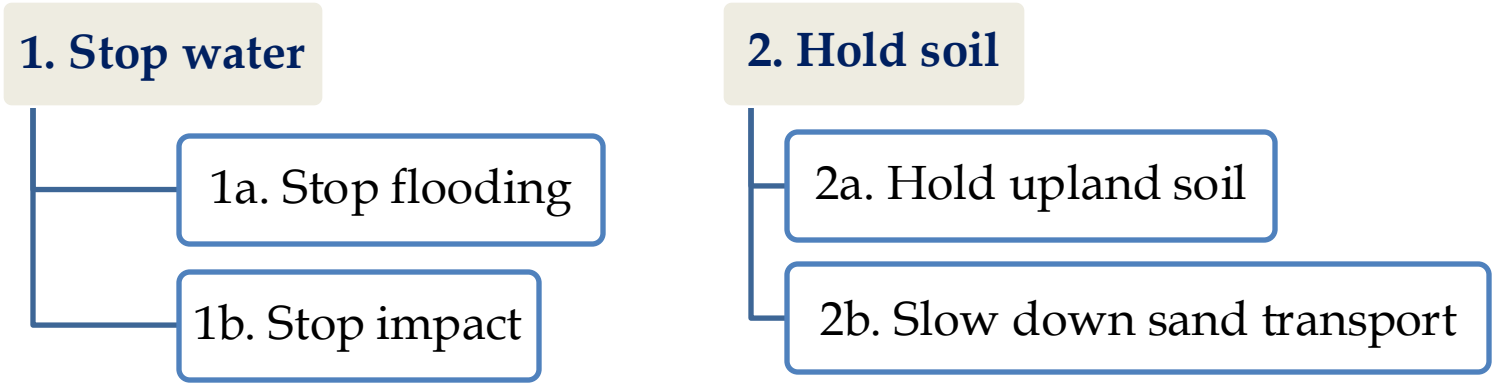
EWCE 471
Coastal Engineering

Lecture 16-17: Types and Functions of Coastal Structures

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What do Coastal Structures Do?



- **Protect infrastructure** from flooding due to high water levels, erosion and impact from waves and currents
- **Protect boat traffic** by reducing waves and wave impact
- **Stabilize navigation channels** by reducing sedimentation, inlet migration
- **Reduce erosion** by stabilizing shorelines/beaches
- **Enhance recreation, beauty**

Soft vs Hard
(Erodible vs. Non-erodible)

- **Hard coastal structures** are engineered solutions designed to resist or prevent coastal erosion and damage.
- **Soft coastal structures** involve natural or nature-based solutions that work with natural processes to protect coastlines.

Soft vs Hard
(Erodible vs. Non-erodible)

- Beach fill
- Dunes
- Marshes
- Bioengineered

- Breakwaters
- Seawalls
- Revetments
- Jetties
- Groins
- Bulkheads

Advantages of Hard Structures over Soft Structures

- ✓ Withstand larger forces
- ✓ Resist erosion
- ✓ Less footprint area
- ✓ Reduce renourishment needs/costs
  - Help extend available sand resources
- ✓ Function in deep water
- ✓ Transition to existing shore over short distances
- ✓ Tend to last longer

Coastal structures are used in coastal defense schemes with the **objective** of –

- ❑ preventing shoreline erosion
- ❑ preventing flooding of the hinterland
- ❑ sheltering of harbor basins and harbor entrances against waves
- ❑ stabilization of navigation channels at inlets
- ❑ protection of water intakes and outfalls

Coastal Structures Functional Areas

1. Coastal protection
   - Seawall, revetment, emergency protection, bulkhead
2. Shore protection
   - Regulation of coastal landscape, nourishment, beach de-watering or beach drain
3. Mixed Coastal/Shore protection
   - Groins, detached breakwaters, headlands, perched beach, artificial pocket beach
4. Beach construction
   - Artiificial beach, beach parks, beach reclamation

Coastal Structures Functional Areas

5. Management Solution
    - Landuse restriction
6. Sea defense
    - Seadike, artificial dune. marsh/mangrove platform restoration

Sea dikes

- Prevent or alleviate flooding by the sea of low-lying land areas
- **Function:** Separation of shoreline from hinterland by a high impermeable structure





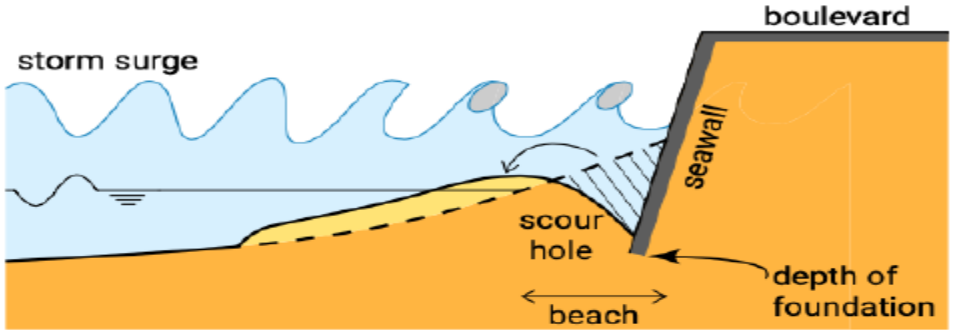
Sea walls

- Protect land and structures from flooding and overtopping
- **Function:** Reinforcement of some part of the beach profile

