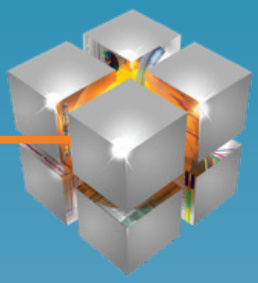
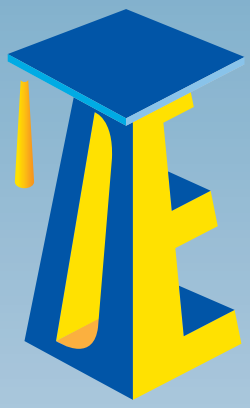
Pegasus Vertex, Inc.

Drilling Software | Sophisticated Yet Simple





WHITE PAPER

Dr. DE

A Simple Way to Solve Complex Drilling Problems

CONTENTS

I. Problem

The past century has seen many advances in drilling technology. Literatures, books, computer programs and various other sources have been put together by the brightest minds of drilling professionals.

While the technological know-how has tremendously driven the industry forward, individuals are sometimes overwhelmed by the vast amount of information they receive from different sources of media.

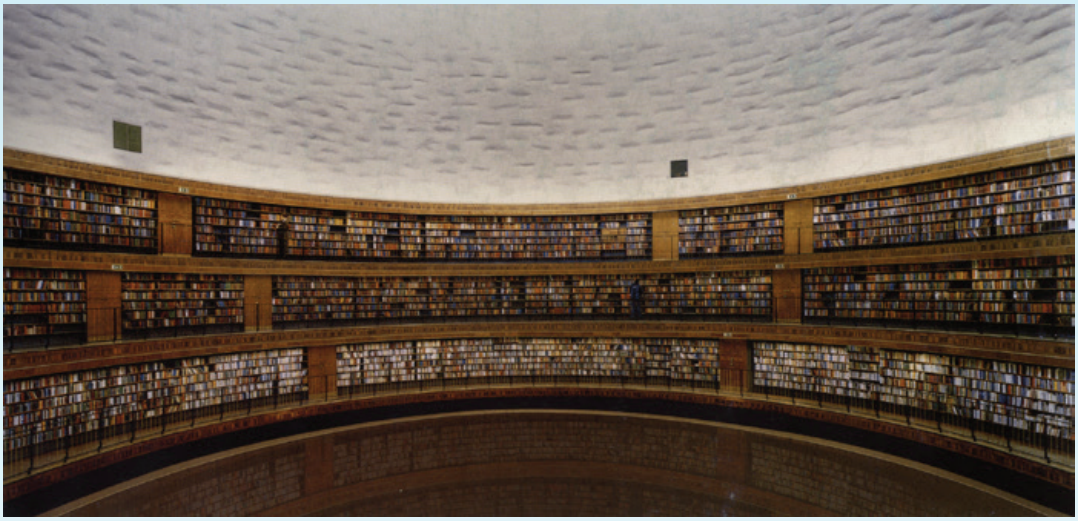


Fig. 1. Knowledge is power

Knowledge is power only when you have access to it in a timely fashion. The internet is loaded with data, but this data needs to be validated. Different pieces of information are scattered around in engineering textbooks, SPE series, IADC manuals, etc. Almost every engineer has their own Excel Spreadsheets, which may generate different answers.

Drilling software can predict the torque and drag for deepwater ERD wells, but may not answer the simple question of the buoyancy factor.

The challenge is to create an all-in-one type of information and knowledge base program. A digital toolbox that bears the following characteristics:

- Quick to access
- Reliable
- Accurate
- Interactive
- Visually intuitive
- Sophisticate yet simple to use

II. Solution

Now much of the technological advances and engineering applications from four decades of hard work have been distilled into Dr. DE, a comprehensive collection of drilling engineering tools in a simple-to-learn and easy-to-use software package.

