BANGLADESH UNIVERSITY OF PROFESSIONALS

Military Institute of Science and Technology

B.Sc. in Environmental, Water Resources and Coastal Engineering, Term Final (Spring) Examination 2021: July-Aug 2021

Student Group: Earned Credit Hours > 108

Subject: EWC 471, Basic Coastal Engineering

Total	**: 3.00 hours (For Physical Examination)**	**Full Marks**	**: 180**
	: 2.00 hours (Online Examination for Section-A + Section-B)		
Section A	**: 1.00 hour (Online Examination)**	**Section A**	**: 90**

INSTRUCTIONS - PHYSICAL EXAMINATION

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 1** in **Section-A** is compulsory.
c. Answer any **OTHER TWO** questions from **Section-A**.
d. Figures in the margin indicate **full marks.**
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

INSTRUCTIONS - ONLINE EXAMINATION (IF PHYSICAL EXAMINATION IS NOT HELD)

a. **Question - 1** and **Question - 4 OR** (Viva Voce) in **Section A** are compulsory.
b. Answer any **OTHER ONE** question from **Q-2 & Q-3** of **Section-A**.
c. Instructions mentioned in d, e and f for physical examination are also applicable for Online Examination.

SECTION-A

Question – 1 **(Compulsory)**

a. State the physical description of coastal zone of Bangladesh. How does the Cyclone Preparedness Programme work during a coastal cyclone. 07

b. The shoreline is a dynamic interface explain the statement in context to coastal morphological and geological process. 07

c. Suppose you are observing waves at Cox's Bazar coast. A wave is travelling from a depth of 380m towards the shore. Sea bottom has a uniform slope of 25H:1V. The approaching wave has a period of 8.2 seconds. At a depth of 4.5 m near the shore, calculate the following parameters using small amplitude wave theory. 16

i) Wave length and celerity.
ii) Local horizontal and vertical accelerations at a location of 2.5 m below the still water level, when $kx-\omega t = \frac{\pi}{4}$ and H = 1.8 m.
iii) Energy and Power of wave, when H = 1.8 m.

Question – 2

a. 'Rip currents are dangerous to the swimmers'- explain it. How the barrier islands and coastal dunes are formed? 07

b. Differentiae among the various wave theories – Airy, Sokes finite amplitude, Cnoidal and Solitary wave theory. 07

c. A broken wave is hitting a vertical breakwater of length 250 m, as shown in the figure below (Figure-1). 16

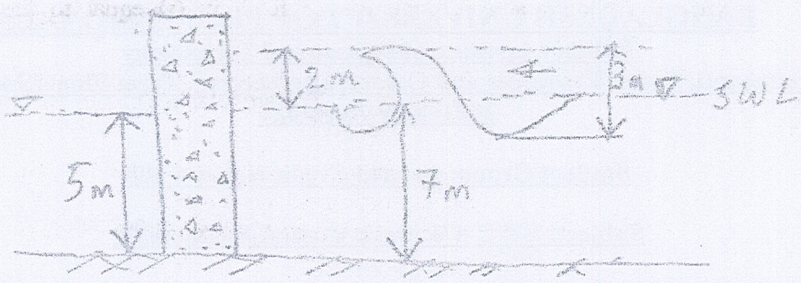


Figure-1 for Q.2(c)

Calculate the total force and moment by the wave on the breakwater.

Question – 3

a. Write down the short notes on 07

(i) Ring of fire,
(ii) DART.

b. Explain different types of wave breaking and also show them with neat sketches. 07

c. The measured wave heights and periods of 34 waves of a wave train are given in Table – 1 below. Calculate 16

(i) Significant wave height and period
(ii) One-tenth wave height and period
(iii) Root-mean square wave height.

