

Monitoring

Monitoring during construction will include *the work of an engineering geologist on site*, who will examine all excavations to see whether the expectations of the preceding investigations have been realized. The identification of exceptions may then lead to an early diagnosis and redemption of any problems.

For the post-commissioning stage, monitoring will involve regular reading of installed instrumentation to check performance against design criteria. This should serve as an 'early warning' system which will initiate a contingency program, thus minimizing the delays which would result from the development of an adverse situation.

Test and inspection:

The design of dams must include the manual for operation and maintained. This manual is a different from dam to another according to dam content and structures. Also, manual must contains appendices for inspection work.

Inspection work:

We must make the inspection daily, weekly, or according to manual for all parts of the dam. Also, we can make additional tests if we need we any problem is appeared as modification or updating for the manual. These works need the inspection team to analysis and study all the maps, technical reports, and available data base of the dam.

The Goal of Test and inspection:

- Determine the behavior of the dam and its structures under the operation conditions to satisfy the optimum advantage of the dam.
- Determine the any problem resulted from operation of the dam early to do the treatment it ,solve any problem before develop the damage and prevent the failure.

These goal my be need more investigations.

Types and style of dam failure:

1. weakness or loose of foundations.
 - Gypsum, weakness of foundation because of earth quick, liquid of sand and clay layer (because of compact the clay layer with high water content).
2. Insatiability of foundation.
 - Seepage
 - Fault movement.
3. failure of slope for upstream face of earth dam because of erosion resulted from wave motion these need to lined with stones and using filters.



4. Problems with spillway.
 - Failure of gate control.
 - Cavitations occur when discharge a great amount of water up normal.

5. problems with outwork, emergency spillway, and tunnel
 - restrictions materials (وجود عوائق)
 - closed with stones (انسداد بآثرية)
 - lined crush (تكسر البطانة)
 - sedimentation.
 - Failure to open the gate.



Therefore the operation test is necessary.

6. problems with concrete.

- Water quality.
- Gas and acid action.

Optical inspection is very important.

7. in small earth dam, may be the small crack in outwork pipe can cause seepage and problem with soil and concrete.(see fig.1).

8. problem with earth-fill dam.

- Inefficient compaction of soil layer,
- Inefficient materials.

9. problem with reservoir sides.(effect on dam use with design level).

- Seepage from hills.
- It is very dangerous when it occur near the structures (spillway....)
- sink hole.





Field Test:

It is very important part of dam safety. The main purpose of it is determined the problems or the structural or hydraulic weakness of the dam.

1-Fill-earth dam:

- Shape, any swelling in slopes (>15 cm not allowed).
- Differential settlement, check the downstream drainage and read the sensors to check seepage, sensors are checked every 10 days.

2-Gravity Concrete dams and Concrete parts:

- Check any pit in spillway may become dangerous with high water velocity.
- Check the surface concrete to determine the cracks and what is its reason.

3-Sides and foundation:

- The connection point of dam with sides or abutments is very important, seepage is the main factor to determine any problem with the dam.
- If the seepage is constant for long time (years), there is no problem,
- If the constant amount of seepage, there is no problem,
- The dangerous seepage is the variant and concentrated seepage; we can treat it by relief wells.

4-Reservoir check:

- Any bubbles or gas theses means a sink in reservoir bed, we need instrument of measurement under water.

Sliding Movement:

- Sudden cutting in slopes,
- Sudden changes in slopes,

- Inclined trees,
- Dry trees,
- Open cracks resulted from tension,
- Changes in slopes of closed hills,
- The trees inter the reservoir from the its sides.

Sliding Movement Properties:

- Volume of Sliding mass,
- Direction of sliding relative to reservoir,
- Location of sliding from dam,
- Check if the sliding in dam or in narrow closed hills,
- Velocity of sliding,
- Mechanism or the reasons of sliding (earth quake, waves, sudden empty of reservoir, heavy rain, empty reservoir quickly and filled reservoir quickly).

Intake and outwork channels:

- Slope stability of channels,
- Stability of lined concrete,
- Stability of stones with filter.

Mechanical instrument:

The operation must be according to design and operation manual, we must check :

- Lifting, gates
- Vibration test
- Heat increasing
- Noise of gate operation
- Power supply
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We must check the following:

- Measurement of reservoir level
- Mechanical part of electrical instruments
- Ear condition
- Galleries
- Stop loges with lifting bridge,
- Screens