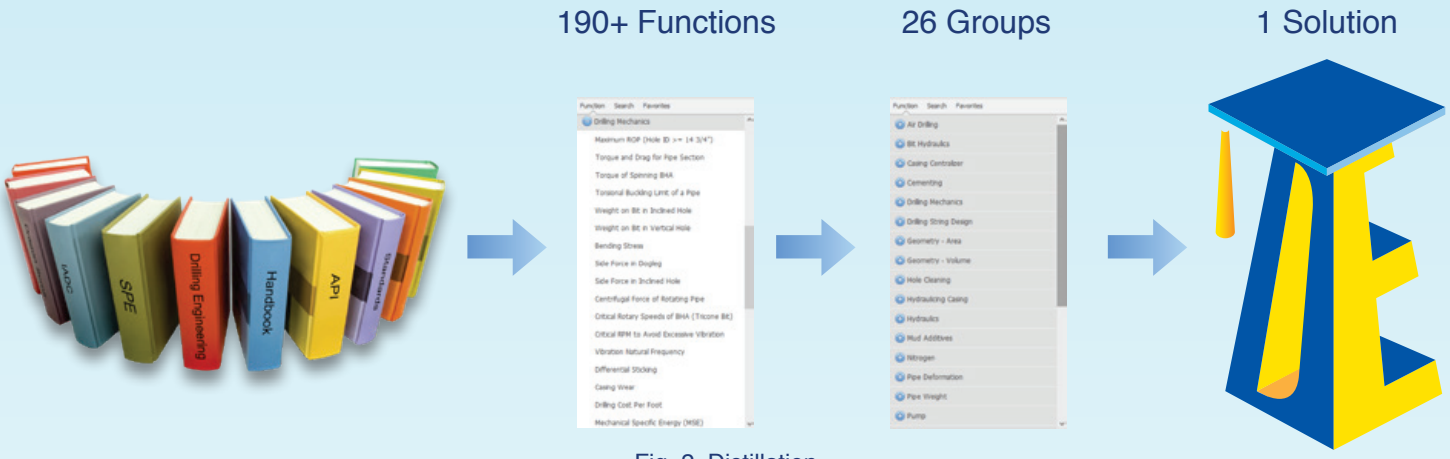


Fig. 2. Distillation

You can bid farewell to pawing through handbooks and Excel spreadsheets for answers, because Dr. DE covers more than 190 functions ranging from the fundamentals of drilling engineering to an advanced well path design and 3D visualization of the wellbore – a must-have resource for every drilling engineer and technician to get the job done right.

With an unmatched number of functions and accuracy, Dr. DE allows you to quickly and accurately perform many daily used engineering calculations. It makes your engineering and sales efforts easier and more efficient.

Some of Dr. DE's engineering features include:

- Daily used drilling engineering problems and solutions
- Extensive and expandable tubular, centralizer and fluid database
- Survey data up to 1,000 points
- 3D wellbore visualization
- Intelligent 2D well path design
- Detailed illustrations
- Support fraction input of tubular sizes, e.g. 9 7/8"
- Search function and Favorite list
- Word, Excel, PDF and HTML reports
- US oil field, metric and customized units

Please see Appendix A (page 14) for the list of 26 groups and 193 functions in Dr. DE.

III. Software

1. Graphical User Interfaces

Dr. DE is designed with our frequent users in mind. Interfaces and input and output tables are arranged in such a way that the software can be run without users going through training or reading the user's manual.

Figure 3 shows the components of the main window for Dr. DE.

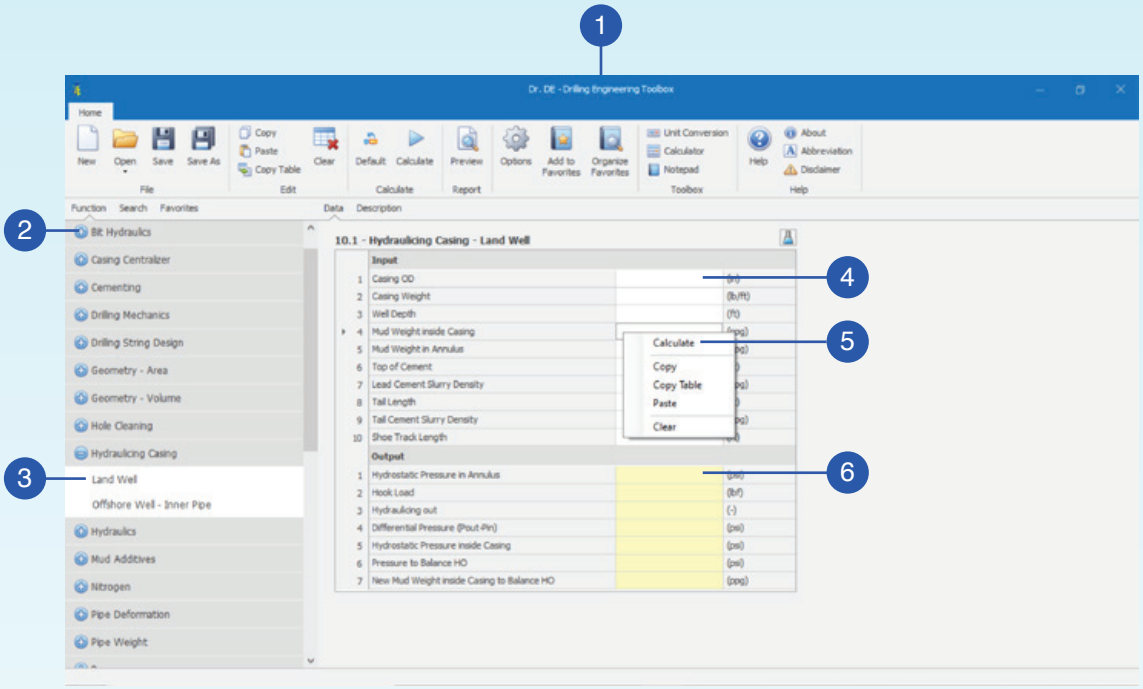


Fig. 3. Components of the main window

(1) Toolbar contains frequently used commands

(2) Groups include various numbers of functions

(3) Function is to perform a particular calculation

(4) Input data for the function selected

(5) Pop-up menu allows the users to start calculation

(6) Output data calculated from the input data

Dr. DE is equipped with many illustrations related to particular functions. These illustrations help users to understand the problems and calculated parameters.

