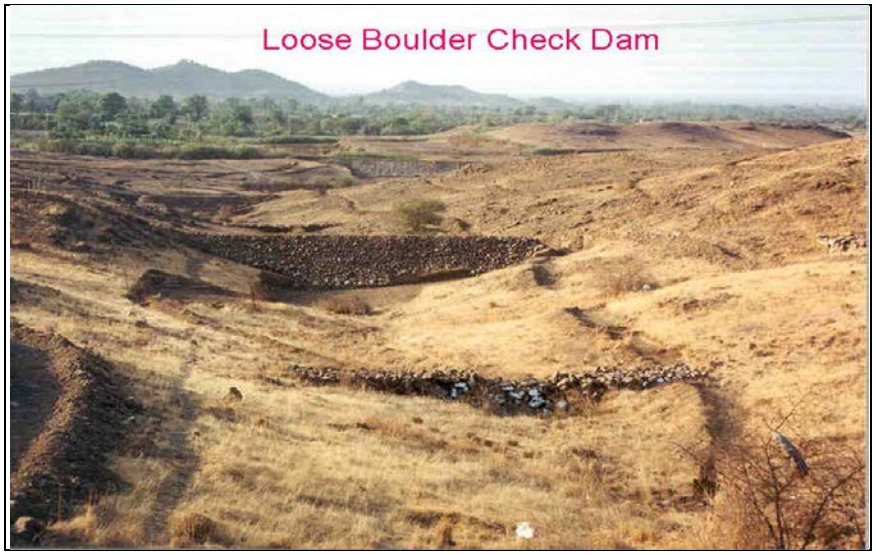
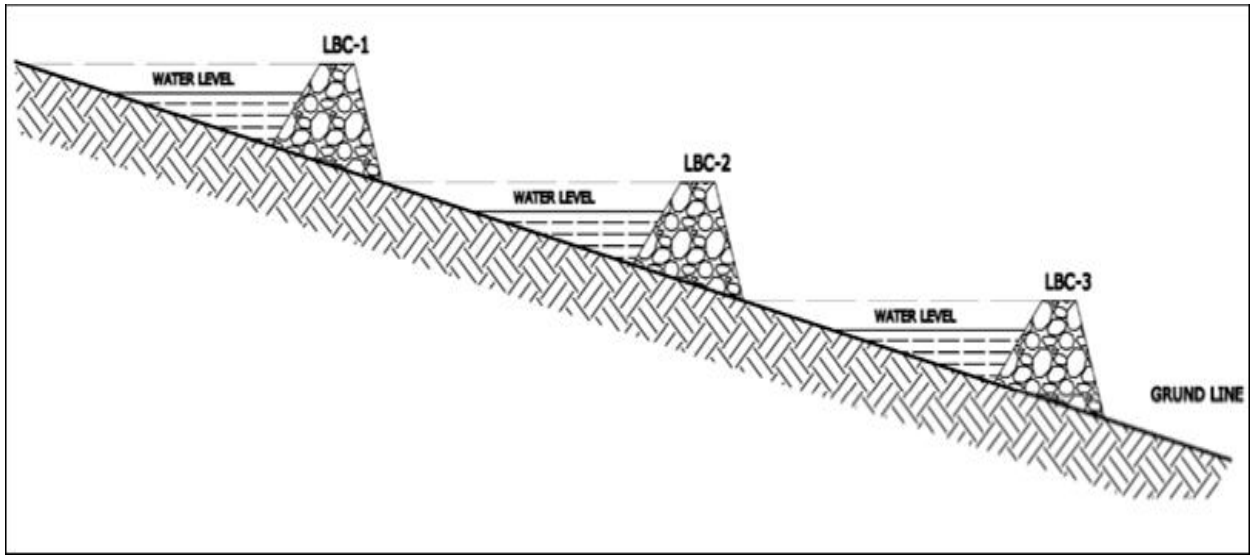
LOOSE BOULDER CHECK (LBC)



LOOSE BOULDERS CHECK (LBC)

(i)Spacing of LBC

By the L-Section of the Gully or Nallah the LBC in series should be placed in such a way that the top of the downstream check dam should be at level with the bottom of the one upstream of it (as shown in the figure below). The horizontal distance between the check dams can be exactly determined. For Estimation purpose we can calculate the numbers of LBC as given below:



Location of LBCs

Example, in the micro-watershed, if there is a stream 1500m long, with a slope of 10%, then how many 1m high loose boulder checks can be made?

