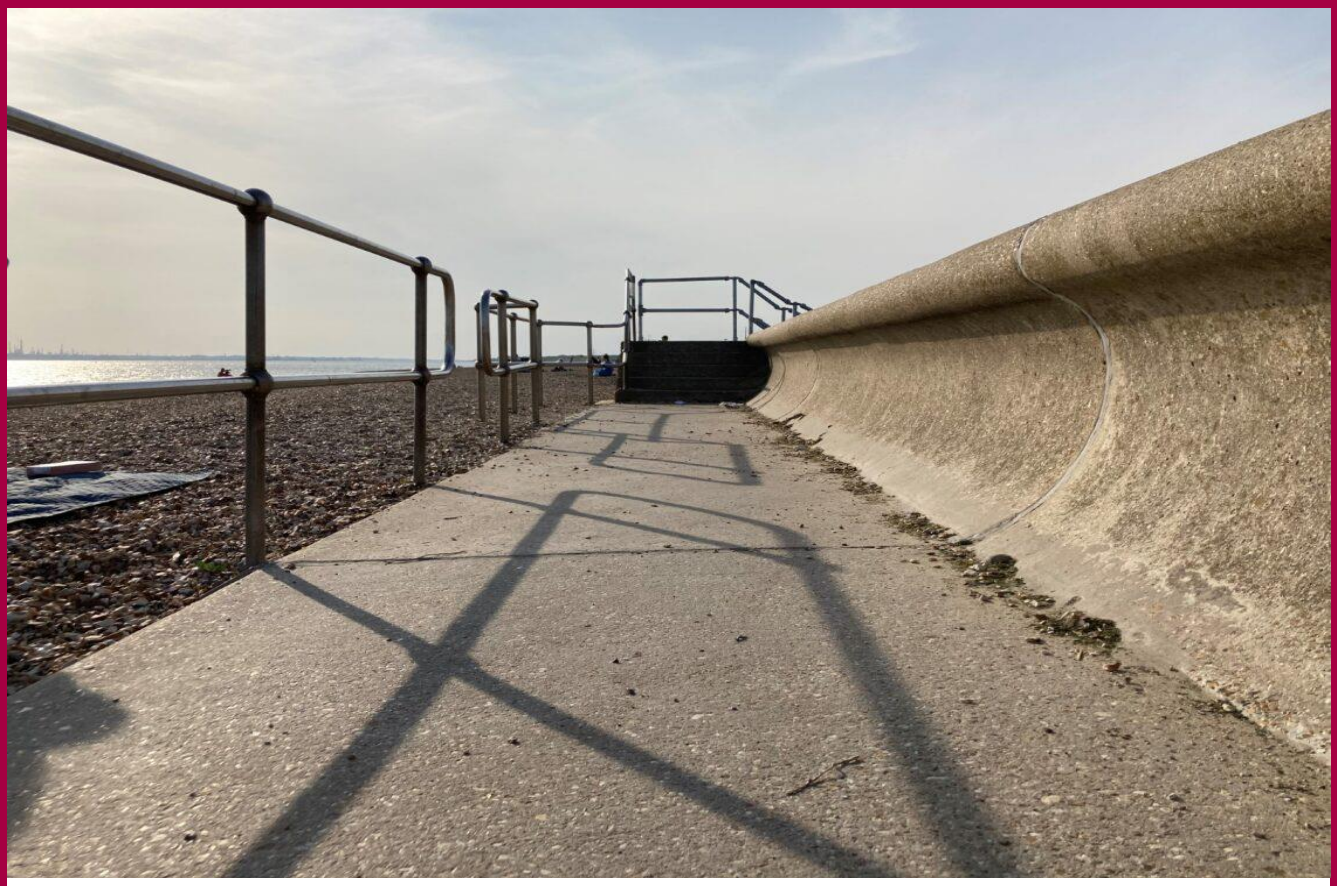


Recurved Sea Wall

A curved wall structure designed to prevent coastal flooding and wave overtopping. The structure acts as an impermeable barrier to prevent tidal flooding and the curved shape added to the top of the wall also reflects wave energy to reduce wave overtopping.

