GEOMORPHOLOGY.

3B – IM sir.
24-02-2015.

(1) Introduction

⇒ Defination:

Geomorphology is the science of landforms. It comes from the combination of three words as introduced greek words. Where "Geo" means earth, "morphe" means forms, and "logoes" means discourse or study or science. so it is the study of landforms.

Etymologically,

Geomorphology
- "Geo" means earth.
- "morphe" means forms.
- "logoes" means logic with study or science.

Basically, geomorphology deals with the formation and history of landforms, rivers, mountains, glaciers etc.

The knowledge of it, is being used more and more for avoiding environmental degradation, for mitigating natural disasters as floods.

for the drainage system, or planning of it, the knowledge of geomorphology is so important. The features of it are so broaded and which having included the geography, geology, Engineering and planning.

=> Process of types and tools;

There are many types of geomorphology. Some of important types are as given below,

1. Process geomorphology.

Running water or wind are studied in detail at inwhich part of geomorphology is called process geomorphology.

2. Fluvial geomorphology.

Running water are studied in this type of geomorphology.

3. Glacial geomorphology.

Running glacier are studied here.

4. Aeolian geomorphology.

Running wind are studied here.

5. Coastal geomorphology.

When coastal water are associated in geomorphology.

6. Tectonic geomorphology.

When the study about the effect of tectonic movements on landforms.

7. Structural geomorphology.

When study about the effect of geological structure on landforms is termed as structural geomorphology.

8. Climatic geomorphology.

The study of the dominant influence of climate on landforms.

9. Applied geomorphology.

When the knowledge of geomorphology is used to flood prevention, environmental impact mitigation is called applied geomorphology.

10. Regional geomorphology.

An account of the landforms and process found over a large area is regional geomorphology.

11. Theoritical geomorphology.

Geomorphologistc who try to build theories that explain how the processes work and how landforms are formed, carry out theoritical geomorphology.

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River morphology:

River is defined as a stream of water-bearing waste of land from higher to lower ground and as a rule to the sea; or as the trunk stream and all its branches in a river system.

The quantity of water in a river always flow from higher landforms to the lower landforms. where the quantity of water in a river varies almost from moment to moment. The flow of water depends on the duration, the amount of precipitation and the local hydrological conditions.

→ The rivers which carry water, only during and immediately after rain are known as ephemeral.

→ The rivers which flow during a part of the year (during wet season of the humid tropics) are called intermittent or non-perennial.

→ But when flow of water in the rivers all the year round are called perennial.

→ When flow only endure for an hour or two streams with interior flow and mix with the water surface within the country are known as endoreic.
And the stream with exterior flow, mix to the sea are called exoreic.

(1) Importance of river morphology:

The following points show the morphology of river how important and also after reading it, we can understand about it's all functions.

i) Drainage basin is considered as a fundemental geomorphic unit, where the landscapes of the earth surface are sculptured by action of river.

ii) In the arid region, after torrential rain some rivulets are developed which also indirectly influence and which controls by river after removing the materials.

iii) Glacial origni materials are transported and deposited down valley by the river as fluvioglacial deposits.

iv) In coastal zone, river can operate in conjunction with marine process and develop different features.

v) It is a modifier of landform.

vi) River's process is most important than other process of geomorphology.

vii) four side uses are, all most human use the river for many significant condition.

viii) Fore irrigation, navigation, fishing, power generation, floatation of timber, recreation etc.

ix) Mainly, the early civilizations were settled along the sides of river for above.

x) River is important for geographical study.

xi) There the most use of river.
1. Development of land form.
2. Related to geomorphological process.
3. Great useful to human being.

So, the importance of river morphology is so much and which is undoubtedly greatful.

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11-08-2015.

Drainage system and patterns.

⇒ Drainage system's basin:

The fundemental unit of study for fluvial-process, which is a portion of the earth's-surface that contains a main stream and tributaries and is denoted or bounded by a drainage divide. The entire area that collects the rainwater and contributes-it to a particular channel is called the drainage basin or catchment area or the watershed or basin area.

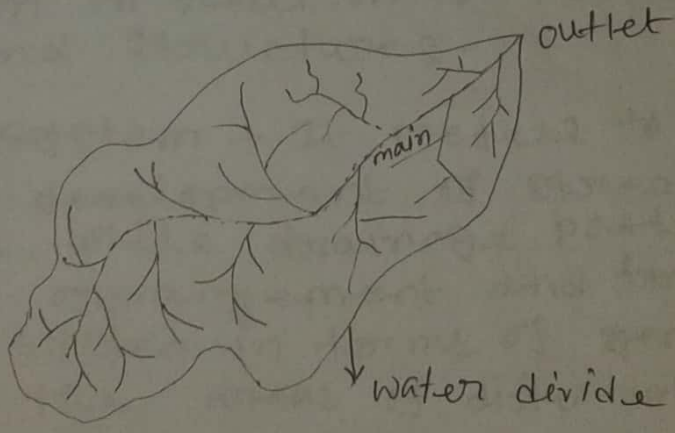

fig. of Drainage basin.

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⇒ Drainage systems and patterns:

The study of the characteristics of drainage network of a particular region is approached in two ways.

1. Descriptive approach – involves the study of the characteristics of the forms and patterns of the streams of a given region.

2. Genetic approach – involves the investigation of the evolution of streams of a region in relation to tectonics, lithologies and structures.

Drainage system – It refers to the origin and development of streams through time, while drainage pattern means spatial arrangement and form of drainage system in terms of geometrical shapes in the areas of different rock, geological structure. etc.

⇒ The origin and subsequent evolution of any drainage system of a region are determined and controlled by two main factors,

① Nature of initial surface and slop.

② Geological structures (folds, faults, joints (fractures), dips etc).

→ Subsequent streams – which follow the regional slope and are well adjusted to geological structures) as consequent streams, subsequent streams, obsequent streams and resequent streams.

→ Insequent streams – which donot follow the regional slope and are not adjusted to geological structures as antecedent streams and superimposed streams.

Drainage system & patterns.

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05-04-2015.

Drainage patterns:

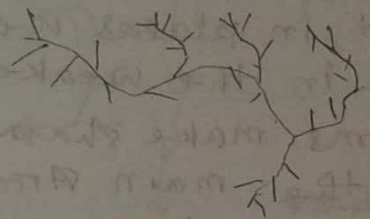
The drainage patterns means the form of the drainage system in and the arrangment of streams in particular locality or region. where, location, number, charactercistics of streams in drain are shown.

There are many types of drainage patterns,

1. Dendritic pattern 2012,09.08

It is the most common form and looks like the branching pattern of tree roots. It is commonly encountered in areas of uniform.

Here charactcristic of it, is the presence of tributary streams branching in all directions. Where in tributaries join the main stream at all angles junction angles considerably less than 90° are prevalent.

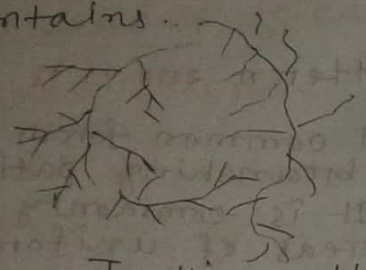


Dendritic pattern.

2: Trellis pattern

It looks like to their name sake the common trellis. It is characterised by elongated tributaries flowing parallel or sub-parallel to the main stream. Main primary and secondary tributaries join the main stream at right angle. It is a characteristics of folded mountains.

Ex: Mizoram, Assam, Rajasthan in India.



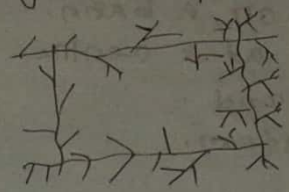
Trellis pattern

3. Rectangular pattern

It is found in regions that have undergone faulting. Streams flow the path of least resistance are concentrated in places where exposed rock in the weakest. tributary streams make sharp bends and enter the main stream at right angle. It displays orthogonal bends in both the tributary as well as the parent streams.

Ex: Downstream of victoria falls (Zambia)

Angulate pattern is a modification of it.



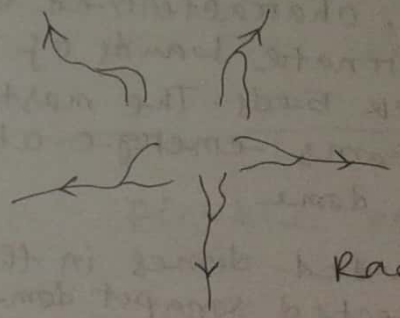
Rectangular pattern.

2012.10.09.08

4. Radial drainage pattern

It is centrifugal pattern develops around a central elevated point. Streams are diverged from centre point, in all directions. Dome structures, volcanic cones, mesas and buttes help to develop these pattern. Streams since follow the slopes and hence they are consequent streams.

Ex; Drainage network of srilanka.

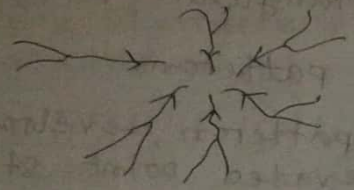


Radial drainage pattern.

5. Centripetal drainage pattern.

It is the opposite of the radial drainage pattern. Where the streams are converged at a point which is a depression or a basin. The streams are gone at a centre point from the high land.

