File No. M- 25021/20/2020-SM
Government of India
Ministry of Ports, Shipping and Waterways
(Sagarmala Cell)

3rd Floor, PTI building,
4, Parliament Street,
New Delhi - 110001,
Dated: December 4, 2020

Subject: Draft Guidelines for Floating Jetties for Harbours, Marinas and Fish landing facilities-reg

I am directed to say that Ministry of Ports, Shipping and Waterways has been working on the issues pertaining to congestion at Fishing Harbours. It has been noticed that many of the nation's fishing harbours are grossly overcrowded, so much so that boats often find it impossible to berth alongside a jetty. It has resulted in reduced efficiency, delays in unloading the catch (affecting its freshness to market), accidents, injuries, and longer working hours.

2. To address the issue, a Task Force has been established to improve the situation. Task force has submitted a draft Guidelines for Floating Jetties for Harbours, Marinas and Fish landing facilities. A copy of the draft guidelines is submitted for perusal.

3 It is requested that your opinion / comments on draft may be sent to Sagarmala Cell in the attached proforma latest by **11th December, 2020 positively** on the following mail - **sagar.mala@nic.in**

4. Your co-operation and early reply will be highly appreciated.

04-12-2020
(Sanjay Kumar)
Under Secretary to the Govt. of India
Tel No.: 2371-4715
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Format for seeking comments on Guidelines for adopting Floating Jetties for Harbors, Marinas and Fish landing facilities.

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Agency Name:

Address with contact details:

Type of agency (Govt/Private/PSU/Individual/Other):

Para-wise Remarks on the draft:

S.no	Para No. of the draft	Existing text in the draft guidelines	Proposed Changes	Remark

Other Remarks (If any):

E-mail this format to **sagar.mala@gov.in** and copy to **jssm-ship@gov.in**

Draft

Guidelines for Floating Jetties for Harbours, Marinas and Fish landing facilities

Ministry of Ports, Shipping and Waterways

1. Introduction

Ministry of Ports, Shipping and Waterways, Government of India, recognises that many of the nation's fishing harbours are grossly overcrowded, so much so that boats often find it impossible to berth alongside a jetty.

In many cases the harbour is totally congested (as seen below and also in the image on the front cover of this report).

Fig. 1

The shortage of berthing capacity means:

- Unloading of the fishermen's catch is difficult, time-consuming and in some cases hazardous.
- Loading of stores and equipment is also difficult, time-consuming and in some cases hazardous.
- Fuelling of boats is often accomplished with jerrycans carried across the decks, or with long hoses, both of which often lead to spillages and pollution.
- Maintenance of boats (e.g. servicing of engines, replacing fishing tackle) is also difficult when not berthed alongside a jetty.
- The situation is exacerbated in harbours having a large tidal range because during the low tide period the distance from the deck of the boat up to the jetty-top can be considerable.

The result of all this is reduced efficiency, delays in unloading the catch (affecting its freshness to market), accidents, injuries, and longer working hours. Ministry of Ports, Shipping and Waterways has therefore established a Task Force which is tasked with improving the situation.

2. Berthing Capacity

The challenge is how to increase berthing capacity in the fishing harbours.

Constructing fixed concrete jetties or quay walls is problematic because:

- Applications to the environmental planning authority may delay or even prevent such construction and will certainly cause the start of works to be delayed for some considerable time.
- Similarly, applications under the Coastal Regulation Zone (CRZ) law may, in some cases, result in such construction being prohibited or at best much delayed.
- Fixed jetties and quays are expensive.
- Fixed jetties and quays are relatively slow to build.

Another consideration is to provide berthing capacity that is appropriate to the boat size. The typical coastal fishing boat (Fig. 2) can make do with lesser facilities compared to the much larger offshore boat (Fig. 3).

Fig. 2

Fig. 3

A disadvantage of the traditional quay is that it only provides berthing along its front edge. This may be justifiable when the fish-handling sheds need to be built on the quay itself, as seen below, but in other cases this is not a cost-effective form of construction.

