Block & Aggregate Drop Inlet Protection

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow		Sandy Soils	✓
Type 2 System	[1]	Concentrated Flow	✓	Clayey Soils	✓
Type 3 System	✓	Supplementary Trap		Dispersive Soils	

[1] A Type 2 sediment containment system may be formed if the sediment trap is designed in accordance with the guidelines established for *Rock Filter Dams*.

Symbol

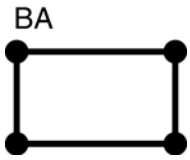

Photo 1 – Block and aggregate drop inlet protection supported by internal timber frame

Photo 2 – Block and aggregate drop inlet protection placed around a drainage inlet within a dual carriageway median strip

Key Principles

1. This system can be designed to operate under two different modes of operation:
   - A Type A structure is designed as a low-flow system (Photo 3) that results in the formation of a settling pond of a specified surface area to promote 'sedimentation' of a specified standard—in such cases flow through the aggregate filter is restricted to allow the slow draining of the settling pond.
   - A Type B structure is designed as a high-flow system (Photos 1, 2 & 4) that promotes the 'filtration' of the sediment-laden water by maximising flow through a combined aggregate and geotextile filter. Sedimentation is encouraged only during high flows when the structure is overtopped.
2. In a Type A system the critical design parameter is the surface area of the settling pond that surrounds the block and aggregate drop inlet protection. In this system the number of de-watering holes formed in the block wall is limited to one per side (Figure 3).
3. In a Type B system the critical design parameter is the allowable flow rate through the combined aggregate and geotextile filter. In this system the number of de-watering holes formed in the block wall is maximised, especially within the lower row of blocks.
4. The primary safety issues relate to the maximum depth of ponding (critical in publicly accessible areas), and ensuring water does not pond on the adjacent roadway (critical for preventing safety risks to passing traffic).

Design Information

Table 1 can be used to select the preferred type of block and aggregate sediment trap for various site conditions and performance outcomes.

Table 1 – Selection of preferred type of block and aggregate sediment trap

Type	Site conditions and performance outcomes
Type A (low-flow system)	• Site conditions allow extensive ponding around the sediment trap. • Large catchment areas where it is unlikely that the nominated design flow rate will be able to pass through a filtration system. • A long service life is required for the sediment trap.
Type B (high-flow system)	• Site conditions significantly restrict the potential surface of the settling pond. • Small catchment areas resulting in low runoff rates [1]. • A short service life is required for the sediment trap. • These systems are likely to require regular maintenance to remove sediment blockages from the filtration system.

[1] Even though a Type B block and aggregate sediment trap is described as a 'high-flow' system, this refers only to the flow rate passing through the filter. In a Type A system, most of the design flow passes over the crest of the structure rather than through the filter. In a Type B system most of the design flow passes through the sidewall filters, thus Type B systems are only suitable for relatively low design flow rates, and thus small catchment areas.

Photo 3 – Type A block and aggregate sediment trap (note, most blocks are turned upwards to prevent through-flow)

Photo 4 – Type B block and aggregate sediment trap (note, most blocks are turned sideways to allow through-flow)

In a Type A system:

- The primary purpose of the aggregate is to allow the sediment trap to freely drain, thus reducing safety risks and allowing sediment trap to be de-silted after major storms. However, the aggregate also allows for the filtering of low flows to achieve a higher water quality during periods of light rainfall.
- During low flows, the trapping of coarse sediment is primarily achieved through gravitational settlement within the settling pond that forms around the stormwater inlet. A limited quantity of finer sediments may be filtered from any water as it passes through the aggregate.
- During high flows, sediment trapping is solely achieved through gravitational settlement within the settling pond.
- If insufficient pond surface area is provided around the inlet, then the sediment trapping efficiency will be significantly reduced and settled sediment will quickly block the aggregate filter.