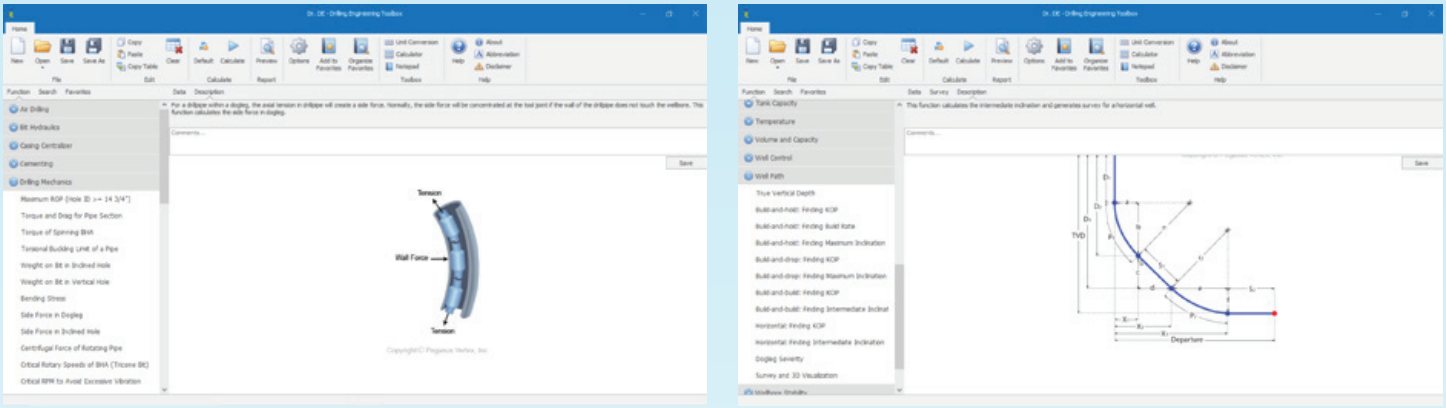


Fig. 4. Illustrations

2. Tubular Database

Dr. DE provides extensive tubular and centralizer databases complemented by a fluid database.

Many functions in Dr. DE require the input of pipe OD, weight and ID, etc. You can input them into the table directly. Alternatively, you can click the button on the upper right corner of the input table to open the Tubular Database window.

