Ex'straw'dinary Engineering

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Background

Engineering disciplines

Civil engineers specialize in the design and construction of buildings, bridges and infrastructure such as roads, railways, water supply and drainage.

Mechanical engineers design structures that move, such as pumps, turbines, drills etc.

Chemical engineers (also called process engineers) design the equipment that can turn one set of substances into another, such as when crude oil is refined into products like petrol, gas and bitumen.

Electrical engineers design the electrical systems and products that allow buildings, oil rigs, refineries and other structures to work.

No matter what the discipline, all engineers focus on designing solutions that do the job in the most efficient or economic way, and are safe for people and for the environment.

Design criteria and design specifications

As they work together as 'engineers', students must identify design criteria and respond with suggestions for basic design specifications for their structure. In real life, this would influence the exact form, features, materials and performance of their solution.

Students can't directly observe the situation in which their structure will be used so it's helpful to try and recreate some of this in your discussions – ideas, taken from bp.com, follow.

The bid document is students' design brief. Some of the design criteria are explicit, such as the height of the platform, although they must piece this together. Some is implicit, such as the conditions in which the platform would operate at sea. Students could also suggest other sources of information, such as data on wind speeds, wave heights etc.

Students should sketch their initial ideas on plain paper and discuss their designs, as they won't get extra straws if they use theirs up early. They need to settle on a design before building it, although they might want to test one straw to see how strong it is.

You may also want to discuss how engineers might go about this for real, using Computer Aided Design (CAD) software and simulations to test their designs. What materials, sizes, joining methods and finishes might be used, such as welding, bolting and painting? What information might need to go on a real set of plans for a jacket structure?

BP obviously won't want to test a finished jacket but will want to know that it is safe. If you are confident, you may want to discuss how BP's contractors might test individual trusses, joints and finishes, and conduct simulations and model tests, to ensure that the finished structure performs safely and to specification.

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Background cont.

A structure to match the elements

Every oil and gas production facility is different. The size, shape and features match the climate and characteristics of the location, as well as the type of reservoir and the specific hydrocarbons within it.

On land, a motorized pump is positioned over a well to extract the oil and gas into tanks or a pipeline. Steam, gas or water may be pumped through a nearby well to flush more of the hydrocarbons out.

At sea everything we do on land has to perch on top of a platform hundreds of metres above the sea floor. Each platform is a major engineering feat. The largest can take years to build and costs billions of dollars. Thunderhorse (currently the biggest in the world) cost $5 billion.

The biggest pieces of a platform arrive at the site ready-built. Cranes lower the massive steel or concrete legs onto a support structure or directly onto the ocean floor. The platform hull is floated into place and welded on. Its height must clear the roughest waves.

While the smallest platforms operate without a regular onboard crew, most offshore facilities include living quarters within the carefully planned maze of rooms and stairwells. Sometimes our engineers decide that multiple platforms are needed, in which case footbridges connect drilling, injection, storage, treatment and living spaces on separate structures above the water.

A production platform can remain active for up to 40 years or longer. With hot, frothy, corrosive oil flowing through the equipment constantly, wear and tear is inevitable. To keep the platform safe and functioning as it should, we constantly monitor the state of the equipment as well as conditions inside the reservoir.

Hard work and close quarters

What's it like to live and work on a remote oil or gas platform? These are manmade structures at sea, and every centimeter of space has been designed to provide workers with safety, the tools they need and perhaps, after a hard day's work, a few comforts.

Industrial areas take up the bulk of the platform space. This is where the drilling and pumping are done. In offices the facility's works are monitored, safety records are kept and the day's assignments are handed out. And then there are areas for eating, sleeping and relaxing, where the production technicians, crane operators, drill engineers, scaffolders, control room staff and others onboard spend their off-duty hours.

Every facility is different, but most platforms have dormitory-style sleeping quarters, visitor accommodations, a restaurant, a coffee house, as well as a cinema, gym and other recreation areas.

An oil and gas platform can be as tall as a skyscraper and as wide as a sporting stadium. More often than not, the view onboard is nothing but ocean, with simple blue lines along every horizon.

The industrial areas of a production platform are noisy with rumblings from pipes, pumps and compressors. The air may smell strongly of oil and gas. Or the wind may blow so hard that it whips odours away instantly. The weather can be harsh. This far out in the open seas there is nothing to shield the facility from extremes of wet, ice, heat or cold.

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To work here you need to wear a safety helmet, earplugs, protective clothing and plastic glasses. "Warning" signs and daily emergency drills help keep potential dangers top of mind, so that no one gets complacent. Shifts are long, up to 12 hours a day, with breaks built in to minimize fatigue and avoid long-term exposure to noise. And each shift is followed by an equally long rest period.

After safety, the one thing on almost everyone's mind is how to keep the oil and gas flowing at the best possible rate. Platform staff monitor equipment showing the pressure in the wells and pipes. In the control room, data fill computer screens while geologists and other onshore advisers stay in contact via video link. Based on the data and advice, the production crew might change the size of the filters the oil flows through or flush more gas or liquids through the wells to force more of the hydrocarbons out.

Of course, not everyone who works on a platform is directly involved in extracting oil and gas. Some cook the food, keep the facilities clean or help produce the electricity that keeps the whole operation running.

It's not all work. After each long shift of up to 12 hours, platform workers take an equally long rest period. Bedrooms are compact and functional, much like the cabins on a ship. Usually two people share a room and sleep on bunks.

If watching a movie or sporting event on satellite TV isn't enough to fill the rest periods, the sea offers its own entertainments. There might be whales to watch, or sea lions or migrating birds.

People come and go frequently from a platform, with one group of workers returning by helicopter or boat as another group leave for their own onshore break. In such close quarters, camaraderie is strong.

Working so far away from cities and conveniences isn't for everyone. But among those who have done it for a while, some say they can't imagine living any other way.

More information

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