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PLANNING AND DESIGING OF FLOATING STRUCTURE

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ABSTRACT:

Floating structures is one of the offshore construction method. Many structures like airport, wind turbine, and oil platforms are constructed in offshore at high budget. In this study, we planned to construct a multi-stored building in offshore for entertainment & residential purpose. There are four basic types of foundation possible in offshore like pile, gravity base, caisson and floating type. We choose the floating type, which is cost effective and also eco-friendly. The structure is designed with the consideration of hydro-elastic property and design considerations for very large floating structures are discussed. The structure supported on submerged floatation chamber which are anchors by taut cables to mass anchors located at a depth of 60 m to 180 m. Construction of such a multi-stored building is feasible by means of state of the art techniques. The cost of multi-store building is 2.1557000 crore, average 1620 m^2. Their presence is largely due to a severe shortage of land and the sky-rocketing land costs in recent times, so floating structures are the only solution to reduce land reclamation and economic construction in offshore.

INTRODUCTION:

The unprecedented growth of multi store building and urban development expand in land-scare city sand island countries city planners and engineersresortto land reclamation to ease thepressure on existing heavily-used land and underground spaces. Using fill materials fromseabed, hills, deep underground excavations, and even construction debris, engineers are ableto create relatively vast and valuable land from the sea.However, land reclamation has its limitation. It is suitable when the water depth is shallow (less than 20 m). Whenthe water depth is large and the seabed is extremely soft, land reclamation is nolonger cost effective or even feasible. Moreover, land reclamation destroys the marine habitat and may even lead to the disturbance of toxic sediments. When faced with these natural conditions and environmental consequences, large floatingstructures may offer an attractive alternative solution for birthing land from the sea.

There are basically two types of large floating structures (LFS), namely the Semi-submersible type and the pontoon type. Semi-submersible type floating structures are raised above the sea level using column tubes or ballast structural elements to minimize the effects of waves while maintaining a constant buoyancy force.

In the search for alternative viable solution, one must consideran multi-store building located on the sea or in other large water bodies of water. This study addresses itself to the concept of the floating multi-store building to be located offshore in relatively deep water (200 to 500 feet) but close enough to population centres

Two-thirds of the world's surface is covered with water. To protect coastal landfrom reclamation They do not suffer from differential settlement due toreclaimed soil consolidation They are easy and fast to construct &Temporarystructure These structures free from noise and pollution and it creates great comfort.

Even construction debris, engineers are able to create relatively vast and valuable land from the sea.Moreover, land reclamation destroys the marine habitat and may even lead to the disturbance of toxic sediments. When faced with these natural conditions and environmental consequences, large floating structures may offer an attractive alternative solution for birthing land from the sea.In the search for alternative viable solution, one must consider an multi-store building located on the sea or in other large water bodies of water. Total cost of the project is generally higher than that of its land-based counterpart. (such a comparison may not be valid in the near future as construction cost are reduced by improved techniques and as available dry and locations are exhausted) .

The advantages of floating concrete structures lie in the economy of the materialsused (concrete is very well suited to a marine environment), in the fact that it is easy to make concrete structures buoyant in the construction stage as well as permanently and for towing, whereas they are or can be made heavy enough for a safe permanent installation, and in the fact that they can also provide storage space.Studieson the legal aspects of Mega float, its design and constructiontechnologies, its environmental impact. Large Floating Structure is a unique concept of ocean structures primary because of their unprecedented length, displacement cost and associated hydroelasticresponse. Requires massive investment of resources and isconsidered a megaproject.

Technology utilized in the project must be well proven or reliable to reduce risk of investment. Researchers and engineers have improved their understanding of hydroelastic response and its implementation in the design method. Detailed and concentrated efforts were undertaken in the MOB and Mega-Float projects.Coherence issues in describing the physical ocean environment and Interpretation in design remains an area for further research. Leading edge technology were developed in many areas of VLFS research particularly inhydroelastic analysis, fatigue design and construction. These results are beneficialnot just for but also for a variety of marine structures. The facilitiesand structures on Mega-Floats are protected from seismic shocks since they are inherently base isolated.