Fig. 4

A few harbours have fixed "finger" jetties that allowing berthing along both sides, as seen below in the photo of Malpe.

Fig. 5

This is a more desirable solution than quay walls, yet it will still suffer from the time-consuming consents process and, in locations with a large tidal range, it still results in the freeboard problem as illustrated in the below photograph.

Fig. 6

The Taskforce has therefore determined that replicating the Malpe layout with concrete **floating jetties** is a seemingly perfect solution to the problem.

3. Floating Jetties

Floating jetties are used in Europe and the Middle East, especially in locations having a large tidal range where a conventional quay would mean the fishing boat floating many metres below the top of the quay during low tide periods.

Fig. 7

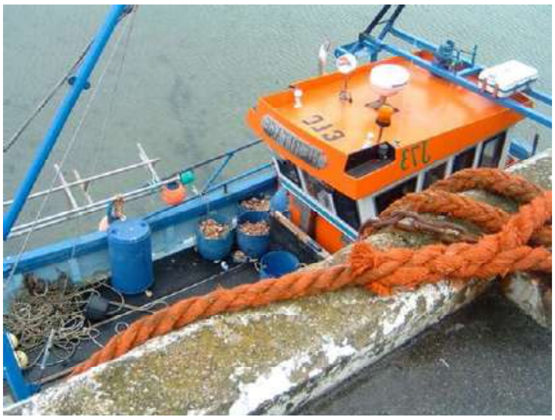

Fig. 8

In such locations, the deployment of floating jetties results in a constant freeboard between jetty and boat. This eases the disembarkation of the catch and the embarkation of ships' stores, with a consequent increase in productivity and safety.

Fig.9

Fig. 10

Fig. 11

Harbour Authorities are generally in favour of floating jetties, not only on grounds of cost but also because:

- They do not require any form of permanent construction on the seabed.
- They can be easily moved or removed in case of a need to re-configure the port.
- The environmental impact is negligible.
- Safety is much improved.

Consequently, the Task Force has determined that **floating jetties** will be an attractive solution for India's over-crowded fishing harbours.

Fig. 12

4. Performance Criteria & Specifications for Floating Jetties

Considering the heavy use of our fishing harbours, it is clear that the structure of any floating jetty must be built of fully reinforced concrete. The use of lighter forms of construction such as steel or aluminium will not provide the strength or durability required. And it goes without saying that a steel structure in saltwater locations would need frequent slipping, chipping and painting, thus imposing on the harbour authority an onerous, ongoing and expensive maintenance regime.

A similar comment applies to the deck of the floating jetty. A deck made from anything other than reinforced concrete will never survive the loads (especially impact loads), the frequent spillages of caustic chemicals and petroleum products, and the degradation caused by sunlight and high humidity.

Our research has therefore focused on the unsinkable, fully reinforced concrete jetty of the type which has recently appeared in India in Maharashtra, Goa, Kerala and Gujarat (see ***Appendix A***). The Goa and Gujarat jetties were approved by NTCPWC, IIT Madras.

Although these featured jetties were made from 12m x 3m modules, we are assured that the construction principles will be identical for larger sizes. In this context we found this image of a much larger model (Fig. 13).

Fig. 13

Another advantage of the floating jetty is that we do not need to apply the "one size fits all" approach. For the small boats of the coastal fleet (similar to Figs. 2 & 9) a 3m wide floating jetty with a freeboard of 0.5m would be adequate.

On the other hand, for the larger vessels of the offshore fleet (similar to Fig. 3) a jetty width of 6m is indicated. We have noted that the width of the finger jetties at Malpe (see Fig. 5) scale from Google Earth at between 6m and 7m. A photograph of this jetty, taken during high tide, is shown below.

