DDRAG – Torque and Drag Model

is a field-proven model that computes torque and drag on drillstrings, casing and tubing. It can be used for planning deviated and horizontal wells, as well as monitoring their progress as they are drilled.

The program has been proven time and again as a powerful and effective tool for predicting tight hole and insufficient hole cleaning, and has reduced field costs and saved time worldwide on a great variety of operations. It can use either the soft- or stiff-string models, as well as calculate wellbore friction factors.

DDRAG is among the most widely used software applications in the petroleum industry.

NOTE: Computer screens within this PDF document may appear slightly distorted. This is due to limitations in the Adobe Acrobat Viewer when displaying graphics. To clearly view details in the graphics, zoom in or print the document.

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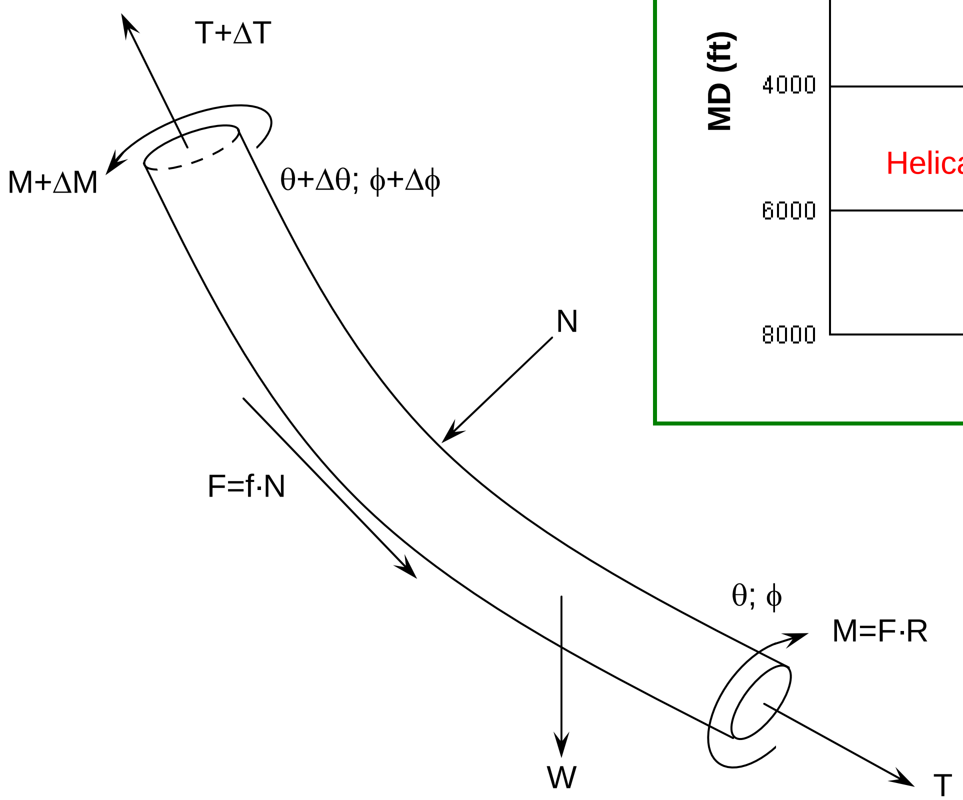
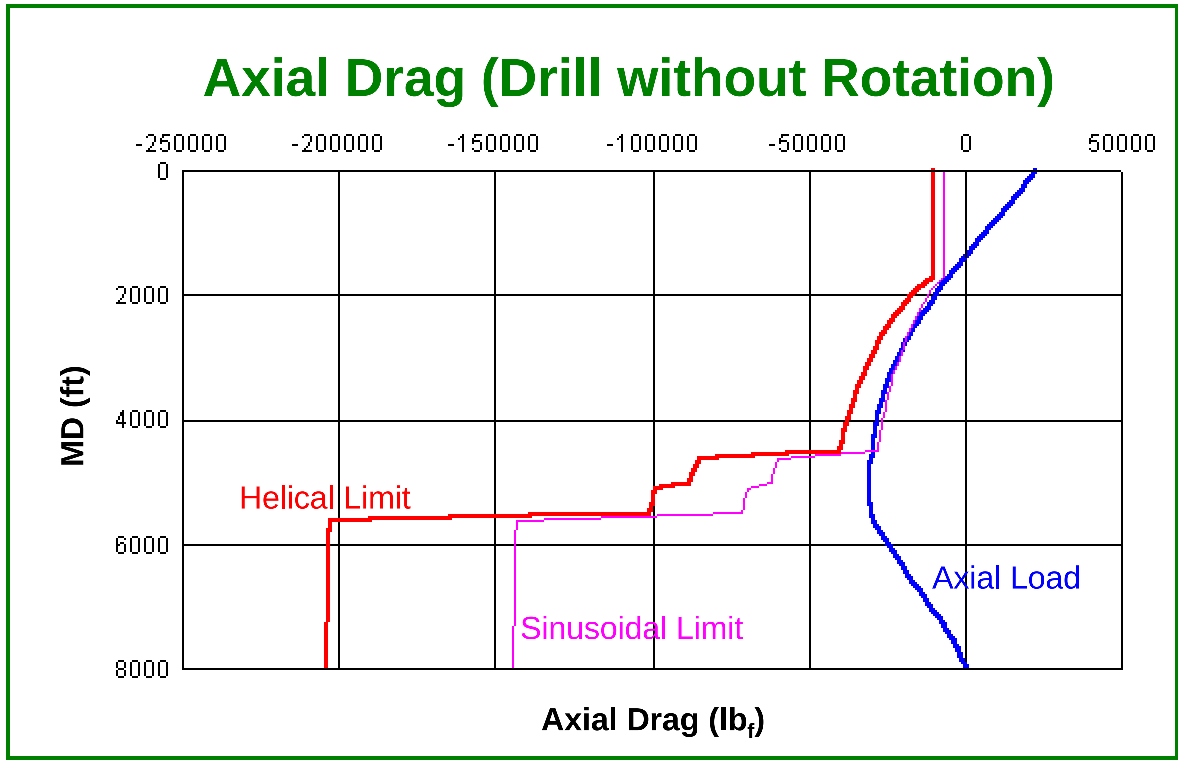
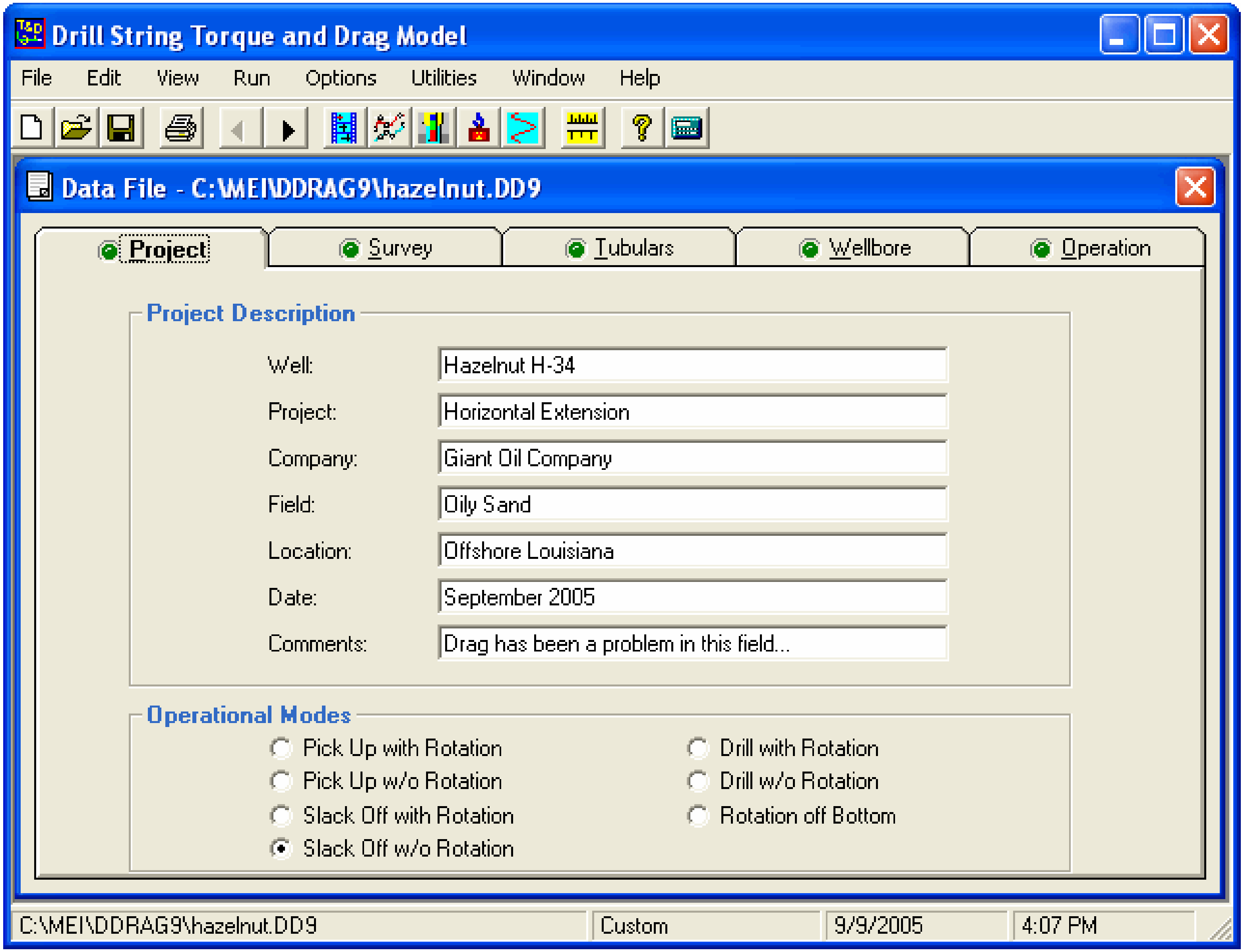
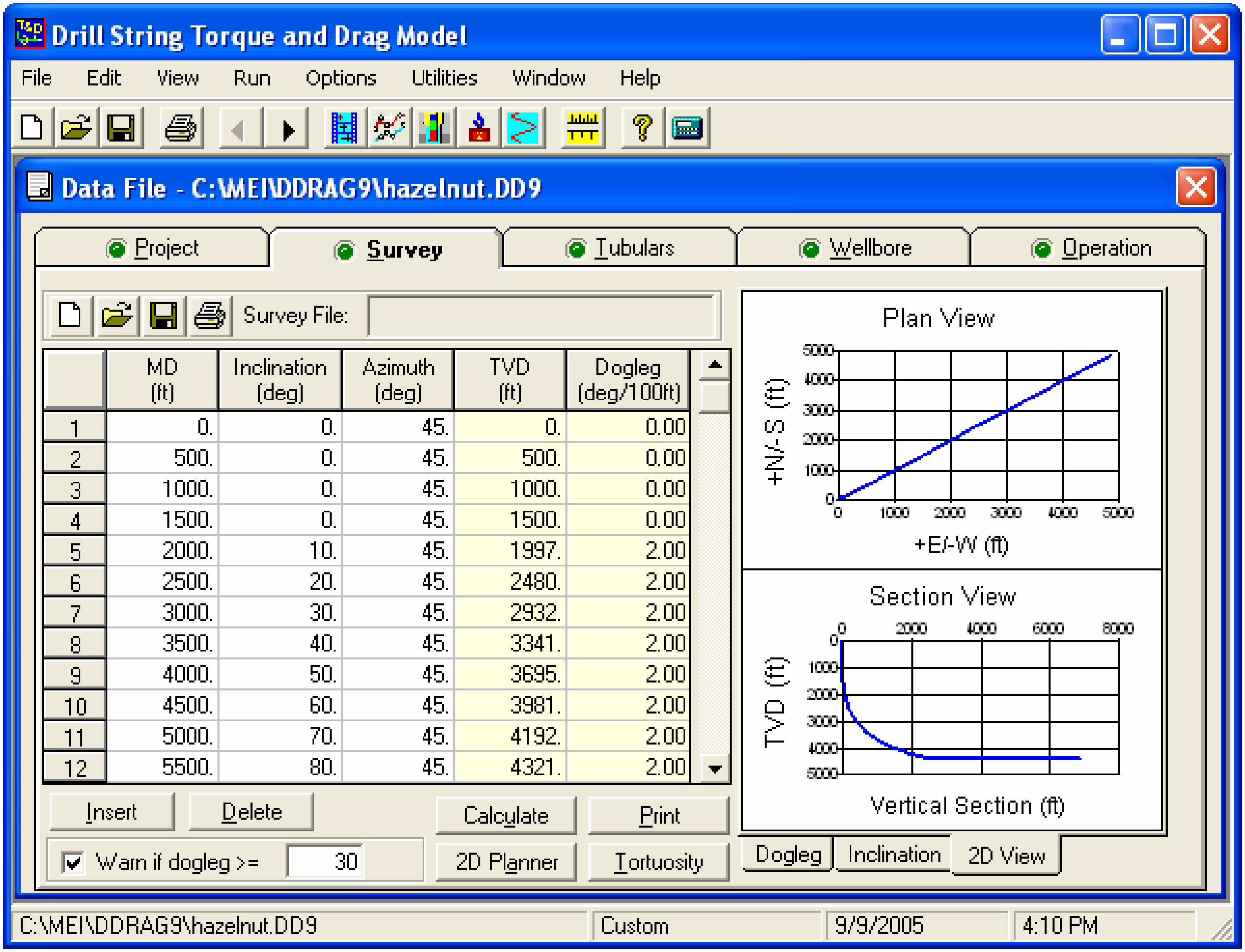