SPECIFICATIONS:

The specification details of the proposed works to be carried out for the said construction are given below.

SUPER STRUCTURE:-

The super structure for both floor will be constructed with first class chamber burnt brick is C.M 1:5 mix. Lintel beam of thickness 230mm will be laid over the newly constructed brick walls. Sunshades with a width of 600mm will be provided wherever necessary.

ROOFING:-

The roofing of the building will be made of reinforced cement concrete mix of 1:1.5:3 ratios with a thickness of 150mm with necessary steel reinforcements.

Weathering course concrete using broken brick jelly in lime mortar will be laid over the roof and the same will be finished with one course of machine pressed tiles in C.M. 1:5 mix and pointed with 1:3 mix.

WOOD WORK & STEEL WORK:-

The doors, windows and ventilators will be made in the best country wood & steel.

FLOORING:-

Plain cement concrete 1:4:8 using 40mm HBG jelly will be laid as flooring concrete to a thickness of 130mm. Floor finish will be of Marble Slab in C.M. 1:3 mix for all rooms.

FINISHING WORKS:-

All the brick wall surfaces will be plastered with C.M. 1:5, 12mm thick. The exposed surfaces of R.C.C. items will be finished with C.M. 1:3,10mm thick.The plastered surfaces will be given two coats of synthetic enamel paint over a priming coat.

LUMPSUM PROVISION:-

Necessary lump sum provisions have been given for the following items of works.

1. Provision for water supply and sanitary arrangement.
2. Provision for electrical arrangements.
3. Provision for staircase arrangements.
4. Provision for cricket ground.
5. Provision for unforeseen items such as increase in cost of Materials, labour charges etc. complete.

The rates adopted in this estimate are based on the MARKET RATES OF 2013-2014.

MATERIALS USED:

Structure components are designed according to standard procedures described in the current IS 456:2000 building codes. Specifications of the principal materials used are summarized below

Material	USE
• Reinforced concrete (cast in place)	buoyance chamber walls 200mm wearing surface mass anchor“box”
• Reinforcing bars	All concrete
• Cable 300mm dia zinc coated Marine cable	Mooring cable

Most of the concrete surface that are exposed to sea water are precast and also Pre-stressed and they are expected to be of a uniformly high density. Service life in excess of at least 25 years can be anticipated, during which period no repairs are necessary, since properly controlled reinforced concrete exhibits high resistance to marine environment.

There is also information on the performance of high strength structural steel in the marine environment in the form of data compiled regarding behavior of steel sheet piling. Corrosion rates are the greatest in the flash zone where the steel surface is alternately exposed to air and sea water. This type of exposure will be experienced in the floating structure at the central portion of the tubuler steel columns. If the column is not specially protected in the zone, itsservice life is controlled by the deterioration of this section.

The mooring cable are fully-submerged at all times and deterioration is expected to be negligible during the service life of the structure.

FLOATING STRUCTURE WITH PONTOON-TYPE FLOATING FOUNDATION:

DESIGN OF SUB STRUCTURE (BUOYANCY TANK)

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In pontoon type, we planned to construct a multi stored buildingthat building rest on the pontoonplatform.

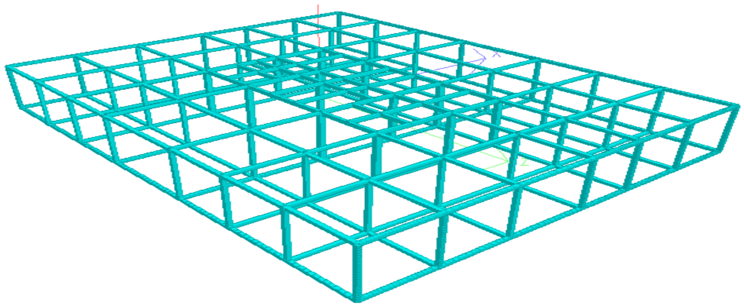

FIG 6.2BUOYANCY TANK (using concrete hollow structure)

The pontoon platform is called buoyancy chamber because of itsshape and structure. It is a hollow structure.We designed a rectanglehollow buoyancy tank. It produced the buoyancy force which is usedfor floating.

