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Use of Soil Mechanics and Marine Studies in Design and Construction of Off Shore Pipelines

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Abstract:-

A good amount of oil & gas reserves are found in the oceanic parts that are the part of the earth covered in water as almost 70% of the earth's crust is covered in waters. Pipelining Offshore is a much more complex process than doing it Onshore. The wave force data is important in determining the amount of protection needed to keep the pipelines safe. The passage of a wave can cause a pronounced pressure differential. Pressure and wave profile of oil surface submerged in the sea is plotted. An overall Bathymetric chart is drawn and a survey is conducted of the seabed sediments. Also, Current and tidal characteristics are determined and a great focus is given to the vertical distribution of the current. This paper also discusses the floatation problems of pipeline in a heavy liquid-soil mixture.

The best procedure is to have a comprehensive soil sediment studies along with special ocean outfalls studies which focus on currents and biology of an area. Use of gravity piston coring along with the use of Reid's method for determining the nature of core and stresses in a pipeline respectively is discussed. The major focus of the paper discusses the importance of soil mechanics and marine studies in offshore pipeline construction along with the important advantages of these above-mentioned studies.

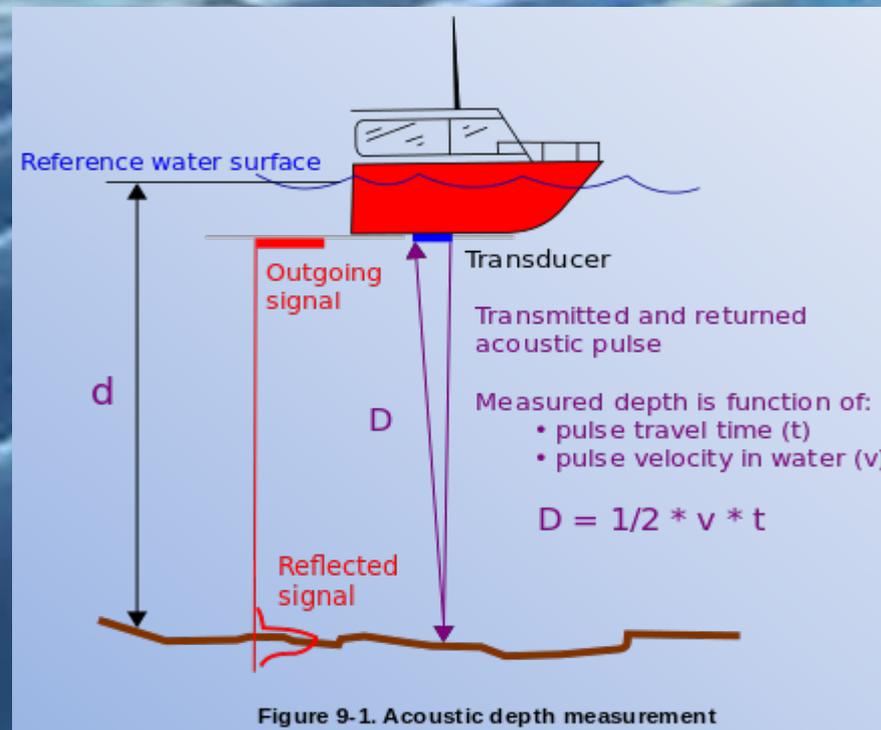
Introduction:-

- An offshore pipeline (otherwise called marine, subsea or submarine pipeline) is a pipeline that is laid on the seabed or beneath it inside a trench. At times, the pipeline is for the most part ashore yet in places it crosses water regions, for example, little oceans, straights and waterways. offshore pipelines are utilized fundamentally to convey oil or gas.
- Enhancing pipeline advancement process has turned into a fundamentally essential point for accomplishing practical administration in seaward and deepwater pipeline operations.
- The main pipeline was worked in the United States in 1859 to transport raw petroleum (Wolbert, 1952). Through the one-and 50 years of pipeline working practice, the oil business has demonstrated that pipelines are by a long shot the most sparing methods for huge scale overland transportation.
- Transporting oil liquids through pipelines is a nonstop and dependable operation. Pipelines have shown a capacity to adjust to a wide assortment of situations including remote territories and threatening conditions.
- When you are regulating a seaward development venture from a separation, it can be extremely difficult to hold control over it. seaward development can be useful for the inland condition. On the opposite side, there still are solid concerns in regards to its effect on the marine life.
- . Amid pipe-laying operations, there will be impacts, for example, aggravation of the seabed, commotion and air emanations. Huge levels of clamour are created amid digging and pipe-laying stages.

