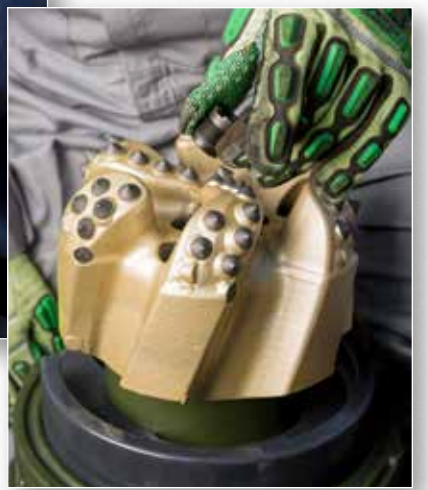
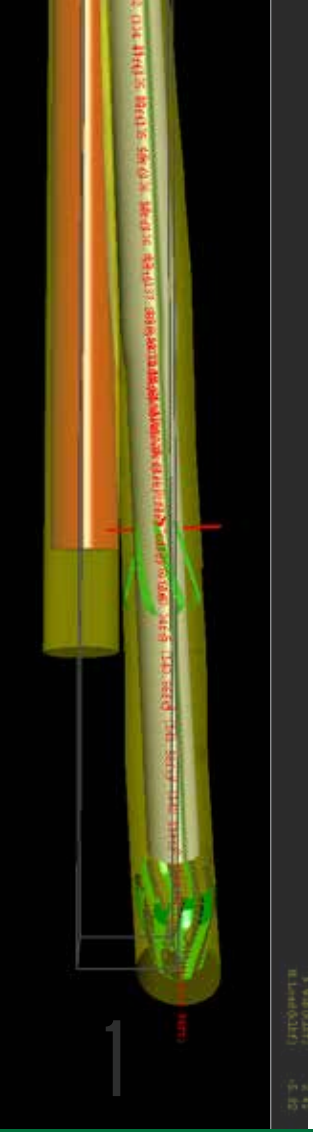
SMITH BITS
A Schlumberger Company



IDEAS

Integrated drillbit design platform



Formation lithology, BHA configuration, and drillstring response can all affect the performance of a drill bit. Taking these drilling parameters into consideration when designing a drill bit ensures that the bit you receive is optimally configured for your specific drilling application, so you can achieve your desired ROP and footage in time to meet your objectives.

Every new Smith Bits drill bit is designed and certified using the IDEAS* integrated drillbit design platform, which our engineers use to simulate and model your entire drillstring and wellbore geometry in 4D.

Seeing bit-to-rock and mill-to-metal interactions in a virtual environment allows you to customize material design and qualify the prediction of bit and mill performance in real time. This eliminates trial-and-error field tests, helping you achieve desired results on the first run.

IDEAS

Integrated drillbit design platform

Features

- Delivers time-based 4D dynamic modeling
- Provides a suite of solid mechanics and programs in one platform
- Gives realistic representation of the entire wellbore construction
- Ensures accurate modeling of cutting interface designs

Benefits

- Eliminates costly trial-and-error field tests with real-time modeling
- Achieves desired results in the first run
- Customizes bits, mills, and cutters for specific applications

IDEAS integrated drillbit design platform

Achieve results on the first run

The IDEAS integrated design platform provides 4D, time-based simulations that capture the entire drillstring and wellbore geometry, ensuring accurate modeling of cutting interface designs for drilling rock and milling metal applications. By integrating a suite of solid mechanics and programs that simulate bit-to-rock and mill-to-metal interaction, you can quickly customize your material design in real time, eliminating costly trial-and-error field tests so you can achieve the desired results on the first run.

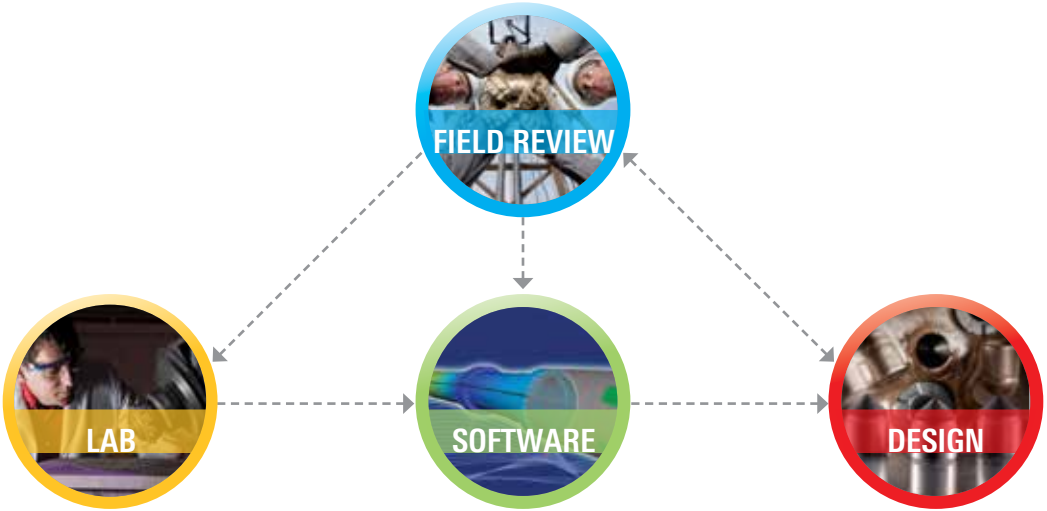
Capture full wellbore construction with detailed simulations

