CHAPTER 4. ADDITIONAL STUDIES (RISK ASSESSMENT AND MANAGEMENT PLAN)

4.1 INTRODUCTION

As with all construction works the designer must be aware of safety during design. However for maritime and coastal works this is particularly important at all the stages in both the development and design of maritime works. Risk evaluation will be a central part in the basic shaping of a scheme and must continue throughout the design process.

Hazard → Mitigate → Highlight

Avoid → Special measures

At the early stages, consideration will be given to high-level risks and their avoidance or mitigation by fundamental changes to the nature of the project. Elements of the work, which will be examined and adjusted to improve the safety of the project, will include location, nature of works, construction materials, programming, etc. However, the focus will become sharper as the project progresses through outline and detail design stages when individual work elements will be considered and adjusted to reduce the overall risk profile. Such elements may include access, temporary works, construction sequence, etc. MMB Passenger Jetty Design based on following;

a) STABILITY
The structure and its elements shall be designed for static stability under overturning, uplift and sliding and for dynamic stability. Appropriate combinations of design actions shall be considered so that stability loads and other actions exceed the destabilizing loads and other actions.

b) STRENGTH
The MMB Passenger Jetty structure and its elements shall be designed for strength in accordance with appropriate Indian Standards together with the requirements of this Document as follows:
(a) Determine the appropriate loads and other actions;
(b) Combine and factor the loads to determine design loads for strength;
(c) Determine the design action effects for the structure and its elements for each load case; and
(d) Determine the design strength. The effects of fatigue from wind, wave and current action under normal conditions shall also be considered.

c) SERVICEABILITY
The structure and its elements shall be designed for serviceability by controlling or limiting settlement, horizontal displacement and cracking. Under the appropriate load combinations for serviceability design, vertical deflection shall be limited in accordance with the requirements of the appropriate materials Standards.

Horizontal deflection and acceleration limits for trafficable structures shall be limited to a maximum deflection

d) DURABILITY

The structure and its elements shall be designed for durability in accordance with Indian Engineering Standards & Guidelines for Maritime Structures

e) REDUNDANCY

Consideration should be given in the design of the structure and its elements to allow for redundancies to prevent failure of the structure in the event of the loss of a critical element.

f) DESIGN LIFE

Design life is the period of time for which a structure or an element of the structure remains fit for use for its intended purpose with appropriate maintenance. The design life of maritime structures will depend on the type of facility, the intended function and the MMB Mumbai’s requirements. Design life should be based on consideration of capital and maintenance expenditure. The designer, in consultation with the MMB Management, should determine an appropriate maintenance regime consistent with the adopted design and materials that will achieve the design life.

Particular care should be taken when considering design life and maintenance regimes for inaccessible elements of the structure. Such elements should have a design life (with no maintenance) equal to the design life of the structure.

g) SCOUR AND SILTATION

The structure and its elements shall be designed to remain stable, of sufficient strength and not become over-stressed in the event of temporary or permanent changes in the level of the seabed due to scour or siltation.

h) SEA LEVEL RISE

Structures shall be designed to allow for future sea level rise caused by global warming. MMB Passenger Jetty Civil structure’s details collected through questioner shared to designer stated as under;

1) Floating Jetty at Meter tide
1) Whether Construction Material Properties suitable for construction. e.g. Steel, Timber & Chains etc with ref to salinity & Pollutants?

Yes, construction material shall be suitable to the marine environment. This needs to be a part of the contract specification. Complete concrete coverage shall be ensured on the rebars to avoid corrosion. Timber is not being used in the structure.

2. Which Type of safety Design selected for sustainability against Natural Calamities like Hurricane, Tsunami?

Wave, wind, current forces act on the structure. Yes, designed against maximum wave height of 3m as noted from the published data as recorded by Mumbai Port Trust. The area is not susceptible to Tsunami. In the normal monsoon season one can expect Beaufort scale 8 to 9, one would expect wave heights of 7 to 8m in deep waters. However, the area under consideration is shallow water and hence Mumbai Port Trust data on wave height is more relevant.