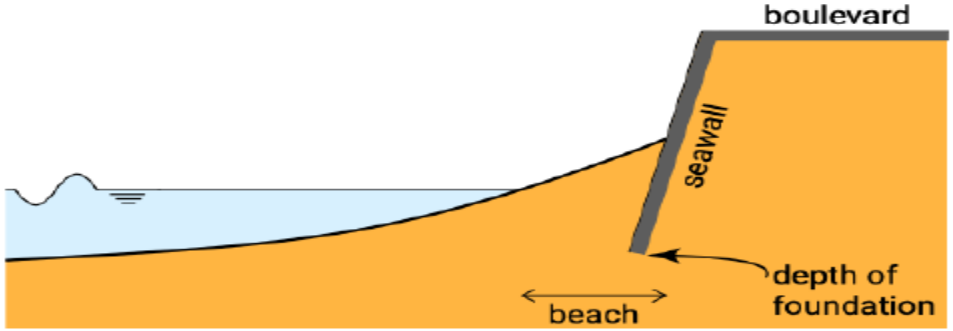




Sea walls



(a) scour in front of a seawall or revetment



(b) maintaining a beach requires e.g. regular sand nourishments

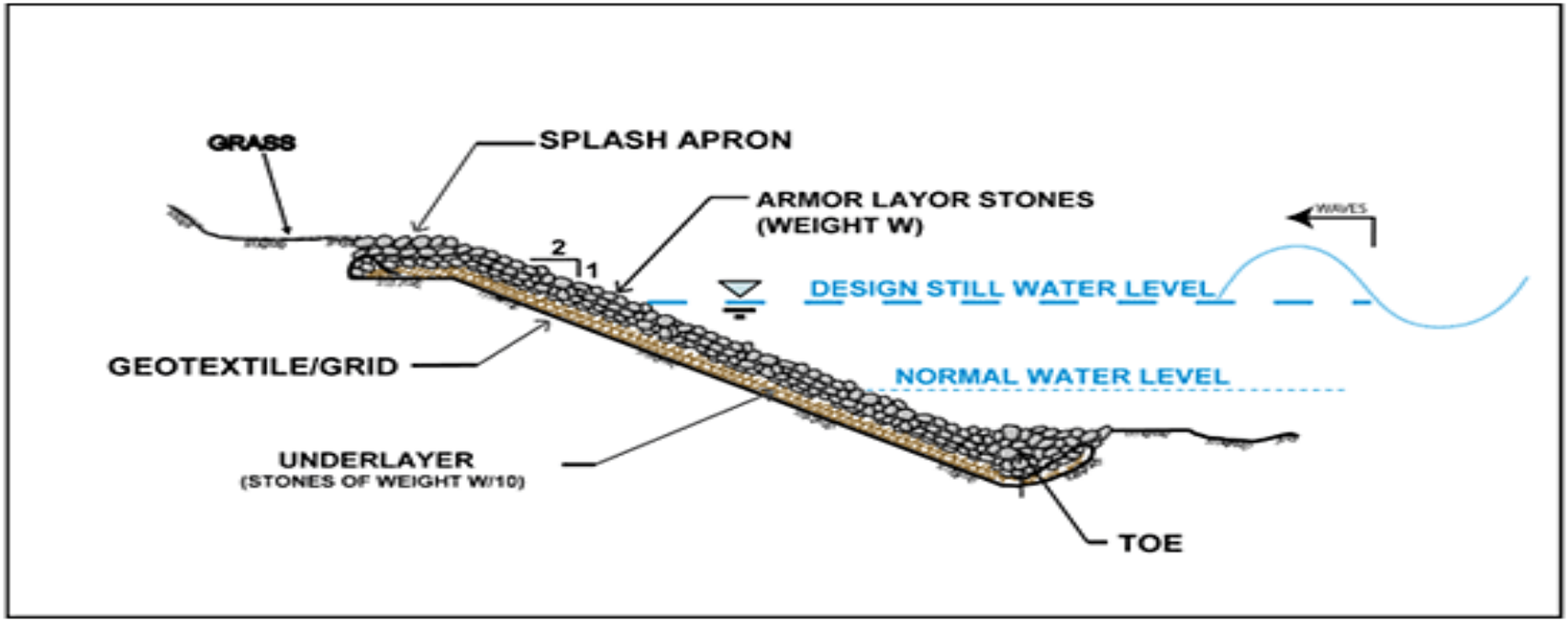
Revetment

- Protect the shoreline against erosion
- **Function**: Reinforcement of some part of the beach profile