The IDEAS platform simulation can incorporate modeling from a full suite of tools, including RSSs, motors, turbodrills, mills, and pipe cutters. This integrated modeling considers the geometry and weight of each drillstring component—from bit to surface. Every change in geometry represents an individual node, allowing us to evaluate dynamics at thousands of locations within the drillstring.

Well survey and casing information provides you with a realistic representation of the entire wellbore construction. Models are extensively verified and validated using theoretical calculations, commercial finite-element packages, in-house and full-scale rig tests, and field tests using MWD or downhole drilling sensors.

Maximize production anywhere in the world

By combining advanced technology and 4D dynamic modeling capabilities, the IDEAS platform performs more than 50,000 simulations each month for customers worldwide. This combination ensures you will receive optimized bits, reamers, mills, pipe cutters, and drilling parameters that enhance your production, regardless of location.



Drillbit modeling

Simulate any bit type using bit-to-rock interaction modeling

Our rock library comprises a broad catalog of rock samples collected from customers' fields, including shale, sandstone, carbonates, evaporates, metamorphic granite, and basalt rock types. By constantly expanding our collection, we can identify the best rock model and provide you with the optimal match to the field rocks' compressive strength, ROP, and surface parameters. In addition, our rock mechanics lab provides scrape and insert indentation tests that allow the IDEAS platform to simulate any bit type, ensuring accurate modeling of bit/rock interaction.

The scrape tests, performed with PDC cutters on rock samples, replicate the shearing mechanism on PDC bits. On each test, the exhibited forces on the cutters and various depth-of-cut take into account WOB, back rake, and side rake angles. The tests are conducted with forces up to 9,000 psi to simulate overburden pressures that might be encountered in the reservoir. These experiments can also be performed on reamers and eccentric bit cutting structure configurations.

To capture the bit/rock interaction of TCI roller-cone bits, insert indentation tests are used to measure the loads required to penetrate the rock at different depths. Then, we produce a 3D image so that the volume of rock removed is accurately measured and integrated into your bit designs. The realistic model shows how the bits destroy rock, giving you a better understanding of unconventional roller-cone designs, such as one-cone, two-cone, and high-shear bits.

Drillbit modeling

Achieve higher drilling performance with a selection of design methods

The design process begins by establishing the baseline performance and outlining your objectives in terms of drillbit durability, vibration, steerability, and ROP. Once your drilling objectives are determined, we incorporate the simulations by conducting studies using one of three primary methods.

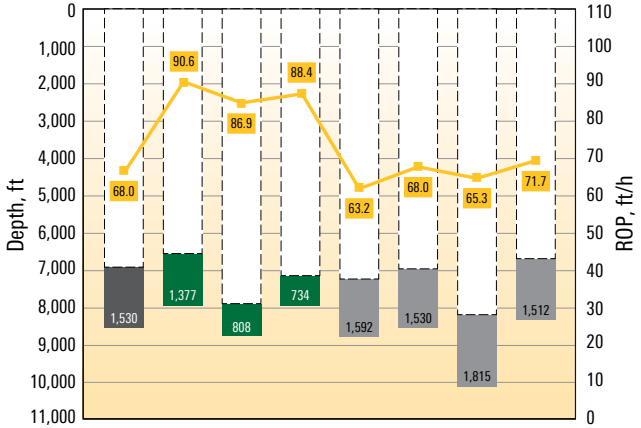
Standard

In development wells that require minimal adjustments, we use proven drillbit designs enhanced through selective feature changes.