3. Whether all season access/approach provided to Inspection & Maintenance Floating Jetty Critical area?

Yes, all season approach is provided to the fixed structure (passenger terminal and walkway) for inspection. However, the floating pontoons shall be inspected on land once they are dismantled during May end - September

4. Whether Welding/Fabrication Quality Assurance standards maintain?

Welding is envisaged only for the brows. These shall be QA tested, possibly supplied by a different vendor to the works contractor.

5) Whether Life safety Fittings/Fencing/Equipments/ Communication system/Signs provided?
These shall be provided by the works contractor during execution of the project. At the DPR stage this can be mentioned in the report. Fencing (railings) will be shown on the drawings.

2) Passenger Jetty

![Passenger Jetty Base Floor Plan](image)

**Figure 4.2. Passenger Jetty Base Floor Plan**

1. Whether Hazardous Material (Diesel) Fuel storage Area protected? How?

Diesel fuel/sullage storage is by means of underground (below passenger terminal) tanks. They shall comply with Petroleum Rules 2002, PESO for tanks up to 25000 lit. Capacity. These tanks shall not have anything placed on top.

2. Whether Solid Hazards Waste Storage & Biodegradable Waste system provided?

Sewage treatment plant is provided for waste water treatment. The treated water shall be utilized for flushing and garden maintenance. The MCGM’s policy for wet/dry garbage shall be followed. Garbage collection point has been provided from where Municipal trucks will collect waste. No storage is provided apart from the garbage collection area which shall have separate bins for biodegradable waste and other categories as per MCGM’s policy.

3) How to maintain Dust, Noise & Air Pollution during Construction Phase?

Rotary drilling shall be utilized minimizing noise and air pollution. Batching plant is not required. Pre-mix concrete shall be used minimizing dust. Drilling in water, noise pollution is minimized.

4) Where Construction Debris will dispose?

Construction debris shall be minimal and shall be carried away by trucks for disposal at designated sites.
5) Whether RMC Trucks/Material Loaded Truck/ Heavy Cranes/JCB/Earth moving Machines will cause accident due to soil Erosion?

There is no soil erosion as rocky bed is available for piling in the sea.

6) Whether Fix or Floating Breakwater required. It’s Design?

**Breakwater is not required as it is a fair weather terminal.**

7) How Fueling system will work with ref to minimize oil pollution?

Fueling system is for filling fuel in the berthed vessels as per their requirement. This will be carried to the floating pontoons by a dedicated pumping/piping system. Service bollards connected to these pipes shall discharge fuel to the berthed vessels. As such no spillage of fuel is anticipated during the filling operation. For the sullage disposal from vessels, portable vacuum pumps shall be utilized. These will suck sullage from vessels and discharge it into the sullage pipes going all the way to the sullage tank. A sullage tanker (truck) will then carry away this sullage once the tank is full.

8) Whether it is safe from Fire/ Explosion? What type of F F protection given to structure?

Fire extinguishers (AFFF, CO2, DCP) shall be provided at specified locations and a sea water fire fighting system is provided with fire hydrants at specified points.

9) Car parking structured/Way/Exist/ F F system/ Flooring is satisfying safety?

Fire main hydrants shall be provided also at all exits/parking area. Entry/exit routes are provided such that emergency vehicles like the fire tender/ambulances can easily go up to the terminal building.

A separate first-aid room (capacity to accommodate wheeled stretchers) with first aid kit has been provided.

3) Apollo Bunder Jetty

![Figure 4.3. Layout of Passenger Jetty, Only 2 meters depth contour line](image-url)
Q1.) Whether construction material will withstand Natural Calamities?

Yes, high grade concrete (M40) shall be used to withstand natural calamities.

2.) Discuss Design Stability with ref to Climate Change Venerable Index? It will not affect in 2050.