Typically constructed from concrete or blockwork. Will often be combined with a revetment structure on the foreshore or sheet piling to prevent erosion and scour.

The addition of the curved shape makes construction slightly more expensive and future modification more challenging.

Cost (per metre)	**£30,000**
Carbon footprint	
Lifespan of asset	**100 years**
Programme (time taken to build)	**12 months**

Vertical Sea Wall

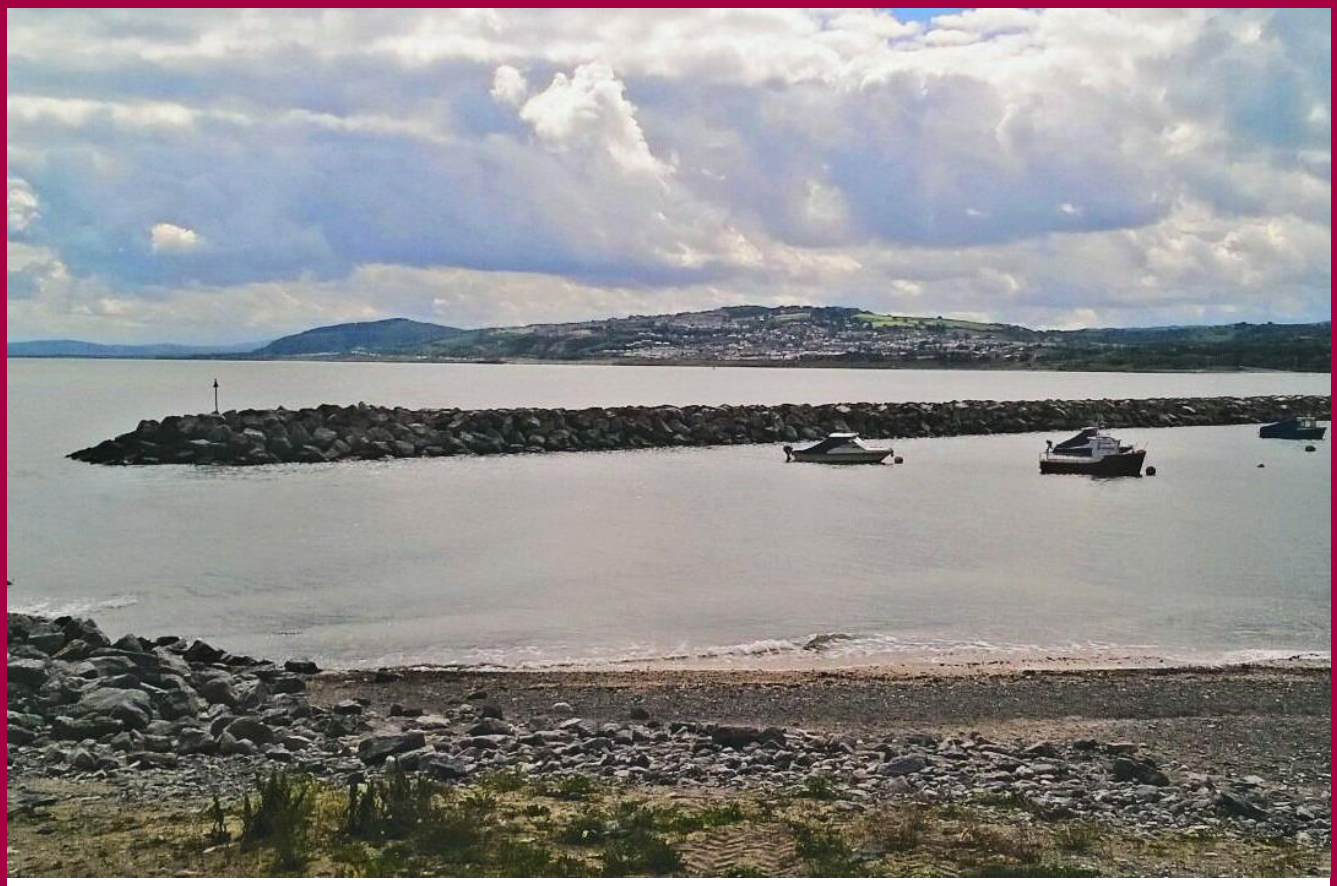
A vertical wall structure designed to prevent coastal flooding and wave overtopping. The structure acts as an impermeable barrier to prevent tidal flooding and reflects wave energy to reduce wave overtopping.