Table – 1

SL. No.	Wave height (m)	Wave period (s)	SL. No.	Wave height (m)	Wave period (s)
1	1.25	6.6	18	1.4	6.6
2	4.0	5.9	19	2.7	5.8
3	3.6	8.6	20	0.9	3.2
4	0.8	3.5	21	1.7	6.0
5	2.95	7.2	22	5.25	13.6
6	1.1	4.0	23	4.2	15.2
7	2.6	5.2	24	3.3	13.8
8	3.2	6.8	25	2.2	6.7
9	3.5	7.9	26	1.2	6.0
10	2.9	6.9	27	4.65	9.5
11	1.5	3.8	28	3.05	9.0
12	0.7	3.0	29	0.65	5.2
13	5.2	11.5	30	5.40	11.5
14	3.7	10.8	31	1.15	6.2
15	1.8	7.2	32	2.62	4.2
16	4.5	9.6	33	1.65	5.1
17	3.0	8.5	34	3.88	8.0

Question – 4

a. Define the following terms: 07

(i) Wind stress,
(ii) Moving wind field,
(iii) Triangular wing velocity and
(iv) Fetch length

b. State the procedure of estimating storm surge height at a enclosed bodies of water having Langhaar shape. 07

c. A fetch in an extra-tropical cyclone can be considered as 420 NM in length with a mean wind speed at 10 m height of 48 knots. It approaches to a coast where the continental shelf is 250 NM wide, the shelf edge is at 610 ft depth and the inshore zone can be considered as 45 ft deep. Compute the total storm surge height assuming: 16

(i) Steady conditions with the fetch 1.5 times the shelf width

(ii) An approach velocity of the fetch in (i) equal to the wind velocity.

(Figure-2, 3, 4 are attached).

OR

VIVA VOCE (Compulsory in case of Online Examination) 30

Useful Equations

$$L = \frac{gT^2}{2\pi} \tanh \frac{2\pi h}{L}$$

$$u = \frac{\pi H}{T} \frac{\cosh k(z+h)}{\sinh kh} \cos(\omega t - kx)$$

$$w = -\frac{\pi H}{T} \frac{\sinh k(z+h)}{\sinh kh} \sin(\omega t - kx)$$

$$a_x = \frac{2\pi^2 H}{T^2} \cdot \frac{\cosh k(z+h)}{\sinh kh} \sin(kx - \omega t)$$

$$a_z = -\frac{2\pi^2 H}{T^2} \cdot \frac{\sinh k(z+h)}{\sinh kh} \cos(kx - \omega t)$$

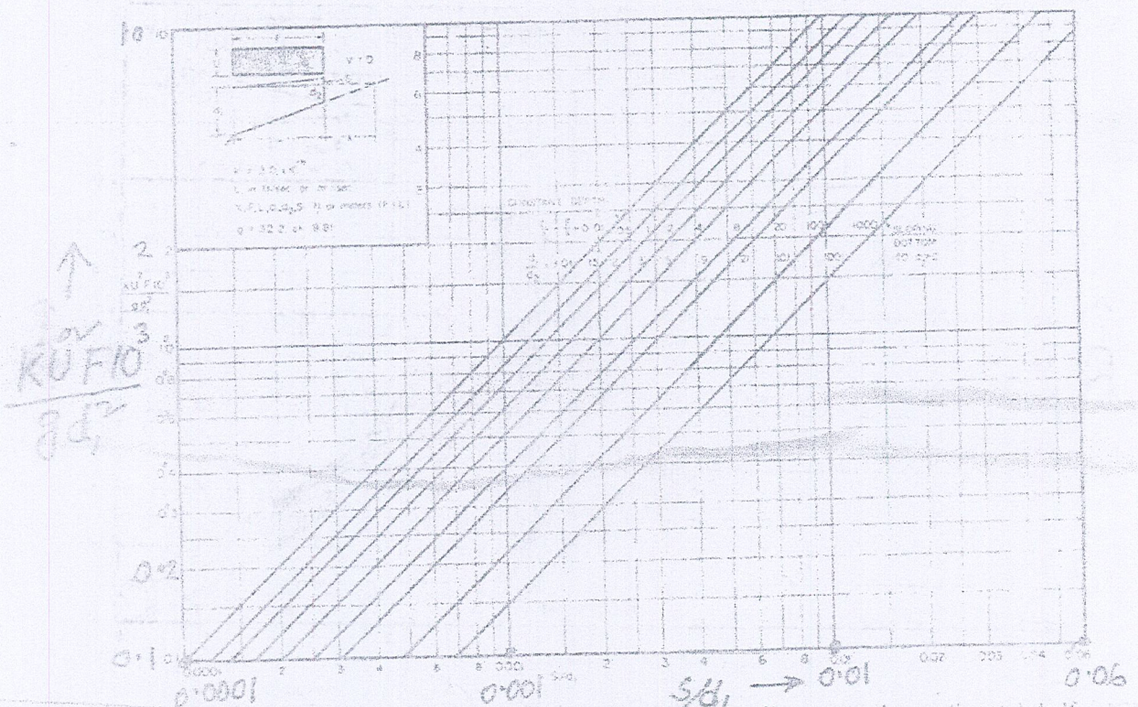


Figure-2: Surge produced by a static uniform wind field extending across the continental shelf.