There are various sea level rise estimates. According to the conservative IPCC (Climate Change 2013: The Physical Science Basis) estimates the predicted rise in sea water level by 2050 is 30cm. The fixed part of the jetty is to be built at a height of 7.5m which at a highest high water (HHW) of +5.38m, which might occur during the monsoon months when the passenger operations will be terminated, is still 2.12m above the water level. In 2050 with a highest high tide of +5.5m (assumed during monsoon months) and increase in water level of 0.30m, the water level would be +5.80m the jetty is still 1.62m above the water level. It is to be noted in this rough weather (May to September) operations will be suspended.

3) How to plan safe Piling operation during Fixed Walkway construction?

The piling operation will take place by rotary drilling method. Qualified contractors and personnel having experience of underwater piling shall be employed for the construction phase. HSE guidelines shall be put in place and strictly adhered to. The construction site shall be made out of bounds for general public.

4) If Fixed Walkway broke down in between, what is alternative arrangement to brought passenger from floating jetty to Base Floor?

**Breakdown of the platform is not stipulated in the design criteria.**

Fixed walkway shall be regularly inspected for any cracks in the concrete which shall be corrected.

5) What type of Life safety provided during construction of fixed walkway

All personnel shall be wearing life jackets. Life saving buoys/ring buoys shall be readily available at site according to the HSE policy.

4) **Civil Platform Model**

![Civil Platform Model](image)

*Figure 4.4: civil platform Model*
1) Whether Civil Platform design is provided Structural Stability? What is Factors for safety of the structure?
Civil Platform considers IS 456 for RCC design and IS 2911 for pile design.

2) Whether Load Factor consider before Design? Statistic Please
Relevant load factors are utilized.

5) Civil Walkway Model

![Diagram of Fixed Walkway]

**Figure 4.5: Fixed Walkway**

1) Whether Civil Platform design is provided Structural Stability? What is Factors for safety of the structure?
Civil Walkway considers IS 456 for RCC design and IS 2911 for pile design.

2) Whether Load Factor consider before Design? Statistic Please
Relevant load factors are utilized.

MMB Jetty Passenger Jetty Factors that may cause for accident/Mishap during construction phase:

- Ground conditions and changes in seabed and beach profile
- Access and working space
- Temporary instability of the works
- Subsea services
- Timing of the works
- Contaminated sediments
- Interaction of the above.
- A manned safety boat in the surf zone is a major hazard and its use should be carefully planned.
• There is limited tug access (i.e. restricted to shallow draught tug which means limited power to act in emergencies). Operations often rely on maneuvering with ropes using winches, two sea moorings and two land moorings.

• The under keel clearance is less and vessels can ground in a larger swell. There may be additional obstructions resulting from operations (i.e. rock placement). Correct vessel selection is important when working in this area.

• Access into intertidal zone (e.g. to unload rocks) becomes more difficult when the tidal range is small.

• Weather reports from established sources are useful but in the surf zone waves are all important. Local knowledge is useful and an inshore forecast can be obtained from specialists sources.

• Man overboard procedure and emergency evacuation will be different in the surf zone (Fig 12).

Figure 4.6: Rescue in the surf zone once things go wrong is particularly hazardous

Risk Mitigation

On coastal construction wave conditions as well as wind speed may well affect the safe working limits of carnage. The rescue boat should be fit for the purpose, of sufficient length and beam to afford reasonable stability and the engine size should be appropriate for any tidal conditions. Where conditions merit, there is much to be said for inflatable craft, since they provide a better chance of getting a person aboard without injury. For work in tidal water $r$, a power-driven craft is essential with a fixed self-starting device on the motor.

6) Rescue procedure

It is essential that:

1) The number of persons at work is periodically checked to ensure that no one is missing

2) Operatives work in pairs so that there is always one to raise the alarm

3) Each person is trained in what to do in the event of an emergency.