Revetment

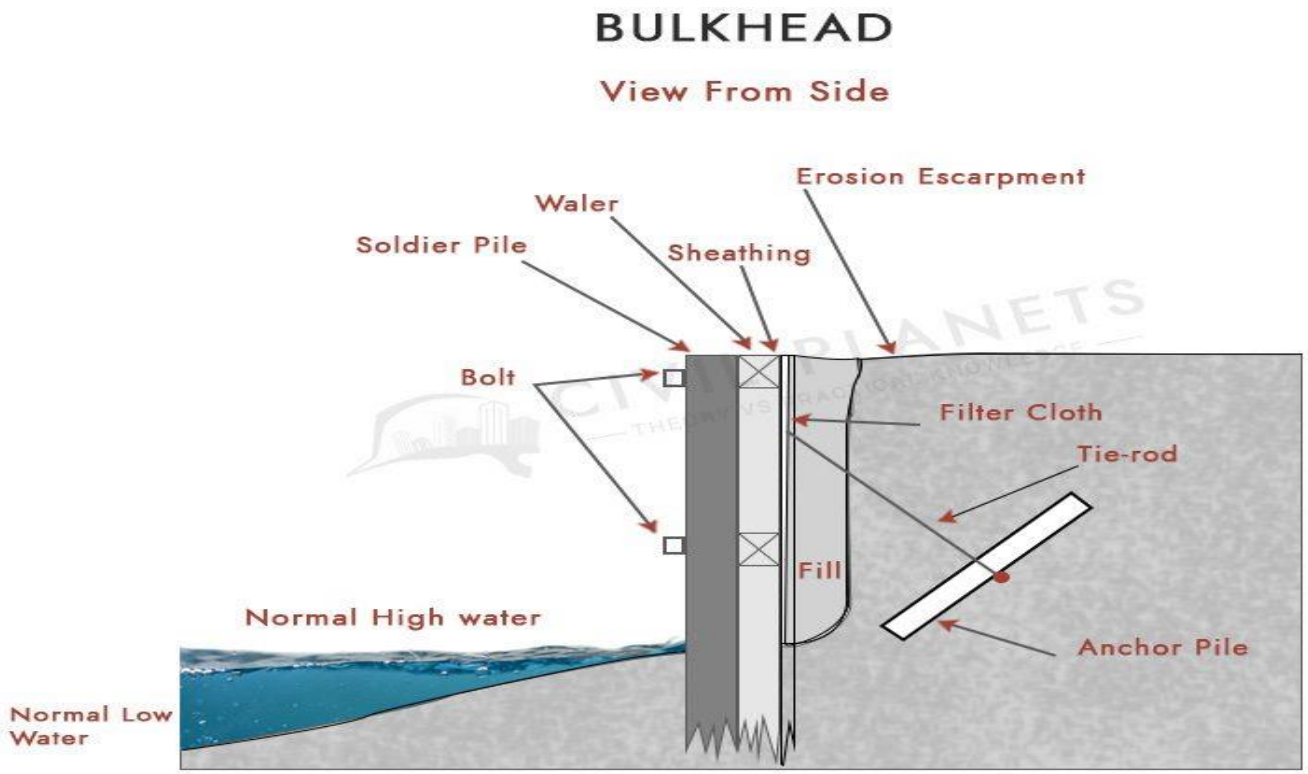

GRASS
SPLASH APRON
ARMOR LAYOR STONES
(WEIGHT W)
2
1
DESIGN STILL WATER LEVEL
GEOTEXTILE/GRID
NORMAL WATER LEVEL
UNDERLAYER
(STONES OF WEIGHT W/10)
TOE

Bulkhead

- Retain soil and prevent sliding of the land behind
- **Function:** Reinforcement of the soil bank



Bulkhead

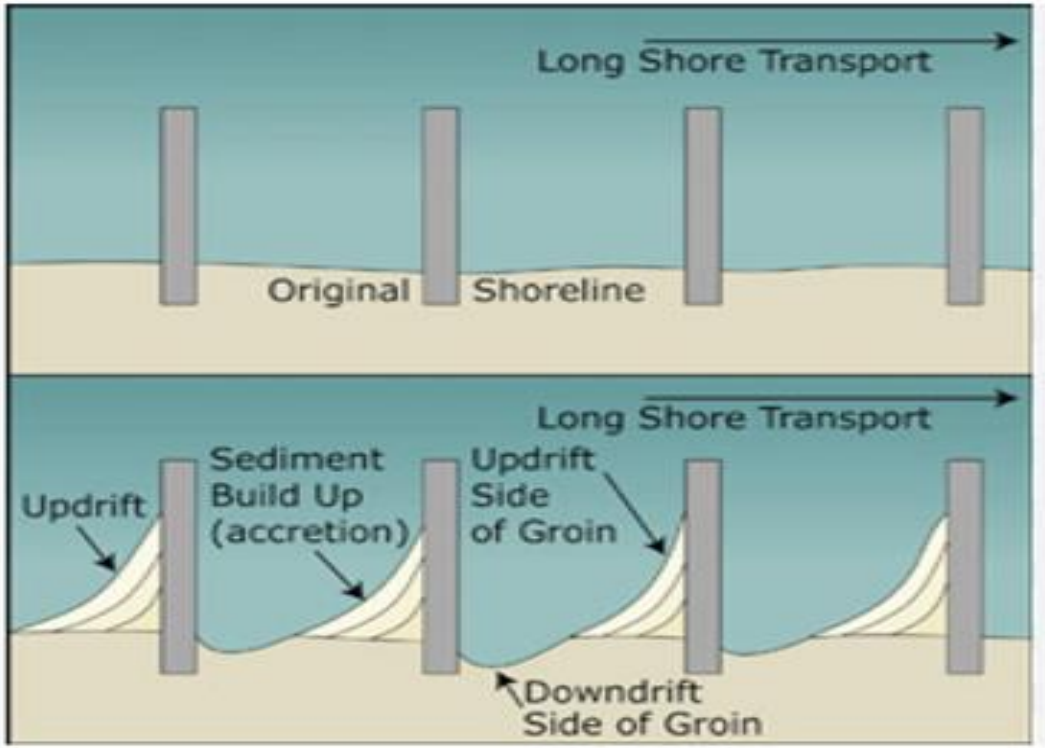

BULKHEAD
View From Side
Erosion Escarpment
Waler
Soldier Pile
Sheathing
Bolt
Filter Cloth
Tie-rod
Fill
Normal High water
Anchor Pile
Normal Low Water