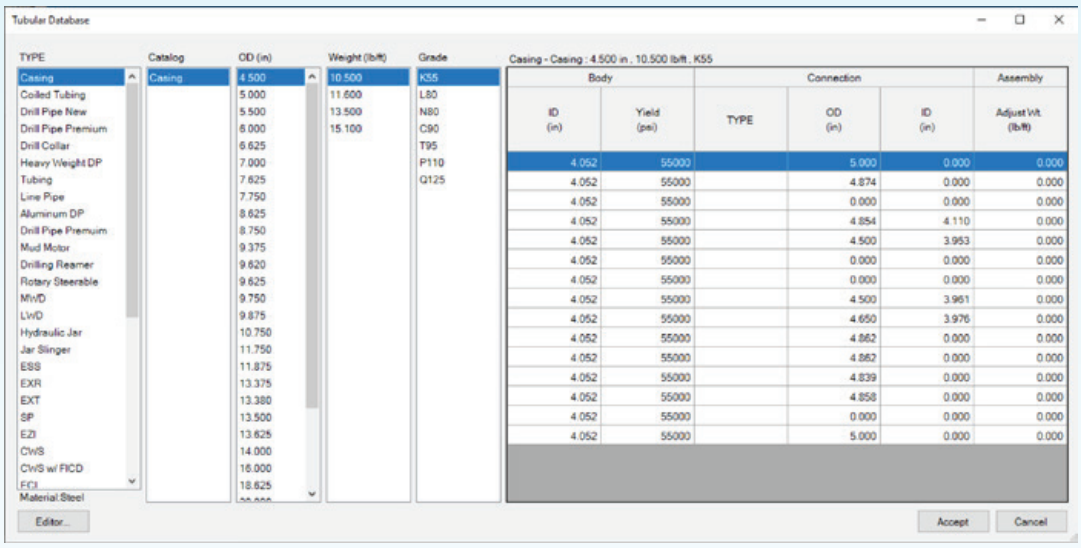


Fig. 5. Tubular Database

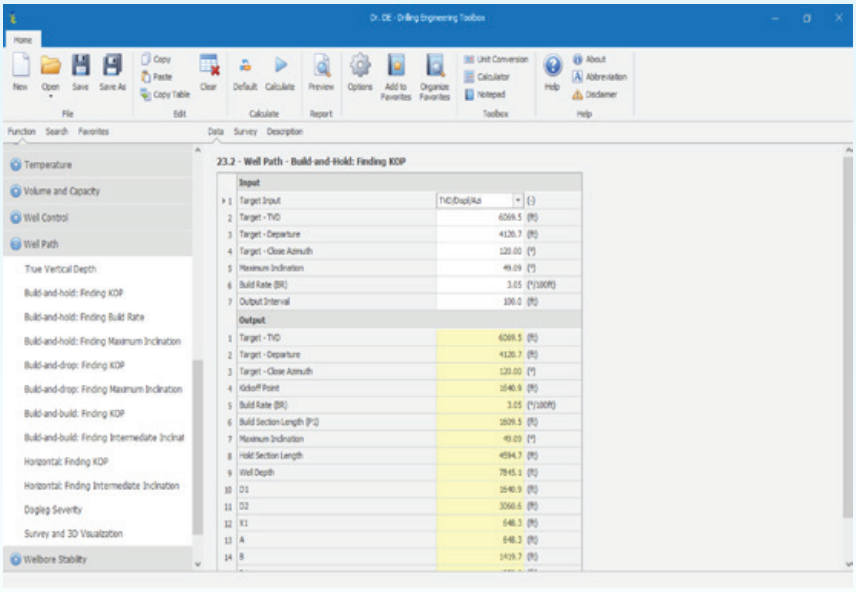
Dr. DE allows the users to input them in fraction format. The fraction format is as follows: an integer + " " + a fraction, e.g. 9 7/8. Once the user hits the Enter key, the program converts the fraction format to decimal format. (e.g. 9 7/8 to 9.875)

3. Well Path Design

For a well path design, there are many input parameters involved as well as a myriad of different combinations. Sometimes the situation may lead to where a valid well path is impossible. Traditionally, the trial and error method can be utilized to obtain the desired design. Dr. DE has an advanced well path design feature called the Well Path Intelligent System. Dr. DE will check the values of the data already inputted and provide a range of the current data in order to create a meaningful well path. The Well Path Intelligent System will save you a tremendous amount of time and effort in complicated 2D well designs.

Well Path Group in Dr. DE includes nine 2D well path design functions.

Well Type	Parameter to be Determined
Build-and-hold	Kick off point (KOP)
	Build rate
	Maximum inclination
Build-and-drop	Kick off point (KOP)
	Maximum inclination
Build-and-build	Kick off point (KOP)
	Intermediate inclination
Horizontal	Kick off point (KOP)
	Intermediate inclination



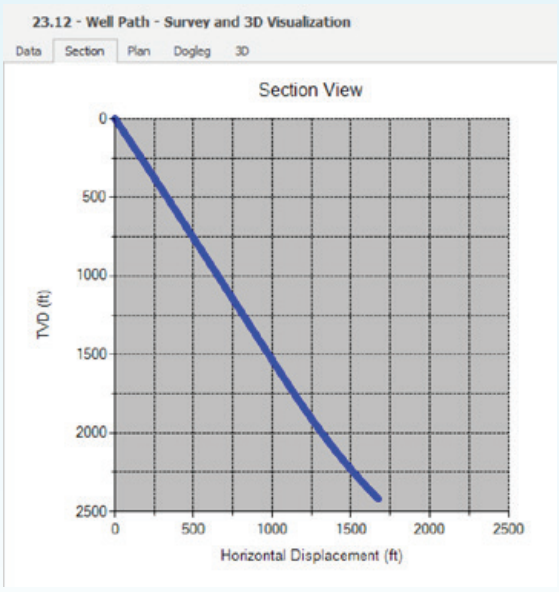


Fig. 6. Well Path Design

4. Survey Import

Survey data can be directly inputted, copied and pasted, imported from text files or PDF files.