4) The rescue procedure should consist of:
   1. A set routine for raising the alarm
II. a set drill to provide rescue facilities
III. A set routine for getting persons to hospital whether for a check-up following immersion in water (possibly polluted), or for treatment as the result of injury

4) Shore-supplied platforms and gangways must comply with the requirements of the Construction (Health, Safety and Welfare) Regulations 1996. At all edges from which a person might fall into water, platforms, guardrails, barriers, etc. are required.

5) Where platforms or gangways are erected above tidal water, decking boards should be secured (clipped or wired down) so that rising water or high winds cannot dislodge them.

6) The provision of additional handholds is always advisable as a precaution in the event of storms.

7) Safety nets

It is often better to use physical barriers rather than nets. However, where used these should be properly secured and slung sufficiently far above high water level for anyone caught in them to remain clear and so that free access of rescue craft is always possible.

8) Harnesses

Harnesses should only be used where no other protective measure can be provided as they can pose an additional tripping hazard and potential fatal suspension trauma. Barges, pontoons, etc. used as working platforms, must be fit for purpose, properly constructed and sufficiently stable to avoid tipping. Attention must be paid to good anchorage and ballasting; point loads near the edge should be avoided; due account should be taken of the variation of load at the different radii of crane jibs for the use of lifting appliances on barges and pontoons.

9) Lifting equipment

Handling of materials and equipment over water often requires the use of floating plant. Consideration must be given to the operational limits of such plant, in terms of wave and current forces as well as operable wind speeds. Particular attention is required when transferring materials to/from a floating platform to a fixed platform because of relative movements between the two.

10) Site tidiness

Site tidiness is key in minimising tripping hazards. Tools, ropes and other materials not in use should be stored away; rubbish should be cleared up promptly. Materials awaiting use should be stacked compactly and restrained, particularly on pontoons and boats. Mooring lines should be clearly marked and protected. Slippery surfaces are dangerous and should be treated immediately. Seaweed, sea-slime and bird droppings should be cleaned off. Oily or greasy surfaces should be gritted.

11) First aid equipment

First aid facilities should be available, in the charge of a first aider or appointed person, on pontoons, barges and near all landing places.

12) Means of access:
A suitable means of communication should be established with the shore during any work activity and in the event of an emergency.

13) Causes of fire

a) Fuel and Storage Tanks

Ferry terminal / jetty contain materials like petrol or diesel for fuelling and are the material of focus in our project as they can pose hazardous actions in the jetty. Individual ferries have hydrocarbons on board, and the proposed jetty will also have docks for dispensing fuel to the ferries coming at the jetty, which requires that they have fuel storage tanks. These tanks need to safely contain the hazardous materials, and the dispensing equipment must be used properly and maintained to ensure that the materials will not leak or spill into the water or onto the pier, which can cause fire. As improper usage or faulty equipment can result in spills and other emergencies, fuelling docks and fuel storage tanks are some of the most incident-prone locations and items in the jetty.

b) Ferry Fire

Ferry fires are one of the most common ways that jetty fires can begin. These fires can spread to the rest of the jetty and to other ferries. The most common causes of ferry fires are electrical malfunctions, unattended portable heaters, smoking, and poor housekeeping. Smoking is a common cause of fires, whether on a ferry or in the jetty. Electrical fires are also common, and can occur whether the jetty is or is not in use. Exposed wiring can arc to outside materials, or it can cause short circuit. Wiring on ferries can become exposed due to the constant movement of the ferry in the water as well as the corrosive properties of the damp sea air. Improperly sized fuses or circuit breakers can also cause wiring to arc to another material. Overloading electrical sockets and accidents with light bulbs may also cause electrical fires on ferries.

c) Fire in public area

Smoking also causes fire in public area like the restaurants, waiting room, common toilets, parking lot and public parks. Electrical fires are common in restaurants due to short circuit or exposed wiring.

d) Other causes - calamity

Fires in the jetty are potentially calamitous. Fires may cause the spread of hazardous materials, especially hydrocarbons from ferries and storage tanks. The types of ferry passing through the jetty can be hazardous and may be in danger of spilling during a fire or another incident. Fires may also ignite when the ferries are not being operated or even supervised.