DESIGNED OF SUPER STRUCTURE BY USING STAADPRO

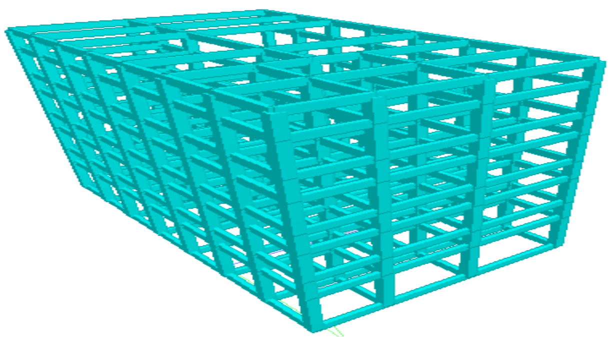

FIG 6.3SUPERSTRUCTURE

The super structure is designed by usingstaadpro.Dead load, live load, floor load and wind load (chennai offshore wind speed 50 m/hr) are considered.Sub structure is also designed by using staadpro. It is located in calm water surface or inside the break water so wave load value is so minimum. It is neglected for that reason.

Mooring cables are used to hold the structure. Cables are fixed in the sea bed.

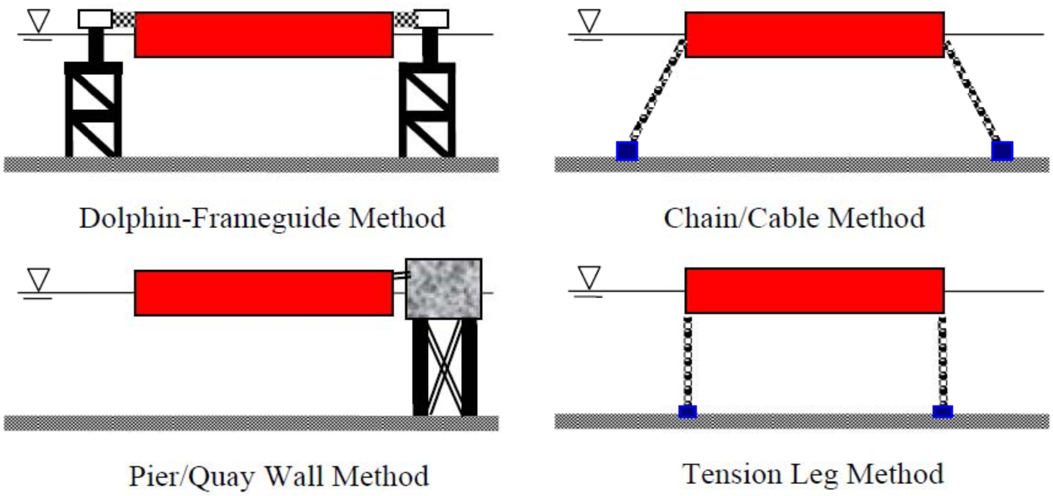

FIG 1 MOORING CABLES

The above 4 methods, we adopt chain/cable method. And it is the cost effective method alsoSub structure is initially constructed and super structure is developed by enlarging the center columns.

In a floating structure the static vertical self-weight and payloads are carried bybuoyancy. If a floating structure has got a compliant mooring system, consisting forinstance of catenary chain mooring lines, the horizontal wave forces are balanced by inertia forces. Moreover, if the horizontal size of the structure is larger than the wave length, the resultant horizontal forces will be reduced due to the fact that wave forces on different structural parts will have different phase (direction and size).

