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# Applications of geosynthetic membranes in soil stabilization and coastal defence structures

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## Abstract

The use of geosynthetic in soil and coastal engineering is increasing and improving due to improvements in its engineering properties and fabrication techniques. While some geosynthetic coastal structures have attained advanced stage in terms of applications and efficiency, others still lack well-structured design formulas and specifications on a sound scientific basis, hence continued experimental works for the better understanding of the hydraulic performance, stability and modes of failure of these structures. Coastal areas are dynamic with unique geomechanical feature such as soil instability, which in any case, may affect the overall performance of coastal defence structures constructed on soft soil or weak foundation. This paper reviews the developments and applications of geosynthetics in soil stabilization and protection of coastal areas with emphasis on shoreline protection. Relevant empirical research data are presented as well as the present and likely future challenges in the use of geosynthetics in soil stabilization and coastal defence structures.

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**Keywords:** Geosynthetics; Shoreline protection; Coastal engineering; Hydraulic performance

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**Nomenclature**

CBR	California bearing ratio	$l$	length of sand container (m)
$\Delta h$	change in height of geotextile tube (m)	$H_m$	mean wave height (m)
$D$	characteristic diameter of sand container (m)	MSW	mechanically stabilized wall
$L$	circumference of the geotextile in a container (m)	MPASR	Multi-purpose artificial submerged reef
GSC	geosynthetic sand-filled containers	CR	over consolidation ratio
$C_1$ and $C_2$	GSC coefficients (-)	$n$	porosity of filling material (-)
$A$	cross-sectional area of GSC (m <sup>2</sup> )	PVD	prefabricated vertical drain
$L_o$	deep water wave length (m)	RSS-RW	reinforced soil segmental retaining wall
$d_{fill}$	degree of filling of GSC (-)	$\Delta_t$	relative density of geotextile tube (-)
$\rho_w$	density of water (kg/m <sup>3</sup> )	$\Delta_c$	relative density of submerge GSCs (-)
$\rho_E$	density of sand container elements (kg/m <sup>3</sup> )	$\frac{R_c}{H_c}$	relative freeboard (-)
a and b	dimensions of a flat rectangular sand bag (m)	SRW	segmental retaining wall
DEM	discrete element modelling	$H_s$	significant wave height (m)
$C_w$	empirical parameter (-)	$\alpha$	slope angle of GSC/geotextile tube structure (°)
EMI	Ernst-Mach-Institute	$G_s$	specific gravity of solid (-)
$R_c$	freeboard (m)	$N_s$	stability number (-)
$f$	friction coefficient between the geotextile and the concrete substructure (-)	$D_{50}$	thickness of armour layer of GSC (m)
$r(x)$	geosynthetic radius of curvature (m)	$\gamma_{slurry}, \gamma_{soil}$	unit weight of fill slurry and the consolidated soil (kN/m <sup>3</sup> )
GRS	geosynthetic reinforced soil	$\gamma_w$	unit weight of water (kN/m <sup>3</sup> )
GRS RW	geosynthetic reinforced soil retaining wall	$V$	volume of GSC/geotextile tube (m <sup>3</sup> )
$T$	geosynthetic tensile force (kN/m)	$B$	width of geotextile tube (m)
GWR	geotextile wrap-around revetment	SIM	stepped isothermal method
$p(x)$	hydrostatic pressure of the slurry (kN/m <sup>3</sup> )	TTS	time-temperature superposition
$H_s$	incident significant wave height (m)	PET	polyethylene-terephthalate
$h_o$	initial height of geotextile tube (m)	HDPE	high density polyethylene
$w_o$ and $w_f$	initial and final water content of fill material (-)	RLT	rapid load tensile tests
$\xi_o$	iribarren number (-)	UTM	universal testing machine
$l_c$	length of the critical sand container (m)	DEM	discrete element modelling

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