Groin

- Prevent beach erosion
- **Function**: Reduction of longshore transport of sediment



Groin


Long Shore Transport
Original Shoreline
Long Shore Transport
Updrift
Sediment Build Up (accretion)
Updrift Side of Groin
Downdrift Side of Groin

Detached breakwater

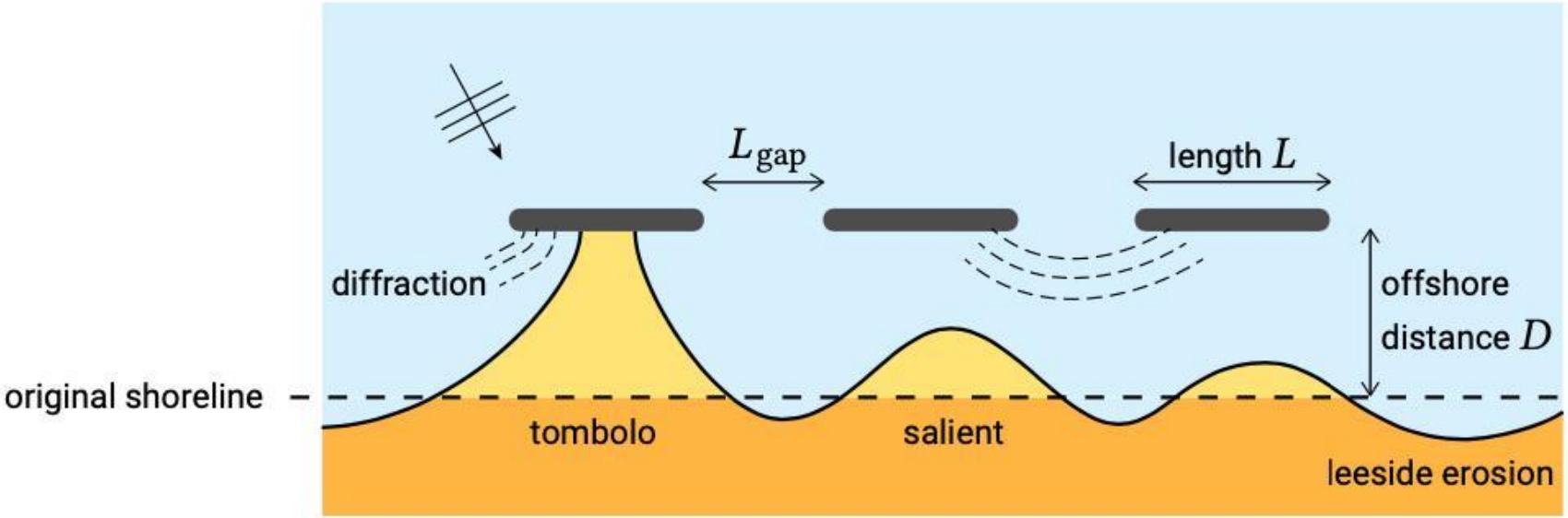
- Prevent beach erosion
- Function: Reduction of wave heights in the lee of the structure and reduction of longshore transport of sediment

DETACHED Breakwater

breakwaters without any constructed connection to the shore. This type of system detached breakwaters are constructed away from the shoreline, usually a slight distance offshore .they are designed to promote beach deposition on their leeside.appropriate in areas of large sediment transport



Detached breakwater



Reef breakwater

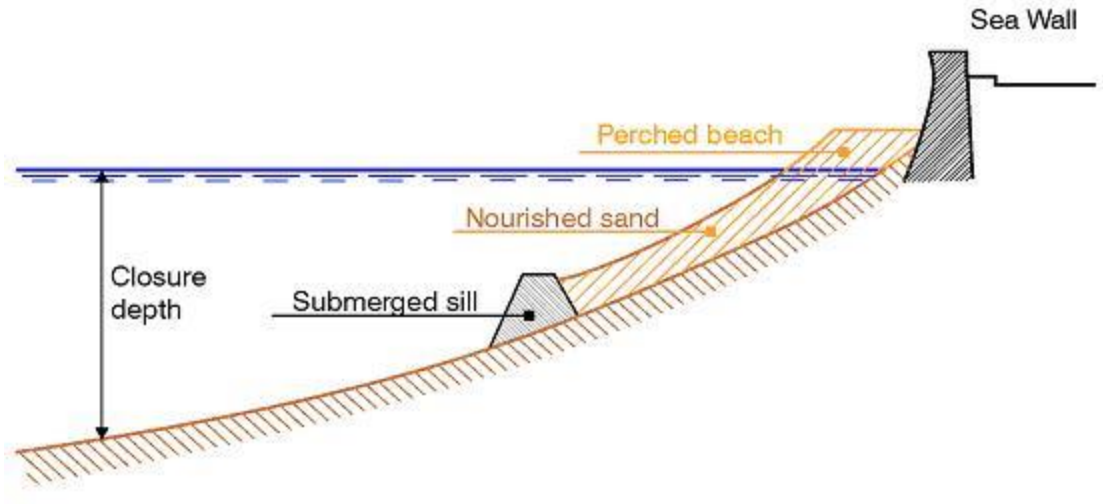
- Prevent beach erosion
- Reduction of wave heights at the shore