Fig. 14

Although a 3m jetty width is inadequate for road vehicles it is fine for hand-trollies and electric trollies (Figs. 15 & 16). And the 6m width is adequate for 3-wheelers and light trucks (Figs. 17 & 18).

Fig. 15

Fig. 16

Fig. 17

Fig. 18

As illustrated earlier (Fig. 13), it is possible to build much wider floating jetties, but we understand that the cost increases very substantially due to the increased volumes of materials required.

Another very important consideration is flotation safety; we advise that the jetties purchased by the Ministry must be unsinkable no matter how much they may suffer from vessel impact or lack of maintenance. The designers of this type achieve this by the use of a special foam core which is encapsulated by concrete on all but the bottom side (in order to save weight). A typical cross-section would appear like this:

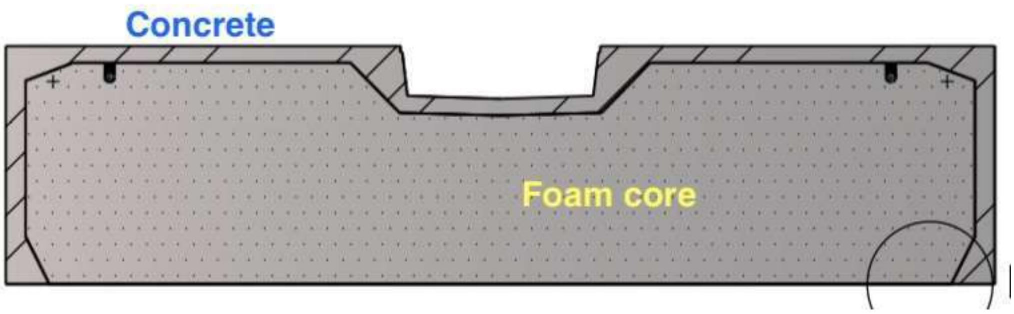

Fig. 19

The open recess along the top of the unit is designed to carry utilities. However, considering the intensity of use in fishing harbours we have taken further advice, which is to instead carry the utilities within under-deck, cast-in ducts. This will ensure that the utility pipes and cables cannot be damaged by the fishermen or their vehicles.

We have prepared a specification / schedule of technical requirements for the floating jetties in ***Appendix B.***

We have learned that an INR 100 crore contract has recently been awarded for about forty floating jetties for the Kochi Water Metro project.

5. Mooring of the Floating Jetties

Floating jetty systems are customarily moored in position either with piles (Fig. 20) or with chains (Fig. 21).

Fig. 20

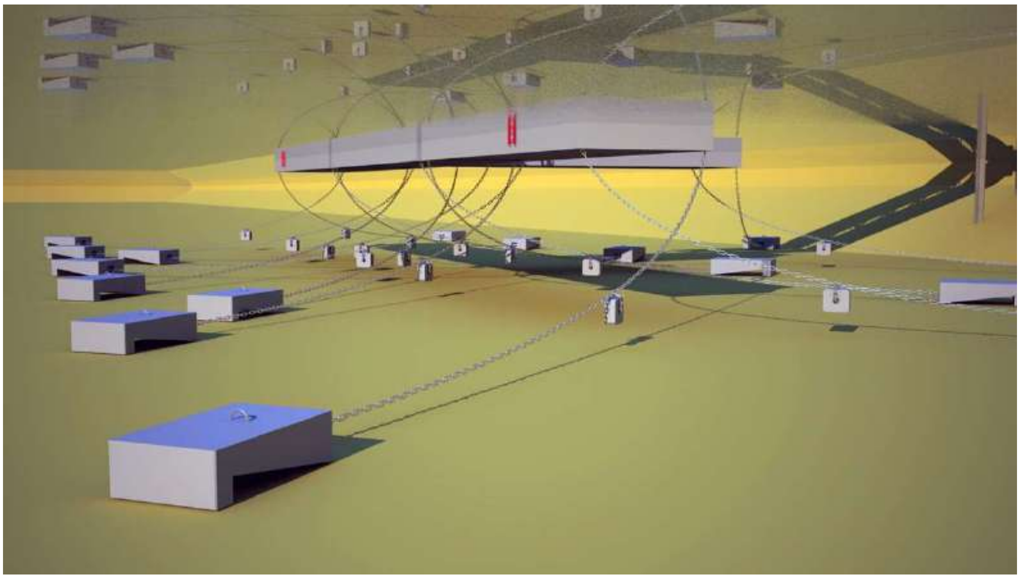

Fig. 21

Each mooring method has its pros and cons;