Ex: Nepal's drainage system.

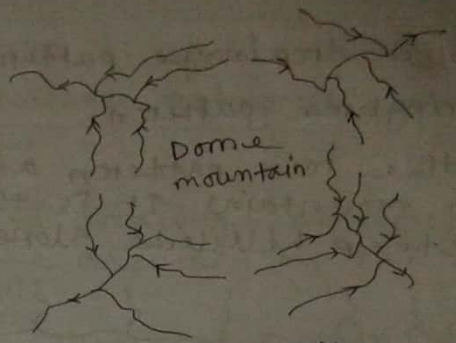


Centripetal pattern.

6. Annular drainage pattern

It is circular pattern, when the tributaries of the master consequent streams are developed in the form of a circle. It is developed over a mature and dissected dome mountain, characterized by a series of alternate bands of hard and soft rock beds. The master consequent streams emerge at the top of the dome.

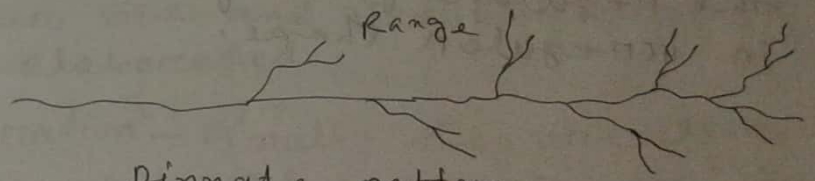
Ex: England denuded domes in the weald, dissected Sonapet dome in Bihar.



Annular pattern.

7. Pinnate drainage pattern.

It is developed in a narrow valley flanked by steep ranges. The tributaries originating from the steep sides of parallel ridges join the longitudinal master consequent occupying the valley at acute angle. It is the upper Son and Narmada rivers denotes as example of pinnate pattern. This pattern resembles the veins of a leaf.

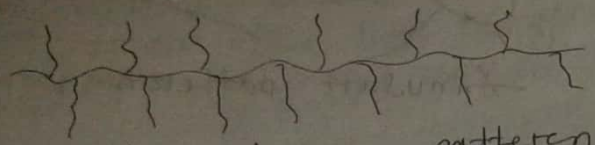


Pinnate pattern.

8. Barbed drainage pattern.

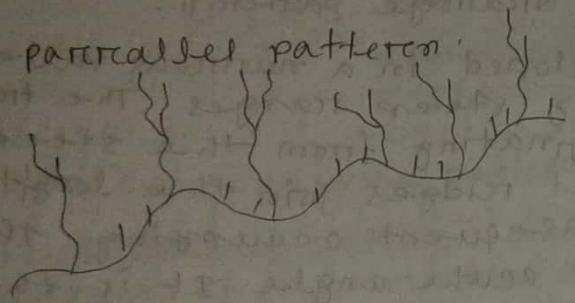
9. Herringbone pattern.

It is the rib pattern and develop-ed in mountains. It is the ridges having steep hillslide slopes.



Herringbone pattern.

10. Parrallel pattern.



11. Irregular pattern.

The streams are not having the regularity, they are in irregular shape.

*Exam 2012.11.09

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05-04-2015.

Phases of drainage network development:

The phases of drainage network develop-ment can be occured by the following ways, where,

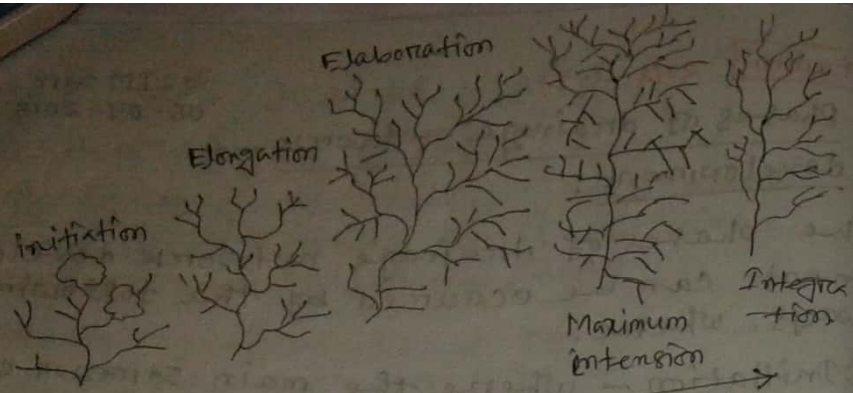
(i) Initiation – Where the main stream or tributary are initiate as main function.

(ii) Elongation – Then next the other lines of streams from main or tributary and which are elongated and increases their number of lines of streams.

(iii) Elaboration – By this process the elongated functions of the tributary can be elaborated in all sides which are the big in size.

(iv) Maximum Extension – At this stage the elaborated lines of streams can get maximum size and also which are at most elaborated.

(v) Integration – Finally they are all in-maximum extensional functions are inte-grated and they are added with one another with facility.



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Importance of streams for several reason:

For the following reasons are having usefulness streams are so important,

(i) It carry most water so which is very important for water cycle.

(ii) In construction of sediment it is very important which increases the fertility of land.

(iii) It carry dissolved ions, products of chemical weathering into the oceans and make sea salt.

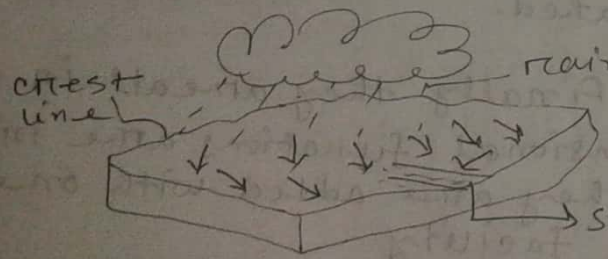
(iv) It is one source of errosional process which control the landscape.

(v) It is the source of water and also having good kind of transportation and which is cheap in the world's human.

River: It is the part of water flowing over land, constrained in a channel. Big streams are river.

Streams: The small source of water as acting river when added with many small other is called streams.

River and streams are created for the rainfall.



⇒ Types of rivers:

1. Upper reaches of rivers:- The river is created from the very high place as hilly areas or upper place from the flat land.

(i) Hilly reach incised rivers – which are in hilly areas and in creating in hill towards the flat land.

(ii) Foothill submontance reach
It is characterised by steepness of their slopes and their bed consists of boulders, gravel, shingle, sand etc.

(iii) Rivers in flood plains:
which can carry water freely from high to below land by the successive bends.

2(i) Aggrading type - where the depth of sediment is high or in more amount.

(ii) Degrading type - Here erosion by water of sediment is high so, the depth of sediment is very less.

(iii) Stable type - The depth of sediment in river is stable type or at a fixed type.

3. Lower reach river;
The river, in which periodic changes in water level occur due to tides is called tidal river.
In this last journey to the sea before becoming tidal a river may split into branches from a delta. This last portion is called a delta rivers.

→ Others type:

(i) Flashy rivers:- River can also be classified according to the stage and nature of flood hydrographs. The river is called flashy if the rise and fall of its floods are sudden. Tamil Nadu.

(ii) virgin river:- In arid zones, a river may completely dry up before joining another river or the sea. rivers of this type is called a virgin river. virgin rivers in states of Gujrat.

(iii) Himalayan river:- The river is created from himalay hill.

(iv) Non-himalayan river:- The river not created from himalay hill or created from other upper reaches place.

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12-04-2015

2012,11,09

Rivers capture or stream piracy:

The diversion of the part of a course of a river by another river is called the stream diversion or stream capture or stream piracy.

The river which captures the course of another river is called the capturing of captor stream.
While the part of the stream which has been divested of it's course and water is called captured stream.

The river capture may be done by the river to another river as in – headward erosion, or by lateral erosion, or capture through the intersection of meanders.

⇒ process:

The following three stages are helped to know the process for river capture and which are as given below,

1. At first stage in fig we see the sarcswall river and the captore river are shown.

2. At second stage the captore river gives such heavy pressure to the sarcswall rivere.

3. At last or 3rd stage there will make newly born river by captor river and dry valley captured sarcs-wall are shown in fig.

By this above the river captu-re has been possible.