- Gauge pad geometry, length, or taper can be modified to alter bit stability.
- The managed depth of cut (MDOC) incorporated into the blade tops of PDC bits can be customized to reduce torque variation.
- SHARC* high-abrasion-resistance PDC drill bit backup cutters, which provide greater drillbit durability in reservoirs with high wear rates, can be applied to one or more blades.
- Stinger* conical diamond element can be inserted into the middle of PDC bits or across the bit face for improved ROP and drillbit durability.
- The i-Design* interactive drillbit design customization allows simulating multiple bit runs in real time for instant feedback, reducing delivery time from bit conception to rig site.

Intermediate

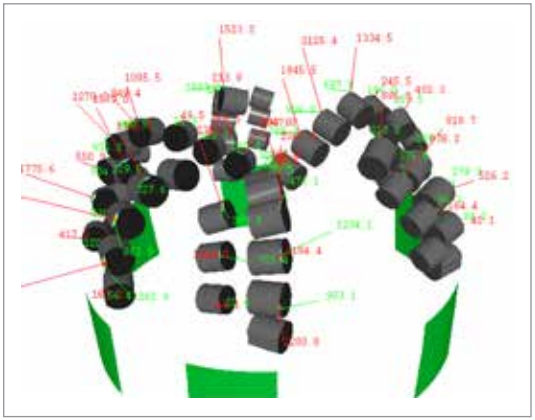
This method is used when the ideal bit type exists within our product lines and has performed in similar applications with exceptional results. Smith Bits, a Schlumberger company, has thousands of bit designs across many product lines, which means that the ideal product might already exist. Using the drilling record system, you can explore millions of bit records from around the world and identify bits used in similar applications. Together, we can analyze how other bits have performed in environments similar to yours. Once the ideal design is identified, additional studies are conducted using standard-tier methods.

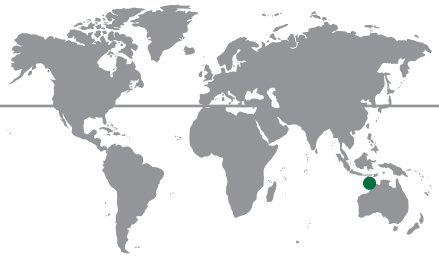


Complex

In deepwater or exploration wells with minimal offset information, drilling performance can be difficult to predict. To ensure that a new drillbit design meets your objectives, design changes are made to the primary cutting structure, altering the position or shape of the bit's primary cutting elements.

We then create new cutting structure layouts and compare them to the baseline product's performance by evaluating simulation outputs.





StingBlade Bits Save More Than 5 Days in the Browse Basin, Offshore Australia

Challenging section adds time and cost to the well

An operator planned to drill a 12¼-in vertical section in the Browse basin offshore Australia through the challenging Dampier, Heywood, Baudin Marl, and Wollaston Formations. These formations are composed of interbedded hard limestones and chert with high compressive strengths, which induce heavy damage to conventional PDC bits. Such damage slows ROP and requires the operator to pull bits prematurely, requiring more time to drill the section.

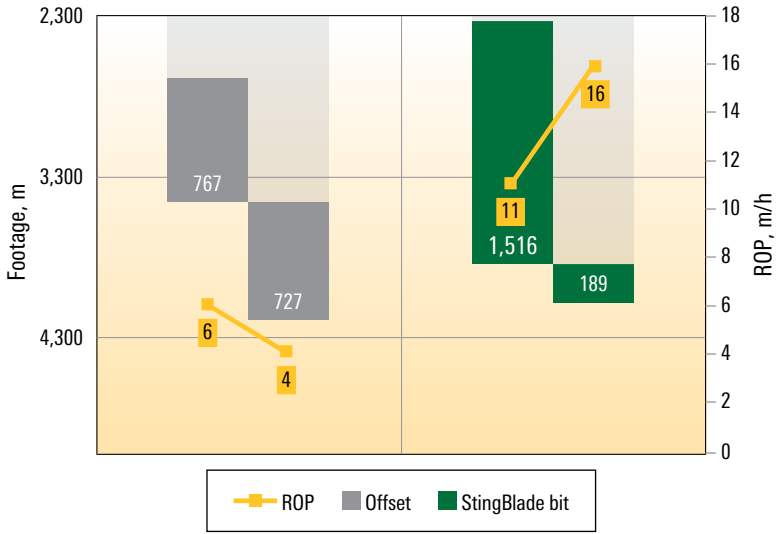
Customized StingBlade bits optimize drilling performance

Smith Bits, a Schlumberger company, recommended using StingBlade* conical diamond element bits, which include Stinger elements across the bit face.