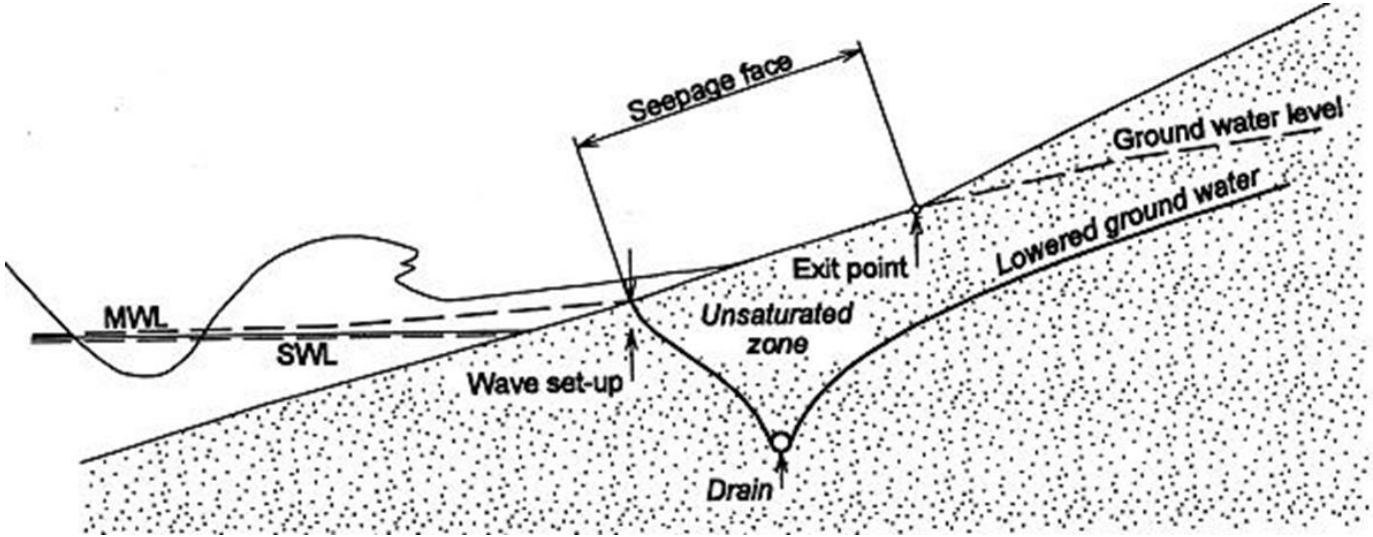
Submerged sill

- Prevent beach erosion
- **Function:** Retard offshore movement of sediment



Beach Drain

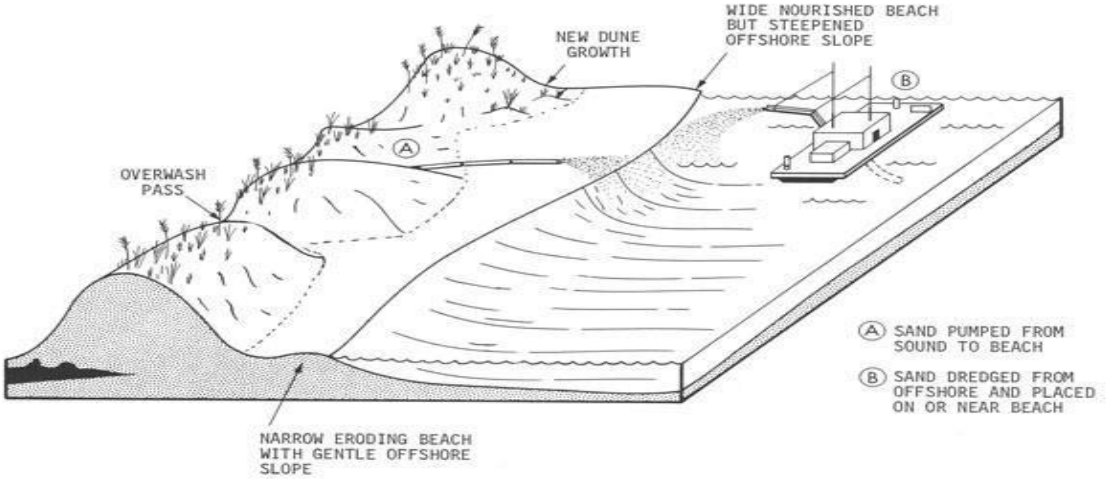
- Prevent beach erosion
- **Function**: Accumulation of beach material on the drained portion of beach