DDRAG can be highly useful in well planning to predict torque and drag for pick up, slack off, drilling with and without rotation, as well as for rotating off bottom. It can also be used to monitor well drilling by determining cased and open-hole friction factors using real field data.



DDRAG's first input page, **Project**, is used to document specific project data and to select the current operational mode.

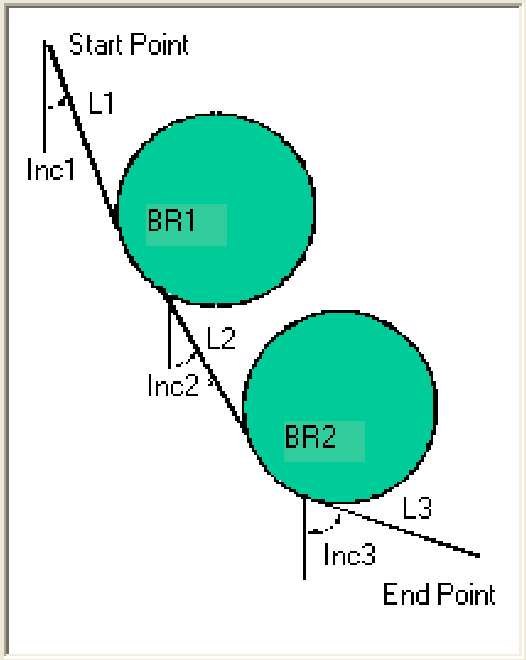


The **Survey** page can separately plot plan and section views of the wellpath, as well as wellbore inclination and dogleg. Data may be copied from a spreadsheet or entered manually. Don't have a survey? Create one quickly with the handy 2D Planner utility.

2D Well Planner

2D Plan

(•) Build/Build ( ) Build/Drop ( ) Build/Hold



Target

(•) TVD/NS/EW ( ) TVD/Horizontal Distance/Azi

TVD (ft): 2200 N/S (ft): 2000 E/W (ft): 150

Planning

	Unknowns (Select 2)	Value
Inc1 (deg)	☐	5
L1 (KOP) (ft)	☑	
BR1 (deg/100ft)	☑	
Inc2 (deg)	☐	60
L2 (ft)	☐	650
BR2 (deg/100ft)	☐	10
Inc3 (deg)	☐	90
L3 (ft)	☐	500