Engineers used the IDEAS integrated drillbit design platform to determine the optimal placement of Stinger elements across the bit face. The Stinger elements' 3D conical shape is designed to fail high-compressive-strength rock with a concentrated point load. The elements also have a thicker diamond layer for maximum strength and durability, enabling farther drilling in abrasive formations.

Improved ROP saves more than 5 days

The first StingBlade bit drilled 1,516 m at 11 m/h, equaling 97% more footage than the best run in the same section of the offset well. ROP also improved by 57% in this run. The second StingBlade bit drilled the remaining section to TD at an average ROP of 16 m/h. Altogether, the two StingBlade bits helped the operator save more than 5 days of drilling time.



Drilling the 1,516-m interval at 11-m/h ROP and the remaining section at 16-m/h ROP enabled the operator to save 5 days of drilling time.

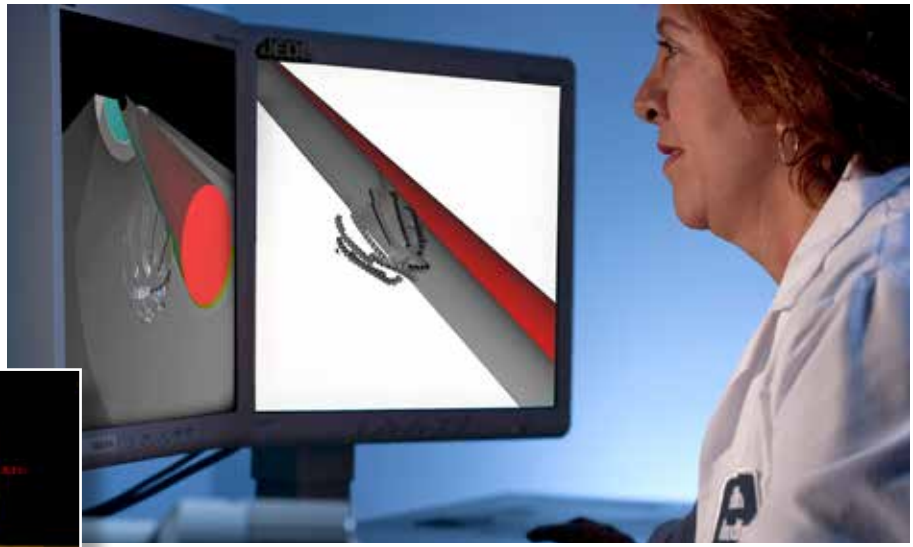
Mill and cutter design

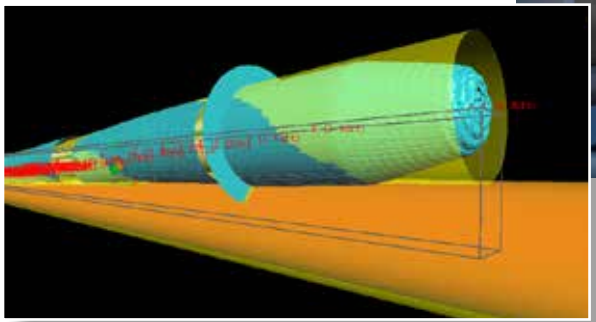
Ensure accurate modeling of cutter designs

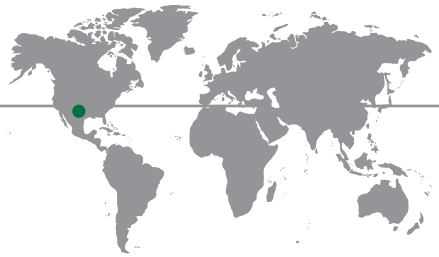
The IDEAS platform is the only milling simulator that dynamically models the interaction of individual cutting structure components and metal from an extensive catalog library that includes a broad portfolio of common casing and tubular materials. In addition to the core metal samples, scrape and insert indentation tests provided by the mechanics lab enable us to simulate any mill type, ensuring accurate modeling of mill-to-metal interaction.

The scrape tests are done on metal casing samples to replicate the shearing mechanism from milling. On each test, the exhibited forces on the casing and various depth-of-cut are performed to account for WOB, back rake, and side rake angles. The tests are conducted with forces to simulate overburden pressures that might be encountered in the reservoir. These experiments enable us to build a full spectrum of shearing models that are used in actual mill designs.

To capture the mill-to-metal interaction, insert indentation tests are performed to measure the loads required to penetrate the metal at various depths. A 3D image is then produced so that the volume of metal removed is accurately measured and integrated into the mill designs to develop a realistic model of how the material destroys metal.