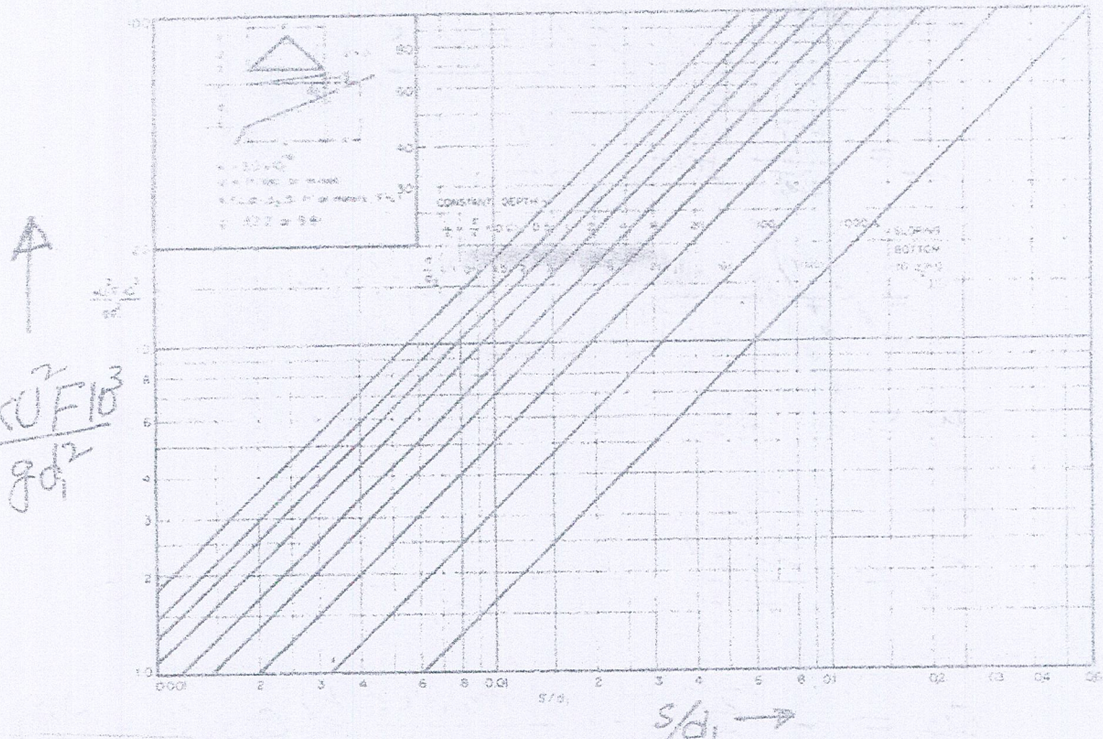


Figure-3: Surge produced by a static triangular wind field extending across the continental

