Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Enhancement of Nutrient and Water Use Efficiency Through Standardization of Engineering Support Systems for Precision Farming” funded by the Philippine Council for Agriculture, Aquaculture and Forestry and Natural Resources Research and Development - Department of Science and Technology (PCAARRD - DOST).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

Department Water Resources Government of Orissa. 2010. Guidelines for construction of check dams

Food and Agriculture Organization. 2001. Small earth dams and weirs in earth and gabion materials

Geyik, M.P. 1986. FAO conservation guide 13/2: Watershed management field manual.

Design of a Check Dam

1 Scope

This standard specifies the minimum design requirements and procedures for a check dam for the purpose of streamflow and/or runoff harvesting.

2 Definition

For the purpose of this standard, the following definitions shall apply:

2.1
check dam
small barrier built across the direction of water flow on shallow rivers and streams intended to convey runoff during peak flow and to slow and hold surface water long enough for the water to deposit sediment it is carrying; facilitates irrigation by using the upstream bay of the dam as pump sump

2.2
gabion
stones wrapped in wire fence meshes for added stability and strength

3 Classification of Check Dams

Check dams are classified based on the type of material used for construction. Table 1 shows the various types of check dams and design considerations and selection.

4 Site Selection

4.1 The length of the river or stream should be sufficient with adequate volume of stored water.

4.2 A drainage system should exist for effective water blocking.

4.3 The site shall be accessible for construction, operation and maintenance.

Table 1 – Classification of Check Dams

Type	Material	Bed Characteristics	Dam and Spillway
Brushwood Check Dam	posts and brush	Gradient: 5% -12% Depth: < 1 m Length: ≤ 100 m Catchment Area: ≤ 1 ha	Maximum dam height: 1 m Upstream and downstream face inclination: 30% backwards Spillway form: concave or rectangular
Log Check Dam	logs and posts planks, heavy boards, slabs, poles or old railroad ties	Length: ≤ 100 m Catchment Area: ≤ 2 ha	Maximum dam height: 1.5 m Upstream and downstream face inclination: 25% backwards Spillway form: rectangular Length of Spillway: 1 m -2 m Depth of Spillway: 0.5 m-0.6 m
Loose Stone Check Dam	relatively small rocks	Length: ≤ 100 m Catchment Area: ≤ 2 ha	Maximum dam height: 1.5 m Foundation depth: ≥ 0.5 m Downstream face inclination: 20% Upstream face: vertical Dam thickness at spillway level: 0.5 m-0.7 m
Boulder Check Dam	boulders	Length: ≤ 900 m Catchment Area: ≤ 20 ha	Maximum dam height: 2 m Foundation depth: ≥ 0.5 dam height Downstream face inclination: 30% Upstream face: vertical Dam thickness at spillway level: 0.7 m-10 m Spillway: Trapezoidal
Masonry Check Dam	cement mortar and non-disintegrating stones	Length: > 900 m Catchment Area: > 20 ha	Computations are shown in Section 5.2
Gabion Check Dam	gabions	Length: > 900 m Catchment Area: > 20 ha	Computations are shown in Section 5.3

ADOPTED FROM: Geyik, M.P. 1986. FAO conservation guide 13/2: Watershed management field manual.