e) Operation and Maintenance

Other sources of fires in ferries and jettys include those caused during maintenance and operation, including fuel transfer, welding, and cargo stowage. If the fuel tanks are overfilled, the overflow could ignite inside the terminal if the fuel begins to leak on the shoreline, it could spread on the pier or light the actual fuel storage tank and cause a fire.
f) Prevention for Jetty fire

1. Fire fighting system to be set up and the Jetty shall have its own independent fire fighting arrangements. Two in Nos. sea water pumps (one duty and one standby) and a jockey pump located at the end of the fixed walkway and the fire fighting pump room shall cater to the fire fighting requirements. The jockey pump will cut in when the pressure in the fire main falls below 6.5 kg/cm$^2$. The main duty pump shall start when the pressure drops further to 6 kg/cm$^2$ and shall maintain the fire main pressure at 7 kg/cm$^2$.

2. Identify smoking zone areas on the jetty and public area to avoid fire due to smoking.

3. Enforcing an inspection program of all electrical equipment at regular intervals can prevent some fires from occurring. This can be done by either the jetty management or the fire department themselves.

4. Ensuring that the fuelling pumps and pipes are safely installed is also important in minimizing fires due to fuels.

5. Another prevention strategy is to require that fire extinguishers be located within certain distances of each other, or to keep other means of fire protection equipment in specific locations of the jetty and public area. Fire extinguishers to be located such that the maximum travel distance to an extinguisher does not exceed 22.86 meters (75 feet) on jetty.

6. At least 2 extinguishers must be located near fuel storage tanks.

7. Fire tenders to be located at each berth.

8. 2 Small fire extinguishers to be located at each berth as well

9. Signage to be provide notification to the public and staff of restrictions that apply to certain areas or facilities within the jetty and public area. Signage should be present at specific locations, such as fuelling procedures at fuelling stations, as well as throughout jetty and terminal. Signage including ‘No Smoking’ signs, fire safety signs, hazardous materials storage signs, and evacuation route signs will be present at the jetty.

10. A manually activated electric fire alarm and an automatic fire alarm that is audible through the jetty and public area is distinguishable from any other signal will be provided.

11. A fire hydrant will be provided as active fire protection measure, and a source of water provided with municipal water service to enable fire fighters to tap into the municipal water supply to assist in extinguishing a fire.

g) Fire fighting equipment

The Following Fire Appliances are to be maintained by Jetty fire team

1. Foam tender
2. Water tender
3. DCP tender
4. Emergency rescue tender
5. Mobile dry powder trailer unit
6. Fire tender
7. High expansion foam generator
8. High volume long range monitor
9. Automatic fire sprinkler
10. Fire hydrant system
11. Fire fighting suits

Therefore, proper care and precaution measures have to be practised at the jetty for any adverse events like fire.

4.2 Emergency planning/preparedness

Particular attention should be paid to effective emergency planning and provision of access to key emergency services such as:

- Nearest Hospital
- MMB Administration
- Coastguard
- Police
- Fire service
- Bomb disposal
- Home Guard
- Nearest MTNL
- Indian Naval base

4.3 Protective clothing and equipment

1) Safety helmets

Safety helmets should be worn at all times for operatives in designated work areas, since anyone struck on the head and then falling into water is at special risk.

2) Footwear

Types with non-slip soles should be worn. Rubber and thigh boots should not be worn as, once filled with water; they act as dead-weight and could drag the wearer under water.

3) Personal buoyancy equipment

Life-jackets or buoyancy aids must be worn where there is a foreseeable risk of drowning when working on or near water and at all times while working on boats.

4) Identify areas which are safe and where no buoyancy equipment is required. Equally areas where there is a high risk should reinforce procedures.

