a point on a stream, usually consisting of a float-actuated pen which traces record on clock-driven chart.

3.116 Water Level (WL) — Altitude reached by surface of flowing or still water.

3.116.1 *High Water* — Highest water level within the period considered.

3.116.2 *Highest High Water* — Highest known water level.

3.116.3 *Low Water* — Lowest water level within the period considered.

3.116.4 *Lowest Low Water* — Lowest known water level.

3.116.5 *Mean High Water* — Mean of highest water levels within the period considered.

3.116.6 *Mean Low Water* — Mean of lowest water within the period considered for example, 'MLW (winter 1901-1920)' is the arithmetic mean of the lowest water during the twenty winters 1901 to 1920.

3.116.7 *Mean Water* — Arithmetic mean of daily mean water levels for a year, or the average of a number of years.

3.117 Wetted Perimeter

a) Length of wetted contact between stream of water and its containing conduit measured, along the cross-section.

b) Part of the periphery of the cross-sectional area of a stream which is in contact with its container.

3.118 Whirlpool* — An eddy of large diameter and high velocity, such as caused by the main stream of a large river, running approximately at right angles across the end of a spur, which may be above water, submerged or partly submerged.

3.119 Zero of Gauge — It is the relative level with respect to an established bench mark of plane of reference of the bottom of the gauge for recording stage at a gauging side. The zero is set below the lowest anticipated stage to avoid negative readings.

4. TERMS RELATING TO CHANNEL EROSION

4.1 Erosion — The wearing away of land by weathering, precipitation, etc, and subsequent transportation of detached material under the influence of gravity through water, wind, etc.

4.2 Scour — The removal of material from the bed of a channel by flowing water.

4.3 Sheet Erosion — Removal of surface layer of soil more or less evenly as a sheet, over a tract or field through action of wind or water.

4.4 Shoal — Submerged patch of deposits of natural boulders on a river bed susceptible to exposure at low stages and, in case of deposits, to locational shifts.

4.5 Slump* — A sudden slip or collapse of the bank, generally, in vertical direction and confined to a short distance probably due to the substream being washed out or having become unable to bear the weight above it.

4.6 Suction Scour* — Scour at the toe of banks caused by the impact and suction of translatory waves created by movement, say, of boats or by tidal action.

4.7 Water Erosion — Gnawing or wearing away of banks of river, land surface or river works due to flow of water.

5. TERMS RELATING TO SEDIMENT LOAD

5.1 Abrasion* — Mutual rubbing of particles of sediment in flowing water as well as in the bed of a channel as a result of which these particles tend to decrease in size.

5.2 Accretion* — Any process of accumulation by flowing water of silt, sand, pebbles, etc. The difference between accretion and alluviation is that the latter is due to retardation of flow wherever the former may be due to any cause and, in fact, includes alluviation.

5.3 Alluvial Cone — A fan shaped deposit of water deposited material at a place where a mountain stream debouches into a plain. An alluvial cone is made up of finer materials than in a debris cone which is a mixture of all sizes and kinds.

5.4 Alluvial Deposit* — Alluvial material or transported sediment deposited in places by the action of running or receding water.

5.5 Alluvial Fan — Outspread sloping deposit of deteritus brought by action of water from neighbouring elevations to a plain or open valley, bottom, roughly forming segment of a low cone with apex at point of debouchment.

5.6 Alluvial Slope Spring — A spring which occurs on lower slope of an alluvial cone at point where slope of water table and surface gradient are equal, this point is often located at the point of gradation from pervious sand with a flat water table slope to less pervious alluvial material which requires a steep slope to carry water supplied from above. Also called boundary spring or border spring.

5.7 Alluviation* — The process of accumulating alluvial deposits of gravel, sand, silt or clay at places in rivers, lakes or estauries, where flow is retarded.

5.8 Alluvium — The sediment deposited by a river, when it spills and spreads over a wide area.

5.9 Antidune* — Sinusoidal-shaped bed features in phase with surface waves. These ridges usually move upstream. An antidune is indicated on the water surface by a regular, undulating wave, in appearance like that formed behind a stern wheel steam boat. The surface waves become gradually steeper on these upstream sides until they break like surf and disappear. These waves are usually in series and often reform after disappearing.

5.10 Avalanche — Moving masses of snow and sometime mountain debris, originally named from their spectacular descent into the valley. Their forms are loose snow avalanches, wind slab avalanches and wet snow avalanches.