Geophysical Survey:-

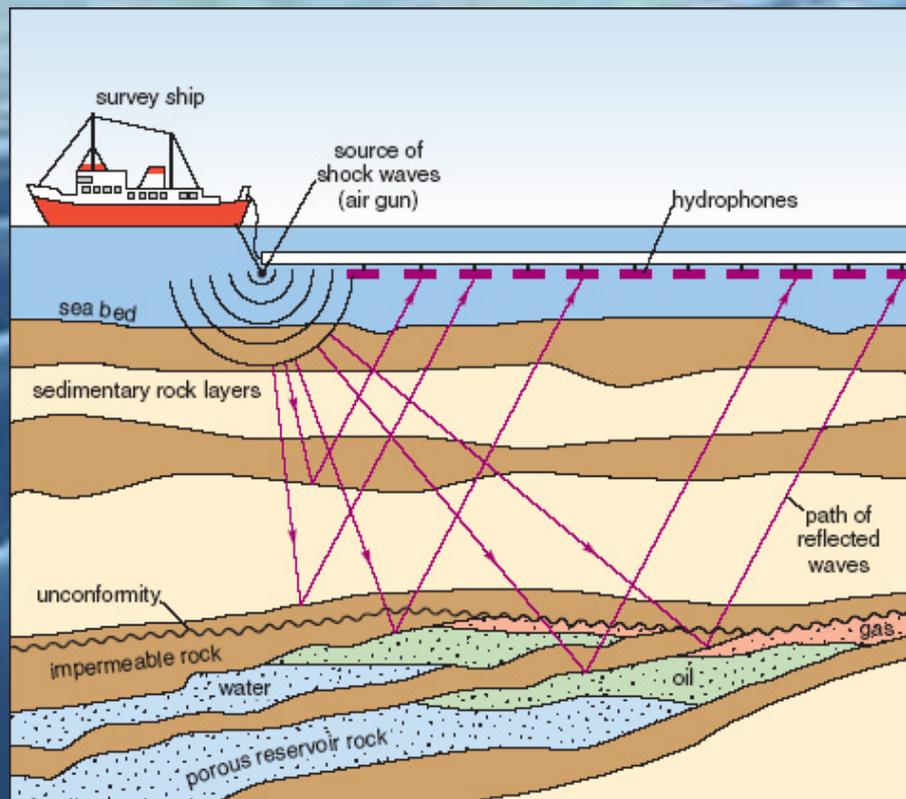
It is the methodical accumulation of geophysical information for spatial investigations. Identification and investigation of the geophysical signs frame the centre of Geophysical flag handling. The attractive and gravitational fields radiating from the Earth's inside hold basic data concerning seismic exercises and the inner structure.

Echo Sounding:- Echo sounding is a kind of sonar used to decide the depth of water by transmitting sound heartbeats into the water. The time interim amongst outflow and return of a heartbeat is recorded, which is utilized to decide the profundity of water alongside the speed of sound in water at the time.



GeoBAS Survey:- The term 'geoBAS' (Geophysical Burial Assessment Survey) describes survey operations using geophysical methods operated from seabed sledges, and towed by the survey ship, to provide continuous quantitative information for the first few metres of soil below the seabed.

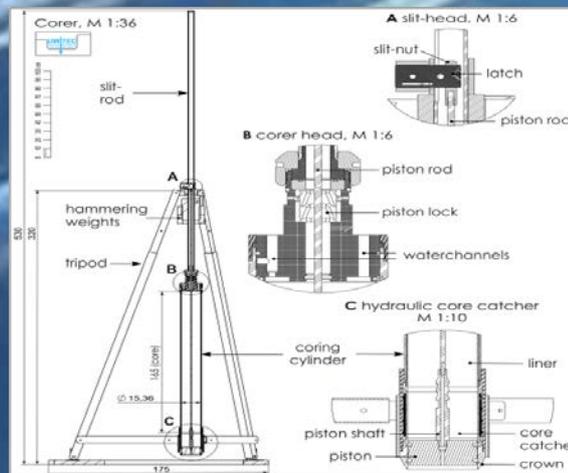
Seismic refraction:- Seismic refraction is a geophysical rule represented by Snell's Law. Utilized as a part of the fields of geotechnical engineering, seismic refraction navigates is performed utilizing a seismograph(s) or potentially geophone(s), in an exhibit and a vitality source.