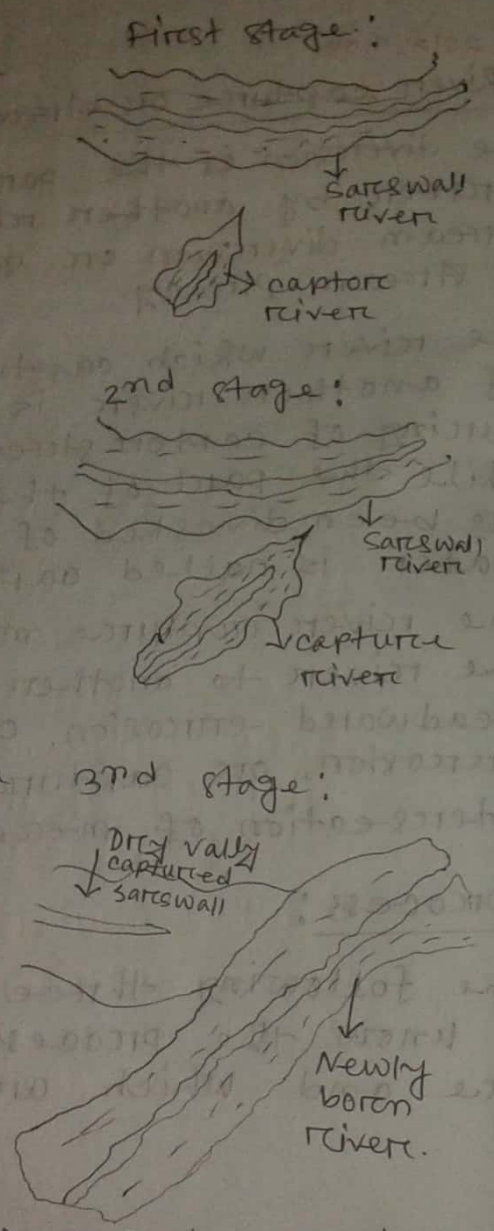

Fig:1 of river capture

for wind gap or misfit or under fit stream the river capture is possible wind gap — The dry portion of the be-headed stream just below the elbow of capture. windgap is also called as col. The misfit or under fit stre-am is the lower course of the cap-tured stream.

For the followings,
① elbow of capture. ② col or wind gaps ③ water gaps ④ Misfit or underfit strea-ms and valleys.

2013, 12, 11, 09, 08,

Ideal conditions for river capture:

Though river capture is any type of natural process, sometimes for ideal condition or favourable conditions the river capture can be occured, the foll-owing conditions are as ideal for the river capture,

i) steep channel gradient.
ii) Relatively narrow valley, so that water may not spread in the other-wise wide and flat valleys.
iii) High volume of water for high velocity for the high discharge.

iv) Soft rocks for the headward erosion.
v) Deeper valley than the valleys of other neighbouring rivers.
vi) Low sediment load, for the active erosion occuring.

So, the above conditions are desired to captor river to river capture.

Types of river capture:

There are three types of river capture. which are as following

1. capture through headward-erosion — when the captor river give pressure infront of it to the sarcswall river.
2. capture through lateral-erosion — when the capture river give pressure by it's side to the sarcswall river.
3. capture through the intersection of meanders — when the captor river and the sarcswall river are intersected with each other and by their intersection this kind of river capture can be happened.

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13-04-2015.

2) The Morphometric Analysis of Drainage basin.

⇒ **Morphometry:**

The measurement of forms of drainage basin as the morphometric analysis of drainage basin.

⇒ **Basin Morphometry:**

The basin morphometry includes the analysis of characteristics of linear, areal and relief aspects of fluvially originated drainage basins.

⇒ **Linear aspects of basin:**

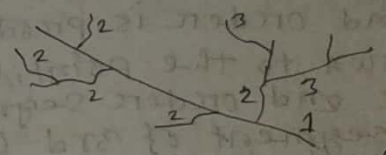
Linear aspects of the basins are related to the channel patterns of the drainage network wherein the topological characteristics of the stream segments in terms of open links of the network system (streams) are analysed.
segments of streams of a particular river, is reduced to the level of graphs where stream junctions act as points and with other points and junction,

⇒ **Stream ordering:**

It is referred to the determination of the hierarchical position of a stream within a drainage basin. Stream order is defined as a measure of the position of a stream in the hierarchy of tributaries.

1⇒ **Gravelius scheme of stream ordering:**

The greatest width, discharge, headwater and branching and junction angles and thus the trunk stream applied to assign the position of 1st order and by same apply the 2nd, 3rd are of order of stream are considered.



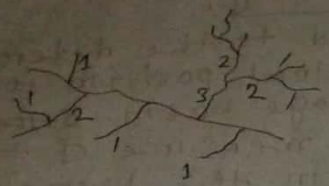
Gravelius order.

*2006.04.

⇒ **Horton's scheme of stream ordering:**

According to Horton ordering of stream. begins from the finger-tip tributaries which do not haven own feeders, rather they are independent in terms of supply of waters and 1st order and 1st order adding 2nd order is formed but 2nd order and 3rd order can't be added, they are not entertened also.

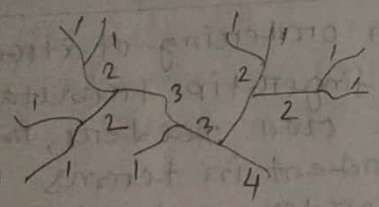
By same way the all order can be formed.



Horton ordering.

3. ⇒ Strahler's Scheme of stream ordering:

It is modified the Horton's scheme of stream ordering by removing the problem of reclassification and renumbering of streams. According to him each finger-tip channel is designated as a segment of 1st order. At the junction of any two 1st order segments a channel of 2nd order is produced and extends down to the point, where it joins another 2nd order segment whereupon a segment of 3rd order results and so forth. It is the stream segment method.

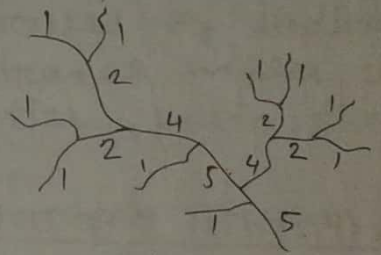


Strahler's ordering.

⇒ Shreve's stream-link ordering method:

Shreve's ordering method follows a hierarchic order, starting from the fingertip streams as of order 1, and increases into a cumulative order after its confluence with another stream. Exterior links are of 1st order and goes on increasing in a cumulative manner. If a link magnetude M_1 joins a link of magnetude M_2 then combination (*) of links M_1 and M_2 gives a downstream link magnetude of $M_1 + M_2$.

$$\therefore M_1 * M_2 = M_1 + M_2. \quad \text{——} (1)$$



Shreve's ordering.

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Bifurcation ratio:

It is related to the branching of the drainage network, is defined as the ratio of the number of streams of a given order to the number of streams of the next higher order and is denoted by Rb.

$$\therefore R_b = \frac{N_u}{N_{u+1}}$$

where,

N_u = Number of streams of given order.

N_{u+1} = Number of streams of the next higher order.

Bifurcation ratio, a dimensionless property of the drainage basin is supposed to be controlled by drainage density, stream entrance angles, lithological characteristics, basin shapes, basin areas etc.

Horton's stream law:

Horton gave some law on stream as known the Horton's stream law. As given following,

*Exam

1. Law of Stream Numbers:

"That the numbers of stream segments of successively lower orders in a given basin tend to form a geometric series beginning with the single segment of the highest order and increasing according to constant bifurcation ratio."

$\therefore N_u = R_b^{(k-u)}$ ——— ①.

where, N_u = no. of stream segments of a given order.

R_b = Bifurcation ratio constant

u = basin order.

k = highest order of the basin

*Exam

Example: Find out the total numbers of stream segments where $R_b = 4$ and highest order = 6.

$\therefore R_b = 4$. $k = 6$.

				No. of stream segment
①	$N_{u_1} = R_b^{(6-1)}$	$= (4)^5$	$= 1024$	
②	$N_{u_2} = (4)^{6-2}$	$= 4^4$	$= 256$	
③	$N_{u_3} = (4)^{6-3}$	$= 4^3$	$= 64$	
④	$N_{u_4} = (4)^{6-4}$	$= 4^2$	$= 16$	
⑤	$N_{u_5} = (4)^{6-5}$	$= 4^1$	$= 4$	
⑥	$N_{u_6} = (4)^{6-6}$	$= 4^0$	$= 1$	
		Total	$= 1361$	Ans

⇒ Length ratio; Length law:

The proportion of increase of mean length of stream segments of two successive basin orders is defined as length ratio (R_L).

$$\therefore R_L = \frac{\bar{L}_u}{\bar{L}_{u-1}}$$

⇒ Relationship betⁿ stream Lengths and basin orders:

The followings are having seen:

① Total stream length of given orders is inversely related to stream orders i.e. total stream length decreases from the lower orders to successive higher orders.

② There is positive relationship between mean stream length and basin order i.e. mean length increases with successive increasing orders.

③ Horton's law of stream length states "that the cumulative mean lengths of stream segments of successive higher orders increase in geometrical progression starting with the mean length

of the 1st order segments with constant length ratio." and the following positive exponential function model of stream length has been suggested.

$$\bar{L}_u = \bar{L}_1 R_L^{(u-1)} \quad \text{---(ii)}$$

where,
$\bar{L}_u$ = mean length of 1st order.
R_L = constant length ratio.

[B] Law of stream slop:

"The mean slops of stream segments of successively higher orders in a given basin tend to form a geometric series decreasing according a constant slope ratio."

The relationship of order and slope may be expressed as,

$$R_S = \frac{S_u}{S_{u-1}} \quad \text{---(iii)}$$

S_u = Mean slop of stream order under consideration.
R_S = worked for successively 1st and 2nd order.

But, $R_S = \frac{\Sigma R_S}{N-1}$. N = No. of stream

Ex: The river of hilly areas, great at hill and tends to the lower. As from vertical interval to horizontal equivalent when slope ratio. is known, the slope of any stream segment can be worked out. $S_u = S_1 R_S^{(u-1)}$.