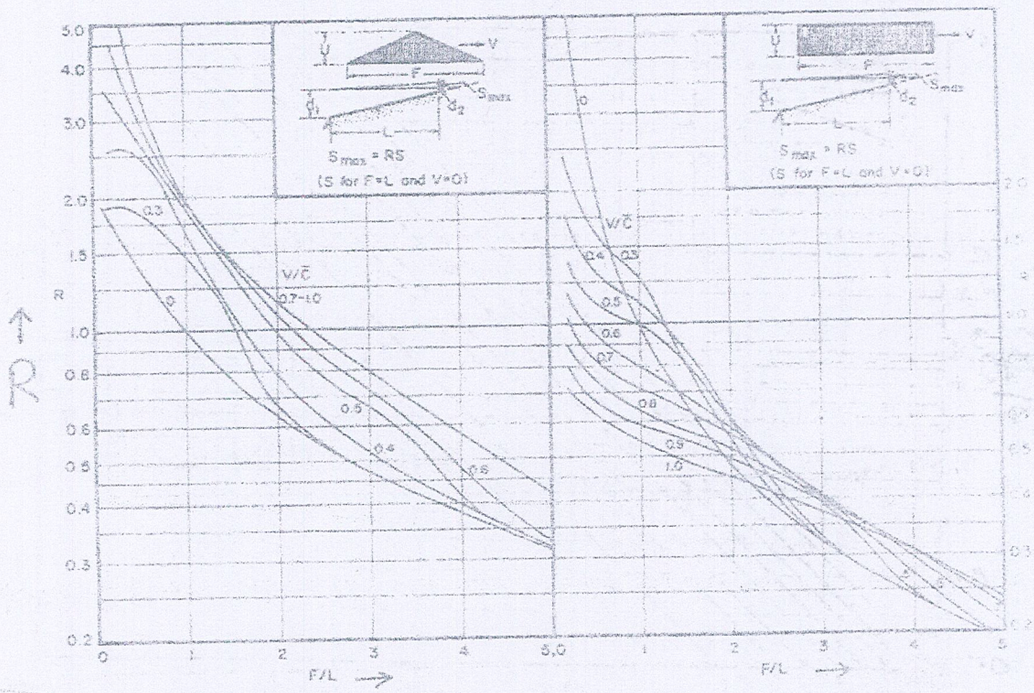


Figure-4: Optimum surge resulting from various fetch lengths and velocities of advance.

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INSTRUCTIONS - PHYSICAL EXAMINATION

a. Use **SEPARATE** answer scripts for each section.
b. **Question - 5** in **Section-B** is compulsory.
c. Answer any **OTHER TWO** questions from Section-B.
d. Figures in the margin indicate full marks.
e. Assume reasonable data if necessary.
f. Symbols and abbreviations used have their usual meanings.

INSTRUCTIONS - ONLINE EXAMINATION (IF PHYSICAL EXAMINATION IS NOT HELD)

a. **Question - 5** and **Question - 8 OR** (Viva Voce) in **Section B** are compulsory.
b. Answer any **OTHER ONE** question from **Q-6 & Q-7** of **Section-B**.
c. Instructions mentioned in d, e and f for physical examination are also applicable for Online Examination.

SECTION-B

Question – 5 **(Compulsory)**

a. State the features of different layers of conventional rubble mound breakwater. Also, show its cross section with neat sketch. 05

b. What design factor governs the formation of Tombolo and Salient in detached breakwater? Show the typical beach configurations with detached nearshore breakwater with neat sketches. 05

c. State the reasons and illustrate the modes of rear side erosion of a sloping front breakwater with capping due to wave overtopping. 05

d. The site and wave conditions along a coastal shoreline areas below: 15

Road level = 115 ft MLLW
Storm surge height = 8 ft
50 year high water level = 112 ft MLLW
MHHW = 110 ft MLLW
Bed level at the end of bank slope = 105 ft MLLW
R.L of MLLW = 100 ft
Bottom slope of sea bed = 1:50
Design wave height = 8 ft - $\frac{last\ two\ digit\ of\ your\ student\ ID}{50}$
Design wave period = 6 sec + $\frac{last\ two\ digit\ of\ your\ student\ ID}{50}$

Design a revetment type shore protection structure with quarry stone armor unit including the filter and toe protection. Also, show the design section with neat sketch. Use attached tables and graph.

Question – 6

a. Define the following terms: 05

(i) Height of tide
(ii) Mean sea level
(iii) Lunitidal interval
(iv) Locked basin
(v) Harbour of refuge

b. Why does tidal bore occur? Write down the principal characteristics. 05

c. What is the role of litoral drift in harbor layout? Suggest few remedies. 05

d. Explain how the adverse natural challenges have been taken care in laying out the Madras harbor in India. With neat sketches show the layout of Madras harbor with outer dock. 15

Question – 7

a. How waves and tidal currents transport material? Briefly discuss different methods. 05

b. List the input datasets for modeling the physical processes in the coastal zone of Bangladesh. Use your judgment. 05

c. How does longshore current change a beach? Briefly discuss with neat sketches. 05

d. Explain the coastal structures (i) submerged sill, (ii) storm surge barrier, (iii) sea wall and (iv) detached breakwater in context to their physical and functional characteristics. 15