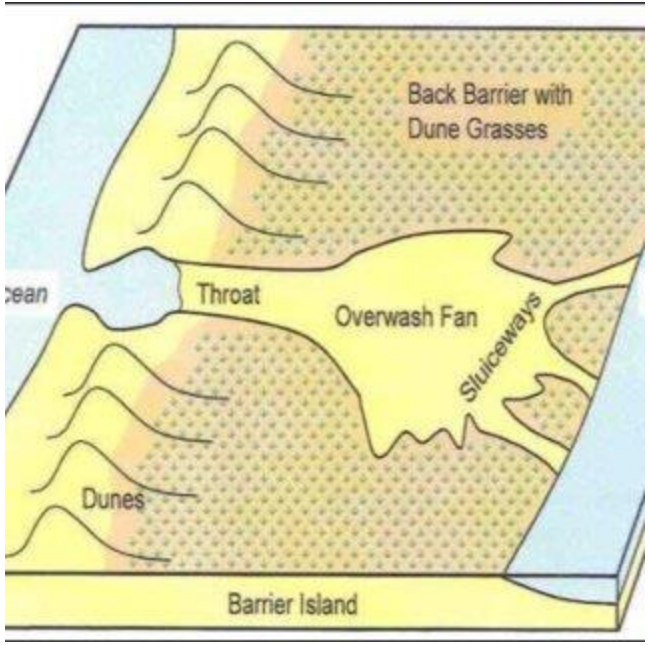
Beach nourishment and dune construction

- Prevent beach erosion and protect against flooding
- **Function**: Artificial infill of beach and dune material to be eroded by waves and currents in lieu of natural supply





Beach nourishment and dune construction



Breakwater

- Shelter harbor basins, harbor entrances, and water intakes against waves and currents
- Dissipation of wave energy and/or reflection of wave energy back into the sea