In a Type B system, sediment capture is primarily through the filtration of water passing through the sidewall filtration system. The appropriate placement of filter cloth can be critical. Inappropriate placement can result in excessive sediment blockage and maintenance problems.

Type A block and aggregate drop inlet protection

Table 2 presents the design requirements for **Type A** block and aggregate drop inlet protection systems for various sediment control classifications.

Table 2 – Design requirements of Type A block and aggregate drop inlet protection systems

Sediment control classification [1]	Design requirements
Type 2	• Minimum surface area (per unit flow rate) of the settling pond during the design flow complies with the requirements for a critical particle size of 0.045 to 0.14mm as presented in Table 3. • Absolute minimum surface area (per unit flow rate) of the settling pond during the design flow of 80$m^2/m^3/s$.
Type 3	• Minimum block height of 300mm.
All cases	• Recommended block height of 300mm (min) to 600mm (max). • Maximum of 1 block per side used as a de-watering flow path.

[1] Discussion of the sediment control classification system is provided in a separate fact sheet.

Table 3 provides the minimum surface areas per unit flow rate of the settling pond for various treatment standards.

Table 3 – Minimum settling pond surface area per unit inflow rate ($m^2/m^3/s$)

Sediment trapping standard	Critical particle size (mm)	Pond water temperature [2]		
		10° C	15° C	20° C
Type 3	**0.20**	45	39	35
	0.15	80	70	61
Type 2	**0.10**	180	160	140
	0.05	720	630	555

[1] Minimum pond area is based on the theoretical (Stokes' Law) minimum pond size plus a 20% safety factor to account for inflow jetting and other variables.

[2] Pond temperature may be assumed to be the same as the typical rainwater temperature during the time of year when the pond is likely to be in operation; otherwise, assume 15 degrees.

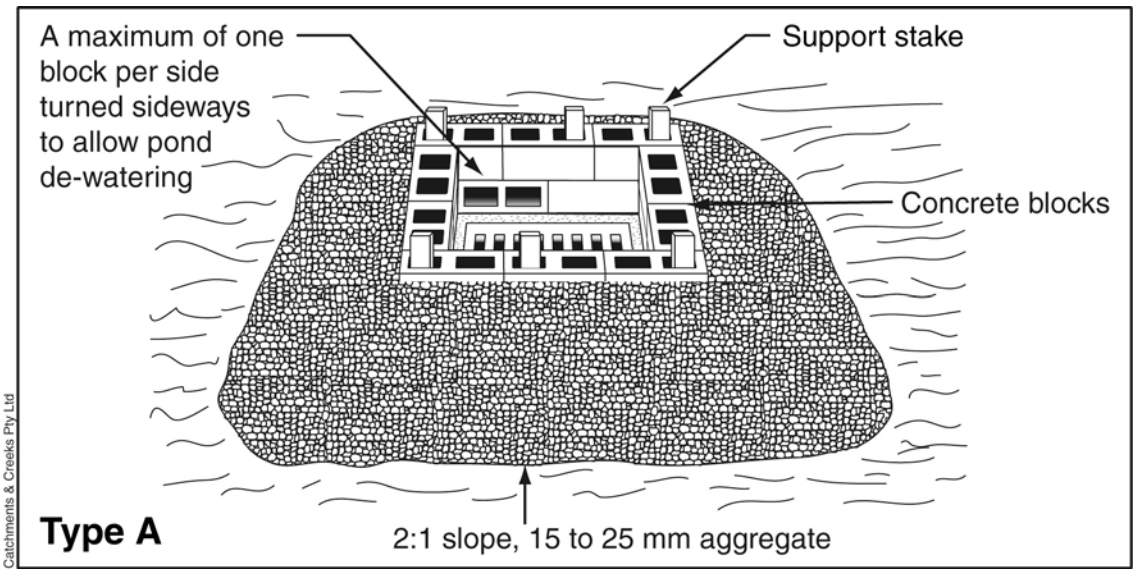

Figure 1 – Type A block and aggregate drop inlet protection

Type B block and aggregate drop inlet protection

Type B systems are design using the procedures set out for *Rock Filter Dams* (refer to separate fact sheet). Their design and operation are critically dependent of the determination of the allowable flow rate passing through the sidewalls of the structure. This requires an assessment of the hydraulics of aggregate and geotextile filters.