Typically constructed from concrete or blockwork. Will often be combined with a revetment structure on the foreshore or sheet piling to prevent erosion.

Sea walls can often be combined with multiple amenity benefits including art installations, seating and paths/promenades for walking and beach access.

Habitat quality of sea walls can be improved by creating textured surfaces enabling marine species to bind to the concrete (known as 'greening the grey')

Cost (per metre)	**£25,000**
Carbon footprint	
Lifespan of asset	**100 years**
Programme (time taken to build)	**12 months**



Nearshore Breakwater

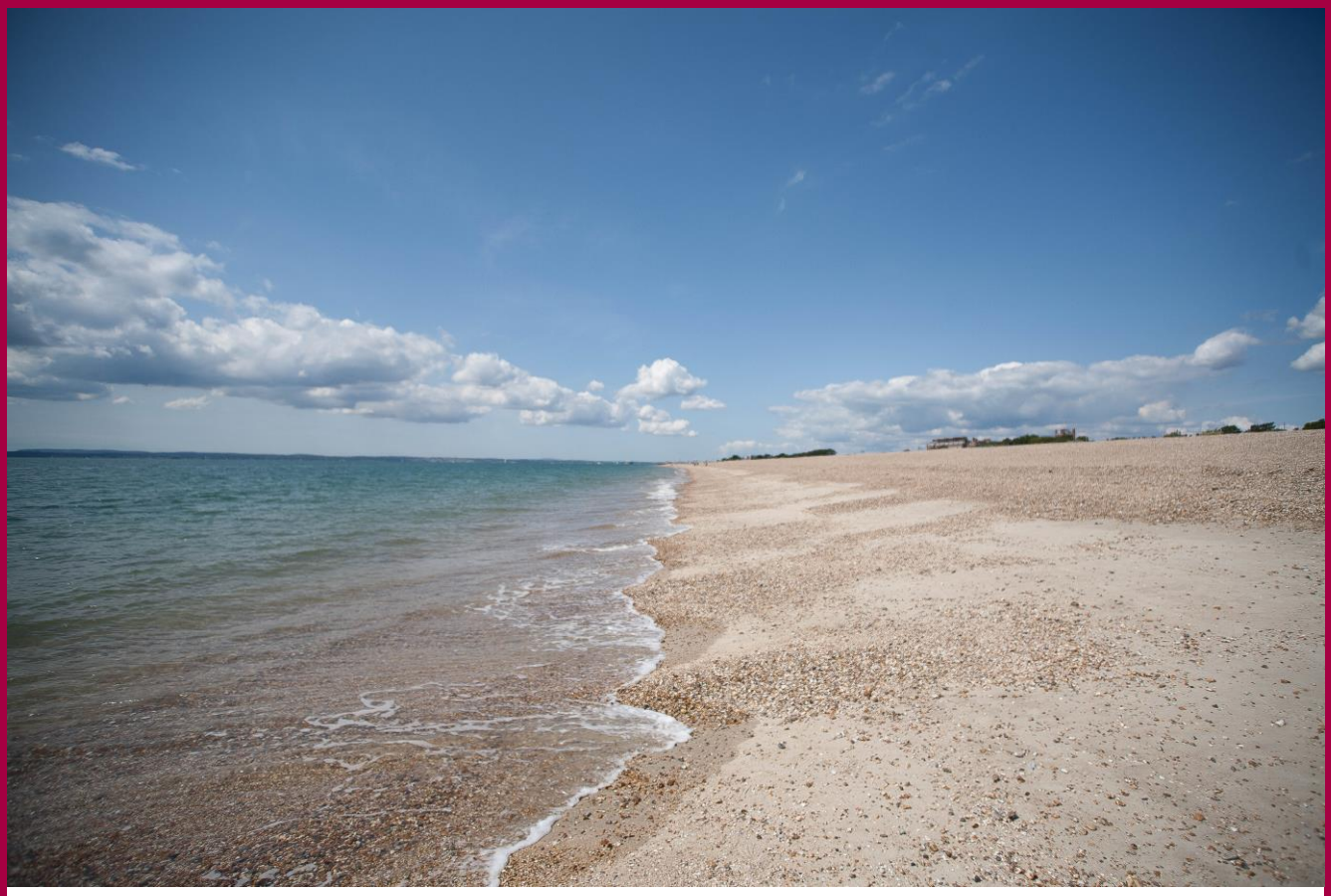
A permeable structure placed within the tidal limits of the foreshore to dissipate and reduce the energy of waves that approach the foreshore.