Survey Interval

Straight Section (ft): 100 Curve Section (ft): 100

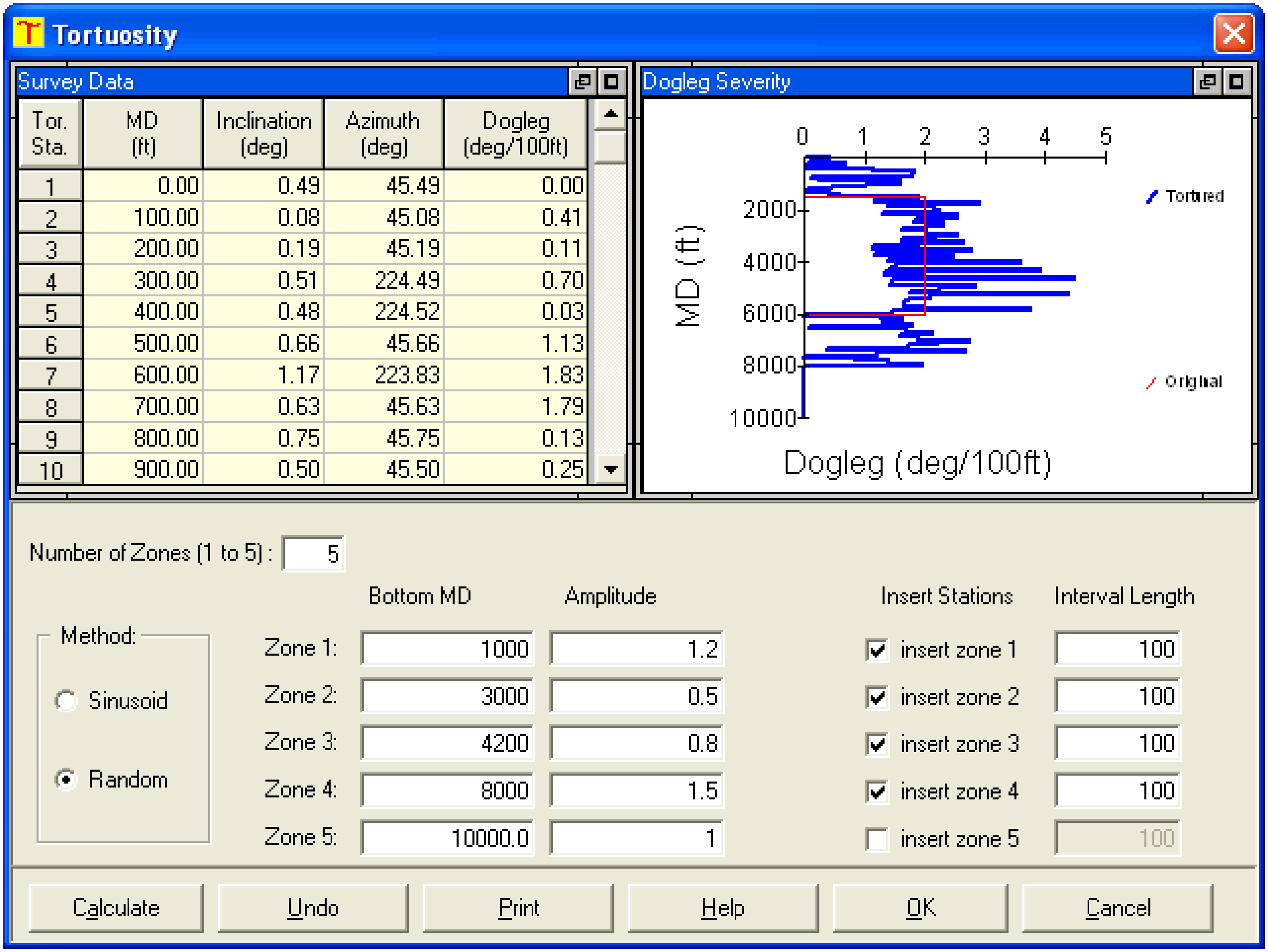
	MD (ft)	Inc (deg)	Azi (deg)	TVD (ft)	N/S (ft)	E/W (ft)	Build Rate (deg/100ft)	Section Length (ft)
1	0.00	5.00	4.29	0.0	0.0	0.0	n/a	n/a
2	893.9	5.00	4.29	890.5	77.7	5.8	0.00	893.9
3	2012.7	60.00	4.29	1798.2	654.4	49.1	4.92	1118.8
4	2662.7	60.00	4.29	2123.2	1215.7	91.2	0.00	650.0
5	2962.7	90.00	4.29	2200.0	2193.8	164.5	10.00	300.0
6	3462.7	90.00	4.29	2200.0	2000.0	150.0	0.00	500.0

Calculate

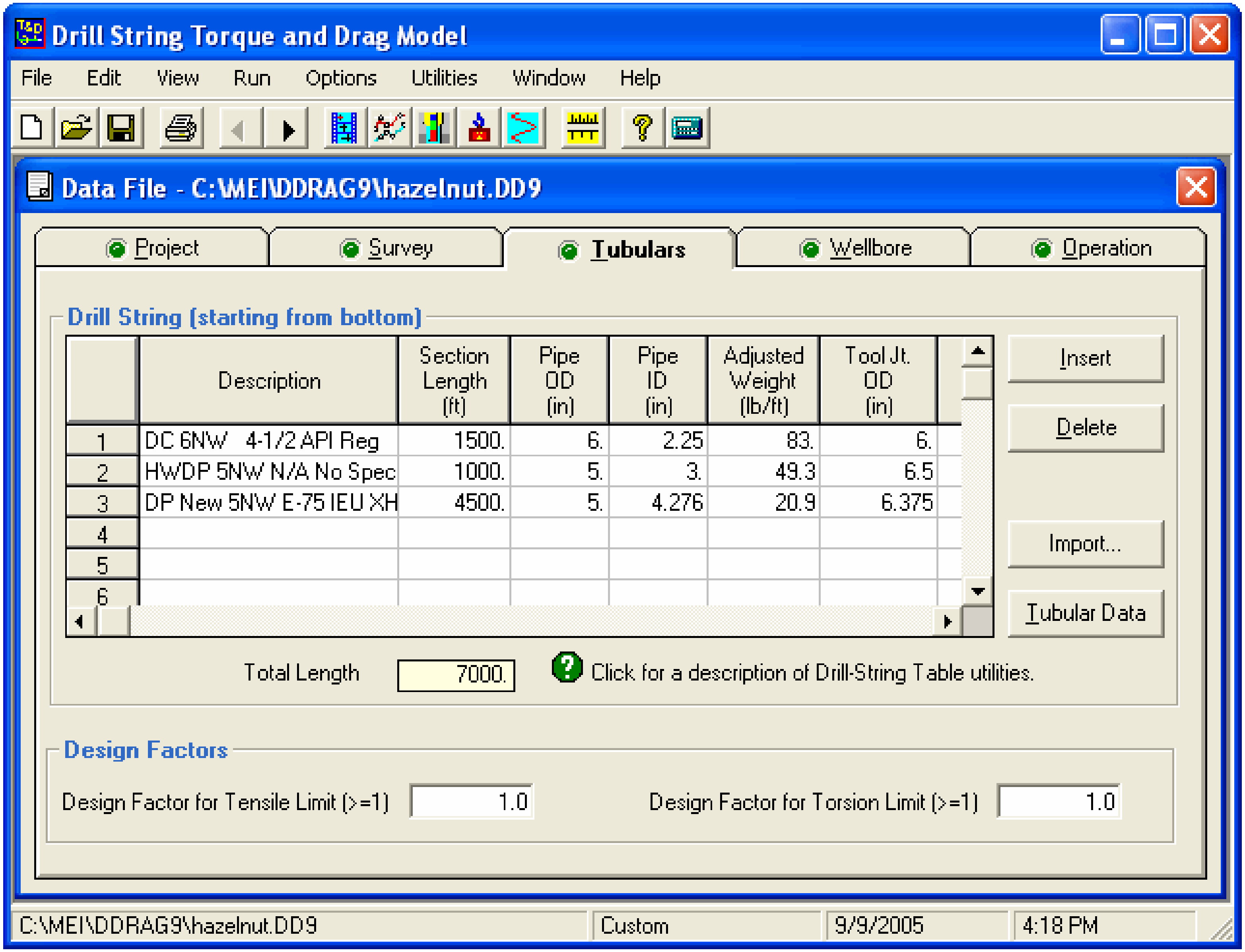
Accept

Cancel

The **2D Planner** allows you to quickly create simple or complicated well surveys. Choose the basic well shape and enter starting values for the primary geometric parameters. After creation, the new survey is automatically exported back to the Survey page.