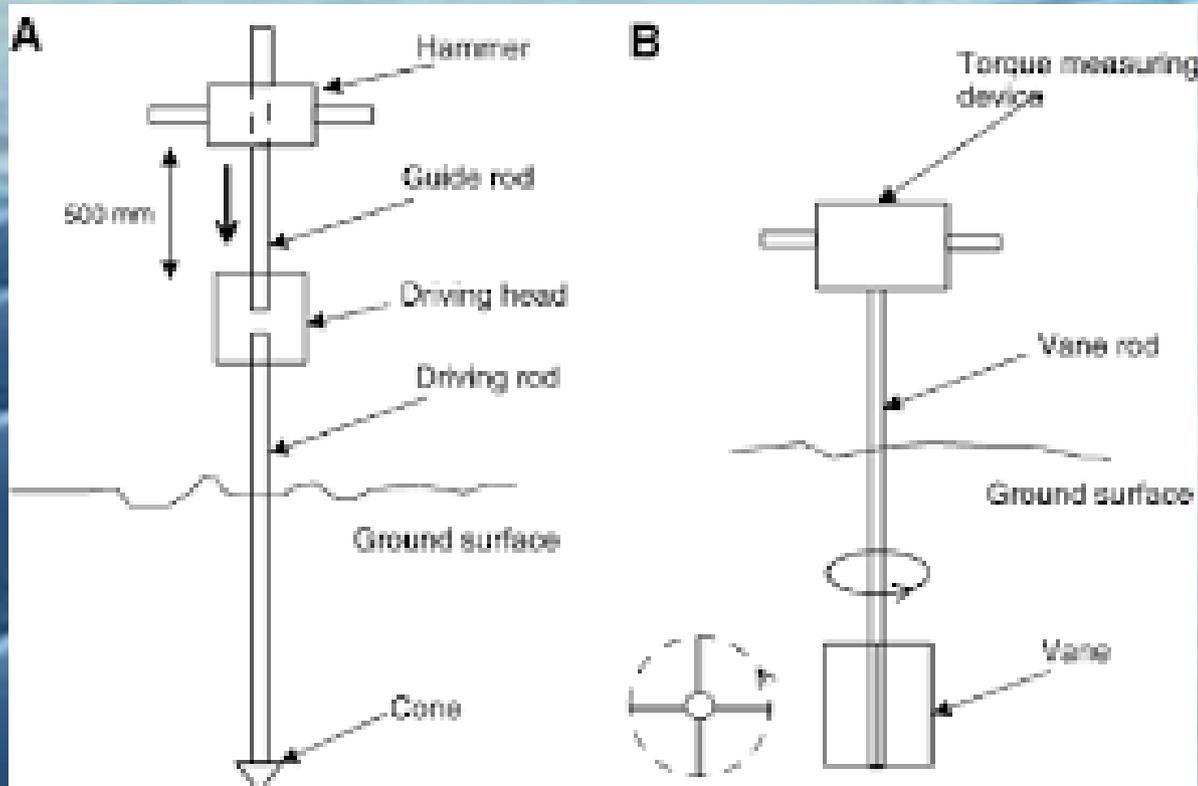
Geotechnical Survey

Coring and Sediment Sampling:- In order to ground-truth geophysical data, it is necessary to obtain a sample of the seabed. There are two main techniques available for sampling unconsolidated sediments : (1) seabed surface sampling using grab samplers to ground-truth data collected with instruments such as side scan sonars and multibeam sonar (i.e. instruments which only image the seabed surface) and (2) seabed coring to ground-truth sub-bottom profiler data (i.e. subsurface data).

Gravity Piston Coring:- Coring is one of a few standard systems to extricate sediments and their faunas from open marine, estuarine, and limnic conditions. cylinder corer with a distance across of 16 cm that empowers infiltration down to 1.5m out of a wide scope of delicate base writes, yields adequate material for numerous investigations, and forestalls silt misfortune due to an extraordinarily composed water powered centre catcher. Rather than digs, gets and suction samplers, dregs corers preferably protect the essential depositional structure of the residue alongside the first profundity appropriation of the encased fauna and faunal stays, for example, shells or skeletal parts.



In-Situ Shear Vane Test:- The vane shear test is an in-situ geotechnical testing technique used to evaluate the undrained shear quality of completely immersed muds without unsettling influence. The test is generally basic, fast, and gives a savvy method for assessing the dirt shear quality; subsequently, it is broadly utilized as a part of geotechnical examinations. The aftereffects of the test are not dependable if mud contains residue or sand. Under the uncommon condition, the vane shear test can be likewise completed in the research facility on undisturbed soil examples; be that as it may, the utilization of the vane shear test in-situ testing is significantly more typical. The test begins by pushing the vane and the bar vertically into the delicate soil. The vane is then pivoted at an ease back rate of 6° to 12° every moment. The torque is estimated at consistent time interims and the test proceeds until the point when a most extreme torque is come to and the vane turns quickly for a few transformations.



