Rock Mulching

EROSION CONTROL TECHNIQUE

Revegetation		Temperate Climates	✓	Short-Term	
Non Vegetation	[1]	Wet Tropics	✓	Long-Term	
Weed Control	✓	Semi-Arid Zones	✓	Permanent	✓

[1] Rock mulching can be used in association with established plants and newly established seedings.

Symbol

Photo 1 – Rock mulching of garden bed in arid environment

Photo 2 – Rock mulching incorporated into stormwater bio-retention swale (post storm condition)

Key Principles

1. Generally used for weed and soil-moisture control on garden beds in arid and semi-arid areas.
2. Also used as an alternative to loose organic mulch in locations where a minor overland flow passes across or along a garden bed.
3. Critical design parameters are percentage cover (ideally 100%) and depth of cover (application rate) in low velocity areas, and mean rock size in areas of high flow velocity.

Design Information

Minimum 100% coverage of the soil surface.

Typically a layer thickness of at least 50mm or twice the nominal rock size (whichever is larger).

Nominal aggregate (rock) size of 25 to 200mm.

Do **not** place rock mulch directly on dispersive soil. Ensure dispersive soils are buried under at least 200mm of non-dispersive soil prior to placement of rock mulch.

Allowable flow velocities for rock with a specific gravity of 2.6 are presented in Table 1.

The equivalent allowable shear stress, based on a critical Shield's parameter of 0.07 and a safety factor of 1.5, is provided in Table 2.

The assumed Manning's roughness for the gravel (used to determine the allowable flow velocity from the allowable shear stress) is presented in Table 3. This Manning's roughness is based on a d_{50}/d_{90} = 0.8 (i.e. a relatively uniform rock size). Note; d_{50} is the nominal rock size of which 50% of the rocks are smaller.

Hydraulic design of rock mulching is only required if the surface is likely to be subjected to significant overland flow that could displace the rock or otherwise cause erosion.

Table 1 – Allowable flow velocity (m/s) for various rock sizes [1,2]

Hydraulic radius (mm)	Nominal mean (d_{50}) rock size (mm)					
	25	**50**	**75**	**100**	**150**	**200**
50	0.86	0.81	Highly turbulent, non-uniform flow. Assume an allowable velocity of 1.5m/s.			
75	1.04	1.03	0.99			
100	1.17	1.21	1.18	1.14		
150	1.35	1.47	1.48	1.46	1.40	
200	1.47	1.66	1.71	1.71	1.67	1.61
300	1.61	1.91	2.03	2.08	2.09	2.06
400	1.71	2.08	2.26	2.35	2.42	2.42
500	1.78	2.19	2.42	2.55	2.67	2.71

[1] Based on a relative density of 2.6 (i.e. rock mass of 2.6 tonne/m^3)

[2] Applicable to slopes less than 5%. Caution if applied to slopes of 5 to 10%.

Table 2 – Allowable shear stress (N/m^2) for various rock sizes [1]

Hydraulic radius (mm)	Nominal mean (d_{50}) rock size (mm)					
	25	**50**	**75**	**100**	**150**	**200**
N/A	18.3	36.6	54.9	73.2	109.8	146.3

[1] Based on a critical Shield's parameter of 0.07 and a safety factor of 1.5.

Table 3 – Assumed Manning's roughness (n) of gravel [1]

Hydraulic radius (mm)	Nominal mean (d_{50}) rock size (mm)					
	25	**50**	**75**	**100**	**150**	**200**
50	0.031	0.046	0.060	0.074	0.099	0.124
75	0.027	0.038	0.049	0.059	0.079	0.097
100	0.025	0.034	0.043	0.052	0.068	0.083
150	0.023	0.030	0.037	0.043	0.055	0.067
200	0.022	0.028	0.033	0.039	0.049	0.058
300	0.022	0.026	0.030	0.034	0.041	0.048
400	0.022	0.025	0.028	0.032	0.038	0.043
500	0.022	0.025	0.028	0.030	0.035	0.040

[1] Based on a rock size distribution of d_{50}/d_{90} = 0.8 (refer to Equation A19 in IECA 2008, Appendix A – *Construction site hydrology and hydraulics*).