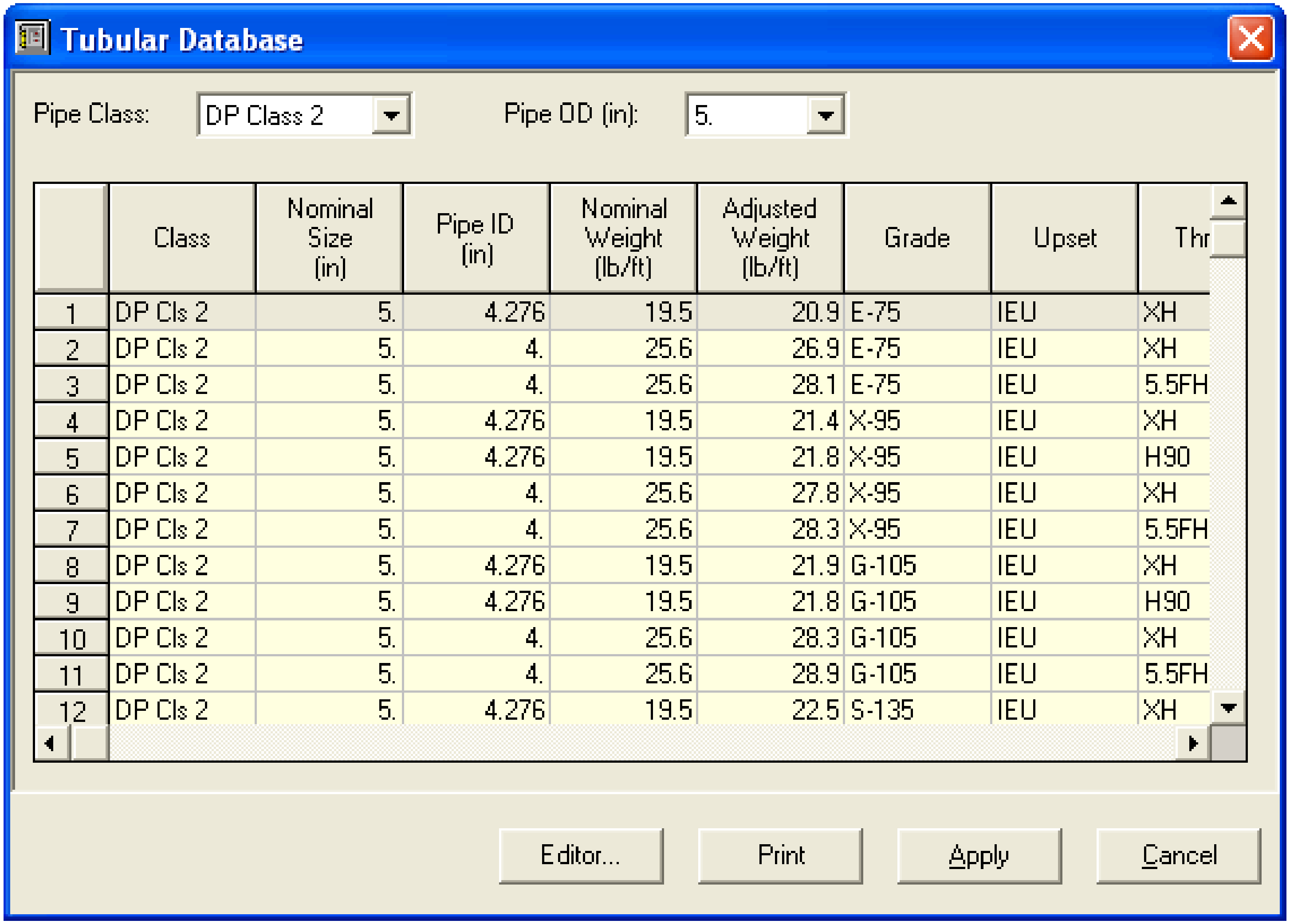


Another important utility is the **Tortuosity** window. Ideal well surveys need to be “tortured” to add imperfections similar to those found in real wells. This well has been divided into five separate segments, each with its own tortuosity. The original survey is in red; the tortured survey is in blue.



On the **Tubulars** page, drillstring components are specified in detail. Design factors may be assigned based on your company's (or client's) standard practices.

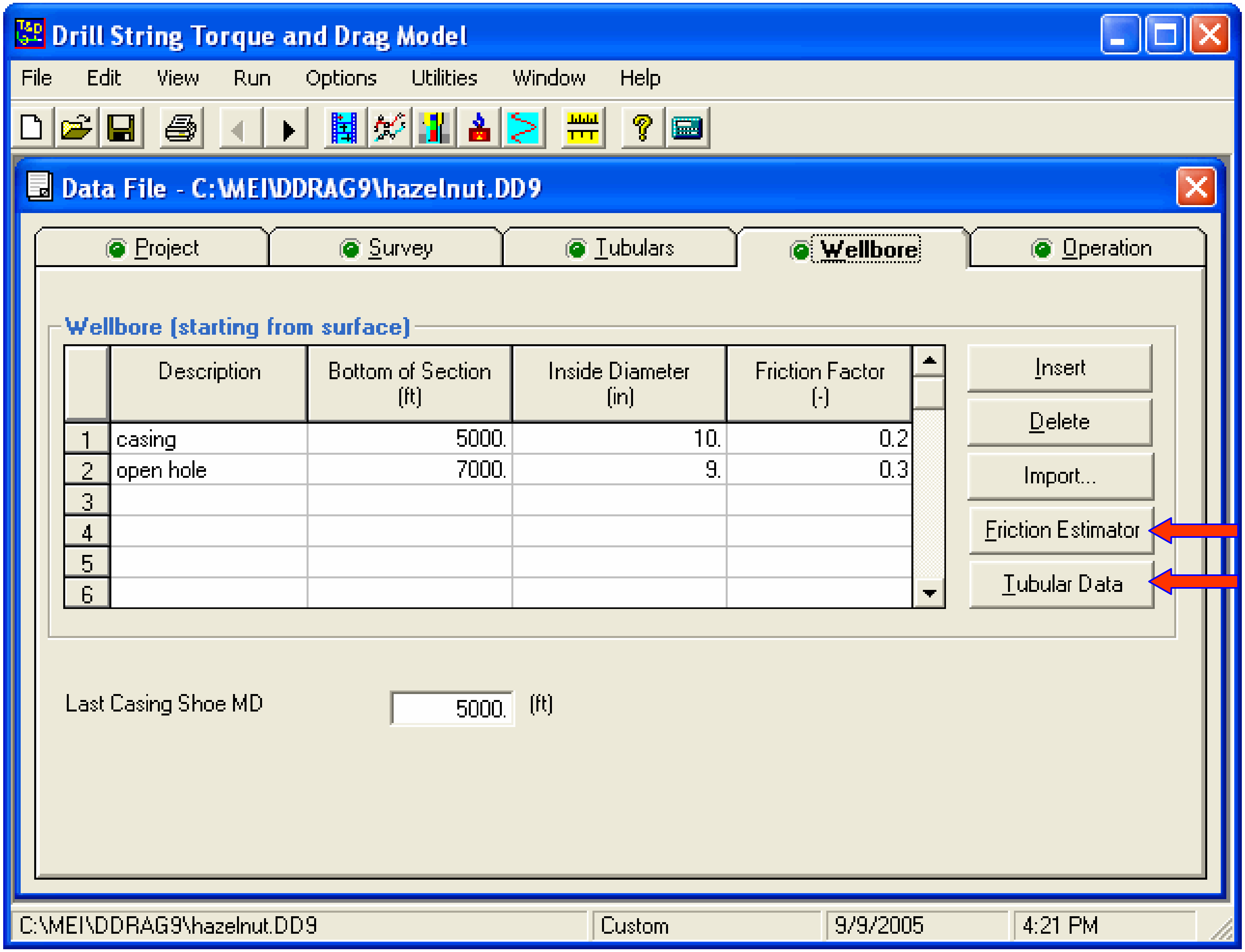
DDRAG



	Class	Nominal Size (in)	Pipe ID (in)	Nominal Weight (lb/ft)	Adjusted Weight (lb/ft)	Grade	Upset	Thr
1	DP Cls 2	5.	4.276	19.5	20.9	E-75	IEU	XH
2	DP Cls 2	5.	4.	25.6	26.9	E-75	IEU	XH
3	DP Cls 2	5.	4.	25.6	28.1	E-75	IEU	5.5FH
4	DP Cls 2	5.	4.276	19.5	21.4	X-95	IEU	XH
5	DP Cls 2	5.	4.276	19.5	21.8	X-95	IEU	H90
6	DP Cls 2	5.	4.	25.6	27.8	X-95	IEU	XH
7	DP Cls 2	5.	4.	25.6	28.3	X-95	IEU	5.5FH
8	DP Cls 2	5.	4.276	19.5	21.9	G-105	IEU	XH
9	DP Cls 2	5.	4.276	19.5	21.8	G-105	IEU	H90
10	DP Cls 2	5.	4.	25.6	28.3	G-105	IEU	XH
11	DP Cls 2	5.	4.	25.6	28.9	G-105	IEU	5.5FH
12	DP Cls 2	5.	4.276	19.5	22.5	S-135	IEU	XH

