

SUSTAINABLE COASTAL LAND RECLAMATION

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1.0 INTRODUCTION

Malaysia has a total land area of 330,290 km² and a total coastline of 4,675 km in length. Long coastline indicates Malaysia has huge potential to enlarge the coastline and expand the land area as land is a basic need in developing urban area. The land also obviously mandatory to all economic activities including residential, industry, tourism, education, agriculture and infrastructure. Day by day, with current globalisation era, buildings and skyscrapers are built non-stop in most country. In results, lands are becoming more limited.



Diagram 1.1 Singapore has increased its land by using sand to reclaim coastal areas.

Source : ("In blow to Singapore's expansion, Malaysia bans sea sand exports", " 2019)

2.0 DEFINITION OF RECLAMATION AND SUSTAINABLE RECLAMATION

The definition of coastal land reclamation is the process of creating new land from the sea. Coastal land reclamation usually been used by small country in order to overcome land shortage and also to fulfil the demand development in infrastructures such as housing and business building. Sustainable coastal land reclamation means that reclamation that does not adversely affect the environment and the marine life and also maintain the environmental sustainability.

3.0 AREA USUALLY TARGETED FOR RECLAMATION PURPOSE

Land reclamation development projects are usually concentrated at the coastal land located near the urban area or crowded places where the economics and financial are at it peak. For example, in Malaysia, at the Straits of Malacca which is already well-known as trade route, they have Pantai Klebang in Malacca did the reclamation of coastal land project and now it became one of the biggest tourists attractions in the country.



Diagram 3.1 Coastal land reclamation at
Pantai Klebang, Melaka
Source : (Noor, 2015)



Diagram 3.2 Coastal land reclamation at
Dataran 1 Malaysia
Source : (Gene & Quin Holdings Sdn.Bhd,
n.d.)

4.0 SOURCE OF SEDIMENT USED FOR LAND RECLAMATION / METHOD USED

4.1 Dry Method

- For filling material for land sources, in particular rock, hillcut and clay fill, the dry method is appropriate. It would generate viscous slurry that would take much longer to become usable land by transporting clay fill material into the sea. A mud wave will be created in front of the fill due to displacement if the seabed soil weak. In that case, a higher amount of filling material would be needed.



Diagram 4.1 Dry Method
Source : (steemit.com)

4.2 Hydraulic Filling

- For granular filling, the hydraulic filling method is appropriate. When filling is carried out from an offshore source, this method is generally used. The fill material is dredged from the borrowing source with its own trailer suction dredger. Pumping from a cutter suction hopper dredger, then pumped through the discharge pipe. Bulldozers are used around the discharge pipe to grade and spread the fill material. Pumping is done with a mixture of water and filling material.



Diagram 4.2 Hydraulic Filling
Source : (iadc-dredging.com)

4.3 Sand Spreading

- When a shallow seabed is encountered or when the seabed soil is too soft, sand spreading is carried out. A rehandling pit is generally required when sand spreading is performed. The spreader is mounted on a small barge which is floating. The end of the discharge pipe is usually closed and along the last two to three sections of the discharge pipes, several perforations are provided. Sand is discharged with water through the perforations.

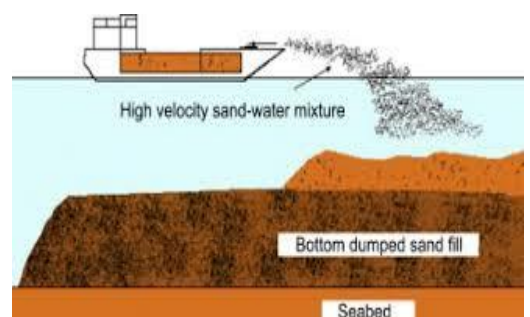


Diagram 4.3 Sand Spreading
Source : (sciencedirect.com)