It is likely to be raised above the level of mean high-water spring (MHWS - the average height of two consecutive high tides during 24-hours of spring tide).

A nearshore breakwater is designed to reduce coastal erosion and wave overtopping experienced at the coastline behind the structure.

These structures would typically be constructed from large rock armour units (1 - 10 tons) or from similarly sized concrete blocks.

Cost (per metre)	**£50,000**
Carbon footprint	👣👣👣👣👣
Lifespan of asset	**100 years**
Programme (time taken to build)	**9 months**



Beach Recharge

Beaches play an important role in reducing wave energy. A bigger beach will likely reduce wave overtopping and coastal erosion.

Beach recharge (also known as nourishment) involves importing new beach material (sand and shingle) to a location. This could be used to provide a new beach or increase the size of an existing beach.

This 'softer-engineered' approach will typically have a limited lifespan of 5-10 years meaning regular additional recharge is required.

Often considered economically viable if the beach also provides a significant amenity function to the area being protected (e.g. if the beach is an important tourist attraction and supports the local economy).

Cost (per metre)	**£150,000**
Carbon footprint	
Lifespan of asset	**10 years**
Programme (time taken to build)	**3 months**

Long Stepped Revetment

Concrete steps introduced on the upper foreshore of a beach with the purpose of reducing the risk of coastal erosion and reducing the volume of wave overtopping.

Typically combined with a vertical sea wall at the landward extent.

Depth of steps need to be sufficiently below the beach level to take account of the potential for future beach lowering and beach scour to prevent the structure being undermined and potentially suffering structural failure.

Some amenity value for steps as seating areas.

Cost (per metre)	**£30,000**
Carbon footprint	👣👣👣👣👣
Lifespan of asset	**100 years**
Programme (time taken to build)	**12 months**