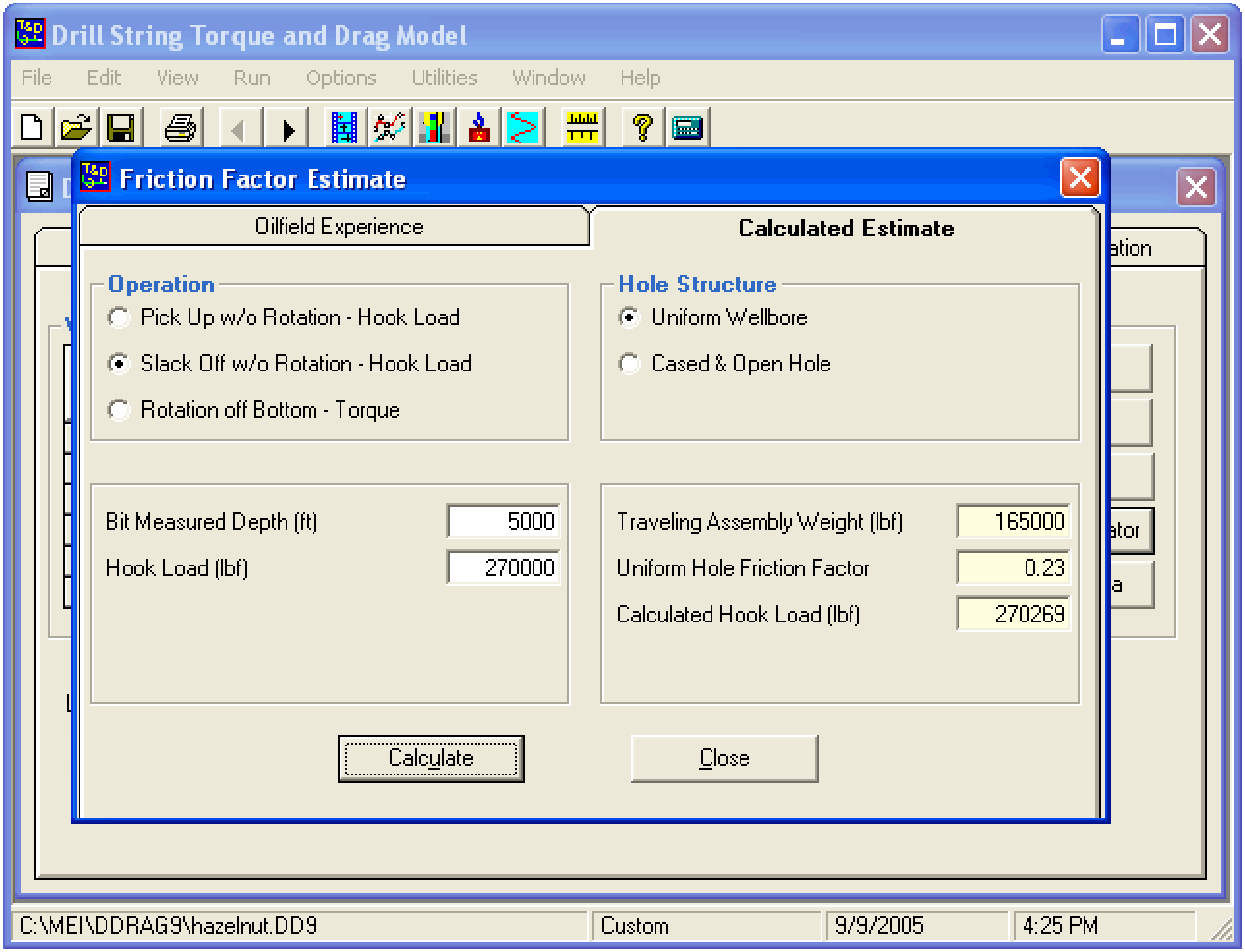
DDRAG

All Maurer Technology programs include an extensive database of tubulars that may be edited/customized. This feature avoids the need to look up the drillstring component's size, weight, ID, etc. each time.



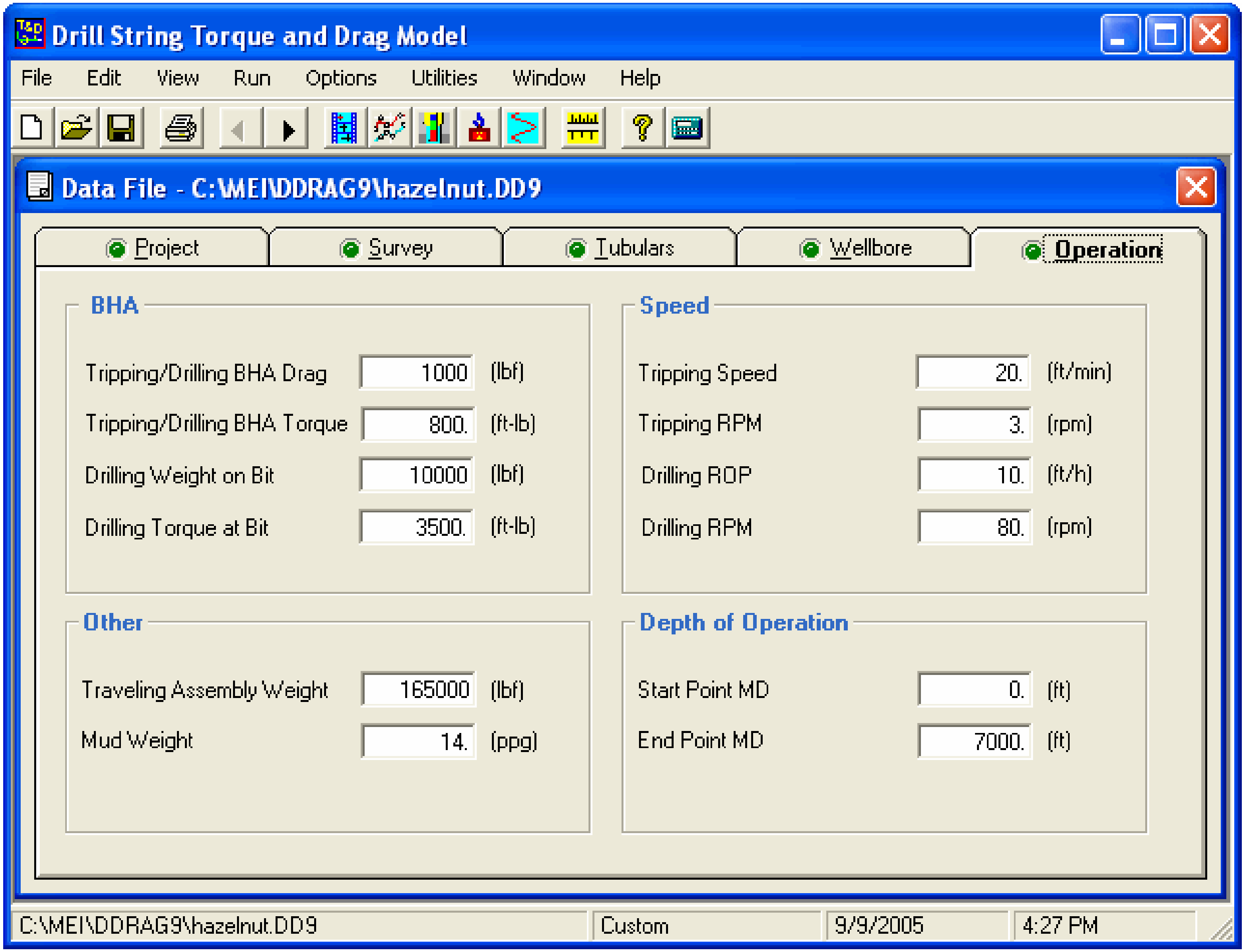
Wellbore geometry is entered on the **Wellbore** page, along with friction factors for each hole section. Open the Friction Estimator or Tubular Database for help with these parameters.