* Horton's form factor:

From factor, $F = \frac{A}{L^2}$ ---(iv)

where, A = area of basin.
1 = Length of basin.

The ratio of area of basin and the square of length of basin is called the form factor.

* Area ratio:

The proportion of increase of mean basin areas betn two successive orders, as area ratio.

$$\therefore R_a = \frac{\bar{A}_u}{A_{u-1}}.$$

where, $\bar{A}_u$ = mean area of a given order of a basin.

* Stream frequency:

The measure of number of stream per unit area is known as the stream frequency or drainage fr. -quency. Like there as S.f.

① very poor (SFvp) ② poor (SFp)
③ moderate (SFm) ④ high (SFH)
⑤ very high (SFvH).

* Drainage density:

Drainage density refers to total stre lengths per unit area.

$\therefore D_d = \frac{L_k}{A_k}$

D_d = Drainage densi
L_k = Total length
A_k = Area, of basin

* Drainage Texture:

Drainage texture means the relative spacing of drainage lines.

$\therefore D_t = A_s = \frac{1}{(t/p)/2}$ where,

D_t = Drainage texture.
A_s = Average spacing betn two streams

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22-04-2015.

River valleys, Gircade curve and profile of equilibrium.

① River valley:

A river valley is an elongated depression between hill or mountain ranges occupie -d and developed by a river.
There is a definite relationship between the size of river and size of valley. where large rivers creat large valley but the small rivers creat small valley.

② River valley development:

A part of total rainfall is turned into the land and some parts are evaporated by air. The part of rainfall at rest of water flows on the surface as run off. for the inclination of the land the - waters are coming together as in the lower portion of rough as in hilly areas and rills are formed which creat the river valley. By - ① valley lengthening ② valley deepening ③ valley widening the river valley will be developed.

*2013, 12, 11, 09

⇒ Valley lengthening:

The valley is developed in length of a river as known as the valley lengthening.

By the following process valley lengthening can be happened,

(i) Head erosion – This increases inforcont of valley length where the waters of rivers are going towards inforont.

(ii) River meandering – when the stream make the zig-zag shape and it's lengthening will be done as the valley lengthening.

(iii) Mouth expansion:

A stream deposits sediment at it's mouth where it meets the sea. It makes the mouth extend towards the sea. The river Nile in Egypt has extended its mouth hundreds of km away to the sea.

*2010, 08

⇒ Valley deepening:

When the valley is developed as increasing deep of valley.

By following, the valley deepening can be done.

(i) Steep slope of river, the deepening is increased.

(ii) Hard rocks and due to dry climate deepening is slow but for soft rocks and dry

(iii) If the endogenetic forces raise the course of stream slowly, the river valley deepens.

(iv) Valley is also deepened on account of the rolling of rock fragments on its floors.

(v) Water in the river with its fast flow deepens the valley by mechanical fraction.

(vi) By solution action valley is deepened.

(vii) pot holes also deepens the valley.

(viii) weathering is also another to deepen the valley.

⇒ Valley widening:

When valley is developed in its wide as called the valley widening.

By the followings valley widening is possible.

① Slumping – water enters holes and cracks of the rocks near sides of the rivers. This water lowers parts of the rocks close by. the weight of rocks increased by the entrey of water into rocks. For this pressure is create on valley's side and widening is done.

② By the formation of gulley in rocks due to stream, the valley widening is possible.

③ Due to vegitation and animals the river valley widening is done.

④ Glaciers also widen the valley.

⑤ Meandering is also another to widen the rivers valley.

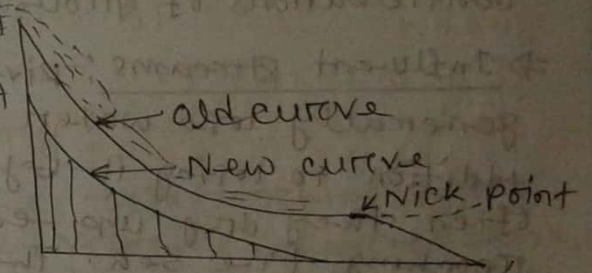
10B - IM site.
28-04-2015.

Rejuvenation: & It's Effects.

Rejuvenation is the sudden and phenomenal increase in the erosive power of the streams and consequent accelerated rate of downcutting caused by steeping of channel gradients either due to negative change in sea level or upliftment of land mass in a rivers course.

Rejuvenation is that matter where the erosive power increases due to the high change of slop of a stream.

Rejuvenation may be effected either at the mouth of the river or in the middle course or in the headwaters of the rivers.



At the fig we see the rejuvenation, of streams.

fig of Rejuvenation.

10c - 2M Sir
28-04-2015

CHANNEL MORPHOLOGY.

⇒ **Introduction:**

channel morphology or river channel morphology includes the consideration of (i) channel geometry (length, width, depth of channel)
(ii) channel fluid dynamics (discharge, velocities.
(iii) Hydraulic geometry
(iv) Channel types.
(v) channel bed topography.
(vi) Channel patterns.

⇒ **Effluent streams:**

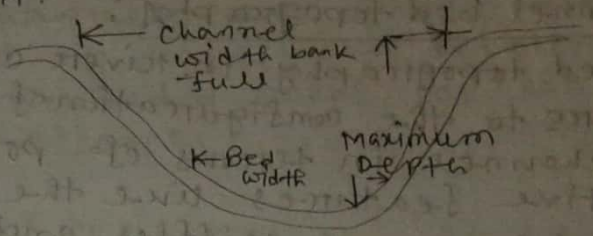
When rivers in humid regions are called effluent streams because they receive contributions of groundwater

⇒ **Influent streams:** Rivers in arid regions generally lose water to the ground in addition to losing it by evaporation and often they dry up entirely without reaching the sea. These are called the influent channel.

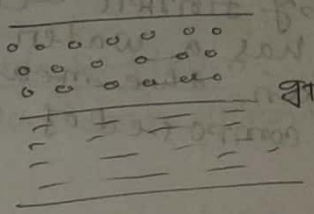
⇒ **Channel gradient:**

The gradient or slope of channel in downstream direction is called channel gradient.

fig.:



⇒ **Ground water level:** The level under which all voids of earth is filled by water then the level is called ground water level. It is level which can be upward in rainy season and downward in dry season.



ground water level.

⇒ **Hydraulic Geometry:**

The analysis of the relationships among stream discharge, velocity, channel shape, sediment load, channel width, channel depth, channel slope etc is called hydraulic geometry of a river channel.

where, Discharge, $Q = w \times d \times v$.

w = channel width, d = depth, v = velo

⇒ Channel bed topography :

The bed topography in river channel refers to the configuration of bed of the channel in terms of positive and negative features like the presence and absence of riffles and pools, pools, islands etc. where they are formed for the depositional or erosional features.

→ A pool is characterised by a water surface profile less than the mean stream gradient and by finer bed material.

→ Whereas a riffle has a water surface slope steeper than the mean stream gradient and is composed of coarser bed material.

Channel types.

① Bedrock channels :-

Bedrock channels are also called erosional channels and simply rock channels as they have been developed on well consolidated rocks, popularly called as bedrocks. - - - - - Book.

② Alluvial channel :

Alluvial channel develop in the regions of sedimentation or alluviation where thick deposists of sediments of mostly fluvial origin have taken place. - - - - - Book.

Channel pattern :-

channel pattern means the size and shape of channel.

1. Leopold and Wolman's channel pattern.

$$\text{Sinuosity index} = \frac{\text{channel thalweg length}}{\text{valley length}}.$$

① Straight channel — when sinosity index (SI) is less than 1.05.

(II) Sinuous channel — when sinuousity is between 1.05 and 1.5.

(III) Meandering channel — when sinuosity index is more than 1.5.

2. S.A. Schumm channel pattern:

(I) Suspended sediment load channels — where sinuosity is greater than 2.1.

(II) Mixed-load channels — where sinuosity is 2.1 to 5.

(III) Bed load channels — where sinuosity is greater than 1.5.

3. A.B Miall channel pattern:

(I) Straigh.
(II) Sinuous.
(III) Meandering.
(IV) Braided channel — where stream is moved and erosion happens.
(V) Anastomosing channel — no move of stream.

Exam

11B - IM sir
06-05-2015

Shape of stream channels:

Shape refers to the configuration or form of the channel in the cross-section. The shape of channel is determined by it's width and depth. which can be measured by the ratio of water surface width to the mean depth, known as form ratio. For narrow and deep channels have low form ratio, and shallow, wide channels have high form ratio. The shape determines the area of friction.

The following four generalisation regareding the channel shape can be made,

1. Most rivers have roughly parabolic cross-sections.
2. River channels are asymmetrical at bends.
3. Rivers increase their width-depth ratio in the down stream direction.
4. Big rivers have relatively large width-depth ratio.

The shape of a channel at a given cross-section is a function of the following three variables.

① The discharge and it's variations.

② The quantity and nature of sedim-ent.

③ The nature of matercials through which the river flows.

⇒ Rivers in flood plains:

Alluvial streams transport predo-minantly the same type of materi-als as the material forming the channel in the lower reaches. These rivers are called rivers in flood-plains.