5.11 Avulsion — Separation of portion of land by the action of river when it breaks across the narrow neck of a horseshoe or oxbow, bend, due to an entire change in the course of a river, when it breakes through one of its banks.

5.12 Bar* — An alluvial deposit or bank of sand, gravel or other material at the mouth of a stream or at any point in the stream itself which causes an obstruction to flow or to navigation.

5.13 Bed Building Stage — Stage of stream at which sediment discharge is maximum for a normal year, indicated by maximum value of product of sediment discharge rate and total length of time during which that stage occurs within the year, generally in neighbourhood of mean water stage of water level.

5.14 Bed Dunes — A succession of mounds of incoherent sediment formed on the bed of a channel.

5.15 Bed Load — The sediment is in almost continuous contact with the bed, carried forward by rolling, sliding or hopping along the bed of the stream. Bed load is also divided into contact load and saltation load.

5.15.1 *Contact Load** — The sediment that is rolling or sliding along the bed of the stream in substantially continuous contact with the bed.

5.15.2 *Saltation Load** — The sediment bouncing and hopping along the bed of the stream or moved directly or indirectly by the impact of the bouncing particles.

5.16 Bed Load Function — Relationship between discharge and bed load rate in given cross-section, may be determined either by direct measurement of stream at that cross-section or by analysis of stream's transporting capacity in the alluvial reach.

5.17 Bed Load Rate — Rate of bed load movement, expressed in weight of volume of bed load transported over entire width of river bed and per unit time.

5.18 Bed Load Sampler — A device for measuring sediment load, moving on or along the bottom of the river bed.

5.19 Bed Material — Sediment mixture of which bed is composed; may be result of either suspended load or bed load movement or both, or may even be residual.

5.20 Bed Material Load — The part of the total sediment transport which consists of the bed material and where rate of movement is governed by the transporting capacity of the channel.

5.21 Bed Ripples* — Undulating ridges and furrows or crests and troughs in irregular formation formed by the action of flow on the bed of a channel.

5.22 Bed Waves* — Wave of sediment formed by the action of flow on the bed of a channel. They are distinguishable from large ripples from the pattern they form on the bed.

5.23 Cat's Paw — Light breeze affecting small area such as would cause patched of ripples on surface of a stream.

5.24 Caving — Wearing down of the bank of a river by the action of flowing water, which hollows out the slopes of the bank and ultimately leads to collapse of the inward leaning bank or shelf, also applied to falling in the concave side of the bank resulting in change of curvature.

5.25 Channel Roughness — Roughness of channels including extra roughness due to local expansion or contraction and obstacles, as well as roughness of stream bed, that is, friction offered to the flow by surface of bed of channel in contact with the water, expressed by the roughness coefficient of the velocity formulae.

5.26 Clay — An aggregate of microscopic and sub-microscopic particles derived from the chemical decomposition and disintegration of rock constitutes. It is plastic within a moderate to wide range of water content.

5.27 Contact Load — Material rolling or sliding along a bed in substantially continuous contact with it.

5.28 Corrosion — Vertical or lateral cut made by river or stream by virtue of abrasive power of its transported load.

5.29 Debris — Material including floating trash, suspended sediment or bed load, moved by a flowing stream.

5.30 Debris Cone — Deposit of soil, sand, gravel and boulders built up at point where mountain stream descends into a valley, or where its velocity is otherwise reduced sufficiently to cause such deposition.

5.31 Delta — Alluvial partly above water level tract formed by deposit in sea, lake or reservoir of sediment carried down the river.

5.32 Denudation — Erosion by rain, frost, wind, running water and other agencies of solid matter of the earth so that strata formerly covered are exposed and elevations are worn down.

5.33 Detritus* — Alluvial material formed by attrition and transported by rivers and canals. This term is equivalent to sediment, but some draw distinction between these two terms by defining detritus as all material carried by the stream whether large or small everything that was brought down or transported by water and sediment as the stuff that settles down.

5.34 Dune* — A sand wave of approximately triangular cross-section (in a vertical plane in the direction of flow) with gentle upstream slope and steep downstream slope, which travels downstream by the movement of sediment up the upstream slope, and deposition of it on the downstream slope.

5.35 Fine Silt — Part of load of solids carried by stream or river which comprises relatively fine material transported in suspension in the flow of the stream without contact with the bed.