<u>Chain moorings</u>

Pro: Chain moorings are preferred when the floating jetty is located in an area with waves because the chain catenary absorbs the mooring forces without causing any snatching. (However, most of the fishing harbours being contemplated will be smooth-water environments.)

Pro: The laying of chain moorings and their concrete gravity anchors or *Danforth* high-holding power anchors (as appropriate for the site conditions) can be undertaken with locally available boats, with load-out by Hydra crane.

Con: Chain moorings need adjustment from time to time, and insurance companies (and prudent managers) usually dictate that diver inspections be undertaken every 3 years or so.

Con: The chain system is relatively complex (as may be seen in Fig. 21) and may be fouled by a fishing boat dropping anchor. And the chain moorings would probably have to be lifted in the event that maintenance dredging has to take place.

Pile moorings

Pro: Once installed, the piles can be "forgotten" for many years; no adjustment is required. The only maintenance required is simple touching up of the protective epoxy paint in the inter-tidal zone.

Pro: The piles hold the floating jetty system precisely in place and the seabed is completely unobstructed.

Cons: Driving of the mooring piles must be done from a work-barge equipped with spuds to ensure accurate positioning. Mobilisation of this equipment is not cost-effective for small installations having only a few short jetties.

The Task Force takes the view that this project is an important National project and so the contractor shall be expected to provide the right type and standard of equipment to ensure the very best result. Upon advice, we propose that for the piled solution the contractor shall equip himself with a demountable, road-transportable work-barge that can be moved from harbour-to-harbour quickly and easily (Fig. 22).

Fig. 22

The seabed in the majority of fishing harbours comprises soft, alluvial deposits. Piling in such soils is best accomplished with a hydraulically powered vibro-hammer which is fast and near silent (Fig. 23). This type of hammer also has the great advantage that it can be used in reverse to extract any piles that have, for whatever reason, been inserted in the wrong position. And the crawler crane aboard the work-barge can, if necessary, be rigged with a grab-bucket to remove/ excavate any obstructions encountered on the seabed.

Fig. 23

Another item of specialised equipment that the prudent contractor will provide is the Multicat (Fig. 24). This multi-purpose craft is the backbone of the international marine construction and dredging industries, although few have been seen in India to date.

Fig. 24

6. Manufacturing the Floating Jetties

The 3m wide x 12m long floating jetties that we recommend as suitable to serve the coastal fleet can be manufactured anywhere since they are road transportable and at about 18t each, not too heavy to launch with locally available mobile cranes.

In the Middle East, units up to 6m wide and 20m long can be transported by road on special trailers with a police escort, but this is only possible because of the excellent road system.

Fig. 25

In calm weather, a string of floating jetty units can be towed at sea from one harbour to another.

Fig. 26

We have concluded that the heavy-duty, 6m wide floating jetty units for this project will have to be manufactured at, or near to the harbour in question, since towing at sea for long distances is unlikely to be very practical, certainly on a year-round basis.

The contractor will have to set up a pre-cast concrete manufacturing facility at the harbour and probably also a plant to produce the flotation foam. This can all be done providing the project is large enough for him to justify it. Therefore, in planning the projects, this Task Force will take account of the various harbour sizes and locations and try to group them to achieve the necessary logistical economies.