⇒ Khadirs:

Streams in flood plain exhibit great freedom in meandering within their parmanent banks or commonly known as khadirs.

Exam: *** 2012, 10, 07, 06.

① figure:

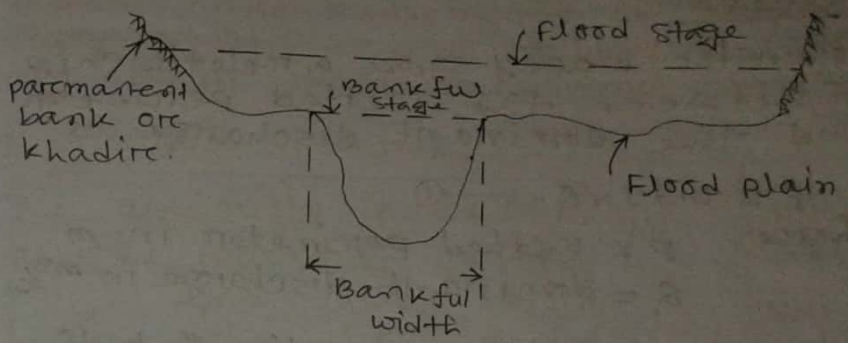


fig. of Typical cross-section of a river with flood plain.

From the above fig. we see a typical cross-section of a river with flood plain where bank as parmanent (khadir), bankfull stage, width and the flood plain with flood stage are shown. which is very common for the shape of a stream chan-nel.

2013.07

Effect of sediment size on channel section:

Scientist Lacey gave a relationship in between the wetted perimeter and the dominant discharge as,

$$P = 4.75\sqrt{Q} \quad \text{---} ①$$

where, P = wetted perimeter in m.
Q = dominant discharge in m^3/sec

Lacey found in naturally that the channel sections have the tendency to get the semi-elliptical shape for the medium types of sediment when passing. But for the coarse sediment the shape is in flatten type of ellips. And for pasing the fine sediment through the cannel then it's shape will be in semi circle which is determined with the above equation.

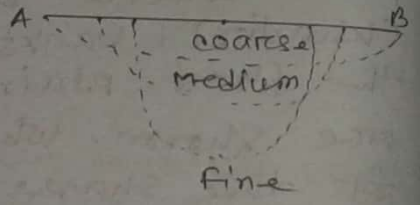


fig. of effect of sediment size on channel section

Because of increasing the size of the sediment, the discharge is decreased and perimeter will decrease. But for fine sediment, discharge increases and perimeter will be increased.

channel pattern or plan form:

There are four types of channel pattern which are as following with having their definations and figure,

1. straight channel:

The sinuosity index (SI) as the ratio of channel length and valley length is less than 1.05 is defined as straight channel.

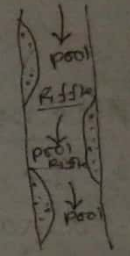


fig. of straight channel.

2. Meandering channel:

A straight channel when having the sinuosity index more than 1.5 then it is called meandering channel.

It can be regular and irregular or simple and compound type.

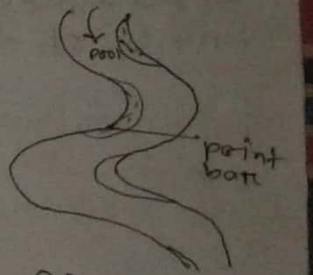


fig of meandering channel.

But

$$\text{Tortuosity} = \frac{\text{Thalweg length} - \text{valley length}}{\text{valley length}} \times 100$$

3. Braided channel:

When the Braiding index is more than 1.5 then the channel section is called the braided channel.

fig. of braided channel.

4. Anabranching channel:

It is defined where the anabranches rejoin the original trunks or unite with a next neighbouring trunk. Sometimes after a distance of tens of miles.

fig. of Anabranching channel

IIC - IM Sir
23-05-2015

Characteristics of meandering river:

1. A meandering river is a graded river
2. The outside bank of each meander loop tends to be deep and undercut and the short straight segment betn adjacent loops is rather wide and shallow.
3. The pool and riffle patterns are commonly found along the stream course of a meander.
4. Meandering streams, in general, have gradients betn about 20 cm/km and about 10 cm/km.
5. Backwater eddy with deceleration of flow are developed at the inner edge of bend where deposists occure.

Deformed meanders:

Sometimes the meanders can be deformed and such types are,

① Local accelerated erosion of banks composed of pockets.

2. Resistance to bank caving due to the presence of compacted silts or clays.

3. Resistance to bank caving due to revetment.

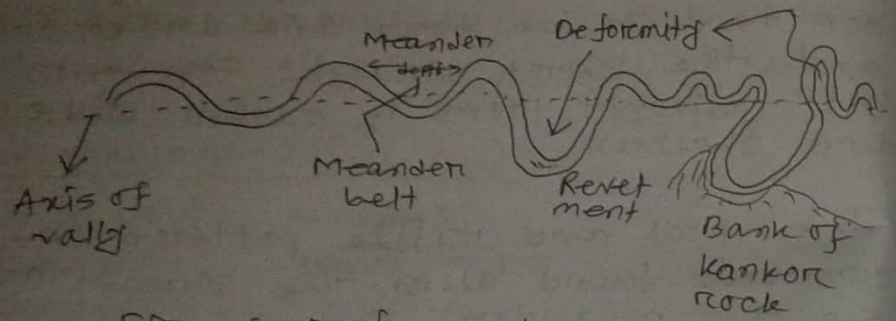


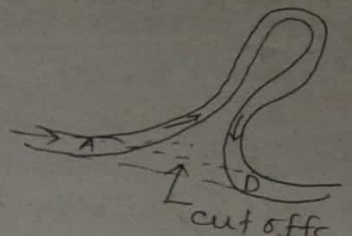
fig. of Deformed meander pattern due to obstructions.

⇒ **Cutoff:**

A neck is the upland between opposing meanders of a stream. A cutoff occurres when the neck between river meanders is eroded away and the meanders join to shorter length of the channel.

⇒ **Naturcall cutoffs:**

when the meanders cutoffs are having done naturcally in it's neck beto the meanders is called the natural cutoffs.



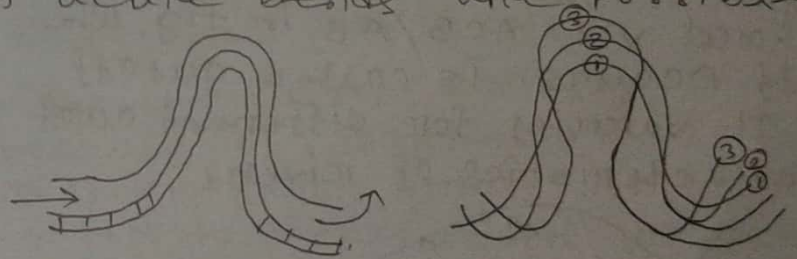
It is like the development of narrow channel.

⇒ **Types of cutoffs:** ** 2010, 09, 06.

There are two types of cutoffs.

1. **Loop or neck cutoffs:**

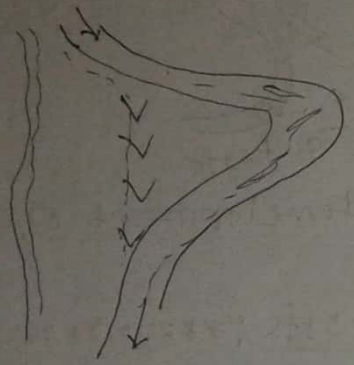
Loop or neck cutoffs occurr when progressive bank erosion at the neck of acute bends are possible.



progressive bank erosion.

2. chute cutoffs:

A chute cutoffs occurres normally across the base of a flat meander and is less common than neck cutoffs. A river flowing along curved paths, in fig.



fige of Development of chute cutoff.

⇒ Cutoff Ratio; ***2013,12,08.

for flow around a bend, the ratio of length of the bend to that of the chord viz. ACB/AB in fig. When a cutoff occurs is called cutoff ratio. It varries for different cutoff and characteristics of rivers.

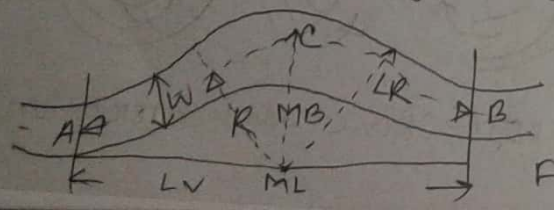


Fig. cut off ratio

it may occurre for cutoff ratios varying between 1.7 to 3.0 in the case of rivers, which cutoff results due to development of a side channel.

*** 2013,12,11,09,07

⇒ Artificial cutoff:

When the rivers cut off or meanderes cutoffs are done by man or by some of machine using, such type is called artificial cutoff.

for artificial cutoffs, Pickels gave a recommendation which is as following.