5.36 Fineness Coefficient — Ratio of suspended solids to turbidity; a measure of size of particles causing turbidity, the particle size increasing with coefficient of fineness.

5.37 Fines — Finer grained particles of a mass of soils, sand or gravel. In hydraulics, material that slowly settles to the bottom of a mass of water.

5.38 Grading — Degree of mixing of size classes or separation into size class of sedimentary material, well graded, implies a more or less uniform distribution from coarse to fine poorly graded, implies non-uniformity or lack of continuous distribution.

5.39 Gravel — Rock fragments usually rounded by water action and abrasion, with lower size limit of two millimetres.

5.40 Gully Erosion — Development of relatively deep, steep-sided channels by action of running water.

5.41 Incoherent Alluvium* — Loose alluvial material which can be scoured as readily as it can be deposited.

5.42 Limiting Discharge* — Minimum discharge in a particular reach of a river at which bed movement begins.

5.43 Natural Load — Amount of sediment carried by a stable stream.

5.44 Regime Silt Charge* — Minimum transported load consistent with a fully active bed.

5.45 Relief Length Ratio — The ratio of relief of watershed between the minimum and maximum elevations and the intercepting length of the watershed.

5.46 Roundness of Particles — Ratio of average radius of curvature of edges of a particle to radius of a circle inscribed in the maximum project area of the particle.

5.47 Saltation Load — *See* 5.15.2.

5.48 Sand Wave — Ridge on bed of a stream formed by movement of bed material, usually approximately normal to direction of flow and with a shape somewhat resembling a water wave.

5.49 Sediment — Fragmental material transported by, suspended in or deposited by a flowing channel without any regard to size. Sediments in rivers and canals may be classified in accordance with IS : 1498-1970*.

5.50 Sedimentation — A term applied to fundamental process responsible for the formation of sediment such as weathering, detachment, transportation and deposition.

5.51 Sediment Concentration — Ratio of weight or volume of dry sediment in water to total weight or volume of the mixture, ordinarily expressed in percentage for high values of concentration and parts per million (ppm) for low values.

5.52 Sediment Delivery Ratio — The ratio between the amount of sediment yield at the recognized site and gross amount of erosion in the respective watershelf.

5.53 Sediment Charge — The ratio of the mean sediment discharge to the water discharge. It is ordinarily expressed in parts by weight sediment per unit volume of water discharged.

5.54 Sediment Discharge — The sediment volume transported in unit time at a given stage through a given section.

5.55 Sediment Hydrograph — Diagram showing variation in sediment concentration or sediment discharge with respect to time. It is also termed as sediment yield of watershed.

5.56 Sediment Run-Off — Weight or volume of sediment transported past a given location in a specific time, for example, a year, month, week or day and therefore called annual run-off, monthly run-off, etc. Also called sediment yield.

5.57 Sediment Water — Water and sediment mixture existing in or obtained from a stream or other body of water.

5.58 Silt — A fine grained soil with little or no plasticity (*see* IS : 1498-1970*).

5.59 Silt Charge — Ratio of weight or volume of silt to weight or volume of water passing a given cross-section per unit of time.

5.60 Silt Factor — Coefficient used to denote size of silt in a flow charged with suspended or bed silt.

*Classification and identification of soils for general engineering purposes (*first revision*).

5.61 Silt Grade — Average diameter of silt particles.

5.62 Silting — Accretion by deposition of silt.

5.63 Sorting — Progressive reduction in grade of load of sediment carried by a river.

5.64 Spit — Long narrow shoal extended from the shore into the sea.

5.65 Suspended Load — That part of the sediment load of a stream, which remains in suspension in the flowing water for considerable periods of time without contact with the stream bed, being kept up by the upward component of the turbulence or by colloidal suspension.

5.66 Thalweg — Line following deepest part of bed or channel of a river.

5.67 Total Load — It is the sum of bed load and suspended load.

5.68 Tractive Force — Force of running water exerted on river bed and in a direction tangential to it.

5.69 Transport Concentration — Rate of sediment passing through a certain cross-sectional area perpendicular to the flow, compared with rate of suspension of water and sediment passing through the same area.

5.70 Transport Competency — Ability of stream to transport suspended load in terms of dimensions of particles transported.

5.71 Trap Efficiency — The ratio of the deposited sediment to the total sediment inflow to the reservoir under given conditions.