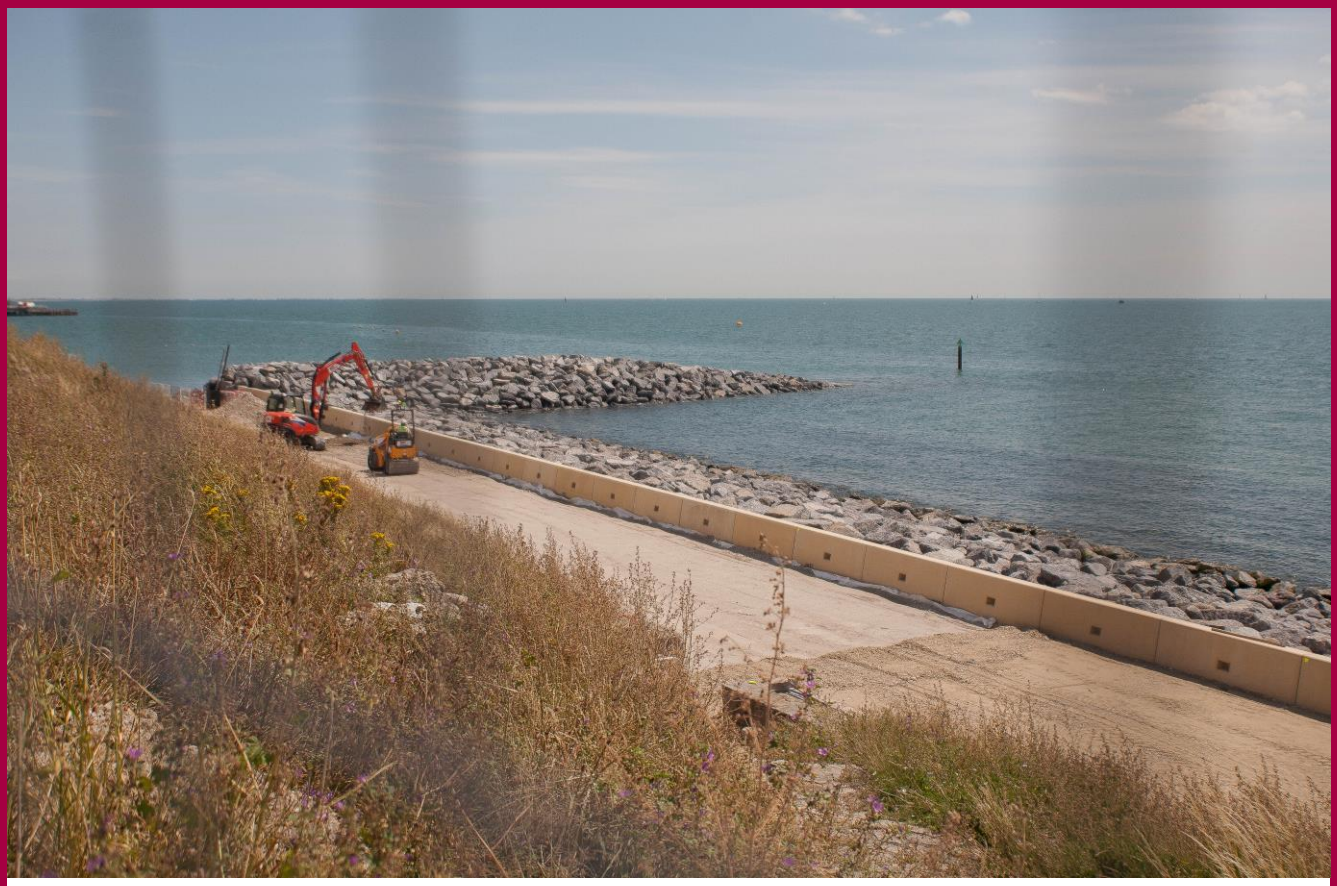
Short Sloped Revetment

Concrete or blockwork impermeable slope often constructed at a steep angle between 1:1 and 1:2.

This is used as an alternative to a vertical wall. If the structure is too steep it can make wave overtopping worse by acting as a ramp for waves to run up and over.

Can pose a health and safety risk to the public and impede access to the beach.

Cost (per metre)	**£20,000**
Carbon footprint	👣👣👣👣👣
Lifespan of asset	**100 years**
Programme (time taken to build)	**9 months**