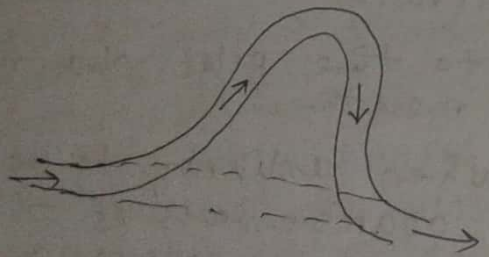
1. The Pilot channel should be tangential to the main direction of river flow approaching and leaving cut.
2. The Pilot channel is usually made on a slight curve which is less than dominant curvature.
3. Entrance to the Pilot channel is made bell mouthed.
4. The cut; when unlikely to develop because of coarseness of the material or of low sheare stress, should be excavated to mean river crosseetion.

5. The width of the pilot cut is unimportant as the cut ultimately widens due to scouring.

6. When a series of cutoffs is to be made, the work should progress from downstream to the upstream.

⇒ Effects of cutoffs:

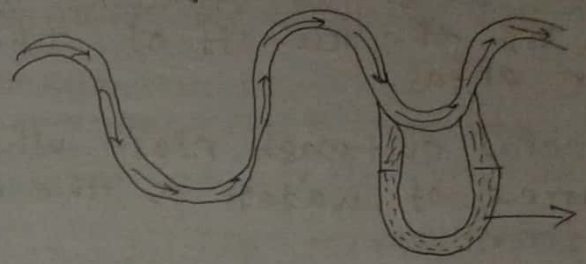
For the cutoffs of meanders, then the length of channel is appreciably reduce, so the slope will be increased so the velocity of stream will be increased and which passes throughth the slop from upstream side towards the downstream side.



A type of cutoff.

⇒ Ox-bow lakes:

When the cutoffs of meanders are looking like horse-shoe then it is called the ox-bow lakes, where the cutoffs making in which lakes.



⇒ Point bars:

The crescent shaped bar occures on the inside of the meander bend and is known as point bars.

⇒ Scrolls:

Migration of point bars gives rise to a series of ridges known as scrolls.

⇒ Braided channel and Distributed type:

When multichannel is distributed in many channels and if they are cut with other then it will call braided channel. If not cut then they are called the distributed channel.

Exam **

Braided streams are found mainly in three contrasting environments;

(i) semiarid regions of relatively low relief and the streams are formed by the runoff of the mountain areas.

(ii) The glacial outwash plain where the source of water is the melting ice front.

(iii) Mature stream in mountain areas - arid, temperate or ever periglacial. The stream gradient is steep.

Exam ***2013, 2012.

Several causes have been assigned to the development of braided pattern:

1. Incompetence of the river to transport bedload.
2. High single channel resistance to flow to move the bedload.
3. Formation of bars and islands.
4. Highly erodible banks.
5. Fluctuations in discharge change.
6. Sediment transport, bank erosion and channel scour.
7. Steep channel gradient.
8. Abundant and coarse bedload.

*Exam: ***2013

Differences; Betn braided and the meandering channels are as following.

1. A meandering river is a single channel but a braided river has multiple channels.
2. For a given discharge, a braided channel has steeper slope than a meandering channel.
3. A braided channel has coarser material than a meandering channel.
4. A braided channel is broader and shallower than a meandering channel.
5. A braided channel is characterised by frequent bank erosion & thus is more unstable than a meandering channel.

Where braiding represents high energy environment

Exam *** 2012, 2011, 10, 08

12B - IM Sir
27-05-2015

Characteristics of Braided pattern:

The following characteristics are found in braided pattern,

i) Aggradation:

Since braided pattern emerges when bed load transport is heavy, braiding of channels is often associated with tendency for aggradation. Bed rises due to construction and come together of sediment. Braiding channels however need not always experience aggradation.

ii) Channel Alignment:

Heavy bed load, generating a wide and shallow cross-section, was seen to be the basic reason for formation of braiding pattern. Here steeper slope and coarser bed material and higher velocities are found. The alignment of braided channels is more or less straight.

iii) Movement of Island:

For the movement of island at the infront side, there increases it and at backside destruction of it can be occured and for this it is moved.

iv) Bank Erosion:

Islands in some of the braided rivers have a tendency to movement of islands, the channel along the bank gets squeezed causing increase in discharge concentration, thus leading to local bank erosion.

* Anastomosing channel pattern: *2013.

It is the special type, where channel patterns are fixed and they can't be met with one another.

* Anabranching pattern:

In which channel patterns are fixed and also they will meet with one another as known to anabranching pattern.
It can be meandering, straight or braided.

According to the Nanson and knighton (1996) anabranching rivers are characterised by,

(i) flood-dominated flow regimes.
(ii) Banks that are resistant to erosion.
(iii) River mechanisms to construct channels and induce avulsion. Avulsion is the sudden shift or diversion of a river to a new course at a lower level on the flood plain, during flood.

** Q. Variables in stream problems:

For study alluvial stream, then it is need to know the vaiable in stream problem. which is discussed by kuiper which are characterised by water and sediment remain essentially constant (e.g. R_s, R_f, T, temperature). Important variables are water discharge Q, bed material transport rate Q_T, representative bed size of bed material d, stream slope S, width to depth ratio r, according to cross-section and the ratio of stream mileage to valley mileag, M, according to shape of stream plan, i.e meander pattern.

we should know which variables are independent and dependent.

r and M_1 are certainly dependent variables where, Q and d are certain independent variables.

Now, in the upper course of the stream the slope of land and hence slope of stream is determined by geologic factors and S can be treated as an independent variables so - fare as stream behaviour is concer- -ned.

Q, S, d determined the magnetude of Q_T. So Q_T becomes dependent

In the lower course of stream Q, Q_T and d becomes independent variables and slope S becomes a dependent variable along with r and M_1.

*** 2009, 2011, 07.06.

Q. Dominant discharge:

The streams can be discharged through the rivers where the discharge may be maximum and can be minimum. The ratio of maximum and minimum discharge can attain values as high as 1000 or more in many stream. Where the maximum discharges will be come very much time and this discharge will be called the dominant discharge.

The variation in sediment load can also be very large. During low flows there may be little sediment transport, while duri- -ng high flows the stream may carrry high sediment with a wide range of sediment size.

The braiding degree can also helping to know it by

$$B.I. = \frac{2(\text{sum of the length of islands})}{\text{length of the reach}}.$$

where for the minimum discharge of the stream, there will happen the erosion in stream river and for maximum discharge there deposition of sediment will occurred.

→ Inglis said, "The dominant discharge and gra-dient to which a channel returns annually, where equilibrium is most closely approached and tendency to change is the least, which varying during a long period of time."

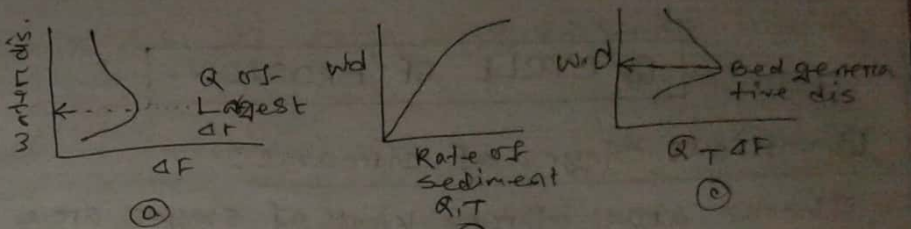
→ U.S.B.R defins, "The dominant discharge carry the greatest sediment load of material coarser than 0.0625 mm with respect to time, which is found slightly greater than the median discharge."

→ Ackers and charlton said,
"The constant discharge would produce the same meander length as produced by the varying discharge as called the dominant discharge.

** 2013.12.07

Bed generative discharge.

Schaffernak said, "the discharge that transports the largest volume of coarser material, is called the bed generative discharge."



Determination of bed generative discharge.

NEDCO recommends finding the depth Do corresponding to the dominant discharge using equation.

$$D_o \int_0^T Q_B \cdot dt = \int_0^T Q_B \cdot D \cdot dt.$$

$$\Rightarrow D_o = \frac{\int_0^T Q_B \cdot D\, dt}{\int_0^T Q_B\, dt} \quad \text{---- (*)}$$

Where, Q_B = Bed load transport rate.

CYCLE OF EROSION.

Various stages of streams:

There are three kinds of stages are seen in streams. We here see that at different stages, the streams work different and has so much effective for the river as well as human being. The following stages are having seen.

① Youth stage:

A young stream is always able to erode its channel in the vertical direction because of greater slope than the slope necessary to carry sediment load coming it.

(i) Vertical erosion.
(ii) High slope for flowing.
(iii) Flow through V-shaped deep gorges or canyons.
(iv) No flood plain but having action on all the valley.
(v) Presence of rapids, waterfalls, steep, varying gradients, presence of lakes,
(vi) Stream bending or meandering exist which are closely confined in valley.

According to Johnson, early youth is ended at elimination of lakes, Middle youth ends at the elimination of falls and rapids.

*** 2012, 11, 10, 09, 08, 07, 06.

② Mature stage:

The mature stage of stream is one kind of stage where some of sediment falls from the stream. It is also graded stream, poised stream, balanced stream, stream in regime or equilibrium.

Mackin has defind the graded stream.

A graded stream is one in which over a period of years, slope is delicately adjusted to provide, with the available discharge and with prevailing channel characteristics, just the velocity requi-red for the transportation of the load supplied from the drainage basin. It is the stream in equilibrium.

Lobeck lists the following characteristics of the mature streams.