Table 4 presents the design requirements for **Type B** block and aggregate drop inlet protection systems for various sediment control classifications.

Table 4 – Design requirements of Type B block and aggregate drop inlet protection systems

Sediment control classification [1]	Design requirements
Type 2	• Minimum geotextile filter specifications: pore size EOS less than 160microns, O_{95} less than 90microns; minimum mass of 300gsm (minimum 'bidim' A44 or equivalent). • Specified design flow rate able to pass through the combined aggregate and geotextile filter system (based on 50% blockage) without flow overtopping the structure [2]. • Absolute minimum surface area (per unit flow rate) of the settling pond during the design flow of $80m^2/m^3/s$.
Type 3	• Any 2 of the above requirements satisfied. • Minimum block height of 300mm.
All cases	• Recommended block height of 300mm (min) to 600mm (max). • Filtration system consists of a combined geotextile and aggregate filter. • Maximum nominal aggregate size of 25mm. • The maximum number of the lower row of blocks on each side turned sideways to act as de-watering holes. • Wherever practical, the upper rows of block should ideally stand vertically such that flow is prevented from passing through the blocks. Thus, all de-watering flows are required to pass through the greatest width of aggregate filtration.

[1] Discussion of the sediment control classification system is provided in a separate fact sheet.

[2] The design flow rate is based on the specified design storm in which the sediment control standard (Type 2 or 3) is required to be satisfied.

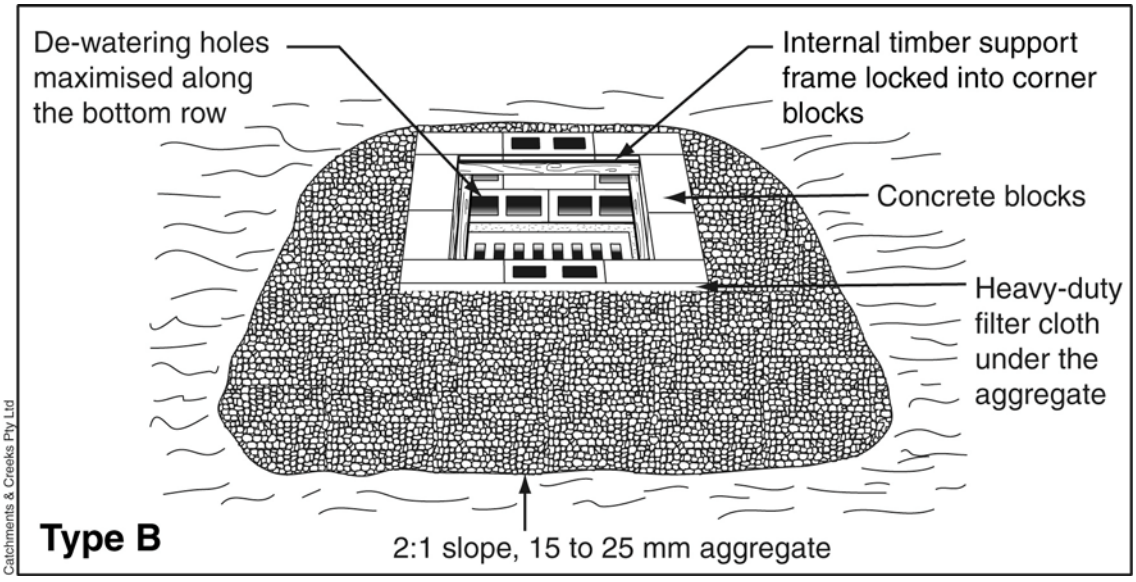

Figure 2 – Type B block and aggregate drop inlet protection

Installation procedure (Type A system shown)