Customized Bit with ONYX 360 Cutters Increases Run Footage 57% in Granite Wash Formation

Abrasive formation shortens cutter life

An operator was experiencing difficulty trying to drill 6⅛-in, 5,000-ft lateral gas well sections through the abrasive reservoir sand that characterizes the Texas Panhandle's Granite Wash Formation. The PDC bits being used were incurring worn, chipped, and broken cutters. Beyond these dull characteristics, damage to the bit's cutting structure quickly reduced ROP to unacceptable levels. In some cases, these conditions were forcing the operator to trip for a new bit after drilling less than 65 ft.

Customized bit with rotating cutters increases durability

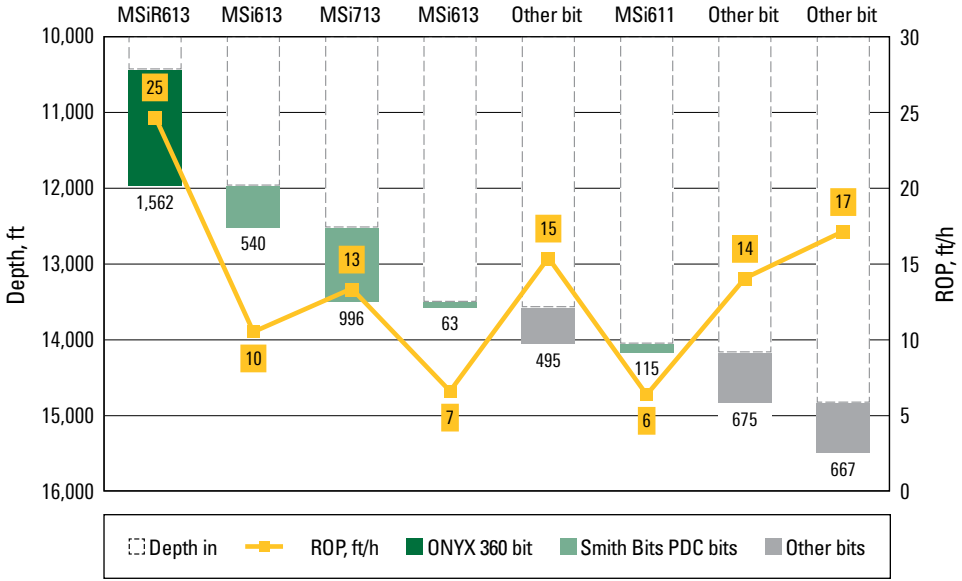
In answer to the operator's bit durability challenge, Smith Bits recommended using ONYX 360* rolling PDC cutters and used the IDEAS platform to position the rolling cutters in the areas of the bit's cutting structure with the highest predicted wear.

To integrate the rolling cutter into a PDC bit's cutting structure, a robust housing is brazed into the bit blade that encloses and secures the cutter while allowing it to rotate. The rolling cutter's orientation in the bit blade relative to its contact with the formation, coupled with the bit's drilling force, drives efficient rotation of the cutter. And because the entire diamond edge of the cutter is used, wear is reduced to allow more sustained rates of penetration and fewer bit replacement trips.

Significantly increased run footage

A 6⅛-in MSiR613 PDC bit fitted with seven ONYX 360 rolling cutters drilled 1,562 ft of the 5,113-ft Granite Wash lateral at an approximate inclination of 90° and at an ROP of 25 ft/h. The average dull condition of the fixed-cutter-only bits used to drill the same formation was graded 6-3, while the bit with ONYX 360 cutters graded 3-1. When compared with the best drilling performance by a fixed-cutter-only bit in the same lateral well, the PDC bit with ONYX 360 rolling cutters had a 44% greater ROP and drilled 57% more footage.

The 6⅛-in MSiR613 PDC bit drilled 1,562 ft in the hard and abrasive Granite Wash Formation at an approximate inclination of 90°. When compared with the best drilling performance by a fixed-cutter-only bit in the same lateral well, the PDC bit with ONYX 360 rolling cutters reported an average ROP increase of 44% and a run length increase of 57%.



IDEAS

To find out more about the IDEAS integrated design platform, visit slb.com/IDEAS.

The IDEAS integrated design platform is a suite of solid mechanics and programs that enables you to customize material design in real time.

Benefits

- Eliminates costly trial-and-error field tests with real-time modeling
- Achieves desired results on the first run
- Customizes bits, mills, and cutters for specific applications

i-DRILL
Engineered drilling system design

ONYX 360
Rolling PDC cutter

Stinger
Conical diamond element

slb.com/IDEAS

SMITH BITS
A Schlumberger Company