Question – 8

a. How do wetlands protect shoreline from erosion? 05

b. Write down the geometric differences of tide dominated and wave dominated deltas. 05

c. State the criteria for designing coastal groins in terms of its length, cross section, height, orientation and layout. 05

d. Explain the Newton's static theory of tide generation and justify the statement "The moon has a more pronounced effect in generating, tides than the sun". Also describe the dynamical theory of tide generation. 15

OR

VIVA VOCE (Compulsory in case of Online Examination) 30

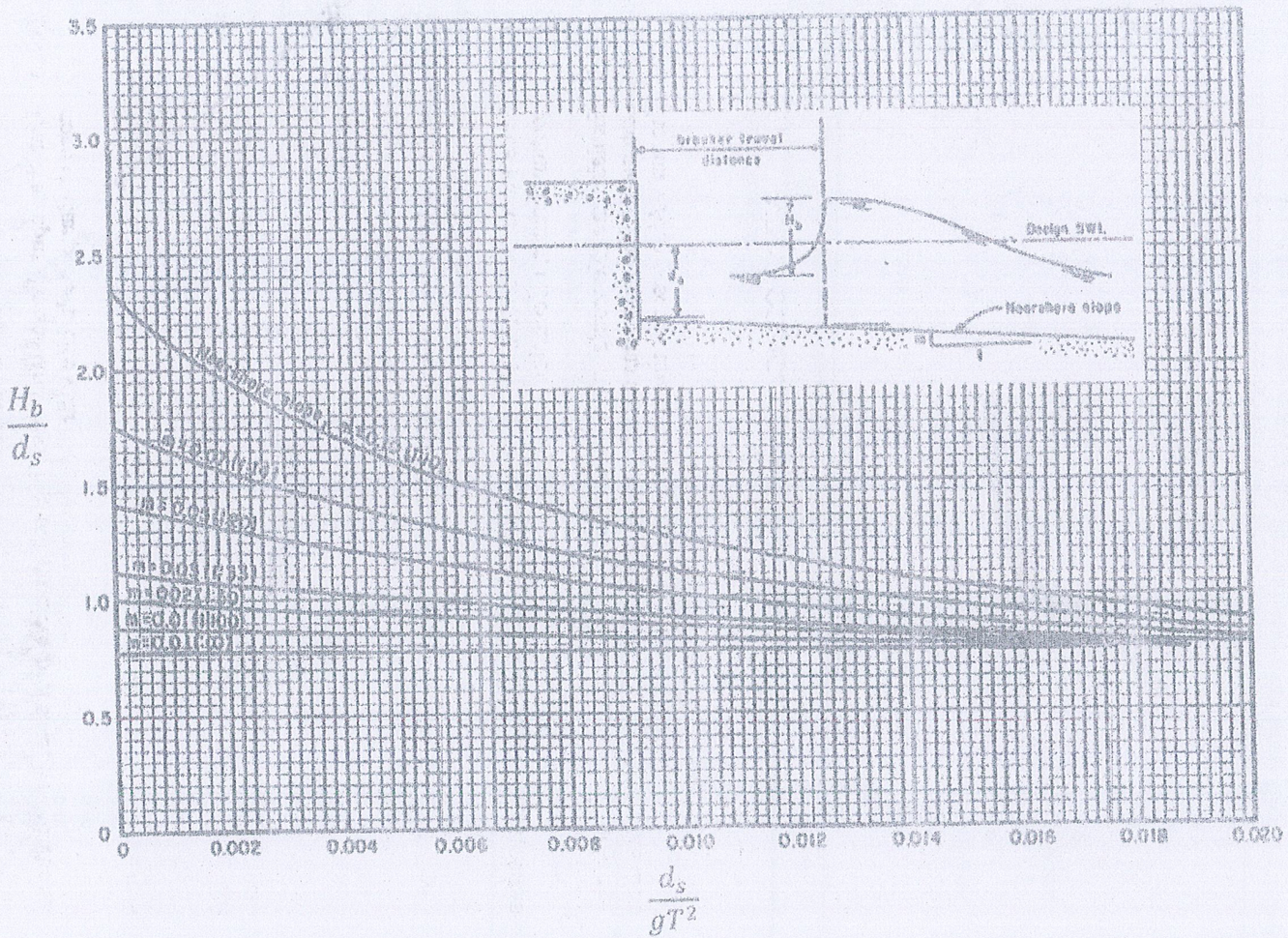


Figure ~~11~~ 5.1: Dimensionless Design Breaker Height Versus Relative Depth at Structure [Weggel (1972)]

for Question 5(d)