A 20m x 6m floating jetty unit is likely to weigh of the order of 90t. To launch 90t from a quay will require a telescopic mobile crane of about 400t nominal capacity (and this assumes that the quay wall is strong enough to safely take the mass of the crane).

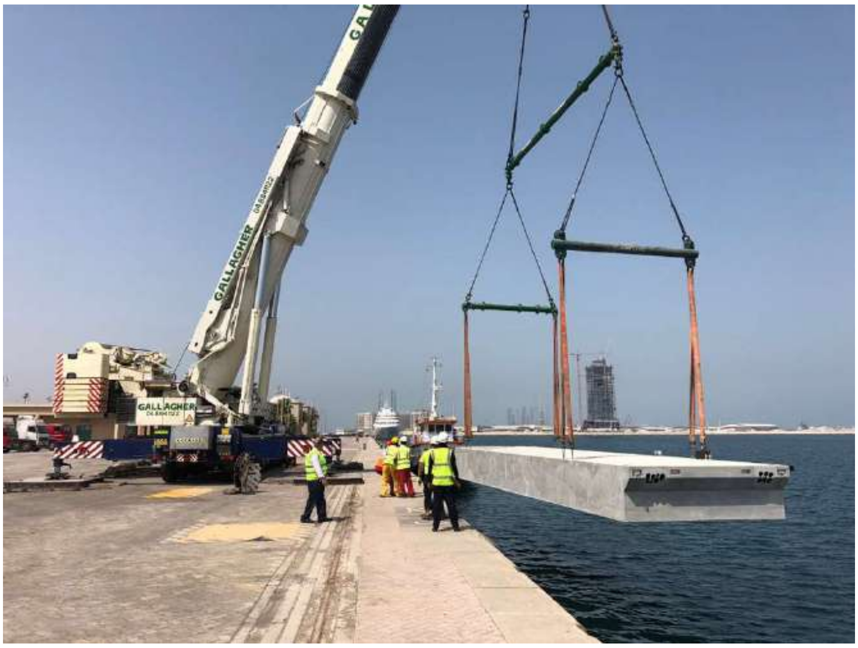

Fig. 27

Such cranes are very expensive to hire, even assuming they are available in the locality, and extremely expensive to purchase (at least INR 20 crore). The contractor can justify retaining such a crane on site only if the project is large enough.

Although the weight of the individual jetty units can be reduced by, say, halving their length, we are informed that this makes the manufacturing process less efficient, and it doubles the number of connecting mechanisms.

Some other options may be available at some harbours, for example, manufacturing in a dry-dock or on a synchro-lift.

Fig.

It will be up to the contractor to find a solution, but the Ministry should be willing to assist with permissions, rentals etc. in order to secure the most economical arrangements.

7. Loading and Stability

7.1 General

Fixed and floating structures should be designed for the following loads:

(a) Dead load.

(b) Live load.

(c) Environmental loads.

(d) Loads from vessel wash.

(e) Berthing and mooring loads.

In designing Floating Jetties, the design should include assessment of the structural ability to resist all loads and the flotation and stability of floating systems. Strength limit-state loads should be calculated for a 1 in 50 year return period for wind, wave, surge and flooding loads.

The favourable sites for floating jetties would have significant waves less than 0.5m in height and average periods of about 8s.

7.2 LOAD COMBINATIONS FOR LIMIT STATE DESIGN

Limit State Design should be used with the load combinations and load factors. Except where loads and load combinations are suggested below, all structures should comply with the requirements of AS 1170.1.

Due to the critical nature of the environmental loads on the design of a floating jetty, serviceability limit state is rarely critical. Stability is dealt with separately due to the special considerations for floating pontoons.