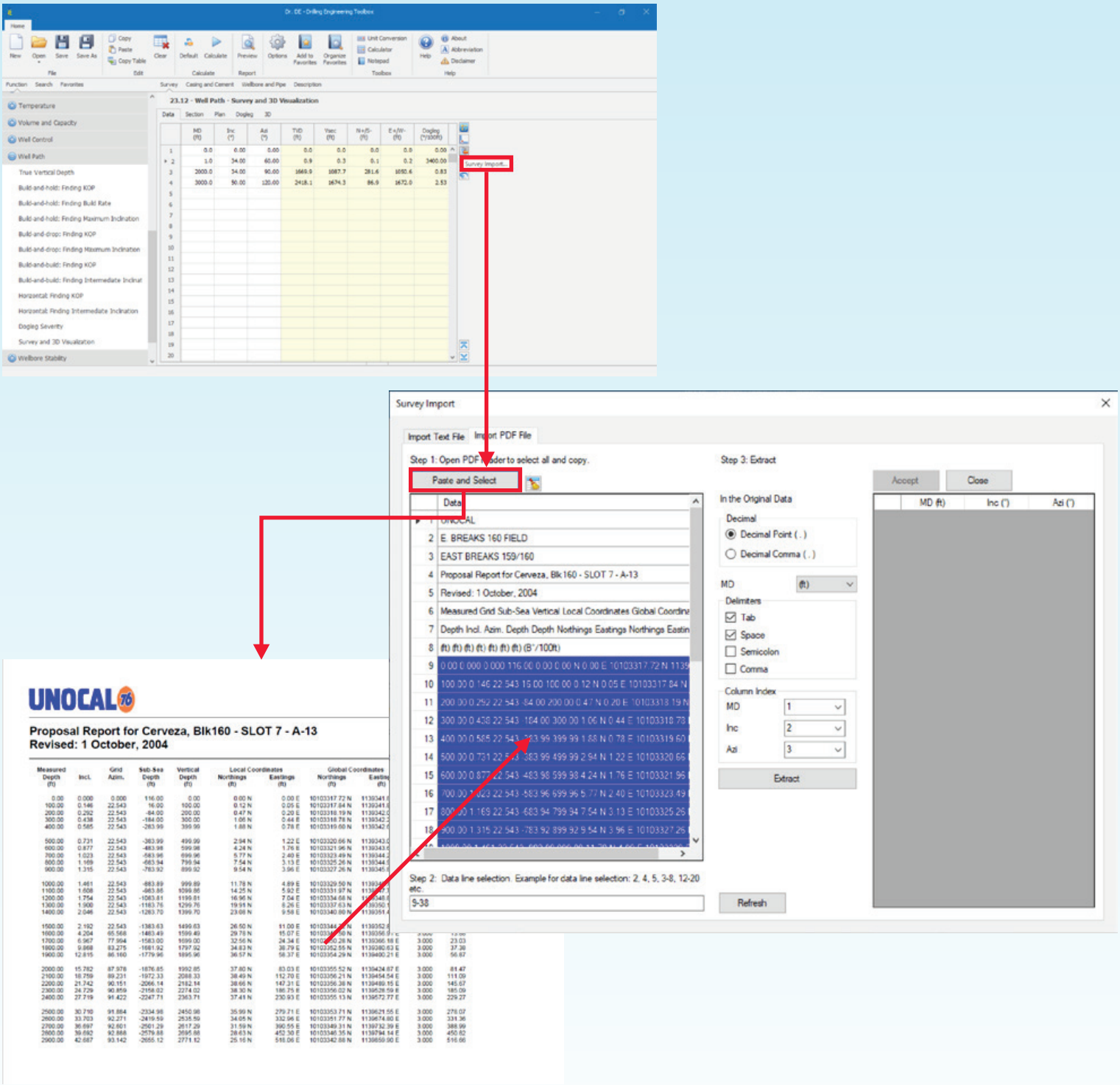


Fig. 7. Survey import

5. 3D Visualization

With the survey data entered or generated by well path design functions, Dr. DE can create a 3D well path visualization with a few clicks. 3D well visualization includes:

(1) Well path

(2) Casing and cement (wellbore structure)