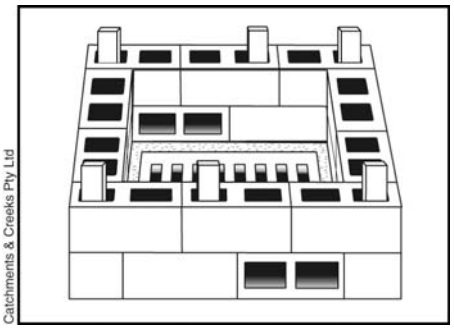

Figure 3 – Stage 1: Placement of blocks (Type A)

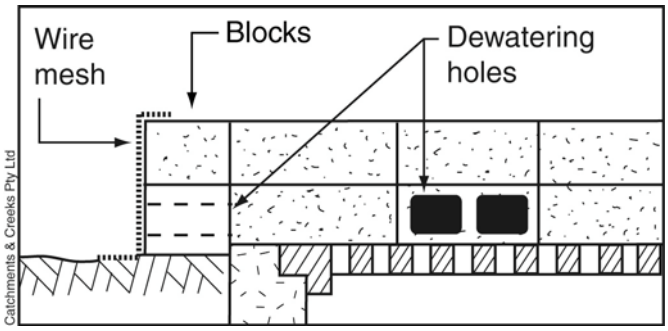

Figure 4 – Stage 2: Placement of wire mesh

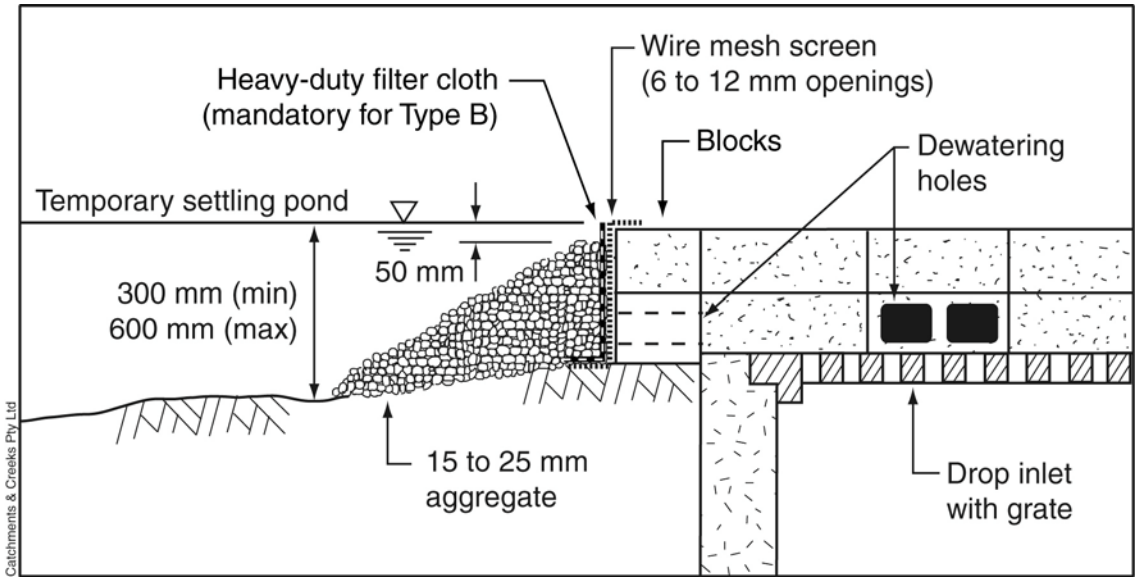

Figure 5 – Stage 3: Placement of filter cloth (if required) and aggregate filter

Temporary flow control bunds may be required to control the depth and extent of ponding and to prevent water bypassing the inlet. The crest of these banks should be at least 150mm above the crest of the support blocks placed around the stormwater inlet.