5.72 Turbidity — Approximate amount of suspended load, measured optically on basis of similarity of interference to passage of light rays through a water sample, when compared with standard samples of recorded turbidity.

5.73 Warp* — Sediment deposited by water, as when alluvial soils are formed, also, a bed or layer of such sediment.

5.74 Wash Load* — Suspended material of very small size (generally clays and colloids) originating primarily from erosion on the land slopes of the drainage area and present to a negligible degree in the bed itself.

6. TERMS RELATING TO RIVER TRAINING

6.1 Apron

6.1.1 *Loose Apron* — A covering of loose stones or blocks laid on the bed of the river to protect it from erosion.

6.1.2 *Rigid Apron* — A floor or lining of concrete, masonry, etc, to protect the surface of a structure from erosion or to withstand hydrostatic pressure, for example, the pavement below weirs and falls, face or nose of spur or groyne, etc.

6.2 Attracting Groynes — *See* **6.17.1.**

6.3 Bank Protection* — A kind of engineering work which aims at the protection of banks of a river or slopes of embankments along it from erosion by the current of flow.

6.4 Bank Revetment* — A type of bank protection which covers continuously the entire slope of a bank or an embankment, including the portions extending far into the river bed, to protect the bank from erosion.

6.5 Bank Sluice* — An opening controlled by shutters or gates in the marginal embankment, for draining out accumulation of water from the interland.

6.6 Barrage — Structure with gates erected across a river to regulate the upstream water surface and the flow across the structure.

6.7 Blanketing — Covering a layer of one grade of material by a layer of another grade of material.

6.8 Bed Groyne — *See* **6.17.2.**

6.9 Blow-outs or Sand Boils or Boils* — Bubbling springs carrying with them a volume of sand. A warning signal to likely leaks and breaches in an embankment.

6.10 Bypass Channel — Constructed to carry flood water in excess of safe capacity of a stream even when stream capacity has been increased by construction of, levees. Such a channel is usually constructed with levees on both banks, parallel and adjacent to the stream, and sufficiently long to carry the flood water along the restricted section of the stream. It is used infrequently.

6.11 By-Wash — Surplus escape for a tank or small reservoir which is constructed flush with ground level for sufficient width, the ground falls away, forming a suitable surplus escape channel. It is termed as natural escape when the ground is not paved, and a paved or masonry escape when protective works such as dry stone pitching or masonry are required.

6.12 Closing Dike* — A structure built across the branch channel of a river in order to stop or reduce flow entering that channel or to separate a dead branch from the main channel.

6.13 Crib or Crib Dam — A timber barrier built in compartments which are filled with stone or other suitable material.

6.14 Denehey Groyne — *See* **6.17.3.**

6.15 Dykes or Levees* — An artificial bank built along a river for the purpose of protecting adjacent land from inundation by flood. Also called 'Embankment', 'Stop Bank' or 'Bund'.

6.16 Fending Groyne or Bankhead — *See* **6.17.1.**

6.17 Groyne — A wall, crib, row of piles, stone jetty or other barrier projecting outward from the bank into a stream, for the purpose of protecting the bank from erosion or for arresting sand movement along the bank, concentrating the flow of a stream into a smaller channel, etc. It is also called 'Spur', 'Spur Dike', 'Transverse Dike', 'Wing Dam' or 'Jetties'. The different types of groynes are given in **6.17.1** to **6.17.13.**

6.17.1 *Attracting Groyne* — The groyne (spur) pointing or facing downstream to maintain the deep current close to the bank (*see* Fig. 3), also called 'Fending Groyne' or 'Bankhead' (*see also* Fig. 8), contrast 'Repelling Groyne'.

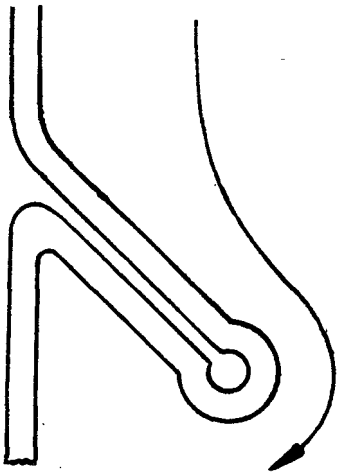


FIG. 3 A TYPICAL ATTRACTING GROYNE

6.17.2 *Bed Groyne* —A groyne built slowly up from the bed, with the effect of progressive and even reclamation over a large area. It is also called 'Sedimentary Groyne'.