DDRAG



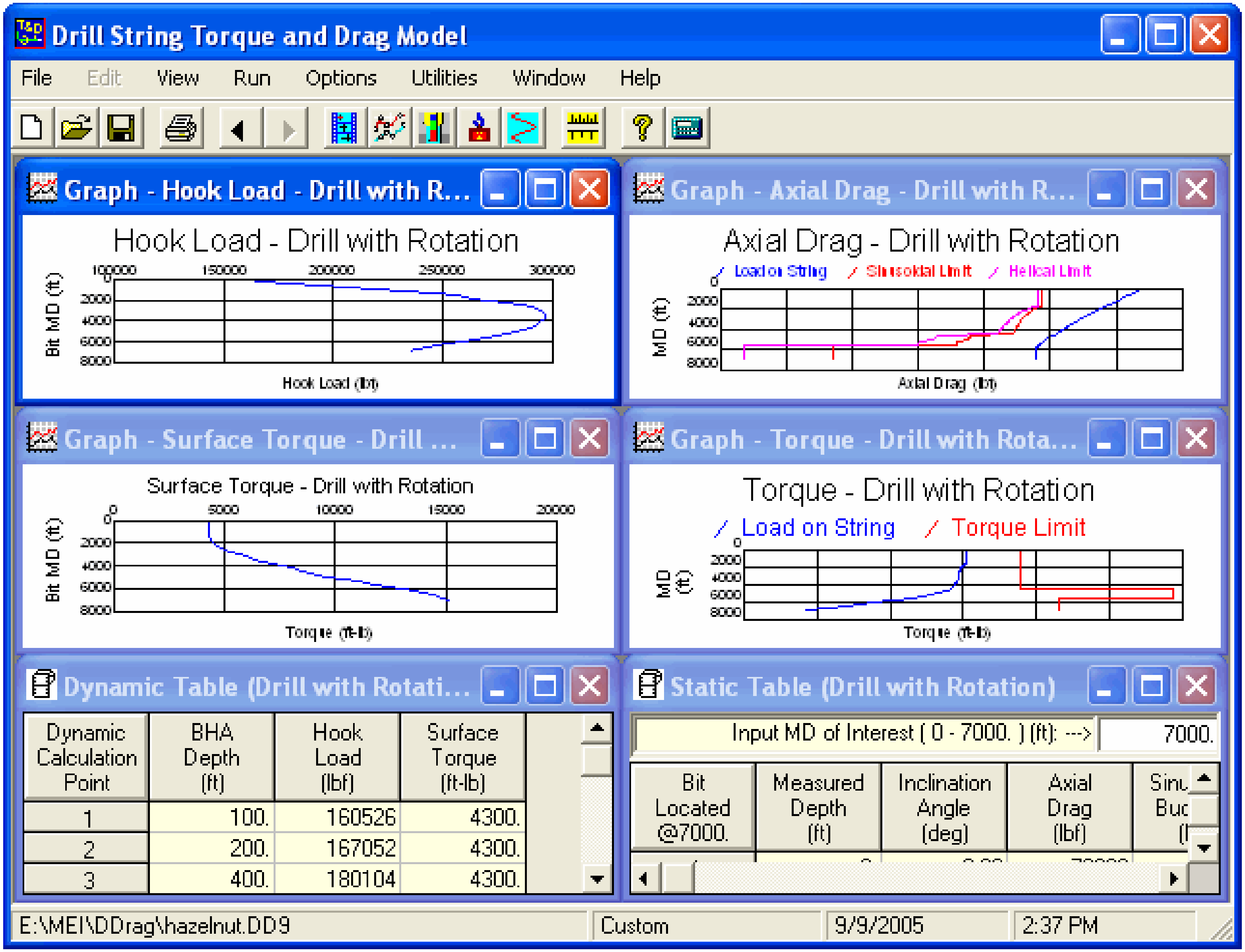
DDRAG

The **Friction Factor Estimate** utility is used to develop an estimate of friction factor based on hole conditions and measured hook load.



Details related to the field operation are entered on the **Operation** page. For drilling (shown), WOB and torque at bit specify end boundary conditions, and ROP and RPM specify pipe velocity relative to the borehole wall or casing.