5.0 IMPACTS ON THE ECOSYSTEM BEFORE AND AFTER THE RECLAMATION.

Coastal reclamation will lead to loss of coastal ecosystem such as mangrove forests. Before reclamation, mangrove forests plays roles as natural buffers that will go against the waves energy and it can also help minimising the impacts on coastal area and protect it from being flooded. The removal of mangrove forest after the reclamation will make the coastal communities vulnerable to food and natural disaster. For example the fish folkers at Pulau Betong located at south-west of Penang island was attributed the mangrove forest there as it helped buffer the impacts of the tsunami back then in 2004 compared to other places that get a direct hit. (Source: Penang Economic Report, 2005)

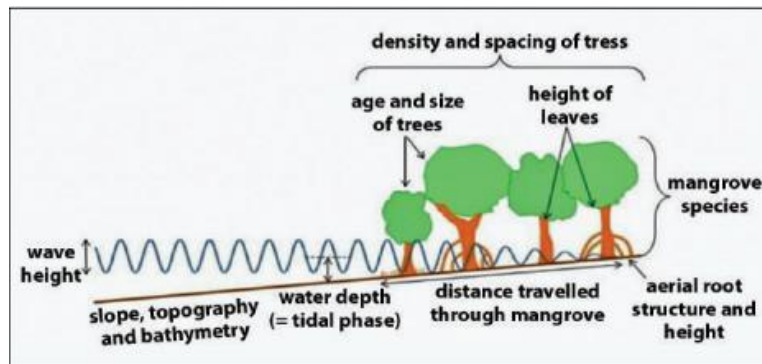


Diagram 5.1 Wave height reduced over 100 m of mangrove forest.

Source : (Sahabat Alam Malaysia, 2020)

Local fishers and livelihood whose source income depended on the fishing industry are also impacted due to land reclamation. Before reclamation fishers can carry out fishing activity freely without any area restrictions and can get bunch of catch. Due to reclamation it lead to the disruption of fishing activities or total loss which make yield and supply of fish decreases. For example it was stated in the Detailed Environmental Impacts Assessment (DEIA) Study for the Proposed Reclamation of Seri Tanjung Pinang in Penang the potential impact on local fishing industries is the reduction or loss of the local fishing ground due to the project print.



Diagram 5.2 Tanjung Tokong fishing village made way for Seri Tanjung Pinang project.

Source : Yong Check Yoon, 2003

6.0 IMPACTS OF DREDGING ACTIVITIES ON MARINE ORGANISM

Benthic animals are more abundant in shallower water especially at the coastal zone and ocean floor. Due to the reclamation activities will destroy the benthos organism habitat. Disturbance at the bottom of sediment from dredging works will also cause permanent loss of benthos habitat. The contractors should choose a suitable place to conduct a reclamation project in order to keep the habitat of the benthos organism.



Diagram 6.1 Habitat destruction of benthic organism
Source: oceanhealthindex.org

Coral reefs play major roles in providing renewable resources like fish, shrimps, squids and other marine organism. Coral reef is also one of the support habitat for the food chains of marine organism. Others than that corals reefs also known as spawning ground, feeding ground and nursery ground for enormous number of marine life. Due to the reclamation activities it will cause coral disruption due to the dredging work and it will cause breakdown in the ecosystem and it will ruined the food chain that will lead to loss of marine organism species. Other than, when the bottom of the sediments are disturbed during reclamation projects it will release toxic chemicals into water column that absorbed by the seagrass . The toxic chemicals will degrade the water quality and will also affect the aquatic living.



Diagram 6.2 Dredging and reclamation activities at Johor.
Source : Victor Barro, n.d.

7.0 SUGGESTION ON BEST PRACTISE FOR LAND RECLAMATION(MINIMIZE THE IMPACT OF RECLAMATION)

7.1 Seawalls Construction.

Seawall is a structure separating land and water areas. It is designed to prevent coastal erosion and other damage due to wave action and storm surge, such as flooding. Seawalls are normally very massive structures because they are designed to resist the full force of waves and storm surge. The seawall will fix the location of the coastline, but it will not arrest the ongoing erosion in the coastal profile. On the contrary, it will to a varying degree, accelerate the erosion. It is quite normal that the beach disappears in front of a seawall, and it will most often be necessary, after some years, to strengthen the foot of the seawall with a rubble revetment. A seawall will decrease the release of sediments from the section it protects and will have a negative impact on the sediment budget along adjacent shorelines. By building the seawalls, the strong waves caused by land reclamation can be reduced to avoid coastal erosion.



