R.S.E.
Reimagine Seaside Engineering

Wave Attenuator Systems

Purpose

The Warner Park Beach is subject to the largest fetch on Lake Mendota of 5.6 miles. As a result the prevailing winds from the southwest create large waves running upon the shoreline. This made it hard for people within the area to launch there kayaks from this spot. Through Including a wave attenuator just of the shoreline it will protect the area from wave attack and create calmer waters.

How They Work

The wave attenuator ultimately works by reflecting the wave energy and dissipating the kinetic energy from the incident wave. The wave induced flow passes the structure and waves break over the top if the structure. If the incident wave period is close to the resonant period of the break water mooring system, the wave dissipation is increased.

Advantages of Floating Attenuators

1. Adaptable to large water level fluctuations
2. Cost doesn't increase with water depth due to mooring system
3. Easily removed in winter when the lake freezes
4. Offers less obstruction to the water circulation and fish migration
5. Not dependent on soil conditions (sandy water bed along Warner Park Beach)

Types Of Attenuators

Box Breakwaters

Box breakwaters are the most frequently used breakwater. They are made from a concrete exterior with either a hollow or polystyrene interior. The design of this attenuator is limited by a 25 ft width and 5 ft draft.

Advantages

- 50 year design life
- Allows pedestrian access for fishing and temporary boat mooring
- Simple shape to build
- Proven performance in moderate wave climate

Disadvantages

- High cost maintenance if damaged- may need towing to dry dock
- Connectors can be a problem if not adequately designed.

Mat Breakwaters

Mat breakwaters are made out recycled tires. Maze, Goodyear and Wave-Guard tires have been constructed and tested. The tires interlock and float on the oceans surface to reduce wave height.

Advantages

- Low cost
- Easily removed
- Constructed with unskilled labour
- Lower anchor load that box breakwaters

Disadvantages

- Lack of buoyancy (foam is usually needs to be added)
- Design life is only 15-20 years
- Only effective in mild waves
- Unappealing aesthetic

Tethered Breakwaters

This is a break water made out of plastic buoys in order to reduce the height of the wave. It work in a similar way to the mat breakwaters but is made from plastic bouts rather than tires.

Advantages

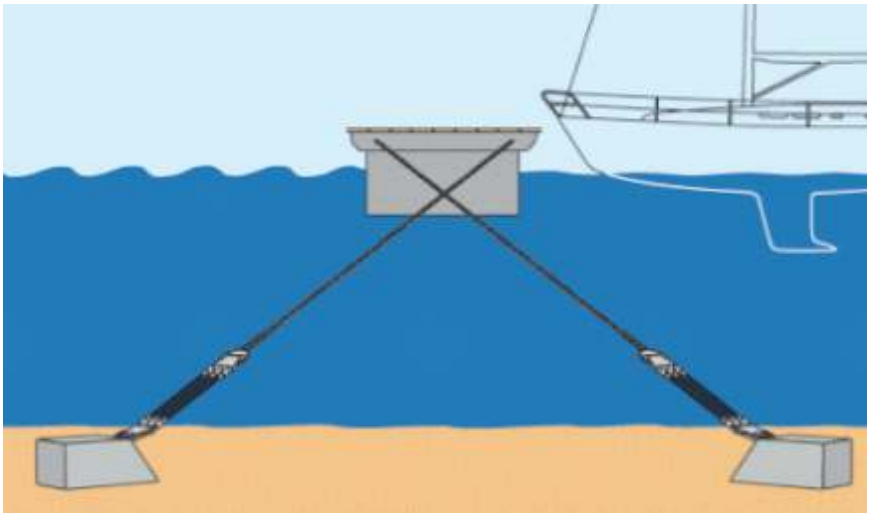
- Easily removed
- Low anchorage needed
- Good aesthetic

Disadvantages

- More expensive than mat breakwater
- Can't be used by pedestrians
- Unappealing aesthetic

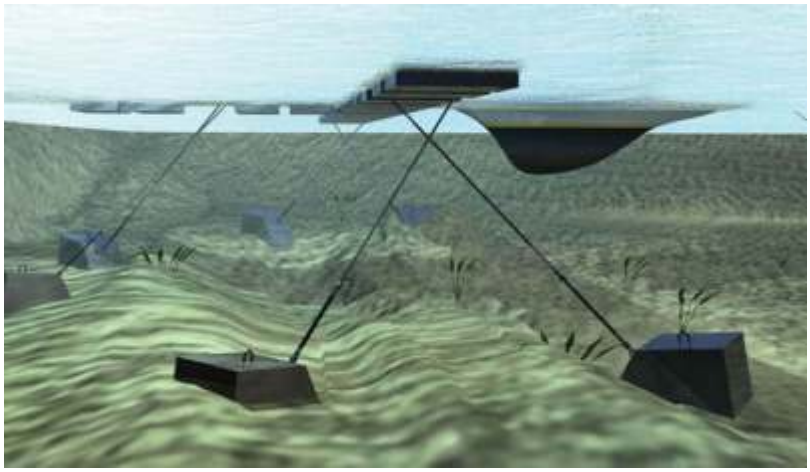
Anchorage System

Floating wave attenuators must be adequately secured in order to function properly. This is done in a variety of ways by anchoring the attenuator to the lake bottom. Many factors, such as lake bottom conditions, typical wave heights, and the need to remove the attenuator during winter months, are considered when recommending an anchorage system for a floating wave attenuator.



Deadweight Anchors

Deadweight anchors are commonly used to secure floating wave attenuators. This system is usually composed of a concrete block that rests on the lake bottom and is heavy enough that it will not slide. The weight needed for the deadweight anchors for a floating wave attenuator is determined by the mooring-line loads and coefficient of soil static friction. This type of anchorage system allows the wave attenuator to be taken out during the winter months and to not be affected by ice heave forces.



Pile Anchors

Another type of anchor that is commonly used with floating wave attenuators is the pile anchor. Pile anchors are driven into the lake bottom soil to a depth that will provide stability from the mooring-line loads of the floating wave attenuator. This depth is determined by the passive strength of the soil in the lake bottom and yielding moment of the pile. If either of these parameters are exceeded by the mooring-line loads, the system will fail. Also, pile anchor systems are not taken out during the winter months, so they are subject to ice heave forces.

Chains, Cables, and Ropes

If a deadweight anchor system is to be used to secure a floating wave attenuator, chain, cable, or rope must be used to attach the anchors to the floating wave attenuator. These three options vary in strength and flexibility, so it is important to select the appropriate option based on the mooring-line loads they will be subject to and the size of the floating wave attenuator. Chains and cables are both very strong, but chains provide more flexibility due to their catenary curve. Ropes are typically used for smaller floating wave attenuators that are subject to smaller mooring-line loads.