The forces in the mooring system will then be small relative to the total wave forces. The main purpose of the mooring system is then to prevent drift-off due to steady current and wind forces as well as possible steady and slow-drift wave forces which are usually more than an order of magnitude less than the first order wave forces.

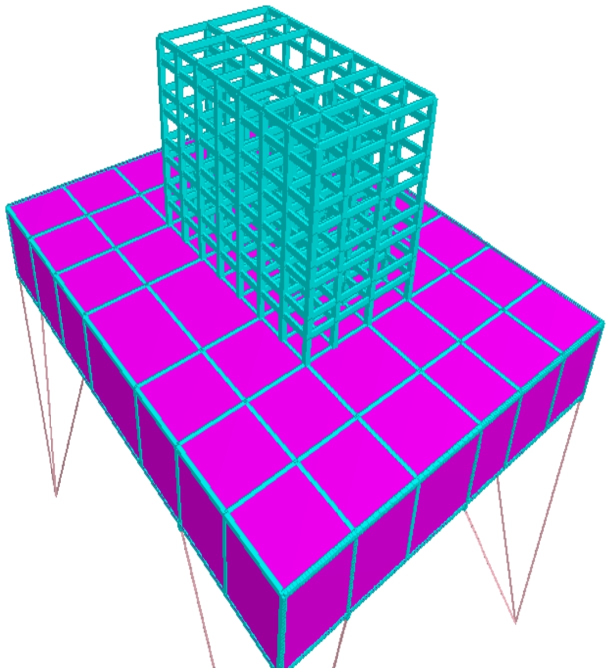

FIG 2 STRUCTURAL MODEL

We are designed the substructure by considering the whole weight of the superstructure. The weight of superstructure is resisted by buoyancy force acting on the substructure. The buoyancy force also resist the self -weight of substructure.

This methodology is collected from ARCHIMEDAS floating principle and ARMSTRONG buoyancy principle.

FLOATING MECHANISM:

A concrete structure will **not** float if the sum of the vertical downward forces (gravitational, **W**) is greater than the vertical upward force (buoyant, **Fb**). When applying this principle to a structure below grade, it can be said that; if the buoyant force (**Fb**) is greater than the mass of the structure and the combined mass of soil surcharges and objects contained within the structure, **the structure will float.**

Example;

Buoyancy is defined as the tendency of a fluid to exert a supporting upward force on a body placed in a fluid (i.e., a liquid or a gas). The fluid can be a liquid, as in the case of a boat floating on a lake, or the fluid can be a gas, as in a helium-filled balloon floating in the atmosphere. An elementary application of buoyancy can be seen when trying to push an empty water bottle downwards in a sink full of water. When applying a downward force to the water bottle from your hand, the water bottle will stay suspended in place. But, as soon as you remove your hand from the water bottle, the water bottle will float to the surface. The buoyant force on the object determines whether or not a given object will sink or float in a fluid.

Computing the Factor of Safety (**FS**)

A factor of safety can be established from the following calculation:

Factor of Safety (FS) = Down Forces/ Up Force = WT/ Fb

WT >**Fb**Structure will remain stationary

WT <**Fb**Structure will float or shift upwards

When **FS** is less than 1, the up force will be greater than the down forces, which means that the structure will float. When the **FS** is greater than 1, the up force will be less than the down forces, which means that the structure will not float.

7.2 Computing Downward (Gravity) Forces

All vertical downward forces are caused by gravitational effects, which need to be calculated in the design of an underground structure in order to determine if the total downward forces (gravitational, WT) are greater than the upward force (buoyant Fb). The total downward force (WT) is calculated by the summation of all downward vertical forces (W).

