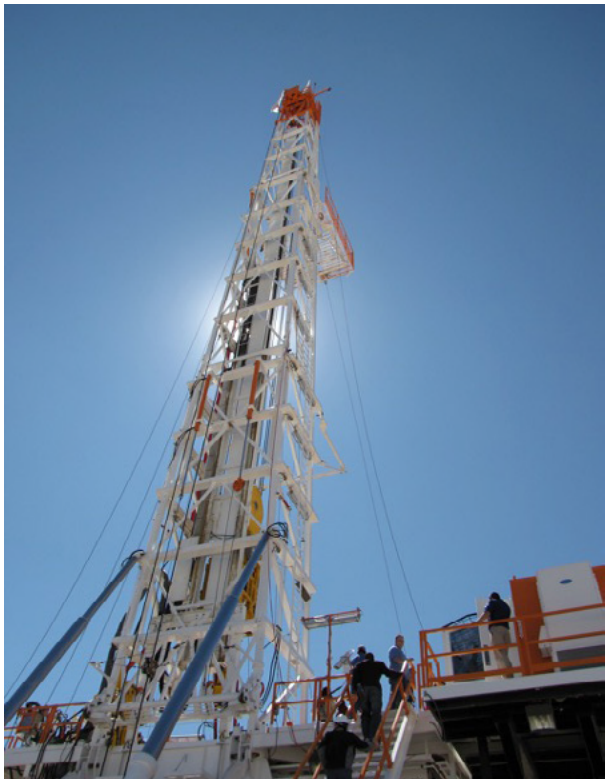


Figure RT-1: With the advent of steel rig construction, derricks were replaced by masts. A mast has fewer pieces to assemble and a smaller footprint than a derrick. Importantly, it remains open on one side, allowing traveling equipment to run freely up and down and has fewer pieces to assembly. IADC image.

Introduction

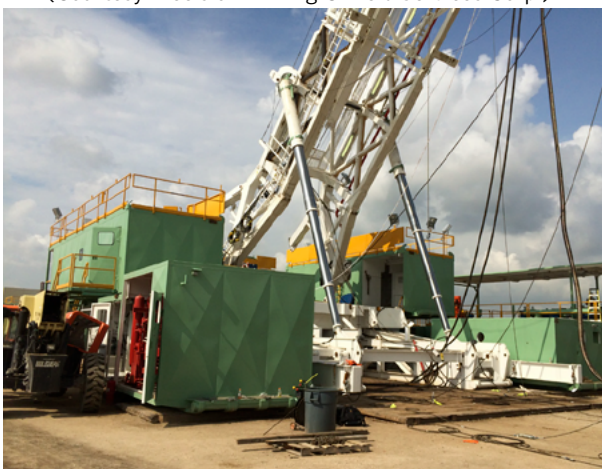
This chapter will explain the various types of drilling rigs used today. It will try to touch on the unique features of each rig type and their relative advantages and drawbacks. This chapter is not meant to be an exhaustive narrative on each rig type, but strives to provide the reader with an overview of each. The one overriding theme that holds true, regardless of rig type, is that the drilling industry has made big changes in the design and layouts of all rig types to improve safety for the people working on these rigs, safeguard the environment, and improve the efficiency to minimize the time it takes to construct the well.

Land rigs

As mechanization made the hunt for hydrocarbons more efficient, it had a direct effect on land rig design. The first land rigs were permanent wooden structures and would be left in place after the well was drilled. Many were just tall poles or simple V-frame structures. As well depth increased, drilling required stronger structures and rig construction from steel became the norm.

Fabricating rigs from steel meant that no longer would the structure be abandoned at the well site. Now, rigs could be moved from site to site, a major advantage. To enhance rig mobility, the original, bulky derrick was replaced with masts. A mast has fewer pieces to assemble and a smaller footprint than a derrick. Importantly, it remains open on one side, allowing traveling equipment to run freely up and down and has fewer pieces to assembly.

Figure RT-2: At top is a mast being raised by the bull lines and drawworks (Courtesy Nabors Industries Ltd.). The photo below shows the mast being raised by hydraulic cylinders (Courtesy Precision Drilling Oilfield Services Corp.).



Once on location, masts can be raised either by bull lines and the drawworks or by using cylinders. Cylinder-raised masts feature 2-3 fully constructed sections that pin together before the hydraulic cylinders raise them or a two-section telescoping mast where the top section is telescoped up after raising.

Fit-for-purpose rigs

Drilling rigs often go where few people wish to venture, such as burning deserts and frozen tundra. Because few or no highways exist to transport rigs in deserts, industry designed fit-for-purpose rigs. To move these rigs across the

Figure RT-A: Winterized Arctic rigs are often modular in design and capable of skidding from wellhead to wellhead. Courtesy Bentec.