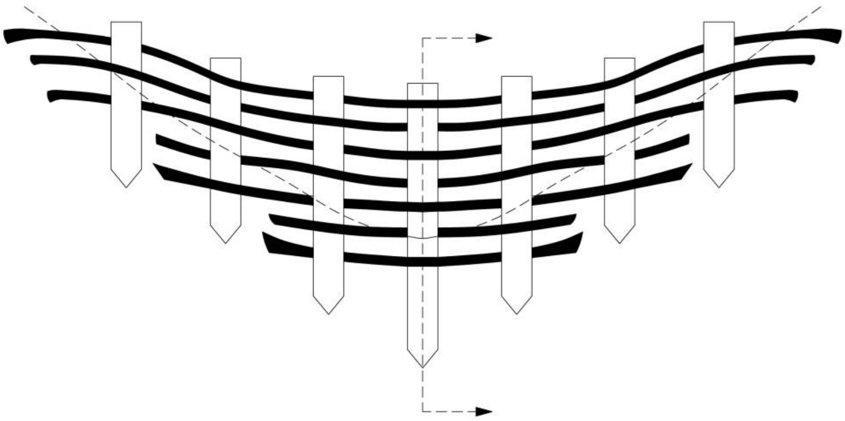

Figure 1 – Brushwood Check Dam

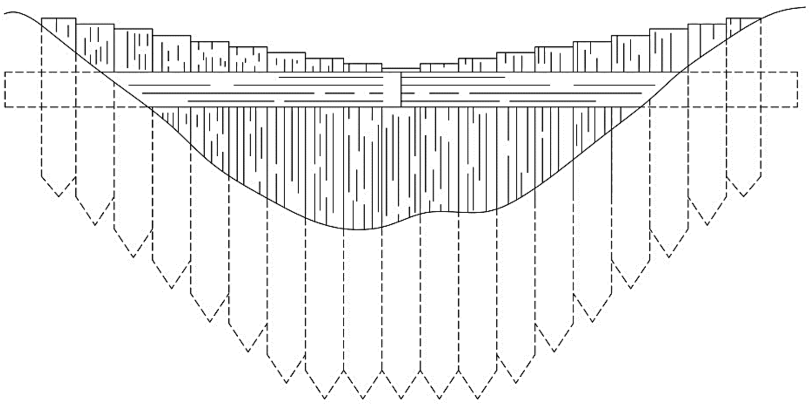

Figure 2 – Log Check Dam

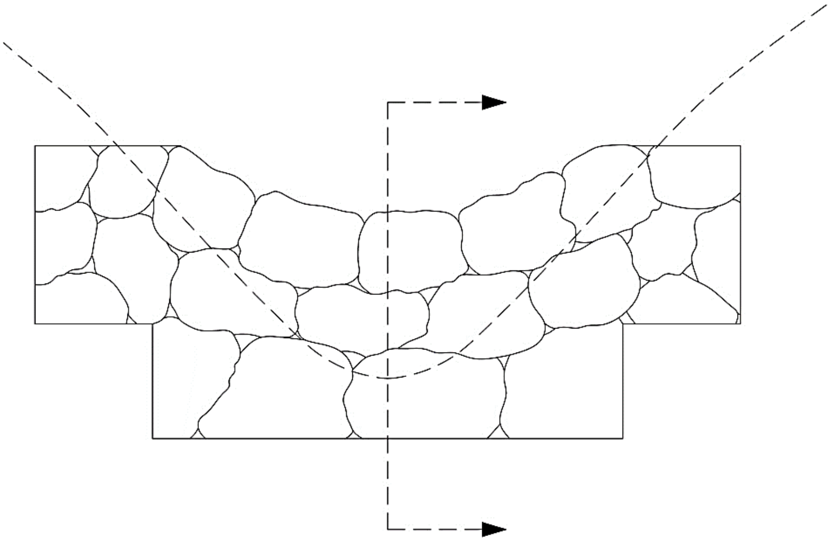

Figure 3 – Loose Stone Check Dam

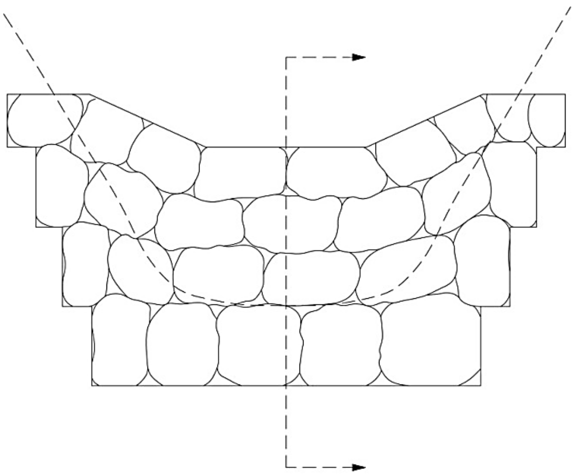

Figure 4 – Boulder Check Dam

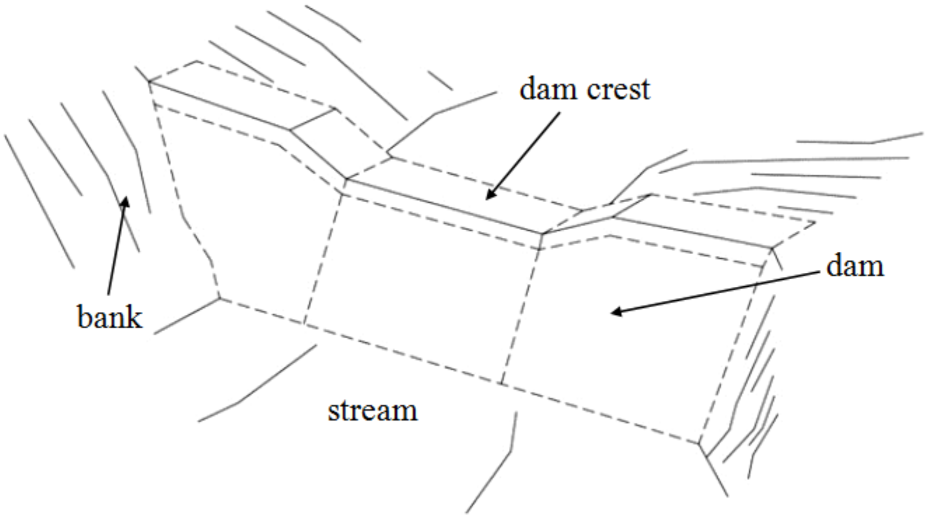

Figure 5 – Masonry Check Dam

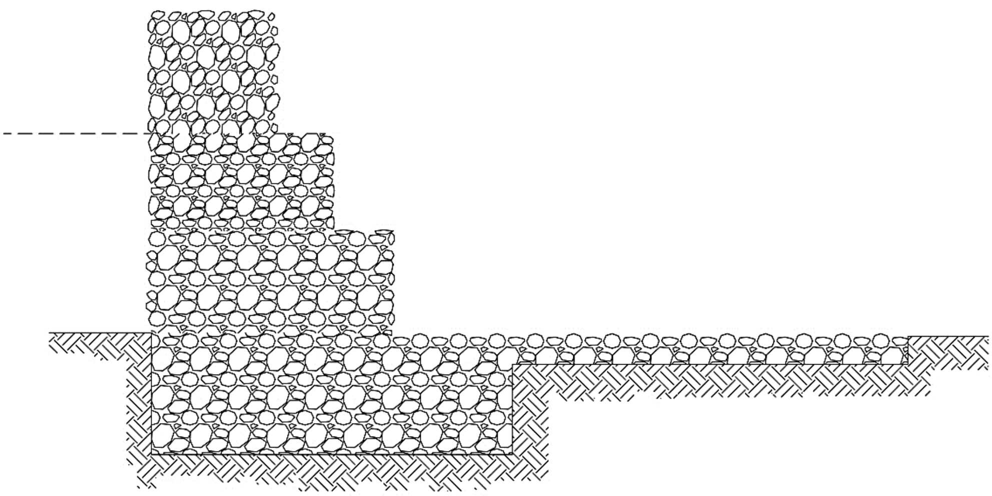

Figure 6 – Gabion Check Dam
SOURCE: FAO conservation guide 13/2: Watershed management field manual

5 Design Procedure

5.1 General

5.1.1 Estimate maximum discharge. Procedures in flood discharge analysis is detailed in Annex A of PAES 613:2016 – Design of a Diversion Dam.

5.1.2 Calculate spillway dimensions.

$$Q = CLD^{3/2}$$

where C = Coefficient which is 3.0 for loose rock, boulder log and brushwood check dams; 1.8 for gabion and cement masonry check dams
L = length of spillway, m
D = depth of spillway, m
Q= maximum discharge of the catchment area at the proposed check dam point, m^3/s

5.1.2.1 The length of the foundation shall be longer than the length of the spillway to prevent scouring and undermining by falling water.