For Strength Limit States, the designer should be satisfied of the appropriate load combinations and load factors for the particular circumstances. Where more accurate data is not available, the following load combinations are suggested:

a) For pontoon piling:
   (i) Wind load (See Note 1) + 1.5 × current load + 1.5 × wave load.
   (ii) The piles are to be designed for water level at highest astronomical tide (HAT) (See Note 2).
   (iii) Where flooding or surges can occur: 0.8 × wind load (see Note 1) + 1.25 × current load + 1.25 × wave load taken at the maximum water level.

b) For the Floating Jetty itself Wind load (see Note 1) + 1.5 × current load + 1.5 × wave load + 1.5 × the vertical effect of wave action.

c) For boat impact:
   (i) 1.25 × the loading created by boat impact.
   (ii) Taken on its own without environmental loads.

NOTES:

1 Wind loading is based on the ultimate wind velocity.

2 Where the water depth in a particular section of the marina varies, the piles should be checked for a water level at lowest astronomical tide (LAT). In this situation the piles in the shallower water will tend to carry a greater proportion of the total loads applied to this section of the Floating Jetty.

7.3 Dead Loads

The dead load should include the self-weight of the structure and the load due to services such as electrical cables and water pipes and fittings (full of water).

7.4 Fixed Structure Live Load

7.4.1 Structures for unrestricted access

Fixed walkways and fingers with unrestricted access should be designed for either of the following live loads, whichever produces the most adverse effect:

(a) A uniformly distributed load over the deck plan of 5 kPa.
(b) A concentrated load of 4.5 kN.

7.4.1 Structures for Restricted access

Fixed walkways and fingers with restricted access should be designed for either of the following live loads, whichever produces the most adverse effect:

(a) A uniformly distributed load over the deck plan of 3 kPa.
(b) A concentrated load of 4.5 kN.

7.5 Floating Structure Live Load

Floating structures should be designed for the following live loads:

(a) Structural load—applied to the full length and width of the structure or to any part thereof so as to produce the most adverse structural effect on the structure.

(b) Flotation load—the floating structure should have 50 mm reserve buoyancy when the flotation load is applied to the full length and width of the structure. If full flotation is not provided to the top of the deck, the minimum freeboard to the top of the deck should be sufficient to maintain 50 mm reserve buoyancy. If the width of the flotation unit varies with the degree of immersion, the minimum freeboard under stability loading should be increased so that the reserve buoyancy is equal to the maximum width of the flotation unit multiplied by the 50 mm freeboard.
(c) Stability load—the floating structure should comply with Clause 4.12 when subjected to the stability load.

If the freeboard is greater than 500mm and the draft is less than 150mm, the response time of the floating jetty to cyclic vertical loading should be checked.

7.5.1 Floatation and stability loads

Floating structures should be designed for flotation and stability loads. These loads should be applied over the whole of the deck area and gangways, where applicable. Design loads should be applied at a location to cause the most adverse action effect. For example, for a finger, the load may be applied across half the width of a floating pontoon.

7.6 Environmental Loads

The principal environmental loads likely to be encountered in Floating Jetty are as follows:

(a) Wave loads, both short-period local wind waves and long-period swells resulting from storm or wind activities offshore.
(b) Wind loads on the Floating Jetty structures and on vessels moored at the Floating Jetty.
(c) Current loads due to tidal currents, river and stream flows, and storm water outlets.

7.6.1 Negative Lift

For floating pontoons, a phenomenon known as negative lift should be considered during flooding. This phenomenon occurs as a result of current velocities passing under the pontoon and causing suction downward on the leading edge of the structure. The negative lift is proportional to the velocity squared, and can result in submersion of the leading edge of pontoon at moderate velocities.

7.7 Berthing and Mooring Loads

The berthing impact force should be derived from the energy impacted to the structure and restraining system from the design vessel striking the structure at a perpendicular velocity not less than 0.3 m/s. For recreational vessels greater than 25 m in length, a berthing velocity of 0.2 m/s may be used and for floating ferry terminals a perpendicular velocity greater than 0.3 m/s may be appropriate.

The effect of berthing impact loads should be considered at both high and low tide. At low tide the pile loading is likely to be the dominant effect. At high tide, the effect of the pile deflection on the structure is likely to be dominant. The mass of the attached water should be taken into account and berthing energy shall be determined for mid-point berthing.