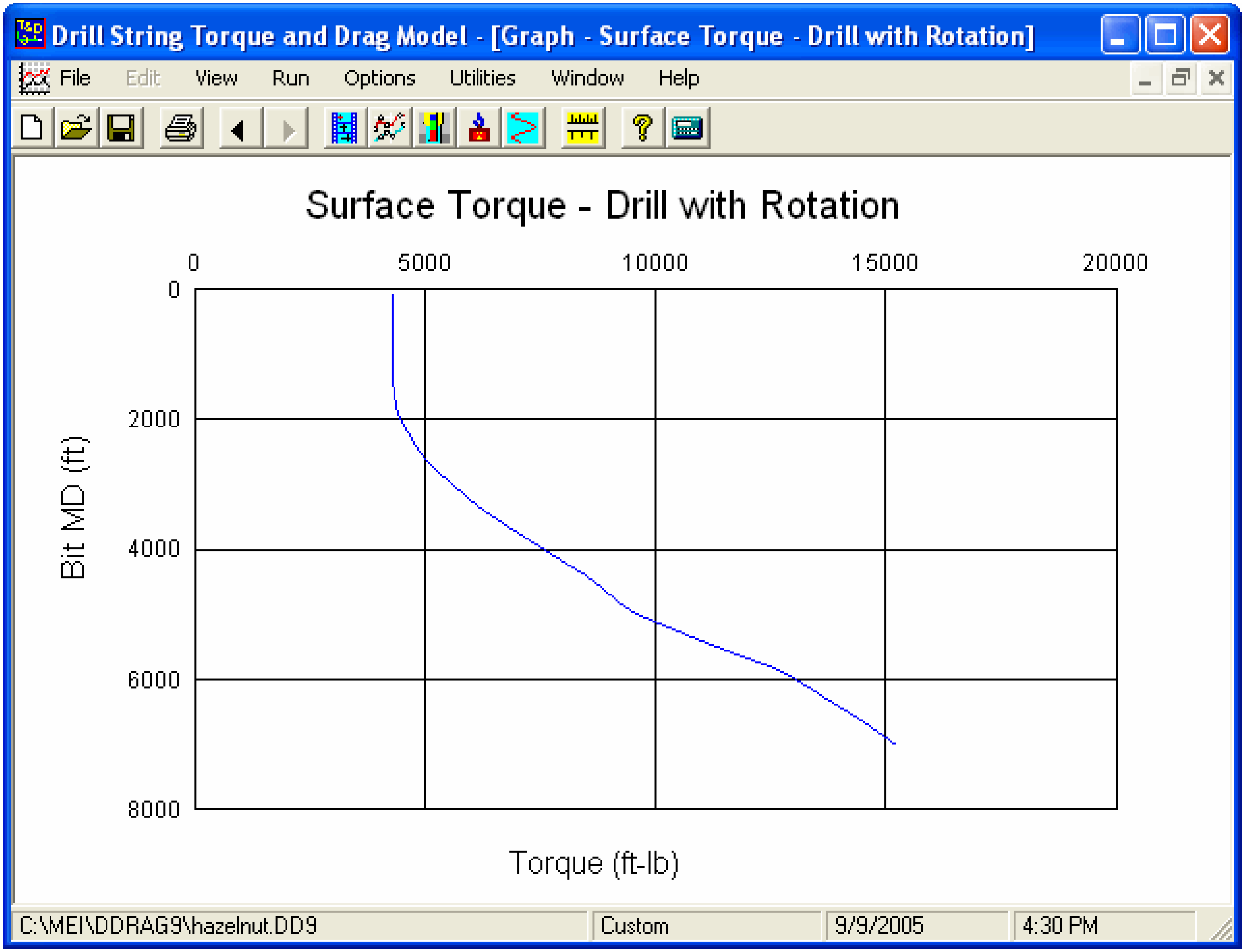
DDRAG



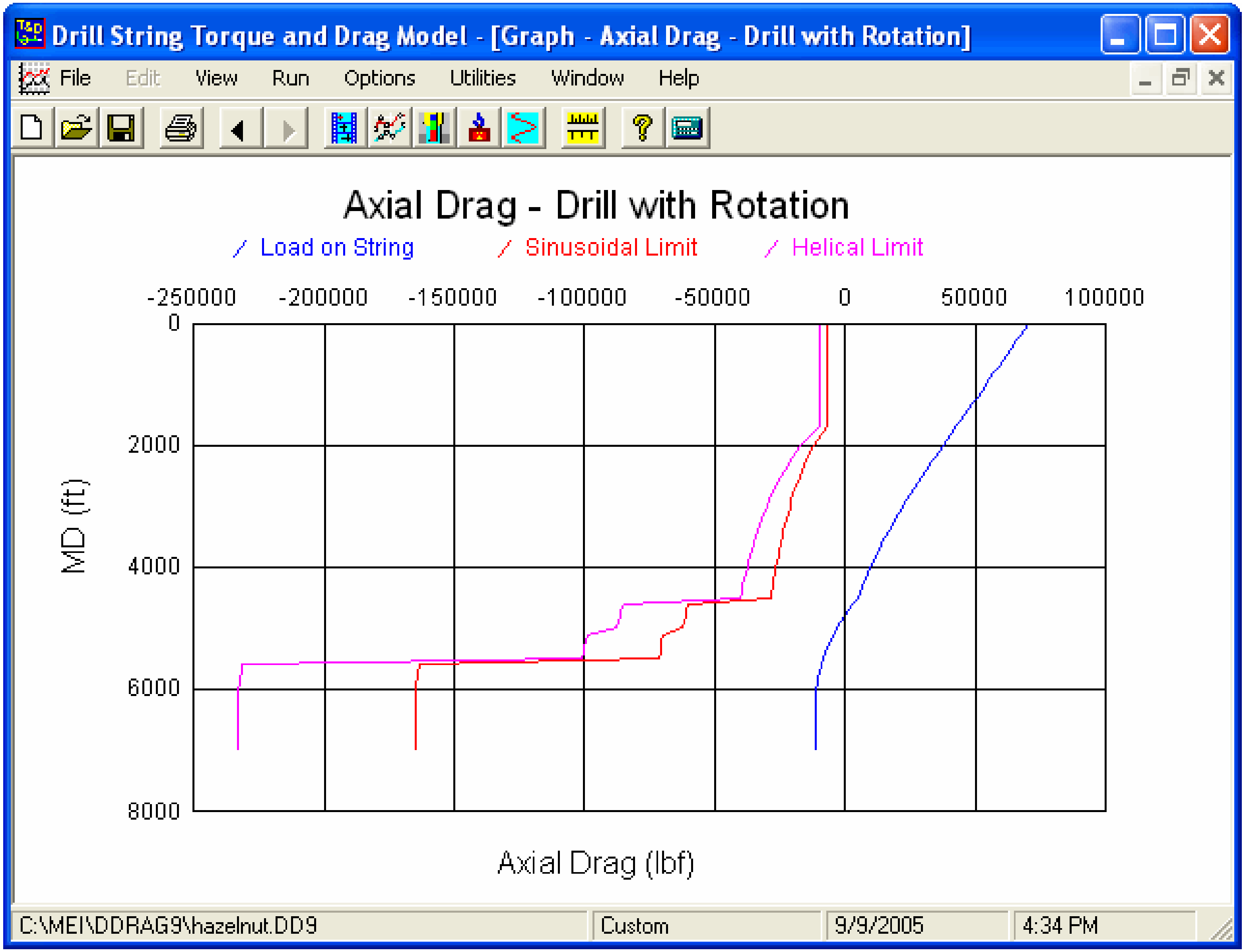
Dynamic Calculation Point	BHA Depth (ft)	Hook Load (lbf)	Surface Torque (ft-lb)
1	100.	160526	4300.
2	200.	167052	4300.
3	400.	180104	4300.

Bit Located @7000.	Measured Depth (ft)	Inclination Angle (deg)	Axial Drag (lbf)	Sinu Buc (l

After all required input data are entered, you're ready to view the output. Principal results are displayed in six graph and table windows. Any of these graphs can quickly be maximized for easy review. (These output windows are shown on the next few slides.)

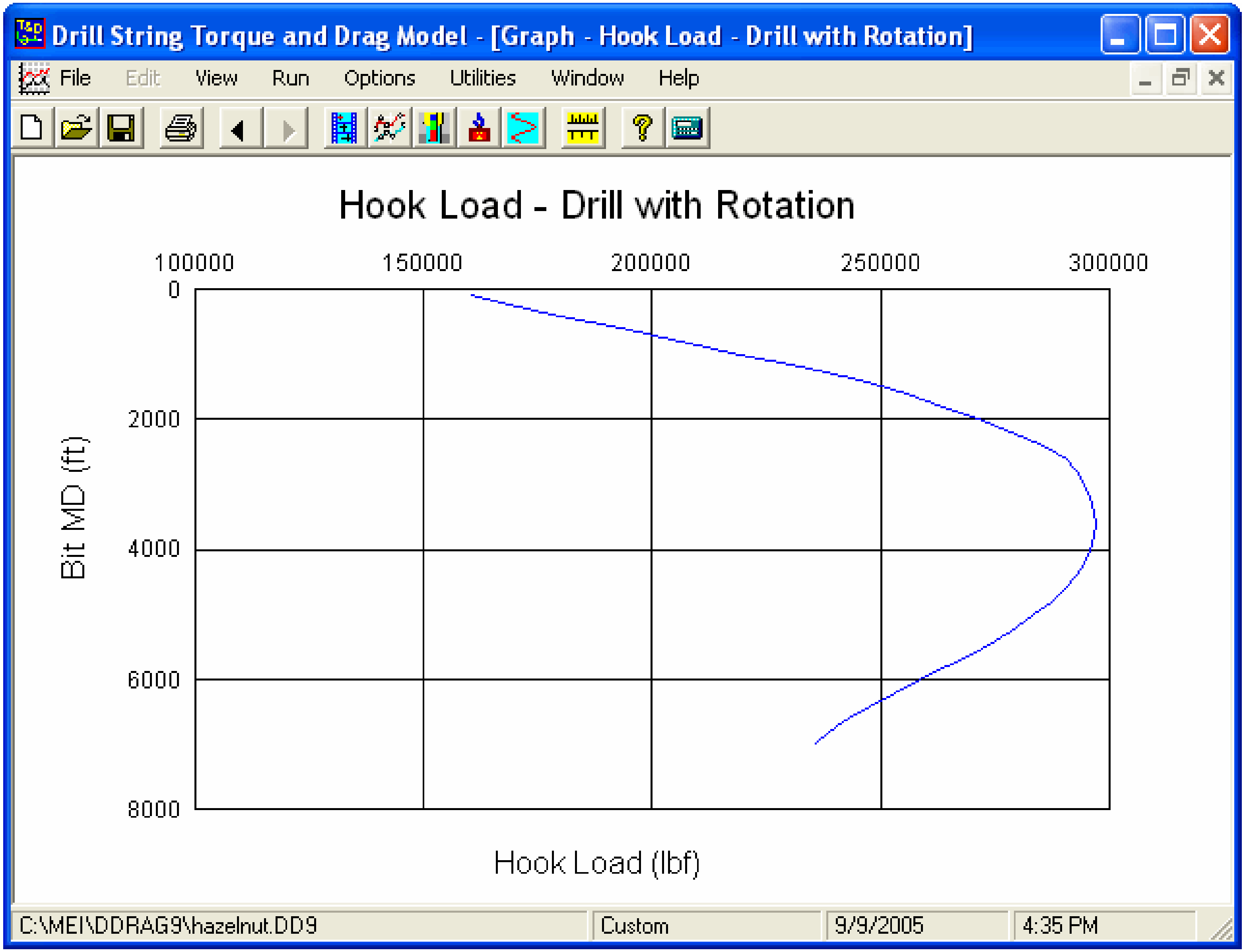


A record of surface torque is shown here as drilling advances from surface to TD. This is a "dynamic" case. All these results correspond to the drilling model we selected (Drill with Rotation).

