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Beach Drainage System

Environmental Issues

An appropriately designed and installed Beach Drainage System decreases the erosional effect of backwash and seepage, and leaves more sand on the foreshore, which enhances the recreational use for the beach and which acts as buffer for episodic storm erosion.

In summary, Beach Drainage is environmentally friendly, merging with nature's own forces in a nearly invisible way, and allowing shore or beach protection and restoration to take place over a period of time with no adverse impact on the neighbouring coastline. The system has no hard structures that will disfigure the natural scenery. It does not disrupt any human activities or the surface ecological system. In fact, the active, accretionary beach encourages re-establishment of local fauna and flora. Additionally, any coastal beautification works will be easier and less costly (versus hard methods which have protruding eye-sore structures) because no rectification work is necessary.

A Beach Drainage System collects and maintains sand on the foreshore, thereby widening and increasing the height of the local beach. This local accretion takes place in a smooth and natural looking way, which requires no construction activities apart, of course, from the installation of the Beach Drainage System itself.

1. Littoral Budget – Downstream Impact

Comprehensive monitoring shows that the 'additional' sand deposited by the efficient functions of the Beach Drainage System apparently comes from modifying the offshore bottom and the littoral transport, defined as the movement of sediments in the nearshore zone by waves and currents.

Littoral transport is divided into two general clauses: transport parallel to the shore (longshore transport) and transport perpendicular to the shore (transversal transport). The material transported is called 'littoral drift'.

Transversal transport is determined primarily by wave steepness, sediment size, tidal variation, beach and sea bottom slope. In general, high steep waves move material offshore and low waves of long period (low steepness waves) move material onshore, while the transport caused by the tidal variation is following the cycle.

Longshore transport results from the stirring of sediment by the breaking wave. The movement of this sediment is a function of the component of the wave energy in an alongshore direction, the longshore current generated by the breaking waves and the tidal variation. The direction of longshore transport is directly related to the direction of wave approach (the angle of the wave (crest) to the shore) and the tidal current. Thus, due to the variability of the resulting current, longshore transport direction can vary from season to season, day to day, or hour to hour.

The rate of longshore transport is dependent on the generated longshore current, wave duration and energy. Thus, high storm waves will generally move more material per unit time than that moved by low waves.

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Because reversals in transport direction occur, and because different types of waves and current transport material at different rates, two components of the longshore transport rate become important. The first is the net rate, the net amount of material passing a particular point in the predominant direction during an average year. The second component is the gross rate, the total of all material moving past a given point in a year regardless of direction. Most shores consistently have a net annual longshore transport in one direction. For the Beach Drainage System it is the gross rate, which is important.

Direct measurement of the amount of littoral drift at a specific cross section at a given time is in fact hardly possible.

Calculations of the potential longshore transport rate using the ‘wave energy flux’ method are therefore normally just giving the order of magnitude of the transportability or transport capacity and not the actual littoral drift which is depending on the available moveable materials as well.

In principle, Beach Drainage only mitigates the problem of beach erosion at the installed location. It does not introduce new sand into the littoral budget. The sand is taken from the existing littoral processes in the area, partly from the shore-face and partly from the longshore littoral transport. Consequently, this should (theoretically) lead to additional erosion at the adjacent downstream beaches; however, in practice this has not been observed on any of the facilities implemented to date. The reason for this is probably the amount of sand trapped is small relative to the sand available in the littoral process, and the smooth shape of the accumulated sand, which unlike coastal structures such as groynes, break-waters and jetties, does not introduce any rip currents.

During storm periods with wave attack moving in a direction not perpendicular to the coastline the zigzag water movement and generated increased nearshore current is eroding some materials in excess from the advanced profile in front of the Beach Drainage System. This material is moved downstream nearshore, which reduces the storm erosion here because these materials have reduced the normal available transport capacity. Instead of expected adverse side effect on the adjacent downstream beach this has benefited by volumes of the sand leaked from the bulge of sand in front of the System, which has acted as a feeder.

During storm events a great deal of sand will be in suspension in the nearshore seawater and is subsequently available to the beach drain at the end of the storm.

2. Wind Erosion and Accretion

Direct wave attacks or surge attacks on the foot of dunes will normally result in dune slides and scarring of the dune vegetation. By scarring the dune vegetation the dune will be subject to both wave and wind erosion. Behind implemented Beach Drainage Systems where the beaches are bordering sand dunes it has been observed that the dune foot has been replenished by wind borne sand from the dry sand in the vicinity of the Beach Drain alignment. Due to the elevated and stabilised backshore the dune vegetation has recovered and extended and thus reduced the risk for wind erosion and encouraged natural dune development.

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3. Flora and Fauna

Beach Drainage is an environmentally friendly concept merging with natures own forces. Sand deposited on a beach by the drainage system is drawn from the local offshore environment and winnowed and sorted by natural processes to be size-compatible with the beach – in contrast to beach nourishment using sand dredged from offshore "borrow" areas.

Because the deposition of the sand takes place over a period of time – and is not deposited en-mass as in nourishment schemes – the local fauna and flora have sufficient time to adjust to the profile changes. There is no disruption of the ecological system.

At Sailfish Point, Florida, after a large amount of sand was accreted due to the Beach Drainage facility, a misunderstanding of the technology caused valuable investigations to be carried out. A misconception developed at the time of this project that the sand was compacted by the water draining through it and this was what stabilized the beach to resist the greediness of the incoming waves from the Atlantic Ocean.

An environmental group produced the theory that the sand had been so dense that the sea turtles might have difficulties in nesting their eggs in the area as usual.

This lead to comprehensive, independent investigations of sand density, humidity and temperature showed that no differences between the results from the drained area and control zones could be identified.

It was also shown that the roots of the seashore plants can easy adjust to the gradual redevelopment of the beach and dune system. The depth from the beach face to the ground water table was increased as expected due to the sand built up and the ground water lowering. However, because the cone of hydraulic depression has a logarithmic shape, the landwards vegetation was not in danger of drying out.