Solution

Basically we have to divide up the length of the stream into portions that will be occupied by units of loose boulder checks and the water stored behind them.

We know that: Slope S = 10%, Length of the Stream L = 1, 500 m, Height of the Boulder Check VI = 1 m. How far will the water stored behind the boulder check go?

HI = V I/Slope x 100 = 1/10 x 100 = 10 m

Also, the base of the boulder check itself will occupy 5m. Therefore the effective width of a boulder check, w = 10 m + 5 m = 15 m

Number of Boulder Checks = Length of stream, L / Effective Width of 1 Boulder Check

= 1500/15 = 100 boulder checks

Similarly, loose boulder checks can be planned for every micro-watershed. After a comprehensive survey in the field with surveying equipment, we can arrive at the actual number of loose boulder checks required as compared to the number we had estimated. By measuring the width of the stream during this survey, we should categorize the different sizes of boulder checks required, which will enable us to know how many 8m long, or 10m long or 13m long boulder checks there will be.

(ii)DESIGN:

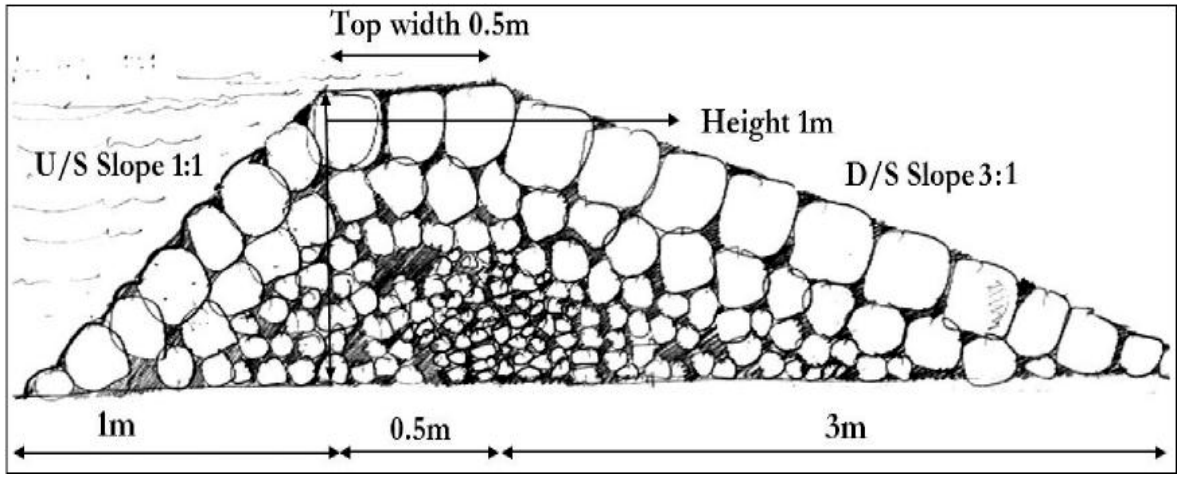
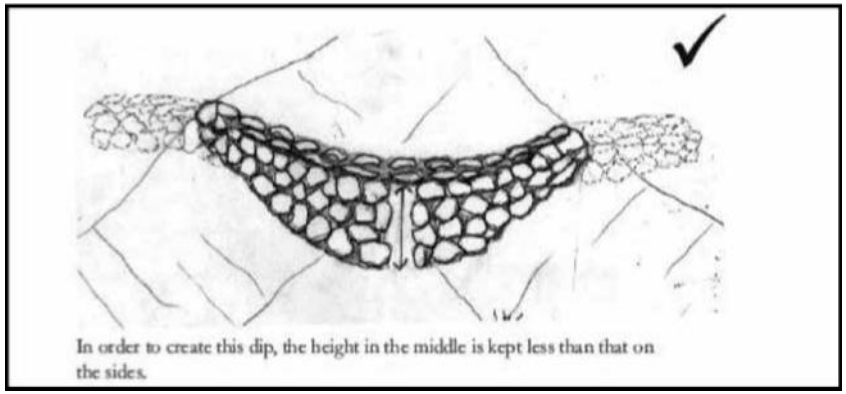