Breakwater



Breakwater

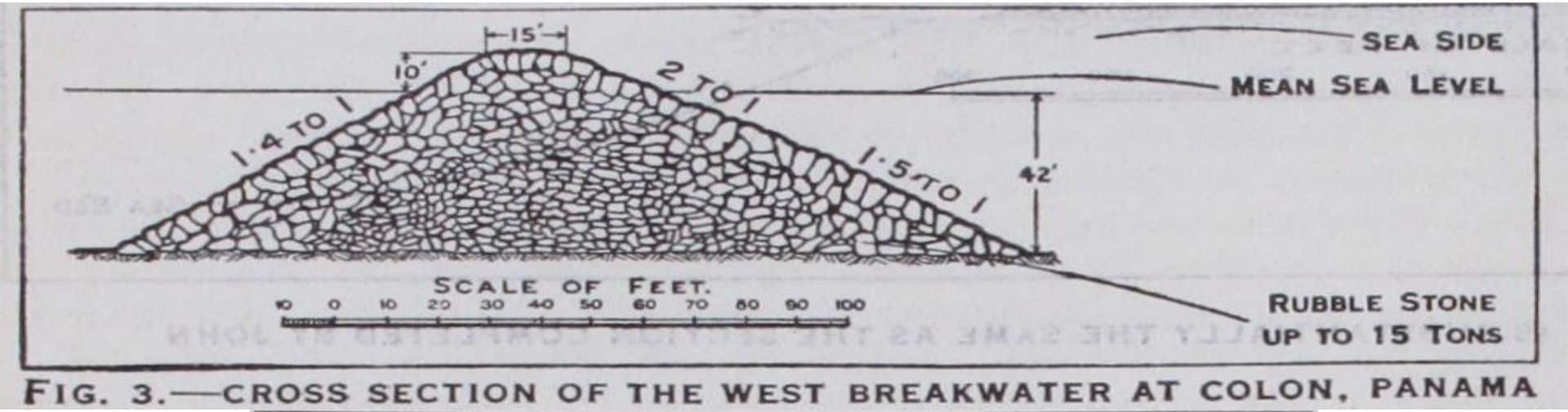


FIG. 3.—CROSS SECTION OF THE WEST BREAKWATER AT COLON, PANAMA

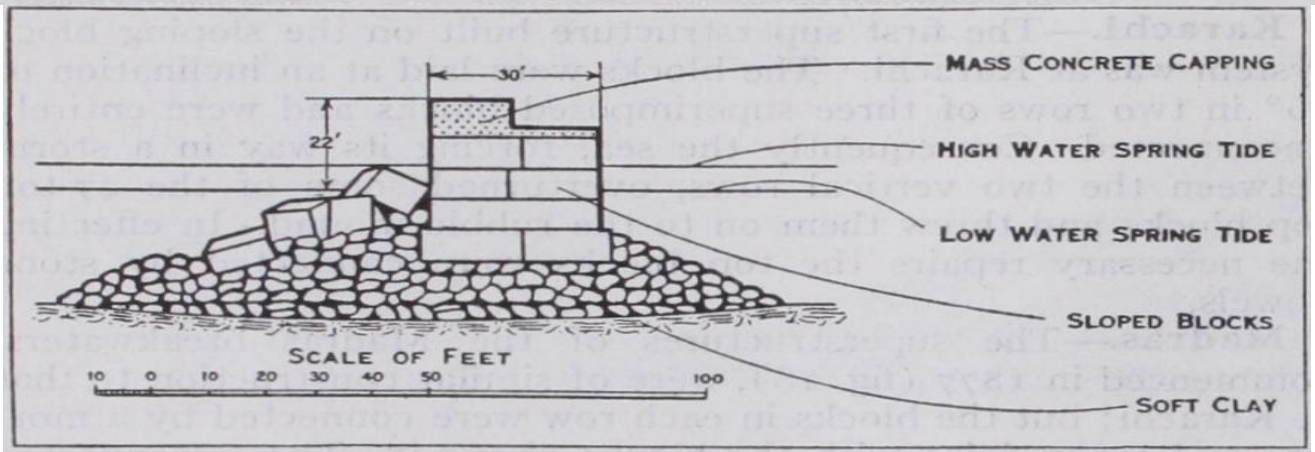


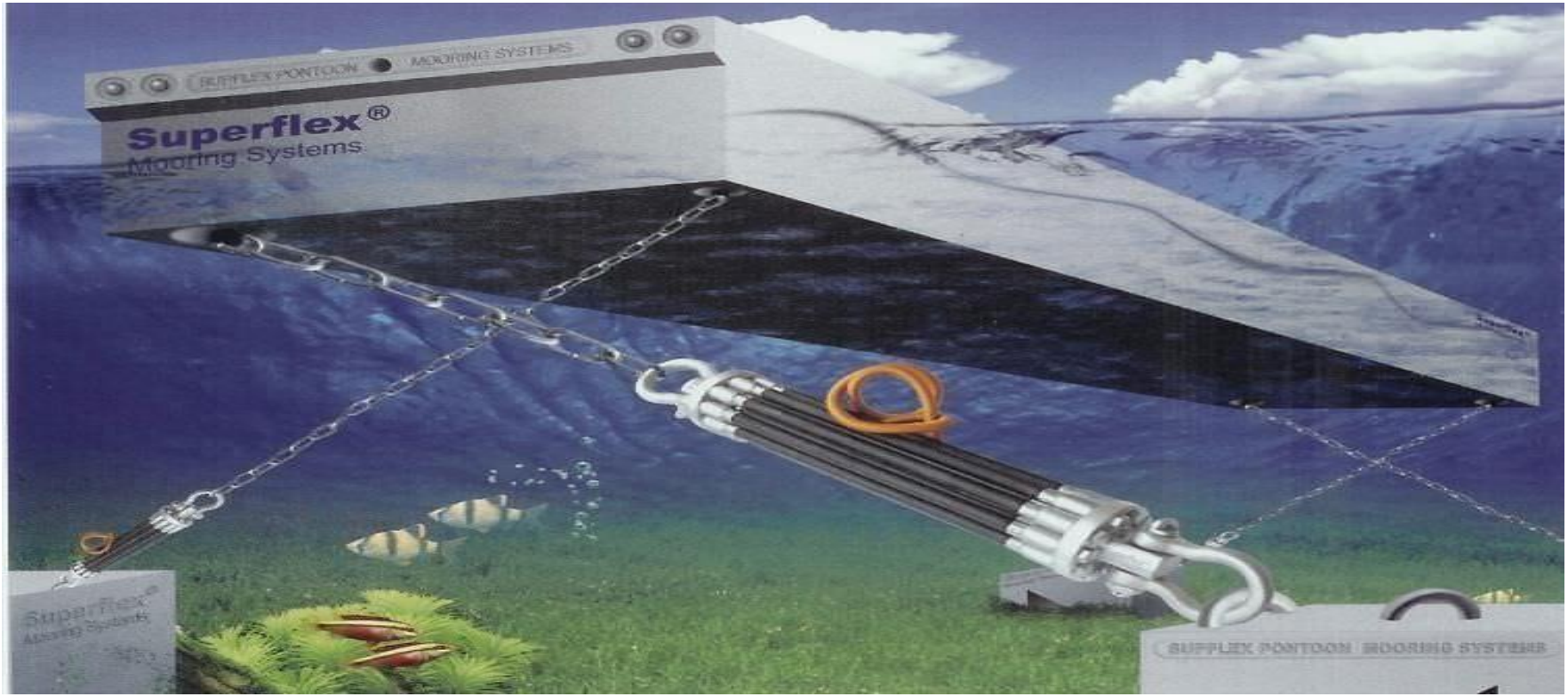
FIG. 20.—CROSS SECTION OF THE BREAKWATER AT MARMAGAO, INDIA

Floating breakwater

- Shelter harbor basins and mooring areas against short-period waves
- **Function**: Reduction of wave heights by reflection and attenuation



Floating breakwater



Jetty

- Stabilize navigation channels at river mouths and tidal inlets
- **Function:** Confine streams and tidal flow. Protect against storm water and crosscurrents



Training walls

- Prevent unwanted sedimentation or erosion and protect moorings against currents
- **Function:** Direct natural or man-made current flow by forcing water movement along the structure



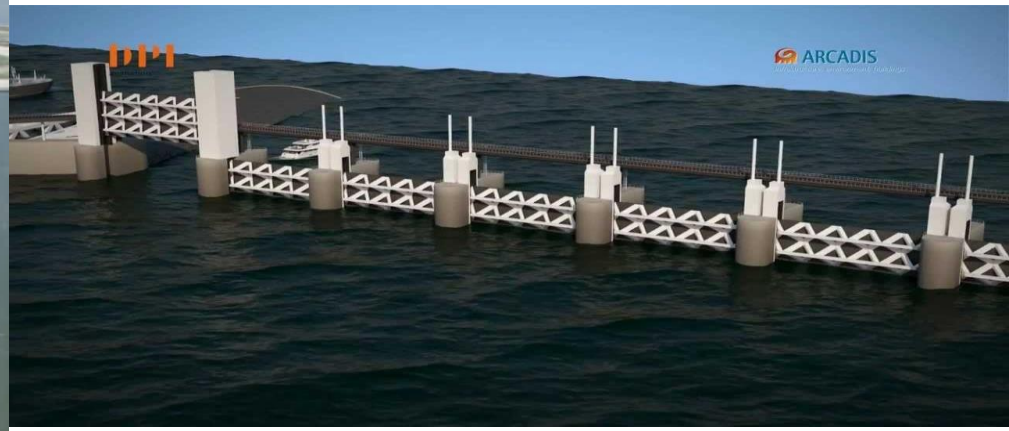
Storm surge barrier

- Protect estuaries against storm surges
- **Function:** Separation of estuary from the sea by movable locks or gates