5) A life-jacket is a personal safety device which, when fully inflated (if inflatable), will provide sufficient buoyancy to turn and support even an unconscious person’s, face upwards within five seconds (ten seconds if automatically inflated).

4.4 Rescue equipment

Lifebuoys and rescue lines

The lifebuoys & lines must be checked to ensure that they are long enough to allow for the state of the tide, height of working place above water.
Daily checks should be made to ensure that lifebuoys and rescue lines are still in their proper place and that no repair work is required as a result of vandalism or other interference.

Grab lines

Grab lines, attached to the working place, or at other places downstream, and long enough to allow for the normal rise and fall in tide, can be supplied to give a person something to grab in an emergency.

The competent diving contractor carrying out the works must ensure that:

- A detailed diving project plan is prepared and all risks fully assessed
- A details of the plan are made known to anyone directly or indirectly involved in the diving operation or its support activities

4.5 Assessment of Inherent Risk: MMB Passenger Jetty Construction/Operation Phase Navigation Risk Matrix

In order to assess the risks associated with the jetty development’s hazard components; frequency and consequence need to be determined. Frequency represents the likelihood of a risk’s occurrence during navigation activities. Consequence represents the outcome of a risk’s occurrence; for example, in terms of personal injury, equipment damage and environmental damage.

A risk score for each hazard is predicted by multiplying the likelihood ranking number by the consequence ranking number, and this score is then used to determine a risk’s position within the risk rating.

Red - major or extreme/catastrophic risks that score 15 or more
Yellow - moderate or major risks that score between 8 and 14

Blue or green - minor or insignificant risks scoring 7 or less

<table>
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<tr>
<th>CATEGORY</th>
<th>RISK</th>
<th>CONSEQUENCE</th>
<th>LIKE HOOD RATING</th>
<th>CONSEQUENCE RATING</th>
<th>RISK RATING</th>
<th>CONTROL</th>
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<td>Damage Marine system. Pollution</td>
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<td>3</td>
<td>Moderate 9</td>
<td>Inspection of Pumps-Tanks /SOP /safety supervision</td>
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<td>Frequent interference</td>
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<td>4</td>
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<td>robust operational procedures implemented through the SMS</td>
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<tr>
<td>--do----</td>
<td>Fishing activity</td>
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<td>2</td>
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<tr>
<td>--do-----</td>
<td>Recreation activity</td>
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<td>2</td>
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<td>2</td>
<td>8 Yellow</td>
<td>Implementation of Evacuation plan Mock Drill</td>
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<td>Sevier/ Vessel May sink /Drowning</td>
<td>4</td>
<td>4</td>
<td>16 Red</td>
<td>Frequent inspection of Vessels for Life safety PPE/PPA Communication system Use of SOLAS sea bed</td>
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4.6 Risk reduction: Mitigation Measures

4.6.1 Safety Measures to be implemented during construction phase

1) The contractor shall adhere to safe construction practice, guard against hazardous and unsafe working conditions and follow all safety precautions for prevention of injury or accidents and safeguarding life and property.

The contractor shall comply with relevant provisions of Dock Workers (Safety, Health and Welfare) Act – 1986 and Dock Workers (Safety, Health and Welfare) Regulation – 1990 and Safety Officer of MMB Mumbai shall be afforded all facilities for inspection of the works, tools, plant, machineries, equipments etc. wherever so required.

2) The contractor shall further comply with any instruction issued by the MMB Safety Officials in regards to safety which may relate to temporary, enabling or permanent works, working of tools, plants, machineries, equipments, means of access or any other aspect. The contractor shall provide PPE’s (Personal Protective Equipments) as well as job specific PPE’s, all as per requirement and as directed by the Engineer.

3) All safety rules shall be strictly followed while working on live electrical systems or installations as stipulated in the relevant safety codes.

4) All mechanical hoisting and hauling devices and equipment required for execution of the work, including their attachments, construction tools, machineries and equipments shall be of adequate capacity and shall comply with relevant safety codes. All the components shall be in good working condition and shall be checked frequently to ensure that no defect/breakage has developed.