Figure: In the construction of a boulder check, bigger boulders are placed outside smaller ones inside. On the outside, the biggest boulders are placed on the downstream side

(a)Cross section of a boulder check:

Through years of experience in watershed development, the maximum height generally accepted for loose boulder checks is 1m. The design height of 1m means that the top of the check in the middle of the stream is 1m above ground level. The top width of the boulder check is usually as 0.4m. As the material used in the check has a high angle of repose, the upstream slope of the check should be fixed at 1:1 in general, to be varied only in exceptional cases where the structure has to handle very high volume of runoff of high velocity. The downstream slope of the boulder check can vary from 2:1 to 4:1 depending on the volume and velocity of runoff. The higher the volume and velocity of runoff, the flatter the slope. Since the boulder check is composed of highly porous material it is not expected to hold water for a long period



Boulder Check with dip

(b)Boulder Check with dip:

- It is advisable to direct the maximum overflows through the middle of the structure
- If no dip is given in a boulder check in the middle, and its sides are not embedded in the embankments, water will tend to cut through the embankments on either side, thus eroding them
- With a dip in the middle and sides embedded on either embankment, water flows over the dip safely without endangering the bund

c) Downstream Slope:

Unlike in earthen structures, the downstream slope of the structure is not made to handle seepage problems. The downstream slope is given for two reasons:

- To absorb the impact of water which enters the structure at a high velocity; and
- To drain out water from the structure and make it trickle through at a non-scouring velocity.

d) The height of the boulder:

Check on either side should not exceed the height of the embankment or 1.5m whichever is lower. The check should be embedded 0.5m into both the embankments. This is to prevent erosion of the embankment where the check joins it. If the bed of the drainage line has only boulders, the boulder

check can be constructed without any foundation digging. If there is mud or sand in the bed, this must be excavated up to a maximum depth of 0.25m to secure an adequate foundation for the boulder check.

iii) CONSTRUCTION:

a) Draw a line running through the center of the proposed site for the boulder check till it reaches the points on either side which are 1.5m above the bed of the stream. Naturally, if the embankments are less than 1.5m high, this line will only reach till the top of the embankment. From this central line, mark 25cm on the upstream and downstream sides and draw parallel lines from embankment to embankment. These lines mark the boundaries of the crest. Suppose the required slope is 1:1 upstream and 3:1 downstream. From the center of the upstream crest line, mark a point at a distance of 1.25m, along the perpendicular to this line. From the center of the downstream crest line, mark a point at a distance of 3.25m, again along the perpendicular to this line. These points mark the upstream and downstream ends of the boulder check respectively. Draw lines connecting each of these points to the end of the crest lines on both sides. The trench in a boulder check is not usually dug in the bed of the stream. But if there is sand or mud at the base of the check, a foundation should be dug to a depth of 0.25m. Generally, digging the trench is only required for embedding the check into the embankment. Along the center line after it enters the embankments, dig a trench which is half a meter wide and half a meter deep. The trench must extend half a meter beyond the point where the crest of the check meets the embankment on both sides. Now the filling begins. The check should be raised in horizontal layers. The largest of the boulders must be placed on the outer sides especially on the downstream face.