6.17.3 *Denehey Groyne* — A groyne provided with a cross groyne at the head giving the entire groyne a T-shape, which protects the main groyne on the same principle as the main groyne protects the bank. It is also called 'T-spur'.

6.17.4 *Fending Groyne* — *See* **6.17.1.**

6.17.5 *Hockey Spur* — A spur shaped at its lower end like a hockey stick.

6.17.6 *Hooked Groyne* — An additional groyne built between the existing groynes when it is found that thay are spaced too far apart (*see* Fig. 4).

6.17.10 *Repelling Groyne* — The groyne (spur) pointing or facing upstream to divert the deep current away from the bank (*see* Fig. 5).

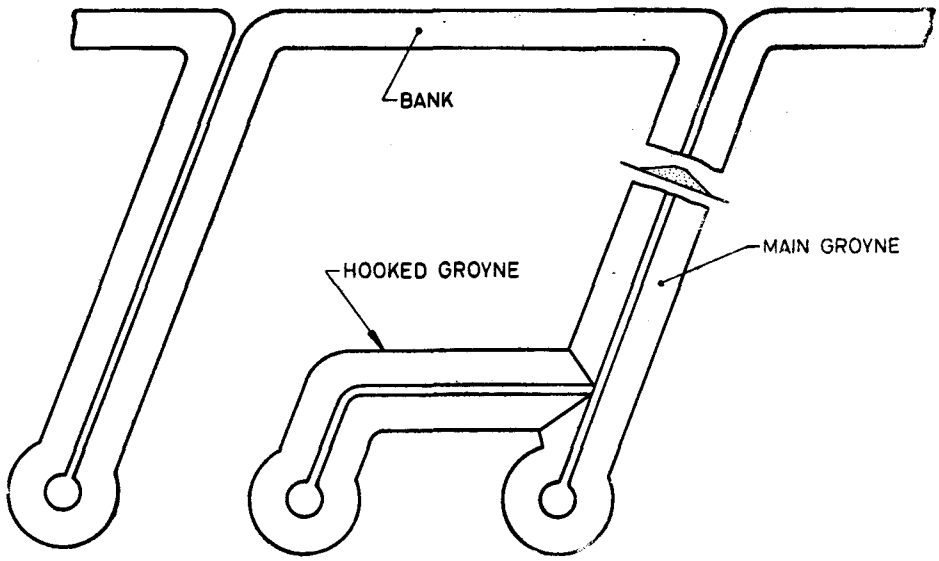


FIG. 4 A TYPICAL HOOKED GROYNE

6.17.7 *Impermeable Groyne* — It consists of rock fill or earth core armoured with resistant material like stone, fascine matter or sausages filled with stone. They are designed to attract, repel or deflect the flow away from the bank along a desired course, also called spur.

6.17.8 *Kinked Groyne* — A groyne provided with a kinked arm, projecting into the river and pointing upstream.

6.17.9 *Pile Groyne* — *See* **6.30.**

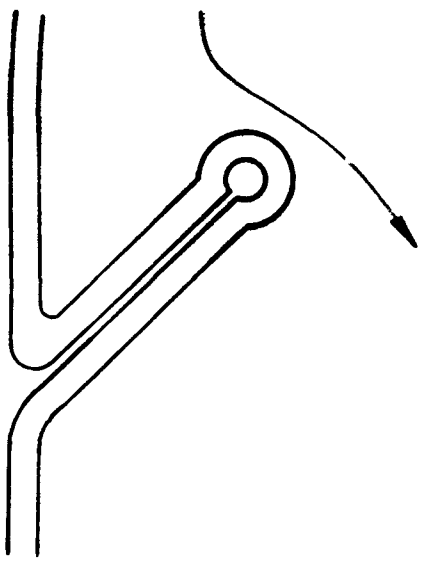


FIG. 5 A TYPICAL REPELLING GROYNE

6.17.11 *Sedimentary Groyne* — *See* **6.17.2.**

6.17.12 *Tree Groyne* — A permeable type of barrier of trees built across a river for diverting the main river into a bypass river or *vice versa* (*see* Fig. 6).