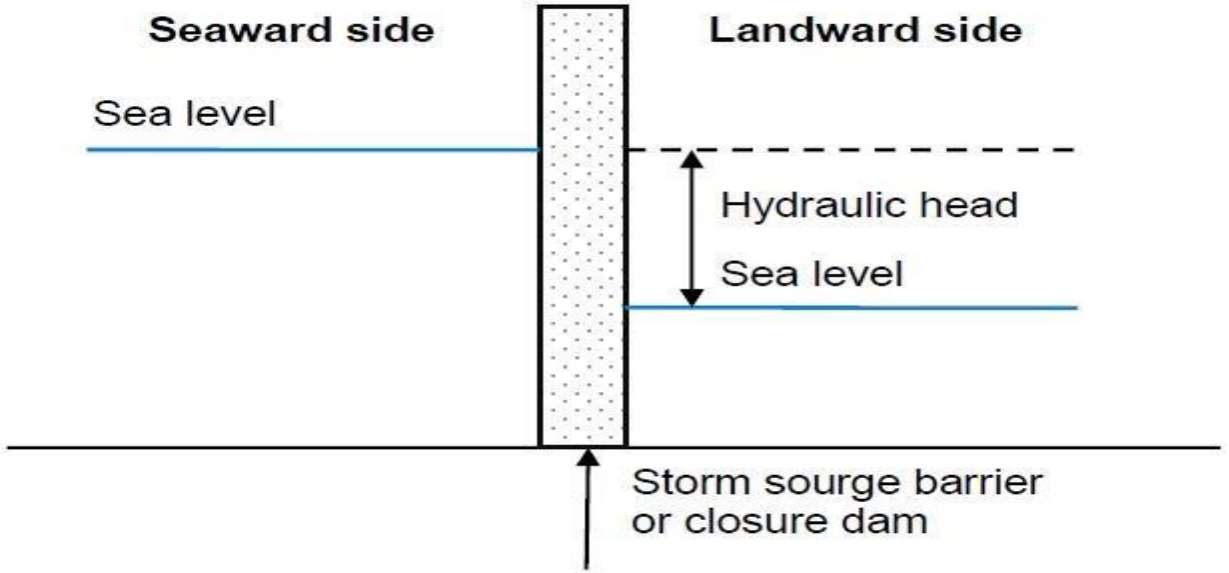


Storm surge barrier





Storm surge barrier



During an extreme event, a storm surge will cause a rise in sea level on the seaward side of the barrier. The presence of a physical barrier such as a closure dam or storm surge barrier prevents high waters from penetrating the estuary. As a result, the water level on the landward side remains low

Pipeline outfall

- Transport of fluids
- **Function**: Gravity-based stability



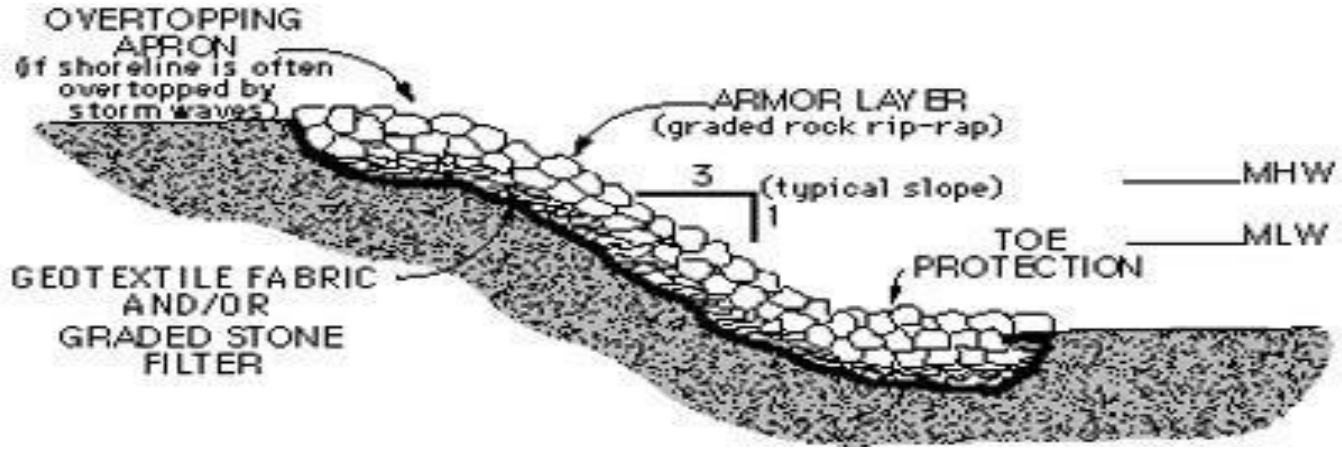
Pile structure

- Provide deck space for traffic, pipelines, etc.
- **Function:** Provide mooring facilities Transfer of deck load forces to the seabed



Scour protection

- Protect coastal structures against instability caused by seabed scour
- **Function:** Provide resistance to erosion caused by waves and current




THANK YOU