Conventional Sea Defences

Seawalls

Seawalls are intended to protect the coast but reflect storm waves so efficiently that their foundations can be undermined. Reflected waves interact with incoming waves, resulting in scour of the seabed material in front of them. This is washed away, eventually undermining the wall. The only alternative to a wall is a beach, bringing us to beach replenishment as another remedy.

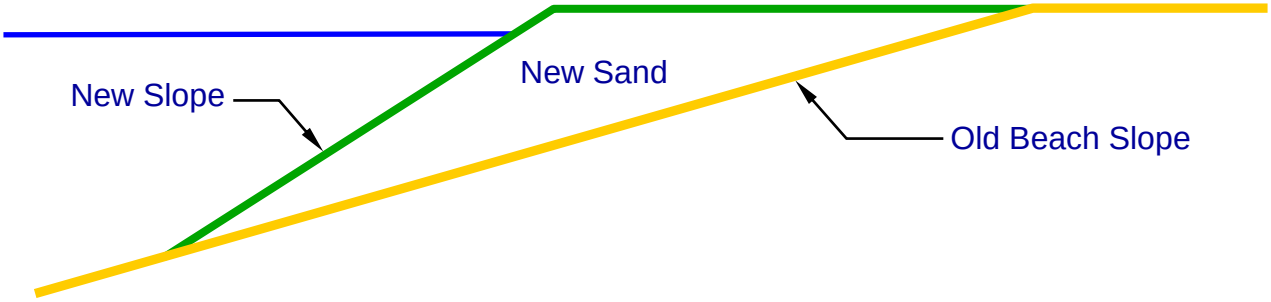
Intact sea wall at Happisburgh, Norfolk, UK

Failed sea wall at Happisburgh, Norfolk, UK

Beach Replenishment

Beach replenishment has become a fashionable alternative to hard defences, especially as beaches are only now being recognised as the best defence against coastal erosion. Nevertheless, the main problem with unsupported replenishment is that sediment newly dumped on the shore creates an unnaturally steep beach profile. This is more typical of offshore bars rather than

beaches. It encourages waves to be reflected (rather than gently dissipated) at the face of the replenished sandbank, which is then swept downcoast more quickly than prior to this process. The result of this is that frequent (often annual) replenishment is needed, entailing a considerable ongoing expense. The diagram below shows why the replenished beach erodes so quickly.

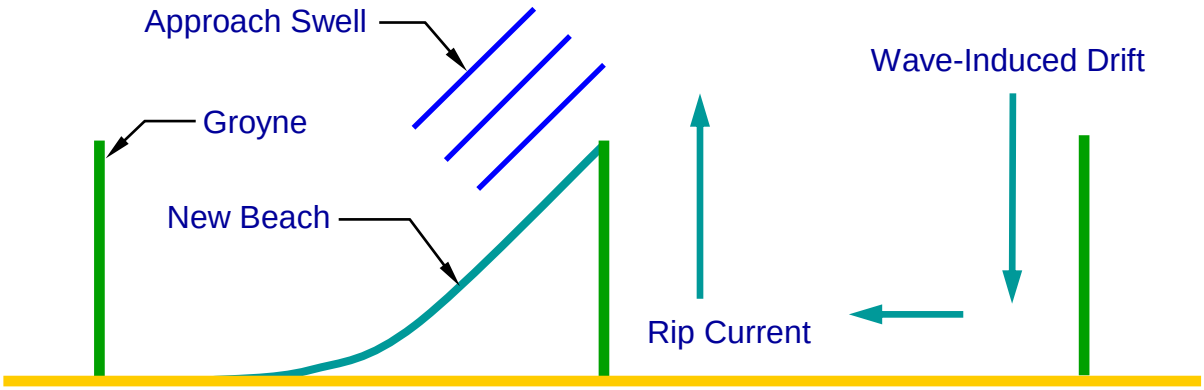


Typical cross-section through replenished beach

Beach replenishment at New Jersey, USA

Groynes

Groynes are, in their basic form, straight walls perpendicular to the shore that are intended to trap sand and prevent it from being carried along the coast. Although groynes reflect waves in a way that sweeps sediment to the shore on their exposed side, the same is not true of the sheltered side. It is on this side that any wave-induced drift must exit the groyne cell, leading to a rip current able to sweep sediment away. Although this is concentrated on the sheltered side, in the event of a storm it can flush all the collected sand well out of reach of the groyne system.



Groyne field, LH cell showing new beach and RH cell its removal by storms

Damage to timber groynes at Trimingham, Norfolk, UK

Similarly to other marine structures such as seawalls, groynes are subject to being undermined at their foundations by persistent wave action. This is particularly true at their ends, where the wave-induced fluid motion sheds vortices. **Vortex** is a term used for fluid rotation, as found in whirlpools and tornadoes. Vortices in the sea are capable of displacing sediment from far greater depths than ordinary sea currents and wave action. They are most destructive at the ends of structures on oceanic coasts. There have been instances in Oregon, USA, where the last 100 metres of armourstone jetty had to be abandoned due to vortex action of this kind.

Breakwaters

Breakwaters are linear barriers, usually aligned parallel to the shoreline. They can be used to prevent waves reaching the shore and eroding the beach. This sheltering effect allows drift sediment to collect between the breakwater and the shore. However, storms are capable of overtopping breakwaters and washing away the sand. Erosion is exacerbated by rip currents concentrated in the gaps between the structures. Once taken out to sea, sand will be swept further down the coast than it would have done with an unprotected beach, just as with groynes. Additionally, the forces undermining the breakwaters can be so severe that nearly 3 metres depth of scour has been observed more than 30 metres from the face of a typical breakwater. Although collapsed elements can serve as foundation for new breakwaters, this is clearly not satisfactory.

Breakwaters at Kaike, Japan