(i) Flood plain with natural levees.
(ii) No rapids of falls.
(iii) Slow moving current of muddy water.
(iv) Width of valley equal to or greater than the width of meander belt.
(v) No lakes except oxbow lakes.

③ Old stage: A stream whose tributaries are all mature or graded as an old stage. Usually in old stage valley is wider than in the mature stage because of the lateral migration of the meander belt across the flood plain.

① Valley formation due to lateral ero-sion and gently sloping.

② Valley floors are covered by the flooding alluvium and form a flood plain over which the stream flows in meandering course.

③ Stream areas are reduced in height and divides become smooth and rounded hills.

④ Lakes, swamps, and marshes are present in the flood plain, not in the instantly interstream areas as in youthfull stage.

⑤ peneplain and Monadnocks are found.

Old stages streams fall the all sedi-ment and istaind, bars are constru-cted.

FLUVIAL GEOMORPHOLOGY.

Types of Fluvial erosion:

The erosions in rivers are happened in mainly two ways. ① chemical erosion. and ② mechanical erosion. Where the chemical erosion are like corrosion, Abrasion, and in mechanically carbonation way. which are also erod by vertical erosion and lateral erosion.

① corrosion or solution: soluble materials are corroed by the dissolution and disintegration and decomposition. Where the soluble materials are existed from-me the parent rocks and are mixed with the running water. Salts are remov-ed from bedrocks by carbonation and are suspended in river. H_2O at every cubic mile wate contains 762587 tons of suspended minerals of 50% $CaCO_3$. By ma-king their solution there happens corrosion in rivers.

② Abrasion or corrasion:

The removal of loosened materials of the rocks of valley walls and valley floors with the help of erosional tools (boulder, pebbles, cobbles, gravels etc) is known as the abrasion or corrasion.

This kinds of tools are moved downward and the two end eroed there and finally at a time it will be very loosend and then their action will less and at a time the abrasion will be breakdown.

(iii) Attrition:

The tools from the meachnically tear and wear, they are stated to pass against themselves at a high velocity and then they are fragmented into the smaller pieces and where the ero-sion will occurre in the river.

(iv) Hydraulic action:

The breakdown of rocks and other particles in the river due to the higher pressurre of water or fluid where by their pressurre on the side of rocks and other material they will be started eroed and at a time their breakage will be seen. so which is included in the hydraulic action.

(B) Erosional Landforms:

For the stream erosion there creats some of landforms which are called the erosional landforms. Some of them are as following.

1. River valleys:

The valleys curved out by the riverers are erosional landforms. The shape and dimension of fluvially originated valleys change with the advancement of the stages of fluvial cycle of erosion. This creats in the youthful stage and in the initially valley development in v-shaped having steep valley side slope of the convex element.

(i) v shaped. (ii) deep and narrow. (iii) having sideslope. (iv) widen due to lateral erosion (v) valleys are transferred into different kinds due to cycle of erosion.

Two types of valleys.

(i) Gorges: Gorges and canyons represent very deep and narrow valleys having very steep side slope. This gorges are formed due to active down cutting of valleys at the youth stage. Gorges are also formed due to the recession of waterfalls. Himalayan riverys are of this type.

(ii) canyons: when the gorges are exte-ded then it is called the canyons. So, it is most of deep, narrow and long valleys. where steepness de-ds on the nature of rock. Grand canyon of colorado river is USA having length 482.8 km and depth 2000 m is the example of this type.

2. waterfalls:

A waterfall may be defined as a ver-tical drop of water of enormous volume from a great height in the long profiles of the rivers.
It is also done due to sudden or abrupt breaks in the longitudinal course of rives due to host of factors e.g. Variation in the relative reesista-nce of rocks.

3. pot holes:

The kettle-like small depressions in the rocky beds of the river valleys are called potholes. which are in-cylindericully introduced.
When the water of rivers are dried at dry season, then sediment will be kept at a depression where small fish are made hole in that depression as known pot holes.

** 4. River Terraces:

Stream terraces are elevated portions of a floodplain created when the stream down cuts and creates a new floodplain at a lower elevation.
Stream terraces are important indicators of environmental change
Down cutting happens due to tectonic activity, increased flow, or lors of sedi-ment load.

(i) steep-like forems.
(ii) It includes flat tread and scarep.
(iii) Flood plains when face the tectonic movement then changes of base level or climate.
(iv) Erosional features, the terrace material may be depositional.

fig. book - 132

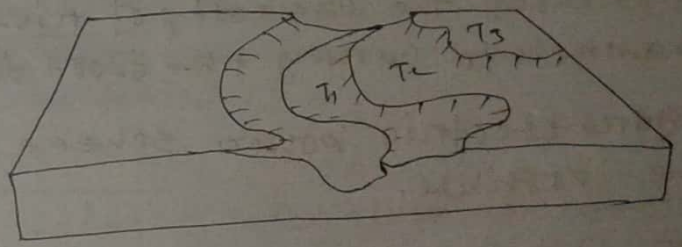


fig. of stream or river terraces.

*** 2013.11.07.06

Effects of Degradation:

1. For a given discharge, the tail water level is lowered as a result of the degradation.
2. The difference between tail water and head water levels will be known and which increase must be anticipated at the time of design in the calculation of uplift pressure.
3. Lowering of water level due to degradation reduces the height of ground water table in the adjoining areas.
4. Deterioration of piling has been done due to lowering of water.
5. Diversion of water for irrigation more difficult.
6. Increases the capacity of river-channel to carry the flood flow.
7. Hydro-electric power scheme can be possible.

Transportation Work of Rivers:

The product of erosion are carried by the stream flow from one place to other. River transport all the erosional product and other material due to land slides, slumping etc. The silt carrying capacity of Ganges (90.000 tons/day). The sediment load carried by the rivers is divided into (i) suspended load, (ii) bed load.

*** 2011.09.08

Methods of transportation work are Rivers:

(i) By traction:- Where the higher and large rock gives pressure on the side of other rock due to some of velocity and they start to transport by rolling, slipping, bumping etc.

(ii) By saltation: The fragments of the rocks move onward by jumping continuously is called saltation.

(iii) By solution:

Some parts of the rock fragments are dissolved in water and making as solution they will transport from one to other.

④ By suspension:

When the rock fragments fall on water and then their weight will be very less in seemed, because of buoyancy. And by this, the particles are transported as suspended part on the water surface.

** Factors affecting the transport power of a river:

1. velocity: If the fragments of rock get high velocity they will be transported very speedy but for less velocity they will be slow in transportation.

2. Nature of river current:

If the direction of that fragment of rock is in direct to the actual position then will transport very fastly other wise slow.

3. Density and buoyancy:

If the fragments of rocks having less weight then for having high buoyancy it will transport very fastly, but for high or heavy weight the transportation will be slow in it's direction.

** Transportation power of a river:

It means that the power helps to transport the materials in the river.

G.K. Gilbert gave a law on the transportation power of a river, as given below and known as Gilbert's sixth power law,

"The transportation power of the streams is proportional to the sixth power of their velocity."

If, transportation power = P_t

velocity of stream = V.

So, According to law,

$$P_t \propto V^6 \quad \text{——①}.$$

Here, if the velocity of stream is double then the transportation power will be 64.

So, $V=2$. putting in equn. ①, then we get,

$$P_t \propto (2)^6 \Rightarrow V=2.$$

$$\therefore P_t \propto 64.$$

#Difference 2+5 → book 143 page.
***-2013, 10, 09, 08, 07, 06

(a) Compitance and capacity of a river:

There are two characteristics of a stream relating to transportation, as given below,

① Compitance:

The compitance of a river is measured by the largest rock fragment that stream can transport. Where compitance = c is proportional to the sixth power of velocity.

$$\therefore c = v^6. \quad \text{---(i)}$$

So, velocity if increased some the compitance will increase in high.

⑪ Capacity:

The capacity of a river is measured by the total load of the stream. If ordinary type of rock fragment load of is here, the capacity is proportion al to third power of velocity of it. for fragments of finer, capacity is porcportional to higher power of its velocity and for fragments of coarser, the capacity is proportional to the lower power of its velocity.

Exam.

(b) problems associated with Deposition:

When deposition happens in the river then it has some of facilities, but when heavy deposition happens then so problems will be occurred by this as the bad effect, some of them are as following.

① Due to over deposition channel bed rises and at over rainfall, the flood can be occurred.

⑪ Due to deposition, at the midst of river shoals are developed which is very bad for the navigation and increases the cost of navigation.

⑪ Heavy deposition in the moute of river distrubs the port facility.

⑫ In the southern part of Bangladesh, due to deposition in the creeks, saline water and it is overflown and flooded the cultivated field.

✓ Heavy deposition is the bad effect for the economy and livihood pattern.

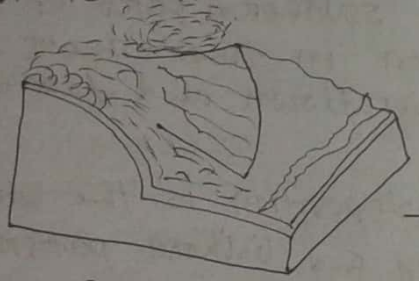
which are the common and if we can minimize this then heavy deposition will be prevented.