5) During work on MMB Jetty project location, the areas of work must be clearly marked with red flags and prominent red lamps (at night) to prevent any danger to workmen engaged at site or to ships berthing at the Jetties.

6) During work at night, the Contractor shall deploy halogen lamps/ other electrical lamps at the required spots to ensure there is adequate illumination for hazard-free work.
7) The Contractor shall also surround vulnerable areas of on-going works with old rubber tyres as a precaution against accidental collision and damage.

8) High quality well-sheathed cables shall be used for all temporary electrical work. All electrical installations shall be grounded and well protected.

9) All accessories such as welding leads, electrode holders, welding gloves and helmets, etc. must be of high quality and should be well maintained and checked.

10) The contractor shall adopt all the above safety measures at his own cost. The contractor shall adhere to safe construction practice, guard against hazardous and unsafe working conditions and follow all safety precautions for prevention of injury or accidents and safeguarding life and property. In case any accident/untoward incident occurs during execution of the work, the Contractor shall be solely responsible for such incident.

11) At all times during execution of the project, the contractor shall provide and maintain at site all necessary first aid measures including oxygen cylinder and mask in proper condition.

12) Marine Environmental Risk, No damage is caused to plants and vegetations unless the same is required for execution of the project proper.

(13) The work shall not pollute any source of water / land / air surrounding the work site so as to affect adversely the quality or appearance thereof or cause injury or death to Marine Eco system Flora & Fauna, animal and plant life.

(14) Labour camp/ Shift room etc, shall be maintained in a clean and hygienic condition throughout the period of their use and different effluents of the labour hutment shall have to be disposed off suitably.

15) Stringent Work permit system to be implemented for safety of workman

4.7 Conclusion

1) Environmental risk: This rock has been geochemically tested to confirm that there would be no adverse environmental effects associated with its use (AMEC 2003). The quarry rock will not be washed prior to placement.

2) Periodic Bathymetric survey to undertake avoid accident as vessel traffic increased or change of route plan.

3) The risks of damage of the jetty & affiliated facilities due to large waves, storm surges design shall revise during expansion/ New construction

4) Periodically structural audit of Civil platform & Fixed walk way is recommended

5) Access & Working space; Tidal working can also put pressure on operators to finish work before the incoming tide prevents work being completed. This pressure can, if not checked, lead to the disregard of health and safety measures

Mitigation: Maximize working space to provide a safe working environment.
6) Consider emergency access and egress from the site in storm conditions. During high tide and storm conditions, the site area was very remote, exposed and site personnel and Jetty infrastructures were vulnerable to wave action.

It was observed that the safety of personnel was compromised by the environmental constraints. The contractor also put into place a weather forecasting system to ensure that potential risk could be monitored.

7) The designer generally focuses on the extreme wind, wave, water level and current conditions appropriate to the design of the permanent works but should also take into account the wave conditions that will affect the works during partly completed conditions. The temporary instability of the works during the construction can result in catastrophic failures and risk to personnel.

It is essential that adequate consideration be given to the critical stages during the construction, when the works may be susceptible to damage from relatively mild wind, wave, water level and current conditions.

8) Only 73 Car parking above Diesel U/G storage tank. Not advisable Unsafe Location. Recommended Separate Parking lot in future away from decided U/G Storage Tank location.

9) At present Assembly point shown in Car parking area, it is too shifted outside Jetty Building in open space near to road for easy Evacuation.

10) With ref to likely traffic in 2045 & Road Congestion, Fire Tender may found difficult to access Jetty. Therefore it is recommended that Fire pumps with Jockey pump alongwith D G Supply may provide to jetty.

11) It is also recommended to construct fixed or floating barrier in the water to intercept waves and create a sheltered to passenger Terminal from abnormal cyclonic storm and wave as additional safety measure considering about 20,808 Passenger/day load (year 2045) & stability of structure with ref to unavoidable corrosion.