Rock Revetment

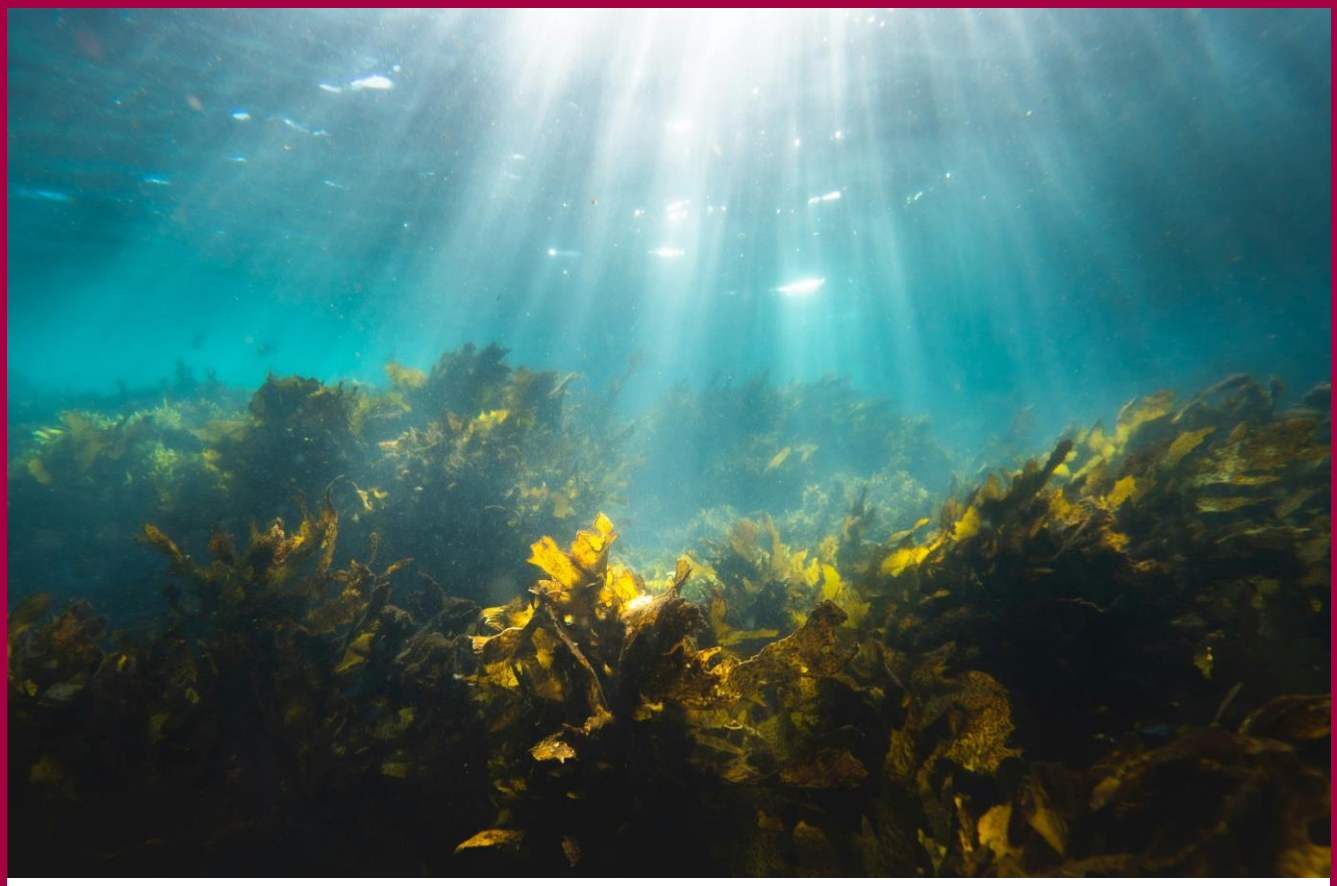
A rock revetment (also known as rock armour) is a protective structure made up of rocks or stones placed along the shoreline to prevent erosion and provide stability. It is commonly used in coastal engineering as it reduces wave energy, helping to prevent overtopping of waves.

Often combined with a vertical sea wall at the landward extent.

Rock armour is more efficient than concrete steps in dissipating wave energy and the structure itself is naturally flexible and can therefore accommodate changes in beach level.

Can cause challenges to beach access and reduce the amenity value.

Cost (per metre)	**£20,000**
Carbon footprint	
Lifespan of asset	**100 years**
Programme (time taken to build)	**12 months**



Kelp

Planting natural kelp in the nearshore or offshore environment can help break up wave energy.

Kelp will slightly reduce wave heights in the nearshore environment but is likely to be removed from the seabed by bigger storm events leaving the proposed protected area vulnerable until re-growth has occurred.

Kelp forests are one of the most productive habitats on the planet and support abundant marine life, providing shelter, feeding grounds and nurseries.

Cost (per metre)	**£5,000**
Carbon footprint	
Lifespan of asset	**2 years (low certainty)**
Programme (time taken to build)	**6 months**

Mangroves

Planting natural mangroves in the nearshore or offshore environment helps dissipate and break up wave energy.

Mangroves have complex root systems that bind together soil and reduce erosion whilst the above ground roots slow down water flows and absorb the impact of waves.

They provide significant biodiversity benefits and are a very low carbon solution.

Mangroves forests only grow at tropical and subtropical latitudes.

Cost (per metre)	**£1,000**
Carbon footprint	
Lifespan of asset	**50 years**
Programme (time taken to build)	**6 months**