WT = W1 + W2+ W3+ W4…

DOWNWARD FORCES (SELF WEIGHT OF SUPERSTRUCTURE) :

Self-weight ofColumns:

W1= volume of column x unit weight of concrete

=0.45 x 0.45 x 14 x 25

= 70.875 KN

No of columns = 33

Total w1= 70.875 x 33

=2338.875 KN

Self -weight of Beams:

W2 = volume of Beams x unit weight of concrete

No of Beams(A)=32

No of Beams(B) =16

Volume of beam(A) = 40.74

Volume of beam(B) = 35.27

W2= (40.74 + 35.27) X 25

= 1900 KN

Self -weight of slabs:

No of slabs= 4

Volume of slab = 12.3 x 21.3 x 0.15 x 4

=157.194

W3= 157.19 x 25

= 3929.85 KN

Self -weight of all brick works:

Volume of brick work from all floors = 1971.04

(include short wall, long wall &

Patrician wall)

W4 = 1971.04x 19

= 37449.80 KN

Self -weight ofsunshed:

Volume of sunshed = 9.07 + 3.38 + 1.37

= 13.82

W5= 13.82 x 25

=345.5 KN

Total downward forces **= 45964.025 KN**

(self-weight of superstructure)

DOWNWARD FORCES:(SELF WEIGHT OF SUBSTRUCTURE)

self -weight of beams:

Volume of beams = 36.99

W1 = 36.99 x 25

= 924.75 KN

Self -weight of columns:

Volume of columns = 57.47

W2 = 57.47 X 25

= 1436.75 KN

Self -weight of slabs:

Volume of slabs = 839.87

W3 = 839.87 x 25

= 20996.75 KN

Total downward forces in substructure **= 23358.25 KN**

TOTAL DOWNWARD FORCES IN THE FLOATING STRUCTURE:

=50000(including live loads) + 23358.25

= 73358.25 KN

7.3 Computing Upward Buoyant Force:

Buoyant Force (Fb)

As stated in Archimedes' principle, an object is buoyed up by a force equal to the weight of the fluid displaced. Mathematically the principle is defined by the equation:

Fb = γf x vd

Fb= buoyant force KN)

γf= density of the water (9.81KN/m^3)

vd= displaced volume of the fluid (m^3)

Volume of buoyancy tank = 45.3 x 36.3 x 6 =9866m^3

Fb = 9.81 X 9866(volume of buoyancy)

= 96785.46 KN

7.4 Factor of Safety (FS)

Factor of Safety (FS) = Down Forces/ Up Force = WT/ Fb

=73358.25 /96785.46

= 0.75

FS is less than 1, the up force will be greater than the down forces, which means that the structure will float.

CONCLUSION:

The definition, applications, analysis and design of very large floating structures have been presented. For details of analysis and design on pontoon-type VLFS, the reader may refer to a large body of references given in a recent literature survey paper by Watanabe et al. (2004). It is hoped that this report will create an awareness and interest in structural and civil engineers on the subject of very large floating structures and to exploit their special characteristics in conditions that are favourable for their applications.

Very Large Floating Structure (VLFS) is a unique concept of ocean structures primarybecause of their unprecedented length, displacement cost and associated hydro elastic response. VLFS requires massive investment of resources and is considered a megaproject. Technology utilized in the project must be well proven or reliable to reduce risk of investment. VLFS has little or no history of performance. Researchers and engineers have improved their understanding of hydroelastic response and its implementation in the designmethod. Detailed and concentrated efforts were undertaken in the MOB and Mega-Float projects. Considerable development of analysis programs occured. Design methodology was formalized and the design flow resulted from the effort. To realize reliability, a risk based evaluation of safety for VLFS was required by the Preliminary MOB ClassificationGuide and recommended by the Technical Guideline of Mega-Float. MOB and Mega-Floatare significantly different in terms of objective and configuration. R&D efforts of MOB and Mega-Float were almost independently carried out but both programs shared similar R&D objectives in many technical aspects.

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