5.1.2.2 The crest of rectangular and trapezoidal spillways should be level.

5.1.3 Check the stability of the check dam. For loose-stone, boulder, gabion and cement-masonry check dams, details of stability analysis are detailed in PAES 613: 2016 – Design of a Diversion Dam

5.2 Gabion Check Dam

5.2.1 If the total height of the gabion check dam is < 3 m, box gabions of the following dimensions may be used:

- 1 m x 1 m x 2 m
- 0.85 m x 0.85 m x 2 m
- 0.75 m x 1.5 m x 3 m

5.2.2 If the total height of the gabion check dam is 3 m to 5 m, use the following formula

$$k = 0.4H$$
$$d = 0.6H$$
$$f = 0.3H$$

where
k = thickness of the dam's crest at spillway level, m
d = thickness of the dam's base, m
f = depth of foundation, m
H = total height of the dam including foundation, m

5.2.3 The stones shall be hard enough to with stand abrasion, non-disintegrating, and resistant to weathering and packed inside the boxes. The bigger stones should be put along the sides of the box gabions while the smaller ones are filled in the middle.

5.2.4 When using box gabions which are 2 m long, after they are one-third full, 5 parallel ties should be placed between their inner and outer sides. Five more should be placed when the boxes are two-thirds full. Four corner ties should be placed.

5.2.5 A lid should be laced with binding wire to the top of all the sides after overfilling a box gabion slightly to allow for subsequent settlement. It lid must be stretched to fit exactly to the sides.

5.2.6 If there is more than one layer of boxes in a gabion check dam, the ones in the upper layer should be laced to those below. A strong inter-connection of all units is an important feature of the technique. Therefore, it is essential that the lacing is done correctly.

5.2.7 If it has layers and is no higher than three meters a binding box gabion shall be placed in the middle or top layer.

5.2.8 The space behind the dam and wing walls shall be filled with soil excavated for the foundation and from the gully bed.

5.2.9 Wings shall enter at least 50 cm into each side of the gully and they should be protected against flash water by wing walls. The angle between the wing and wing wall is 0 to 45 degrees. The height of a wing wall is equal to the depth of the spillway.

5.3 Masonry Check Dam

5.3.1 If the total height of the masonry check dam is < 2 m, crest thickness should be 0.4 m. The base thickness is calculated according to the height and inclination of the dam's downstream face.

5.3.2 If the total height of the masonry check dam is 2 m to 6 m, use the Hoffman formula

$$d = 0.462\ H$$

where
d = thickness of the dam's base, m
H = total height of the dam including foundation, m

5.3.3 If the total height of the masonry check dam is 6 m to 8 m, use the formula

$$k = \frac{1 + 10\ H}{10}$$

where
k = thickness of the dam's crest at spillway level, m
H = total height of the dam including foundation, m

5.3.4 The dams shall not be constructed on points where there is mass movement of soil blocks and shall be built on a bed or torrent channel's stable points just below the sliding area to hold debris and material as well as to stop the movement of soil blocks.

5.3.5 The foundation of the first dam shall be dug to a durable layer below, such as solid rock. If there is no solid layer, the foundation shall be dug at least 1 m deep, and a reinforced, concrete layer at least 20 cm thick shall be constructed. On this concrete layer, the body of the first masonry check dam shall be built with sharp-edged and non-disintegrating stones, and Portland cement mortar (250 kg cement per cubic meter of sand. The ratio by weight is 1:4 or 1:5).

5.3.6 The foundation of the other dams shall be at least 1 meter deep, if they are not constructed on solid rock. The inclination of the base's upstream face is minus 20%.

5.3.7 The wings shall enter at least 1 meter into the sides of the bed.

5.3.8 An aqueduct (diameter 20 to 50 cm) shall be built on ground level and drainage holes (diameter of each hole at least 10 cm) shall be made during the construction of the dam. The vertical and horizontal distances between the holes are one and two m respectively. The gradient of the aqueduct and drainage holes is 5%.

5.3.9 The upstream face of the dam is vertical, whereas its downstream face inclination is 20 % (1:1/5 ratio).

5.3.10 The stones shall be piled behind the mouth of the aqueduct. If possible, the space behind the dam should be filled to the spillway with soil excavated for the foundation and from the gully bed.

5.3.11 Wing walls shall be built behind the wings of the dam to protect them against flash water. The angle between the wing and wing wall is 30 to 45 degrees. The space behind the wings should be filled with soil. The height of the wing walls is equal to the depth of the spillway. The construction of wing walls is dry rock work.

5.3.12 The stones used in constructing masonry check dams shall be hard enough to withstand abrasion, non-disintegrating, and resistant to weathering.

5.3.13 A counter-dam shall be constructed in front of the first masonry check dam. It shall be built as cement masonry work.