6.17.13 *T-Spur* — *See* **6.17.3.**

6.18 Guide Banks or Bell's Bund* — A protective or training embankment constructed at the site of a weir, bridge, etc, to guide the river through the waterway provided in the structure (*see* Fig. 7 and 8).

6.19 Hockey Spur — *See* **6.17.5.**

6.20 Hooked Groyne — *See* **6.17.6.**

6.21 Impermeable Groyne — *See* **6.17.7.**

6.22 Inverted Filter — A layer or layers of pervious or semi-pervious material to provide drainage and to prevent movement of soil particles with the flowing water.

6.23 Inverted Filter Revetment — An type of bank revetment consisting of layers of filtering medium of which the particles gradually increase in size from bottom upwards. Such a filter allows the ground water to flow freely but it prevents soil particles from being washed out.

6.24 Marginal Bund — An embankment built along a river bank upstream of weir or barrage on one or both banks connected to high bank as a line of defence against spilling of the river on flood plain during floods and confining the flows within

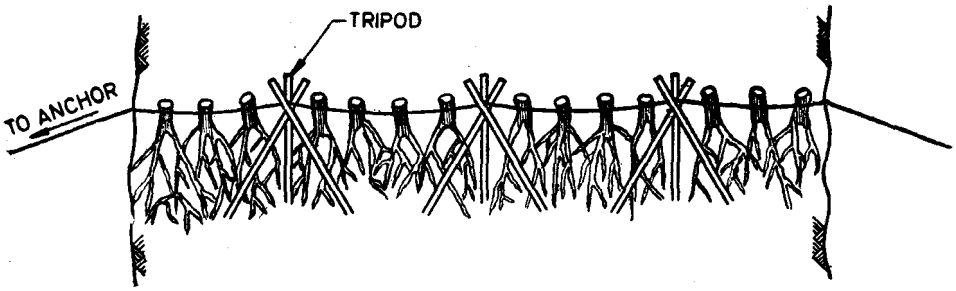
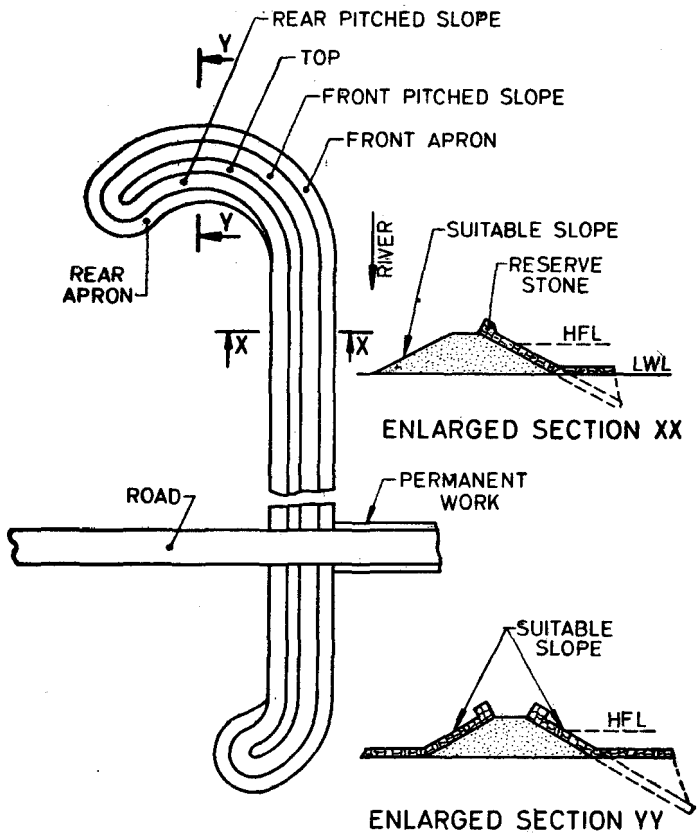


FIG. 6 A TYPICAL TREE GROYNE



L = length of work
HFL = high flood level
LWL = low walk level

FIG. 7 A TYPICAL GUIDE BANK

the river section leading to the weir or barrage (*see* Fig. 8).

6.25 Mattress* — A blanket of brush or poles interwoven or otherwise lashed together and placed to cover an area subject to scour, weighted with rock, concrete blocks, layers of stones as well as blanket of bush or poles, etc, or otherwise held in place. Also section of a bank revetment below normal low water.