Table 5-1 for Question 5(a)

Table 2-2
Rough Slope Runup Correction Factors (Ceratsa et al. 1975b)

Armor Type	Slope (cot θ)	Relative Size H/K_r[a]	Correction Factor r
Quarrystone	1.5	3 to 4	0.60
Quarrystone	2.5	3 to 4	0.63
Quarrystone	3.5	3 to 4	0.60
Quarrystone	5	3	0.60
Quarrystone	5	4	0.66
Quarrystone	5	5	0.72
Concrete Blocks[b]	Any	8[c]	0.93
Stepped slope with vertical risers	1.5	$1 \le H_o'/K_r \le 4$	0.75
Stepped slope with vertical risers	2.0	$1 \le H_o'/K_r \le 4$	0.75
Stepped slope with vertical risers	3.0	$1 \le H_o'/K_r \le 4$	0.70
Stepped slope with rounded edges	3.0	$1 \le H_o'/K_r \le 4$	0.86
Concrete Armor Units			
Tetrapods random two layers	1.3 to 3.0	-	0.45
Tetrapods uniform two layers	1.3 to 3.0	-	0.51
Tribars random two layers	1.3 to 3.0	-	0.46
Tribars uniform one layer	1.3 to 3.0	-	0.50

[a] K_r is the characteristic height of the armor unit perpendicular to the slope. For quarrystone, it is the nominal diameter; for armor units, the height above the slope.
[b] Use H_o' for $d/H_o' > 3$; and the local wave height, H_o for $d/H_o' \le 3$.
[c] Perforated surfaces of Dolos Blocks, Nolos Blocks, Nonoslaps, and concrete masonry units placed hollows up.
[d] K_r is the riser height.

Table 5-2 for Question 5(d)

Table 2-3
Suggested Values for Use in Determining Armor Weight (Breaking Wave Conditions)

Armor Unit	n[1]	Placement	Slope (cot θ)	K_D
Quarrystone				
Smooth rounded	2	Random	1.5 to 3.0	1.2
Smooth rounded	>3	Random	1.5 to 3.0	1.6
Rough angular	1	Random	1.5 to 3.0	Do Not Use
Rough angular	2	Random	1.5 to 3.0	2.0
Rough angular	>3	Random	1.5 to 3.0	2.2
Rough angular	2	Special[2]	1.5 to 3.0	7.0 to 20.0
Graded riprap[3]	2[4]	Random	2.0 to 6.0	2.2
Concrete Armor Units				
Tetrapod	2	Random	1.5 to 3.0	7.0
Tripod	2	Random	1.5 to 3.0	9.0
Tripod	1	Uniform	1.5 to 3.0	12.0
Dolos	2	Random	2.0 to 3.0[5]	15.0[6]

[1] n equals the number of equivalent spherical diameters corresponding to the median stone weight that would fit within the layer thickness.
[2] Special placement with long axes of stone placed perpendicular to the slope face. Model tests are described in Markle and Davidson (1979).
[3] Graded riprap is not recommended where wave heights exceed 3 ft.
[4] By definition, graded riprap thickness is two times the diameter of the minimum W_{50} size.
[5] Stability of dolosse on slope steeper than 1 on 2 should be verified by model tests.
[6] No damage design (0 to 5 percent of units move). If no rocking of armor (less than 2 percent) is desired, reduce K_D by approximately 50 percent.

Table 5-3 for Question 5(d)

Table 2-4
Layer Coefficients and Porosity for Various Armor Units

Armor Unit	n	Placement	K_Δ	P (%)
Quarrystone (smooth)	2	Random	1.00	38
Quarrystone (rough)	2	Random	1.00	37
Quarrystone (rough)	≥3	Random	1.00	40
Graded riprap	2[a]	Random	N/A	37
Tetrapod	2	Random	1.04	50
Tribar	2	Random	1.02	54
Tribar	1	Uniform	1.13	47
Dolos	2	Random	0.94	63

[a] By definition, riprap thickness equals two cubic lengths of W_{50} or 1.25 W_{100}.