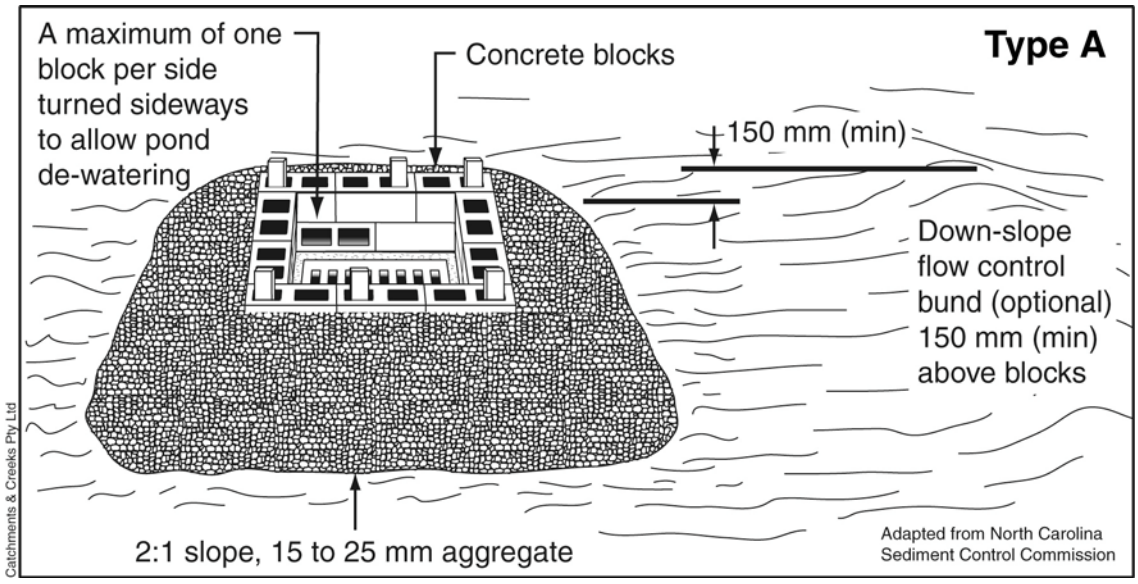

Figure 6 – Block & aggregate drop inlet protection shown with an optional flow control bund to manage water ponding around the stormwater inlet

Description

Block and aggregate drop inlet protection systems consist of hollow, concrete blocks secured around the outer rim of a stormwater inlet. At least one block on each is side turned sideways to allow water to flow through the void. Aggregate and possibly filter cloth is placed around the blocks to filter low-flows.

The crest of the blocks acts as a high-flow bypass that regulates the maximum depth of the settling pond.

Where necessary, the sediment trap is partially surround by a flow control bund to control the depth and extent of ponding.

There are two distinct design philosophies depending on site conditions. A Type A system primarily relies on the establishment of a settling pond of specified surface area. A Type B system primarily relies on the filtration of the design flow through the sidewalls of the sediment trap.

Purpose

Used to remove and retain sediment from stormwater runoff before it enters an underground drainage network.

Most commonly used in road construction as a sediment trap around field (drop) inlets located within the median of dual carriageways.

Limitations

These types of sediment traps provide limited turbidity control, and are generally classified as either Type 2 or 3 sediment traps.

Catchment area limited to around 0.4 ha.

Not suitable for inaccessible areas where regular maintenance cannot be performed on the sediment trap.

Can become a traffic safety hazard.

Advantages

Simple to construct and remove.

Generally structurally sound even during severe storms.

Can assist in reducing sediment build-up in stormwater drains and culverts, thus reducing the cost of post storm clean-up.

Disadvantages

Generally requires regular maintenance due to the relatively small sediment storage area.

Drainage and flooding problems can occur if poorly designed or poorly maintained.