(3) Wellbore and pipe

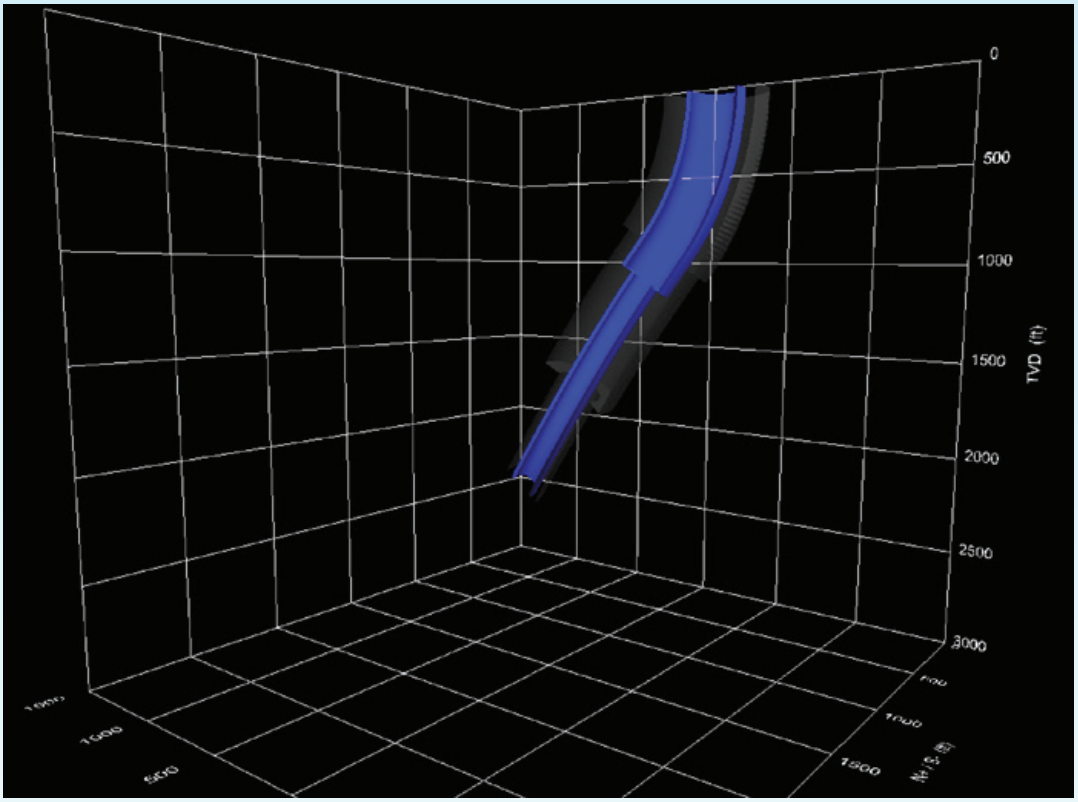


Fig. 8. 3D Wellbore Structure

The 3D visualization of wellbore related data enhances well planning and directional drilling. It also bridges the gap between the rig and office environments.

6. Reports

Dr. DE provides the following methods for output results: Copy and Paste, Word, Excel, Power Point and HTML Report.

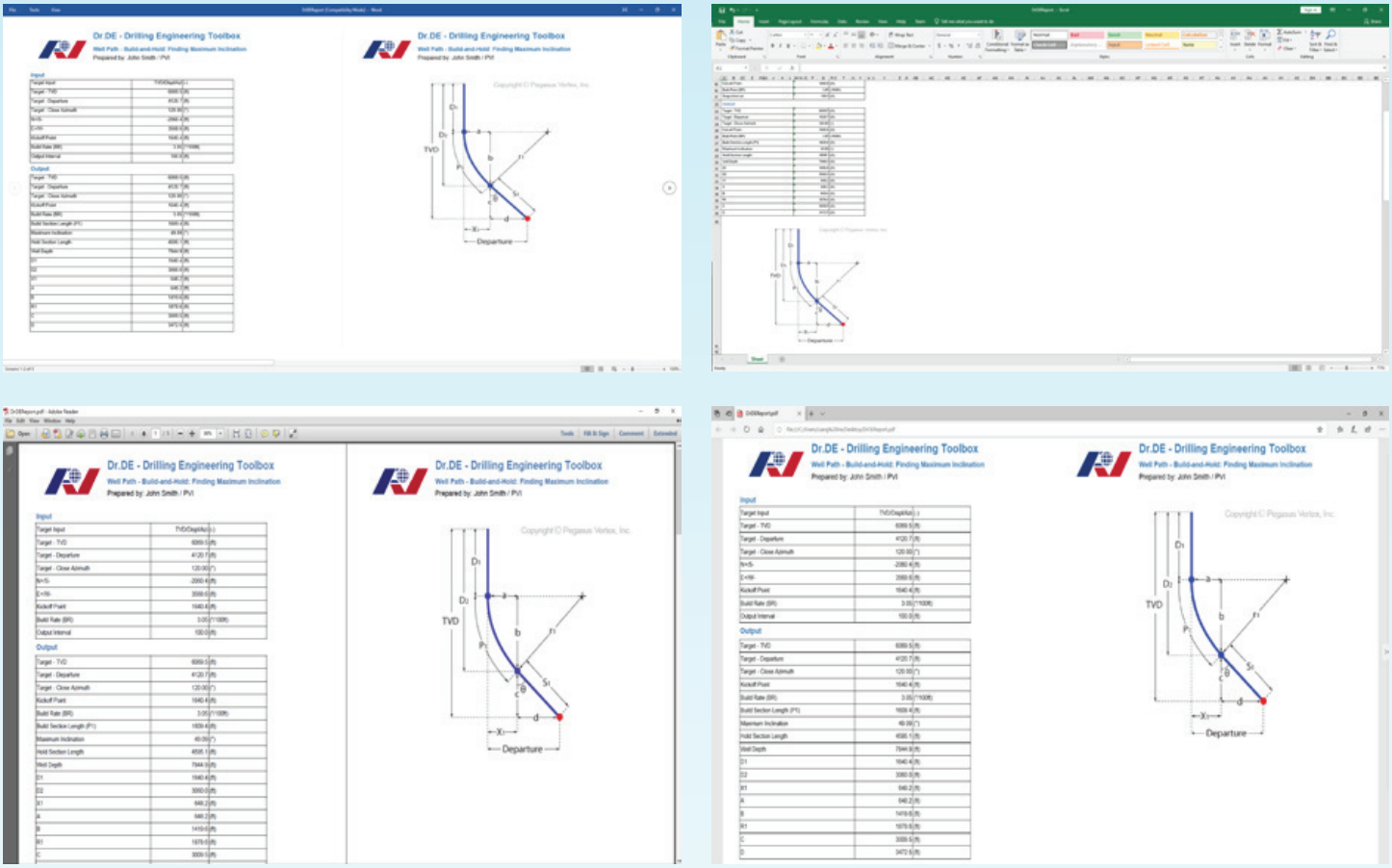


Fig. 9. Reports

7. Search and Favorites

Due to the large number of functions and vast areas Dr. DE covers, you may feel overwhelmed and lost. Dr. DE provides simple solutions. Click the “Search” tab and type the keywords of your desired function. As you type, Dr. DE will dynamically provide a list of possible matches in the drop-down list below. When you finish typing, the search result list will display all possible matches. Clicking any of those matches will take you to the corresponding function.