The incorporation of flexible vegetation (e.g. native grasses) into rock-mulched swales (Photo 2) can significantly increase the allowable flow velocity compared to either non-vegetated rock, or vegetated swales without rock mulching. Currently information is not available on the allowable flow velocities for such vegetated, rock-mulched, drainage swales. Adoption of the allowable flow velocities presented in Table 1 would be considered a conservative design approach.

Description

Rock mulching is the application of a thick blanket of rocks, aggregate or gravel on the soil surface.

The term 'rock mulching' normally refers to the use of large rocks with little or no fines, with the mean rock size (d_{50}) based on the expected overland flow velocity.

The term 'gravelling' normally refers to the application of gravel, included fines, on roads and car parks. It is generally not used in areas of concentrated flow.

Purpose

Used for weed and soil-moisture control in garden beds and for the stabilisation of overland flow paths passing through garden beds.

When used as a garden mulch, it can assist vegetation growth by:

- reducing moisture loss from the soil;
- reducing watering demands;
- controlling soil temperature fluctuations;
- reducing soil erosion around the root system of juvenile plants.

Rock mulching controls soil erosion by:

- reducing raindrop impact;
- protection the soil from high velocity flow;
- reducing wind erosion.

Rock mulching can also be useful in arid and semi-arid areas where continuous vegetation cover is difficult to achieve, but severe storm events, and therefore raindrop impact, can still occur.

Limitations

The rock mulch should cover 100% of the soil surface to give adequate protection against erosion.

Rock mulching should **not** be placed directly onto dispersible soils. Instead dispersive soil should be covered with a minimum 200mm layer of non-dispersive soil before rock placement.

Advantages

Produces a low cost, trafficable surface.

Disadvantages

May not provide effective long-term weed control unless incorporated with an underlying weed control blanket.

Location

Garden beds in arid and semi-arid areas

Garden beds and overland flow paths not protected with groundcover vegetation.

Bridge abutments under heavy shade-producing decks that can limit vegetation growth.

Common Problems

Severe erosion (rilling) regularly occurs when rock mulching is placed directly over a dispersive soil. To reduce the potential for such problems, dispersive soil should be covered with a minimum 200mm layer of non-dispersive soil before rock placement.

Note: a filter layer, such as filter cloth, usually does not provide adequate protection (i.e. isolation and containment) of the underlining dispersive soils.

Special Requirements

Important to make sure overland flow is not deflected along the edge of the rock mulch, but is allowed to flow freely across the treated area.

For effective weed control, place the rock mulch over a suitable weed control blanket.

Site Inspection

Check for erosion along the up-slope edge of the rocks.

Check rock size and percentage cover.

Performance Indicators

Application depth measured at random test locations.

Aggregate size, and particle size range measured using conventional particle size test procedures (if required).

Installation

1. Refer to approved plans for location, extent, and application details. If there are questions or problems with the location, extent, or method of application contact the engineer or responsible on-site officer for assistance.
2. Spread enough rock to completely cover the surface of the soil at the density or thickness specified in the approved plans. If the application density is not supplied, then apply at a thickness of at least 50mm or twice the nominal rock size (whichever is greater).
3. If the exposed soils are dispersive, then ensure these soils are covered with a layer of non-dispersive soil (minimum 200mm) before placement of rock.
4. Make all necessary adjustments to ensure any surface flow is allowed to pass freely across the treated area following its natural drainage path.

Maintenance

1. Inspect all treated surfaces fortnightly and after runoff-producing rainfall.
2. Check for rill erosion, or dislodgment of the rocks.
3. Replace any displaced rocks to maintain the required coverage.
4. If wash-outs occur, repair the slope and reinstall rock cover.
5. If the rock mulching is not effective in containing the soil erosion it should be replaced, or an alternative erosion control procedure adopted.