Soil Studies:-

Traditionally, lateral stability of the pipeline on soil was determined using soil friction coefficient and ranged from 0.7 to 1.0 for sand and 0.3 to 0.5 for clay without considering the embedment. Now, a more rigorous approach is taken by computing the embedment and factoring the additional resistance provided by the soil. A reduction in drag and lift forces occurs when there is embedment. This embedment takes place when small oscillations of the pipeline occur under wave action. The amount of embedment of the pipeline in soil depends on the bearing capacity of the soil.

Breakout Force:- The breakout force is the maximum force needed to move the pipe from its stable position on the seabed. This force can be significantly higher than the force needed to maintain the movement after breakout due to suction and extra force needed for the pipe to "climb" out of its depression. The breakout forces can be simulated in a finite element model, according to Brennodden(1991), which gives the following equations for the maximum breakout force in the axial and lateral direction.

Pipe Penetration in Soil:- In a limited element model, a non-straight weight/entrance relationship might be utilized. The extra parameters (undrained shear quality for the earth and inward rubbing plot for erosion materials, for example, sands) and submerged soil thickness. This infiltration is to some degree entangled by the round type of the pipeline, which prompts a joined impact of grating and bearing limit opposing soil entrance. With a specific end goal to build the weight/infiltration relationship said over, an approach in light of various techniques for computing the seabed entrance as an element of the static ground weight has been utilized. nice of a statically stacked pipe into the dirt can be figured as an element of pipe width, vertical contact weight, soil quality

On-Bottom Stability

Pipelines introduced on the seabed are subjected to hydrodynamic powers. Waves and unfaltering streams that are attributes of every single seaward zone subject the pipeline on the seabed to drag, lift, and inactivity powers. For sidelong solidness, the pipeline laying on the seabed must oppose these powers and at the very least be at harmony.

The required pipeline submerged mass will have a direct impact on the required pipelay tensions, installation stresses and the pipe configuration on the seabottom. From the installation viewpoint, especially where spans are not a concern, the priority is to minimize the required pipeline submerged mass.

There are several analysis methods available on which to base pipeline stability design. Three different methods are used by pipeline industry:

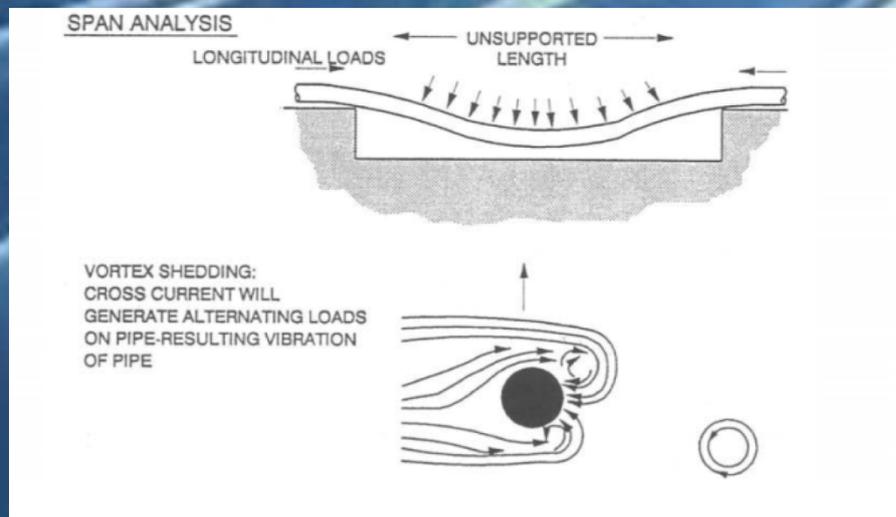
- 1) Dynamic analysis: Using PONDUS
- 2) Generalized stability analysis: Using PIPE
- 3) Simplified stability analysis: Using Spreadsheet

Span Analysis:-

Over an unpleasant seabed or on a seabed subject to scour, pipeline crossing can happen when contact between apparent separation. In such conditions, it is ordinary code necessities that the line is explored for:-

- 1) Fatigue
- 2) Excessive Yielding

The flow of wave and current around a pipeline span, or any cylindrical shape, will result in the generation of sheet vortices in the wake (for turbulent flow). These vortices are shed alternately from the top and bottom of the pipe resulting in an oscillatory force being exerted on the span. If the frequency of shedding approaches the natural frequency of the pipeline span then severe resonance can occur. This resonance can induce fatigue failure of the pipe and cause the concrete coating to crack and possibly be lost.



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