Likewise, when you find groups or functions that you like, you can add the functions to your Favorites list. As your list of favorite functions grows, you can keep it organized by creating folders. You may want to organize your functions by topic.

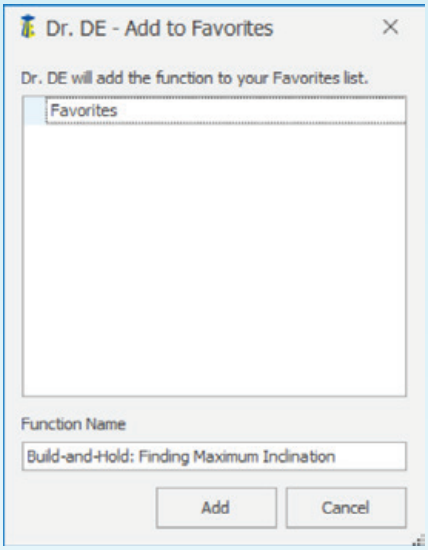


Fig. 10. Search and Favorites

This powerful toolbox software was built on rock-solid foundation of:

- PVI’s years of drilling engineering and software experiences
- Best elements from PVI’s existing software
- 100+ technical references and resources
- Careful scrutinizing, compiling and verification
- Rigorous and extensive testing

Think of Dr. DE as an assistant with a doctorate degree, educated and trained to simplify and empower your drilling engineering process. With the incomparable collection of functions and intuitive access, solving drilling problems or pleasing the clients has never been so easy. Finally, when your clients or manager are ecstatic by the work you produce, Dr. DE would insist that you take all the credit.

IV. The Future

A successful software recognizes the need for future expansion to manage the increased complexity that comes with evolving technological solutions. We embrace the opportunities of adding your desired functions into Dr. DE.

2000 years ago, Chinese philosopher Lao Tsu said: “A journey of thousand miles begins with the first step.” We would like to invite you, our fellow drilling engineers and technicians, to start the journey with Dr. DE; you will never be alone.

For more than a decade, PVI has been committing to providing software solutions to the drilling community. Today, PVI is proudly setting a new industry standard for digital technical tools with the unveiling of Dr. DE, a comprehensive toolbox that goes beyond what has been seen in the current drilling software market.

Dr. DE is also available as a web version. The Dr. DE web version offers our customers the same powerful functionality as the standalone and network versions, while enabling them to easily access the software through internet. The web version also provides the ability to have multiple users within one account and PVI offers a free trial of Dr. DE for customers who sign up for our e-Newsletter.

For more information on Dr. DE, please contact PVI at:

Pegasus Vertex, Inc.
6100 Corporate Dr., Suite 448, Houston, TX 77036
Tel: (713) 981-5558 / Fax: (713) 981-5556
info@pvisoftware.com
www.pvisoftware.com

VIII. Appendix A: 26 Groups and 187 Functions in Dr. DE

Group Name	Function Name
Air Drilling	Gas Expansion Equation
	Required Gas Circulation Rate
	Air Drilling Pump Pressure
	Air Drilling Pressure Loss in Pipe
Bit Hydraulics	Bit Size Selection
	Nozzle Area
	Bit Hydraulics
	Bit Hydraulics Optimization
Casing Centralizer	Standoff - Given Standoff
	Standoff - Given Annular Clearance
	Standoff of Rigid Centralizer
	Equivalent Pipe OD
	Casing Sag Between Centralizers
Cementing	Cement Additive
	Weighted Cement
	Length to be Cemented
	Sacks of Cement
	Balanced Cement Plug
	Fluid Volume
	Open Hole Excess Estimation
	Wiped Mud Film When Using only Top Plug
Drilling Mechanics	Maximum ROP (hole ID >= 14 ¾")
	Torque and Drag for Pipe Section
	Torque of Spinning BHA
	Torsional Buckling Limit of a Pipe
	Weight on Bit in Inclined Hole
	Weight on Bit in Vertical Hole
	Bending Stress
	Side Force in Dogleg
	Side Force in Inclined Hole
	Centrifugal Force of Rotating Pipe
	Critical Rotary Speeds of BHA (Tricone Bit)

	Critical RPM to Avoid Excessive Vibration Vibration Natural Frequency Differential Sticking Casing Wear Drilling Cost per Foot
Drilling String Design	Mechanical Specific Energy (MSE) Drillpipe Length for a Specified BHA BHA Length for Desired WOB Maximum Permissible Dogleg Severity Pipe-Wall Thickness Modification
Geometry - Area	Annulus Circle Ellipse Section of a Ring Sector of a Circle Segment of a Circle Segment of an Annulus - 1 Segment of an Annulus - 2 Triangle Rectangle Parallelogram Trapezoid
Geometry - Volume	Hollow Cylinder Hollow Sphere Oblique Prism Pyramid Truncated Pyramid Right Cone Truncated Right Cone
Hole Cleaning	Slip Velocity Amount of Cuttings Bulk Density of Cuttings Carrying Capacity Index (CCI) Cuttings Suspension Contact Time in Annulus