Diagram 1.5 Seawall construction

7.2 Smart Water Sensor

A Smart Water Sensor is used to monitor the water quality in rivers, lakes and the sea. For the alternative to get a sustainable coastal land reclamation, perhaps the government can consider the idea of importing the Wasp mote (wireless sensor) Smart Water that have been launched by Libellium, a Spanish IT company to detect water pollution during the reclamation. The approach is to do the reclamation in stages to make sure turbidity and pollution can be controlled gradually. In every gap of reclamation stages, the probes of the instrument will be put on seawater surface or coastal water to monitor the water quality. If the water quality parameters exceed the optimum value, the reclamation process will be delayed. However when the water quality parameters have improved, the reclamation will be continued. Equipped with the water sensor, are multiple sensors that can measure a dozens of the most relevant water quality parameters. The parameters are including pH level, dissolved oxygen (DO), BOD, COD, oxidation-reduction potential (ORP), conductivity (salinity), turbidity, temperature, suspended solids, ammonium, nitrates and phosphorus. Changes in these parameters will give the information of the water quality in seawater.



Diagram 1.6 Smart Water Sensor
Source : (Libellium.com, 2014)

7.3 Trailing Suction Hopper Dredger (TSHD)

Trailing suction hopper dredger (TSHD) is a marine engineering ship that has a full sailing capacity used to maintain navigable waterways, deepening the maritime canals and to replace sand eroded by storms or wave action on the beaches. These activity are made by large powerful pumps and engines that able to suck sand, clay, silt and gravel.

Trailing Suction Hopper Dredgers is good to use for reclamation project and it was widely used in maritime construction and maintenance projects. Trailing suction hopper dredgers are equipped with one or two suction pipes ending in drag heads. The drag head moves slowly over the bed collecting the sand like a giant vacuum cleaner. The mixture of sand and water is pumped into the hopper of the dredging vessel. Excess water flows out through so-called overflows. Dredging stops when the maximum hopper capacity is reached.



Diagram 1.7 Trailing Suction Hopper
Dredger (TSHD)

Source: [wikimedia.org](https://www.wikimedia.org)

8.0 CONCLUSION

Coastal land reclamation to yield valuable land space for a variety of uses has been carried out for some time in Malaysia and is expected to be on the upward trend. The success of such projects depends on sound engineering practices and adequate attention to potential environment impacts. Engineering considerations for the planning and design of coastal reclamation projects include layout planning, simulation studies, protection against erosion, geotechnical considerations, sand sourcing, allowance for sea level rise and etc. Greater efforts are required in the field of adaptive and basic research to upgrade local skill and technology for the planning and design of coastal reclamation works. Modern technique such as numerical modelling holds great promise for future application.

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"Together we protect our ocean"
-SALWA SABRINA BINTI ZOLKIFLE-

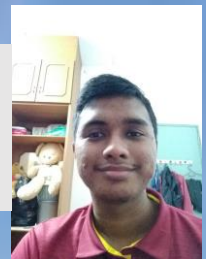
"Oceans are getting sicker,
Let's do something quicker.
Save our ocean"

-MUHAMMAD ALIFF RAHIMI BIN MOHD SUFIAN-



"I hope that our ocean are well maintained all the
time"

-NORSHAIRA BINTI MOHD ASRI-



"I wish for a sustainable ocean ecosystem. I love beach and
I'd do anything in my power to have a sustainable ocean
ecosystem. I really feel it's my responsibility to do as much
as I can to protect our beautiful ocean"

-ALLIA AFIQAH BINTI ANUAR-



"Do not take oceans for granted, they are made for reasons"
-WAN MARYAMSYAMIMIE BINTI WAN SALLAM-



"marine life is one of the important resources in
our ecosystem. so taking care of it is the
responsibility of all of us"

-NUR LISA HAFIZAH BINTI ABDUL HALIL-

