

Geology of Dam Sites

- **The Success of a dam is not only related to its own safety and stability but also to the success of associated reservoirs. In other words, on construction, if a dam stands firmly but if its reservoirs leaks freely then such a dam is to be treated only as a failure because the purpose for which it was constructed was not served.**

Geology of Dam Sites



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- Therefore, **utmost care is needed in planning for the success of both the dams and the reservoir.**
- **Careful geological studies bring out the inherent advantage or disadvantage of a site and such studies go a long way either in reducing or in increasing the cost of a dam considerably.**



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- **The Important Geological requirements which should be considered in the selection of a dam are as follows:**
- **Narrow River Valleys**
- **Occurrence of the bedrock at a shallow depth.**
- **Competent rocks to offer a stable foundation**
- **Proper Geological Structures**

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Narrow River Valley

- At the **proposed dam site**, if the river valley is **narrow**, only a **small dam is required**, which means the cost of dam construction will be less. **On the other hand**, if the valley is **wide**, a **bigger dam is necessary** which means the **construction cost will be very high**.

Narrow River Valley



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- Therefore, it is preferable from the economy point of view, to select such a site along the river valley which has the least areal cross-section (i.e., the narrowest part of the river).
- But such sites should not be blindly selected without further investigations, because sometimes they may have severe defects which may lead to serious leakage from the reservoir and may affect the safety of the dam.

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Bedrock at Shallow Depths

- To ensure its safety and stability a dam has to necessarily rest on (Physically) very strong and (Structurally) very stable (i.e. bedrocks). If such competent bedrocks occur near the surface or at shallow depths, the foundation cost of the dam will naturally be less. On the other hand, if competent bedrocks occur at great depths, the cost of the foundation will be very high because it involves extensive work of excavation of loose overburden and concrete refilling.

Bedrock at Shallow Depths



Geology of Dam Sites

Effects of Associated Geological Structures

- For the stability of a dam, the occurrence of favorable geological structure is a very important requirement. Under structural geology we have learnt that those rocks bear certain inherent or original physical properties, such characters get modified either advantageously or disadvantageously when geological structure occurs in those rocks.

Tunnels

Tunnels

- **Tunnels are underground passages or routes** (or passages through hills or mountains) used for different purposes. **They are made by excavation of rocks below the surface or through the hills or mountains.**
- **Like dams, bridges and reservoirs, tunnels are also very important civil engineering projects, but with some differences.**
- **Unlike other civil engineering constructions which lie on the surface, generally, tunnels lie underground** (i.e.. within the rocks). For this reason, the needs for their safety and stability is much more important.

Tunnels



Tunnels

Effects Of Tunneling On The Ground

- **The tunneling process deteriorates the physical conditions of the ground.** This happens because due to heavy and repeated blasting excavation, **the rocks gets shattered to great extent and develop numerous cracks and fractures.** This reduces the cohesiveness and compactness of rocks. **In other words, rocks becomes loose and more fractured and porous. This naturally adversely affects the competence of the rocks concerned.**

Tunnels



Tunnels

Geological Considerations for successful Tunneling

- As already stated, the safety success and economy of tunneling depend on the various geological conditions prevailing at the site. As usual, the important geological factors which interfere with this civil engineering project (i.e. tunneling) are also lithological, structural and ground water conditions.

Tunnels



Tunnels

Importance of Rock Types

- Since tunnels through underground rock masses, obviously the nature of rock types which are encountered along the tunnel alignment is very important for the safety and stability of the tunnel.
- In brief, the competent rocks (i.e. those which are strong, hard and massive) will lead to safe but slow tunneling and incompetent rocks (which are loose or soft or fractured), though amenable for easy tunneling, will be unstable and hence require lining. Of Course, if tunnel extends for considerably long distances, the kind of rocks en route may vary from place to place, i.e. Competent at some places and incompetent at some other places.

Tunnels



Tunnels

Suitability of Igneous Rocks at the Tunnel Site

- **Massive igneous rocks, I.e. the plutonic and hyperbyssal varieties, are very competent but difficult to work.** They do not need any lining or any special maintenance. This is so because they are very strong, tough, hard, rigid, durable, impervious and tunneling, **do not give way to collapse, floor bumps, side bulges or to any other deformation.**
- **The volcanic rocks, too in spite of their vesicular or amygdaloidal character are competent and suitable for tunneling.** Further, by virtue of frequently present vesicular or amygdaloidal structure, they are more easily workable than intrusive rocks.

Suitability of Igneous Rocks at the Tunnel Site



Tunnels

Sedimentary Rocks at the tunnel Site

- In general, **sedimentary rocks are less capable than igneous rocks. Among the different sedimentary rocks.**
- **Thick bedded, well-cemented and siliceous or ferruginous sandstones are more competent and better suited for tunneling.** They will be strong, easily workable and, moreover, do not require any lining. **Thus they possess all the desirable qualities for tunneling, provided they are not affected adversely by any geological structures and ground water conditions.**
- **Shales, by virtue of their inherent weakness and lamination, may get badly shattered during blasting.** But being soft, they can be easily excavated and hence tunneling progresses faster through shale formations. **Proper lining is necessary for tunnels built in Shales.**

Sedimentary Rocks at the Tunnel Site



Tunnels

- **Among limestones, dolomitic limestone are harder and more durable.** They are better than other varieties. **On the other hand, calcareous limestones or porous limestones are naturally weaker and softer.**
- In a majority of the cases, sedimentary rocks. **Being relatively softer, enables fast progress of work, but by virtue of their weakness requires suitable lining.**

Tunnels



Tunnels

Metamorphic Rocks at the Tunnel Site

- **Among different metamorphic rocks, gneisses are nearly similar to granites in terms of their competence, durability and workability.** Hence, they are capable of withstanding the tunneling process without requiring any lining. **The gneissose structure may be advantageous in the excavation process.** Schists, phyllites, etc, which are highly foliated and generally soft, are easily workable but necessarily require good lining.
- **Quartzite are very hard and hence very difficult to work they are more brittle too. They are competent and need no lining.**

Metamorphic Rocks at the Tunnel Site



Tunnels

Importance of Geological Structures

- **Effects of Joints at the Tunnel Site**
- **Most of the rocks in nature possess irregular cracks and regular joints, which are plane of complete separation in rock masses, and clearly represent weakness in them. There will be more qualitatively and quantitatively nearer the surface but generally disappear with depth.**

Effects of Joints at the Tunnel Site