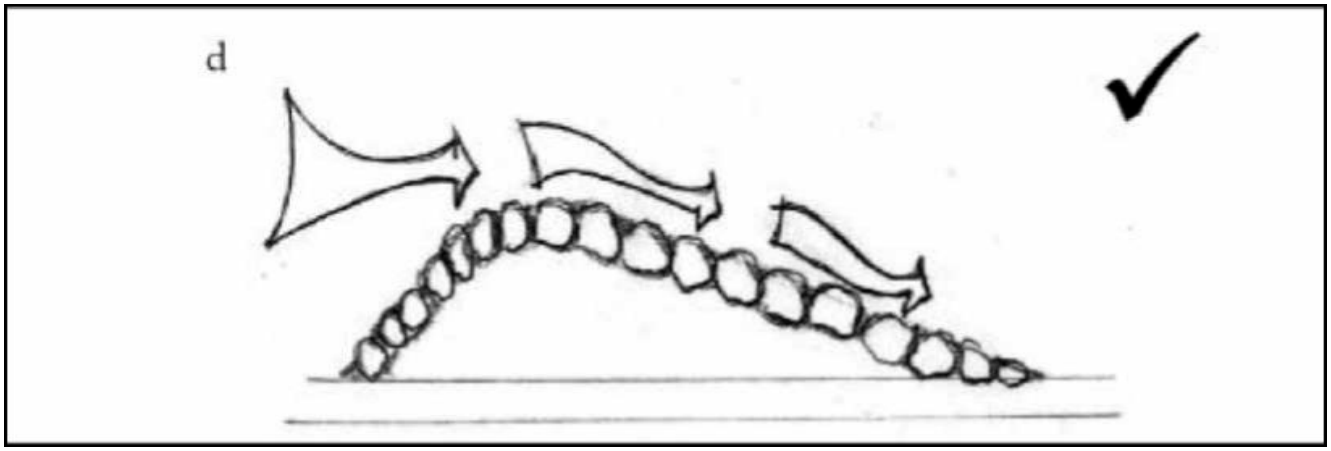


Figure: The largest boulders must be kept on the outer side as shown in the fig. above. Otherwise, smaller boulders will be displaced by the force of water and the boulder check will break

(b) The trenches cut into the embankments on either side of the check and must also be filled up with boulders. As successive layers are laid out, care must be taken that the downstream and upstream slopes are maintained as per design. When one reaches the crest of the check one must ensure that the top layer slopes down away from the embankments dipping towards the center of the check, thus providing a channel for the safe exit of excess runoff.

iv) MATERIAL:

a) The larger boulders must be placed on the downstream face of the check. The outermost edge of the downstream side must be dug up to a depth of 0.25m and the largest boulders available must be placed at the lower most edge of the check on the downstream and anchored to the ground.

b) Smaller stones can be used to fill up the interiors of the check.

c) The use of boulders with a diameter of less than 15cm (or weight less than 1 kg) must be avoided.

d) The use of angular stones gives greater stability to the check than the use of rounded boulders.

e) Shale, limestone, mudstone or any loosely cemented rock must not be used, because they disintegrate when in touch with water.

v) ESTIMATION OF LBC:

For estimation of LBC average height of center and side of structure at different places of cross section of LBC should be worked out to arrive at the quantity of LBC.

vi) DOs AND DONTs:

DOs:

- Locate the check only where the height of the stream embankment is greater than or equal to the sum of the peak depth of flow in the drainage line and design height of the structure.
- The top of the check should be lowest in the middle of the stream and highest at either embankment.
- The height of the check in the middle of the stream should be 1m above ground level.
- Upstream slope of the check should be 1:1 while the downstream slope can vary from 2:1 to 4:1.

- The bed of the stream at the base of the check should be cleared of mud/sand up to 0.25m depth.
- The top of the check should extend into either embankment by cutting a trench and filling it with boulders.
- Larger boulders should be placed on the outer portion of the check.
- The use of angular boulders should be preferred.

DONTs:

- No checks where the bed slope is above 20%
- No checks should be constructed where boulders are not adequately available within a radius of 50m.
- Do not use boulders dug up or picked up from the neighborhood, such use would increase soil erosion in the area from where the boulders are picked up.
- Do not use boulders of diameter less than 0.15 m at any point which comes into contact with flowing water.