6.26 Natural Levee — Low alluvial ridge adjoining channel of stream, composed of sediment deposited by flood waters which overflowed the bank of the channels.

6.27 Permeable Spur — A spur constructed from the bank essentially of rows or balli piles braced and laced together, and loaded with altering permeable layers of fine brush and boulders restrict the velocity of silt laden waters flowing along the bank and thereby induce silting above the spur.

6.28 Pile Groyne — *See* **6.30**.

6.29 Pitched Islands — Artificially created islands

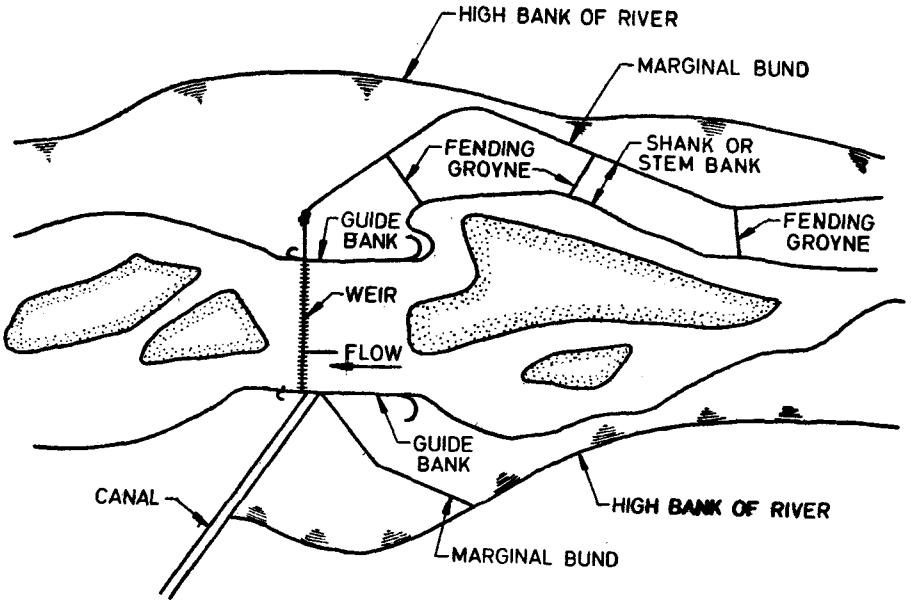


FIG. 8 BANKS AND EMBANKMENTS

used as river training measure in the river bed, duly protected by revetment or stone pitching on all sides, to direct and maintain the approach to some engineering work in the desired direction.

6.30 Pile Dike* — A type of permeable structure for the protection of banks against caving and consists of cluster or piles driven into one river and braced and lashed together. Also called 'Pile Groyne'.

6.31 Retired Embankment* — An embankment built at a safe distance from the river edge behind the existing embankment as a second line of defence.

6.32 Repelling Groynes* — *See* **6.17.10.**

6.33 River Training — Engineering works (including artificial plantations) with or without the construction of embankments built along a river or a section thereof, in order to direct or to lead the flow into a prescribed channel.

6.34 Sedimentary Groyne — *See* **6.17.2.**

6.35 Toe Protection — Protection in the form of launching apron, principally to protect the toe of the revetment or groyne (spur) by loose stone launching itself in case of scour developing at the toe. Also termed loose stone apron.

6.36 Shank* — An embankment connecting a groyne head to the river bank or marginal bund. Also called 'Stem Bank' (*see* Fig. 8).

6.37 Spur — *See* **6.17.**

6.38 Spur Dike — *See* **6.17.**

6.39 Tarungars* — Wire crates containing loose bricks or stones placed downstream of a structure to protect it from scour or erosion.

6.40 Training Wall* — A structure built along or connected to the bank of a river substantially parallel to the direction of flow, for example, an extension to a flank wall, intended to direct fast flow from a sluice or spillway away from erodible banks of a river or canal.

6.41 Transverse Dike — *See* **6.17.**

6.42 Tree Groyne — *See* **6.17.12.**

6.43 Tree Retard or Current Retards* — A type of permeable structure for the protection of banks that are subject to caving. It consists of trees bound together into a raft. These rafts are sunk one above the other to a desired height and form permeable dikes extending out into the channel and retard the flow of water through them and material is deposited that gradually builds up a bar along the bank.

6.44 T-Spur — *See* **6.17.3.**

6.45 Wing Dam — *See* **6.17.**

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