7.8 ANCHOR LOADS

Floating structures should be designed to include the effect of the elasticity in the anchorage system. The loads transferred into the structure will depend upon the method and number of attachment points.

7.9 Stability

A principal factor in safe pedestrian or vehicular access on floating structures is stability, i.e., the ability to withstand overturning forces or moments and return to a normal attitude after removal of these unbalanced forces or moments.

A floating structure is stable if under all conditions of loading the metacentre is located an adequate distance above the centre of gravity. Alternatively, adequate stability is provided if under all loading conditions, the whole of the top of the flotation structure is clear of the water surface and the opposite chine remains submerged.

APPENDIX A

Photographs of Floating Jetties Recently Installed in India

Gateway of India

Captain of Ports jetty, Panaji, Goa.

Flagstaff House, Indian Navy, Kochi.

Seaplane jetty at Statue of Unity, Gujarat.

APPENDIX B

Specification / Schedule of Technical Requirements (SOTR) for Floating Jetties

Schedule of Technical Requirements (SOTR) for Floating Jetty Systems for Vessels up to about 20m/65ft Length Overall (LOA).

To achieve the best combination of utilisation, durability, sea-worthiness, safety, and low maintenance, plus the ability to be moved/re-located (if ever required), floating jetties should meet the following specifications.

Ser.	Specification	Rationale
1	The jetty shall be constructed of reinforced concrete of grade M45 or greater.	To ensure stability and seaworthiness, zero corrosion, low maintenance, and safety.
2	The concrete shall be reinforced with hot-dipped galvanised steel or corrosion-resistant steel.	To ensure that the reinforcement does not corrode and affect jetty usability during its design life.
3	The deck of the jetty shall be plain concrete with a brush finish.	To ensure safety under-foot, even during wet conditions.
4	Cast-in plastic utility ducts to be provided along each side and along centreline of the jetty.	To accommodate water and electricity services.
5	All connecting parts and all cast-in components shall be of stainless steel.	For strength and non-corrosion.
6	Stainless steel mooring bollards shall be directly connected to the main structure of the jetty at 4m spacing along both sides of the jetty. 5t capacity for 3m wide jetties, 10t capacity for 6m wide jetties.	For mooring the fishing boats.
7	Option to cast-in a stainless-steel or aluminium fender plate along the berthing faces.	To provide additional resistance to vessel impact and abrasion from the vessels' tyre fenders.
8	Cast-in stainless-steel sockets along top edge at 1m spacing.	To allow future fitting of hanging fenders (if required).
9	Access gangways fabricated from grade 6031-T6 or 6036-TS aluminium. Internal clear width of 1.8m for 3m jetties and 3.5m	To provide safe and convenient access with low weight and no corrosion.

	for 6m jetties. Decked with FRP anti-slip grating. Length to ensure a maximum gradient at low tide of 1:4 (15 degrees).	
10	The jetty shall be designed for mooring in position either with chains or with steel or concrete piles.	To ensure safe positioning of the jetty against all normal environmental and operational forces.
11	The jetty shall be designed to withstand a constant, everyday wave height of 0.3m from any direction, and an occasional (i.e. storm) wave height of 0.6m from any direction.	To ensure durability and survivability.
12	The jetty shall have a demonstrable service life under normal operating conditions of at least 20 years with minimum maintenance.	To ensure durability and value for money.
13	The unloaded freeboard of the jetty shall be nominal 0.5m for the 3m width, and nominal 0.8m for the 6m width.	To ensure convenient compatibility with the vessels berthed alongside.
14	The jetty system shall hold accreditations from Indian national classification authorities. The system must have a track record of at least 10 years in harsh environmental conditions.	To demonstrate that the jetty system meets recognised quality and safety standards.

Details of all designs and specifications of the pontoons and all their component parts shall be submitted approval.