Clays and silts can quickly block the aggregate and geotextile filters.

Common Problems

Drainage and flooding problems can occur if the 'filter' blocks with sediment.

Can be damaged by road traffic.

Special Requirements

It is essential to exercise extreme caution when placing these devices along public roadways.

Sediment blockage of the trap may cause flooding and traffic safety problem.

Adequate ponding must be allowed to occur around the sediment trap in order to achieve particle settlement.

Where necessary, a flow control bund may need to be used to control the depth and extent of ponding.

Location

Surrounding field (drop) inlets.

Stormwater inlets located within the median of dual carriageways.

This concept can also be adopted for the control of sediment at the inlets culverts and stormwater pipes.

Site Inspection

Check that the correct type of structure has been installed.

Check that the number and location of de-watering holes are appropriate for the type of structure.

Take note of where bypass flows will travel.

Look for potential flooding or traffic safety problems.

Check the maximum allowable pond depth.

Check the height and stability of any associated flow control bund.

Materials

- Concrete blocks: precast open-void concrete blocks.
- Aggregate: 15 to 25mm crushed rock.
- Filter cloth: 'bidim' A44 (min) or the equivalent.
- Mesh: wire mesh with 6 to 12mm open grid.

- Posts/studs: minimum 1500mm^2 (min) hardwood, 2500mm^2 (min) softwood, or 1.5kg/m (min) steel star pickets.
- Timber cross-members: typically 25 x 75mm timber lengths.

Installation

1. Refer to approved plans for location and dimensional details. If there are questions or problems with the location, dimensions or method of installation contact the engineer or responsible on-site officer for assistance.
2. Check that the plan identifies the type of structure (Type A or B). If not identified, contact the engineer or responsible on-site officer.
3. Prior to installation, check that the installation of the sediment trap will not cause undesirable safety or flooding issues.
4. Excavate a level foundation the width of the blocks and at least 50mm below the crest of the storm drain. Place the bottom row of blocks against the edge of the storm drain for lateral support and to avoid wash-outs when overflows occur. All blocks should be placed without mortar.
5. For Type A structures: on each side of the structure lay one block in the bottom row on its side to allow flow to pass through the block wall into the drainage. All other blocks should be laid with the cavity face-up.
6. For Type B structures: all blocks on the bottom row should be laid on their side to allow flow to pass through the blocks. All other blocks should be laid with the cavity face-up.
7. Install additional rows of blocks as required to obtain the specified structure height. The top of the block wall should operate as a spillway to control the maximum pond depth.
8. Ensure the maximum pond depth will not cause a safety hazard, including undesirable flooding of an adjacent property or roadway.
9. For Type A structures: if needed, anchor the blocks with timber studs or metal stakes.
10. For Type B structures: if needed, secure the blocks with an internal timber frame anchored into the cavity of the corner blocks.
11. Place wire mesh over the outside face of all block openings to hold aggregate in place.
12. If specified (mandatory for Type B structures) place heavy-duty filter cloth over the wire mesh. To minimise the risk of sediment blockage of the filter cloth, place a layer of aggregate against the wire mesh before wrapping the sidewalls with the filter cloth (this increases the effective surface area of the filter cloth).
13. Place aggregate around the structure at a stable slope, typically 2:1(H:V).
14. Where necessary, establish a flow control bund to control the extent and depth of the settling pond.
15. Take all necessary measure to minimise the safety risk caused by the structure and to prevent unsafe entry into the stormwater inlet.

Maintenance

1. Inspect the sediment trap after each runoff-producing rainfall event and make repairs as needed to the sediment trap and associated flow control bunds.
2. Remove collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Sediment deposits should be removed immediately if they represent a safety risk.

Removal

1. When the up-slope drainage area has been stabilised, remove all materials included deposited sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
2. Bring the disturbed area to a proper grade, then smooth, compact and stabilise and/or revegetate as required.