Hydraulicing Casing	Land Well Offshore Well - Inner Pipe
Hydraulics	Equivalent Circulating Density (ECD) Hydraulics Diameter Mud Hydrostatic Pressure Hydrostatic Pressure with Mixture of Oil and Water Mud Weight Increase Due to Fast Drilling Pressure Drop (Bingham Plastic) - Pipe Pressure Drop (Bingham Plastic) - Annulus Pressure Drop (Power Law) - Pipe Pressure Drop (Power Law) - Annulus Annular Pressure Loss - Quick Estimate Surface Equipment Pressure Loss Annular Velocity - From Diameter Annular Velocity - From Capacity Hydraulic Horsepower Hydraulic Impact Force Loss of Overbalance due to Falling Mud Level Loss of Overbalance due to Lost Returns Hydrostatic Pressure Decrease When Pulling Pipe Out Surge and Swab Pressure Flow Split Critical Static Gel Strength Pressure Required to Initiate Flow Pressure Drop in Spooled Pipe Depth of Washout Annular Shear Rate
Mud Additives	Brine Density Change Barite Density Control with Solids Dilution Density of Oil/Water Mixture Final Density and Volume Number of Sacks Required Oil/Water Ratio from Retort Data Original Volume Required Amount of Oil/Water Added

	Original Volume Required with Limit Final Volume
	Maximum Solid Fractions
	Mud Density Control
	Solids Control for Weighted Muds
Nitrogen	Properties and Conversion Data for N2
	Amount of Nitrogen to Fill CT
	Gas Density
	Volume Factor
	Foamed Cement - Given Foam Density
	Foamed Cement - Given Foam Quality
	Foamed Cement - Given Nitrogen Injection Ratio
	Pressure and Density of Gas Column
Pipe Deformation	Moment of Inertia
	Moment of Inertia of a Rectangle
	Stiffness
	Pipe Elongation
	Pipe Twist
	Pipe Bending
	Buckling Limits
	Pressure, Tensile and Torsional Limits
	Length of Free Pipe
	Critical Length of Tool - Abrupt Dogleg
	Critical Length of Tool - Circular Dogleg
	Triaxial Stress (Von Mises Stress)
Pipe Weight	Buoyancy Factor
	Buoyed Weight in One Fluid
	Buoyed Weight in Two Fluids
	Pipe ID from Pipe OD and Weight
	Pipe Weight From OD and ID
Pump	Duplex
	Triplex
Rheology	Fann Viscometer Reading
	Get N and K from PV and YP
	Get PV and YP from N and K
	PV, YP, N and K

	PV and YP Estimation Critical Annular Velocity and Flow Rate
Snubbing	Pressure Area Required Hydraulic Pressure Pipe Buckling at the Surface
Tank Capacity	Horizontal Cylindrical Tank with Flat Heads Horizontal Cylindrical Tank Vertical Cylindrical Tank with Flat Bottoms Vertical Cylindrical Tank Rectangular Tank with Flat Bottoms Rectangular Tank with Sloping Sides
Temperature	Temperature Conversion Formation Temperature
Volume and Capacity	Volume Conversion Pipe Capacity Pipe Displacement Annular Capacity Pipe and Annular Volumes Hole ID from Hole Volume Equivalent Hole ID from Caliper Volume Equivalent Hole ID from Excess Stroke
Well Control	Maximum Surface Pressure and Pit Gain Choke Line Pressure Loss New Estimated Choke Line pPressure Loss Formation Pressure and Mud Weight Required Gas Flow into the Wellbore Height and Weight of Influx Hydrostatic Pressure Reduction Kick Severity Kick Tolerance Rate of Gas Migration in a Shut-in Well Shut-in Casing Pressure Shut-in Drillpipe Pressure Bottom Hole Pressure with the Well Shut-In on a Kick

	BHP When Circulating Out a Kick - Offshore Maximum Mud Weight with Returns to Rig FLoor Casing Burst Pressure - Subsea Stack
Well Path	True Vertical Depth Build-and-Hold: Finding KOP Build-and-Hold: Finding Build Rate Build-and-Hold: Finding Maximum Inclination Build-and-Drop: Finding KOP Build-and-Drop: Finding Maximum Inclination Build-and-Build: Finding KOP Build-and-Build: Finding Intermediate Inclination Horizontal: Finding KOP Horizontal: Finding Intermediate Inclination Dogleg Severity Survey and 3D Visualization
Wellbore Stability	Mud Weight for Inclined Holes Maximum Allowable Mud Weight from LOT
Wireline	Wireline Diameter Wireline Weight Wireline Tension for One Section
Mud Formation	Mud Formulation