***- 2011.09.05.07.06

Alluvial fans and cones:

Most important depositional features of the piedmont are alluvial fans. In the upper reach of a river in the mountain region, the slopes are steep and the flow has a high velocity. sediment concentration is therefore also high. At the foothills the river descends into the plains where the slope suddenly be comes flat and velocity drops. Then the capacity of flow to carry sediment reduces. The sediment deposits and causes bed aggradation. Bed is raised the river shifts laterally. By this process a cone shaped delta is built by the river which presents the shape of a fan.

This formation is known as alluvial fan.



→book 147. 148.

fig. Alluvial fan.

⇒Alluvial cones:

When alluvial fans increase in height by the deposition of the fans and their slope becomes steeper. This formation is called alluvial cones.

Causes of Alluvial fan:

1. The most popular theory of fan initiation is that a drastic reduction in gradient between the eroded valley and the receiving plain causes deposition load.

2. The break of slop changes the hydraulic geometry of the main channel. It increases the width, decreases the depth and flow velocity and the causes the deposition of some of the transported material.

3. Sometimes the changes in the direction of trunk wash or the increasing friction and decreasing velocity, debouching of the flow from the constricted channel create fans at different places down the slope.

⇒Graphical Importance of Alluvial fan:

(I) Cities develop near the peripheries of alluvial fan.
(II) Water is available for irrigation from it
(III) Water is gone to seepage. so if no water having on surface. then we can get it from there.
(IV) Soil can be fertile of this fan, which is good for the agriculture.

** Flood plain:

A flood plain is the relatively flat area that borderes a stream which is periodically inundated with water during high flow periods. At youthful stage the stream broadens it's valley instead of deepening it. The width of streams also increases lots of, when the flood comes. the speed of the stream increases. The capacity to carry sediment also increases of it. When water goes out of valley, speed is reduced, and deposits of sediment. The area inwhich a stream spreads it's sediment is called flood plain.

Flood plain is constructed and destroyed continously. Depositions are,

1. colluvium.
2. Channel deposit.
3. Overbank deposits.

fore above flood plains are formed at flood times.

fig. book - 151.

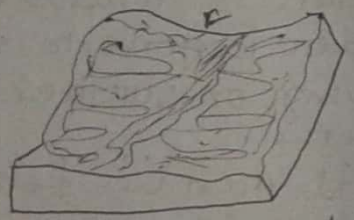


Fig of flood plain.

Bars:

Along the stream channel are likely to be found numerous deposits of sand and gravel commonly. designated by such names as channel bars, point bars, diagonal bars, delta bars, transverse bars.

channel bars are located in the stream course and are perhaps most characteristics of braided streams.

point bars are called meander bars.

**** 2011.09

Natural levees:

A natural levee is a narrow ridge of alluvium deposited at the side of the channel. They are highst near the river and slope gradually away from. During flood period the whole plain, frome one valley wall, to the other, is under water, and the water is current most rapid along the deep line of river channel. silt bearing water spreads out and mingles with shallow flood waters on either side. It quickly loses its velocity and much of the silt and sand settle along the both sides of river channel. During flood period such type of deposition occurres year after year and as a result a slightly higher ground is formed as called the natural levee.

The defination will be clearred by the above fig. of the natural levee.

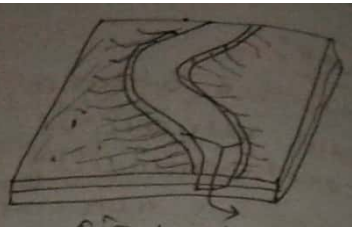


fig.1 Natural levee.

(i) All stream can't make this.
(ii) Durcing flood period it will happen.
(iii) Due to deposition of sediment it will occurre.
(iv) Avercage height of it is 10m.
(v) It is one kind of stabilized landform.
(vi) It can be used for agricultural purposes.
(vii) continuous sedimentation and flood can be checked by it.
(viii) which causes gradual rise of the river beds.
(ix) It prevents tributarey from joining main river.

(ii) Delta:

The deposition feature of almost triangular shape at the mouth of a river debouching either in a lake or a sea is called delta.

"Delta" dervived from Greek latter, by the Herodotous in Nile river.

Ex: Granges delta in Bangladesh.

Size of it, depends on the characteristics of rock, vegetal cover, rate of erosion and amount of annual rainfall. Avercage depth of sediments in the Mississippi delta is about 610m.

*** 2011,10;08,07.

conditions for Delta formation:

As given below,

(i) suitable place in the forcm of shallow sea and lake shores.
(ii) long courses of rivers.
(iii) Medium size of sediment which can be deposited very frequently.
(iv) Largge amount of sediment supply.
(v) Relatively calm or sheltered sea at the mouths of rivers.
(vi) Accelercated rate of erosion in the catchment area of the concerned river.

7. Almost stable condition of sea coast and oceanic bottom.

So, for the formation delta, the above conditions are very important.

Factors affecting type, shape, progress of Delta:

Delta can be formed due to sediment deposition, so it are built out of the materials transported from catchment basins. The area of it also the one factors.
If it will be high then shape will be big and there will be progressive delta can be formated.

Other's factors are coastal currents cyclones, human interference etc. also effect the delta formation.

Differences:

The differences between the fans and deltas are as following.

1. The flow of water in an alluvial fan is suddenly decreased but it decreases slowly in delta. The results into slow but more systematic deposition in a delta.

2. The surface of the lake or sea is the limit of delta, but has no limitation about such kind at alluvial fan.

Types of delta:

1. High destructive delta — sediment are continuously removed by wave and tidal currents.
2. Wave influenced deltas — Rapid removal of debris by strong long shore wave currents and make a flat delta.
3. Tide influenced deltas — funnel-shaped where distributions are open and straight by strong tidal scour.
4. High constructive deltas — Large supply of debris from the river from a broad - by curving shoreline resembling the alluvial fan.

Instability of Rivers:

When the dynamics characteristics of rivers are disturbed and the rivers has lost it's property due to this bad condition created by the autogenic or man made reason as known as the instability of the rivers.

*** 2010.09.08.07.06

→ Autogenic instability:

When the instability of rivers are done due to the action of river is called the autogenic instability.
The reasons are as given below,

① Lateral shifting and changing of channel positions by aggradation.

② Erosion on concave and more sedi-ment deposition.

③ Shoaling due to flocculation and increase in salinity due to reduction in tidal influx.

④ Flattening of slope due to extensi of delta.

→ Allogenic instability:

When the instability of river has been occurred due to the creation of bad matters by man as called the allogenic instability.

The reasons are as given below,

① Aggradation of upstream and degradation on down stream by construction of dam for water storage.

② Change in river water and bed levels and in the river slope due to flood embankment.

③ Increase of sediment load due to landslide.

④ Increase in channel flow due to very flow from return channel.

⑤ Change in base level for tributary.

Man and Rivers.

⇒ Relation of man, rivers:

1. Domestic uses.
2. Irrigation
3. Industrial uses.
4. Navigation.
5. Hydropower. → page - book - 161. IM site.

⇒ 2008.

Q) Write a short notes on bed rock channel.

⇒ Feature of bed rock channel:

The following feature of bedrock channels are very important.

① It is also known as "erosional - channel".

② It is developed by well consolida-ted rock or bed rocks.

③ It occurres when ever "potenti-al rates of removal" exceed "sediment supply".

④ Most of the bed rocks are sinuous.

⑤ Having more variation in it's size it will be formed as channel.

Example: Colarado river, USA.

2008

Q1 Write a short notes on Alluvial channel.

⇒ **Alluvial channel:**

1. It is developed in the regions of "sedimentation" or "aluviation".
2. There are six types of "temporal changes" in natural alluvial channel
   - (i) Transverse bar shift.
   - (ii) Alternate bar shift.
   - (iii) Neck cut off.
   - (iv) Chute cut off
   - (v) Meander shift.
   - (vi) Rapid channel diversion.

   fig. 78 page

3. According to the degree of temporal changes alluvial channels are
   - (i) Stable
   - (ii) unstable channel.
4. According to variable which influence and control –
   - (i) suspended Load channel with straight course and uniform depth.
   - (ii) suspended load ---- with high sinuosity, uniform channel width and stable banks.
   - (iii) Mixed load straight channel.
   - (iv) Meander braided transition channel.
   - (v) Bed - load channel.

Example: Ganga - Yamuna plain of north India.

⇒ **Difference:**

Youth Stage	Mature Stage	old Stage
(i) passes hilly region.	(i) plain	(i) low gradient
(ii) high velocity	(ii) Low.	(ii) very low.
(iii) Maximum Slope.	(iii) Small	(iii) Zero.
(iv) width less of river.	(iv) increased width.	(iv) widest width.
(v) Max. transportation.	(v) Midium.	(v) Minimum.
(vi) Minimum deposition.	(vi) Less.	(vi) Maximum deposition.

⇒ Main factors influencing the erosion done by wind :-

① Nature of rock.
soft → fastly eroded.
Hard → Takes time to eroded.

② velocity → wind.
High V → high erosion.

③ presence of vegitation.

④ presence of moisture.