Figure RT-3: Desert drilling rigs were purpose built to traverse the roadless sands of this tough environment. Note the size of the tires relative to the people in the foreground. Courtesy Nabors Industries Ltd.

Video RT-1: Views of modern Arctic rig. Courtesy Bentec.

sands, the entire drilling structure is placed on wheels, many of which can reach 12 ft in height. The huge wheels allow the rig to be pulled to the next location by truck or tractor.

Industry has adapted the "standard" drilling rig for other specialized environments. For example, Arctic rigs are winterized, with heating and cooling systems for the rig floor, drillpipe and casing storage and other areas. Often modular for easier fabrication, Arctic rigs are often capable of skidding from wellhead to wellhead.

With current mechanization, wells on land can be drilled in as little as 14 days, and drilling speed is now a rig design factor. However, this rig complexity has increased the share of rig moving time, relative to total operating days. Drilling contractors today often seek designs that shorten rig-up times.

Walking rigs

Industry's improved understanding of accessing tight-permeability formations, especially shale rock, has also impacted rig design. In today's shale operations, many wellsites are configured for multi-well drilling. The entire rig mast and substructure walks or "skids" short distances to the next location. As a consequence, rigs require additional structural reinforcement, adding weight and increasing design com-

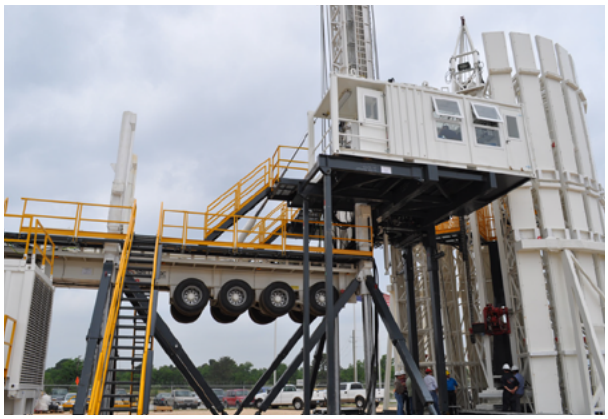


Figure RT-5: Trailer-mounted rig working on location. Courtesy Drillmec Drilling Technologies.

Figure RT-4: One of the latest trends is "walking" rigs, used in multi-well locations to access drill sites that might be 100 ft apart (left). Photo above shows a close up of a rig "foot". Photo at left courtesy Entro Engineering. Photo above an IADC image.

Video RT-2: Example of walking rig. IADC video of Wisco Moran drilling rig.

plexity. However, the mud system does not move with the mast and substructure, as with desert rigs. Consequently, heavy and complex festoons and flowline systems are being added to allow the rig to "walk" 100 ft without rigging down.

The search for the land rig design that accommodates all the latest drilling equipment and can still move quickly from wellsite to wellsite continues. Today, the industry box-on-box substructures, telescopic substructures, as well as designs featuring cantilevered masts in which the mast and rig floor are elevated in a single step. (This was originally introduced as the "Dreco Slingshot"). Rigs are being built to handle single stands of drillpipe, as well as doubles and triples. Many of the smaller single style rigs being mounted on trailers for easy transport.

Offshore rigs

Explorers began finding and drilling for oil in the ocean early in the 20th Century. The earliest offshore wells were drilled by equipment that differed little from land rigs, except that they were mounted at the end of piers protruding into the ocean. Platform rigs have come a long way since then, and other types of marine rigs evolved to meet varying water depths and other environmental demands offshore.

Platform rigs

As industry stepped out beyond the reach of land-based piers, platform rigs were installed on large steel "jackets", the bottom-supported frames supporting the rig substructure, derrick and, often, fluid-processing equipment for produced oil or gas (Figure RT-6).

Platform drilling rigs themselves are essentially of the same type and construction as land based rigs, with BOPs on surface verses subsea, and special considerations to minimize weight that needed to be supported by the platform. Depending on the size and capacity of the particular platform, if it was not of sufficient size to support the complete drilling package, plus all of the equipment, materials, and liquids necessary for the drilling operation, the use of a tender vessel was often required. The tender vessel, be it a barge, semisubmersible or ship, would maintain station alongside the platform, and all of the necessary manpower, electrical power, mud pumping capacity, equipment and materials stored/located on the tender is transferred to the platform rig as required.

With the advent of extended-reach and horizontal drilling, enabled by steerable drilling technology, a significant number of wells (typically 8, 12, or 16) could be drilled from a single platform, maximizing oil recovery. Platform drilling rigs were deployed onto these large platforms.

Eventually, drilling operations proceeded in water far too deep to ever land a bottom-supported steel jacket. Indus-