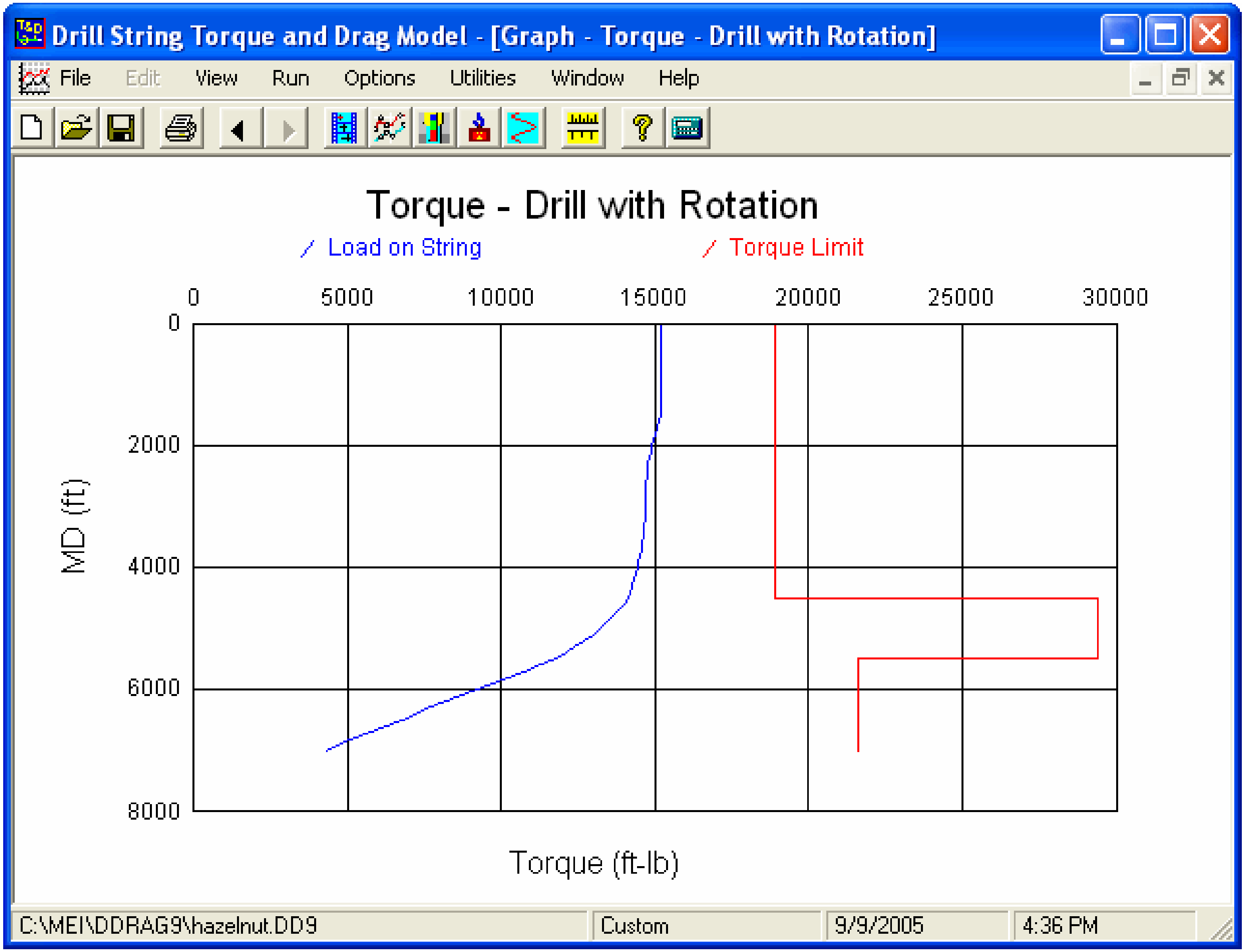


The blue curve is a “snapshot” of axial loads along the string when the bit is on bottom. Data to the right of the vertical line at 0-lb_f drag represent tension and to the left compression. The other two curves represent buckling limits for sinusoidal (red) and helical buckling (magenta).

DDRAG



In a vertical well you would expect the hook load to increase almost linearly with depth. In this example horizontal well, note how the hook load begins to decrease as the bit passes through half of the curve at about 4000 ft measured depth.



This graph shows the level of torque for each point along the drillstring, as the string is rotated with the bit on bottom.

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Drill String Torque and Drag Model - [Static Table (Slack Off w/o Rotation)]

File Edit View Run Options Utilities Window Help

Input MD of Interest (0 - 7000.0) (ft): ---> 7000.0

Bit Located @7000.0	Measured Depth (ft)	Inclination Angle (deg)	Axial Drag (lbf)	Sinusoidal Buckling (lbf)	Helical Buckling (lbf)	Spring Buckl. (lbf)	Drag Limit (lbf)	Normal Force (lbf/ft)
1	0.0	0.	30229	-7006	-9907	-91873	396000	0.
2	100.0	0.	28586	-7006	-9907	-91873	396000	0.
3	200.0	0.	26942	-7006	-9907	-91873	396000	0.
4	300.0	0.	25299	-7006	-9907	-91873	396000	0.
5	400.0	0.	23656	-7006	-9907	-91873	396000	0.
6	500.0	0.	22013	-7006	-9907	-91873	396000	0.
7	600.0	0.	20369	-7006	-9907	-91873	396000	0.
8	700.0	0.	18726	-7006	-9907	-91873	396000	0.
9	800.0	0.	17083	-7006	-9907	-91873	396000	0.
10	900.0	0.	15439	-7006	-9907	-91873	396000	0.
11	1000.0	0.	13796	-7006	-9907	-91873	396000	0.
12	1100.0	0.	12153	-7006	-9907	-91873	396000	0.
13	1200.0	0.	10509	-7006	-9907	-91873	396000	0.
14	1300.0	0.	8866	-7006	-9907	-91873	396000	0.
15	1400.0	0.	7223	-7006	-9907	-91873	396000	0.
16	1500.0	0.	5579	-7006	-9907	-91873	396000	0.
17	1600.0	2.	3965	-7006	-9907	-91873	396000	1.41
18	1700.0	4.	2324	-7006	-9907	-91873	396000	0.05
19	1800.0	6.	711	-9042	-12785	-91873	396000	1.18
20	1900.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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All output data are also presented in tabular form for reviewing, printing, and/or storing to disk for use in other applications.

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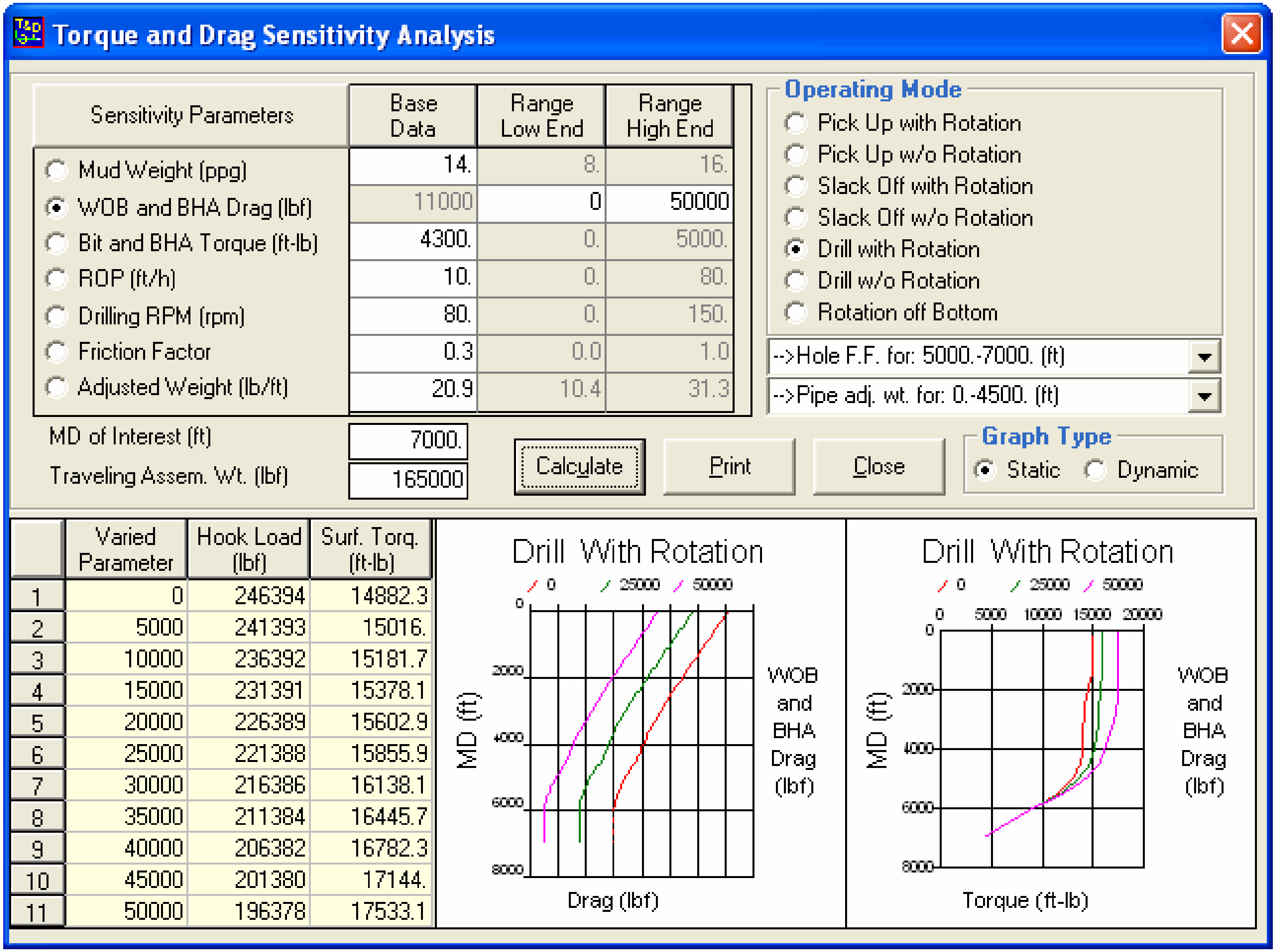
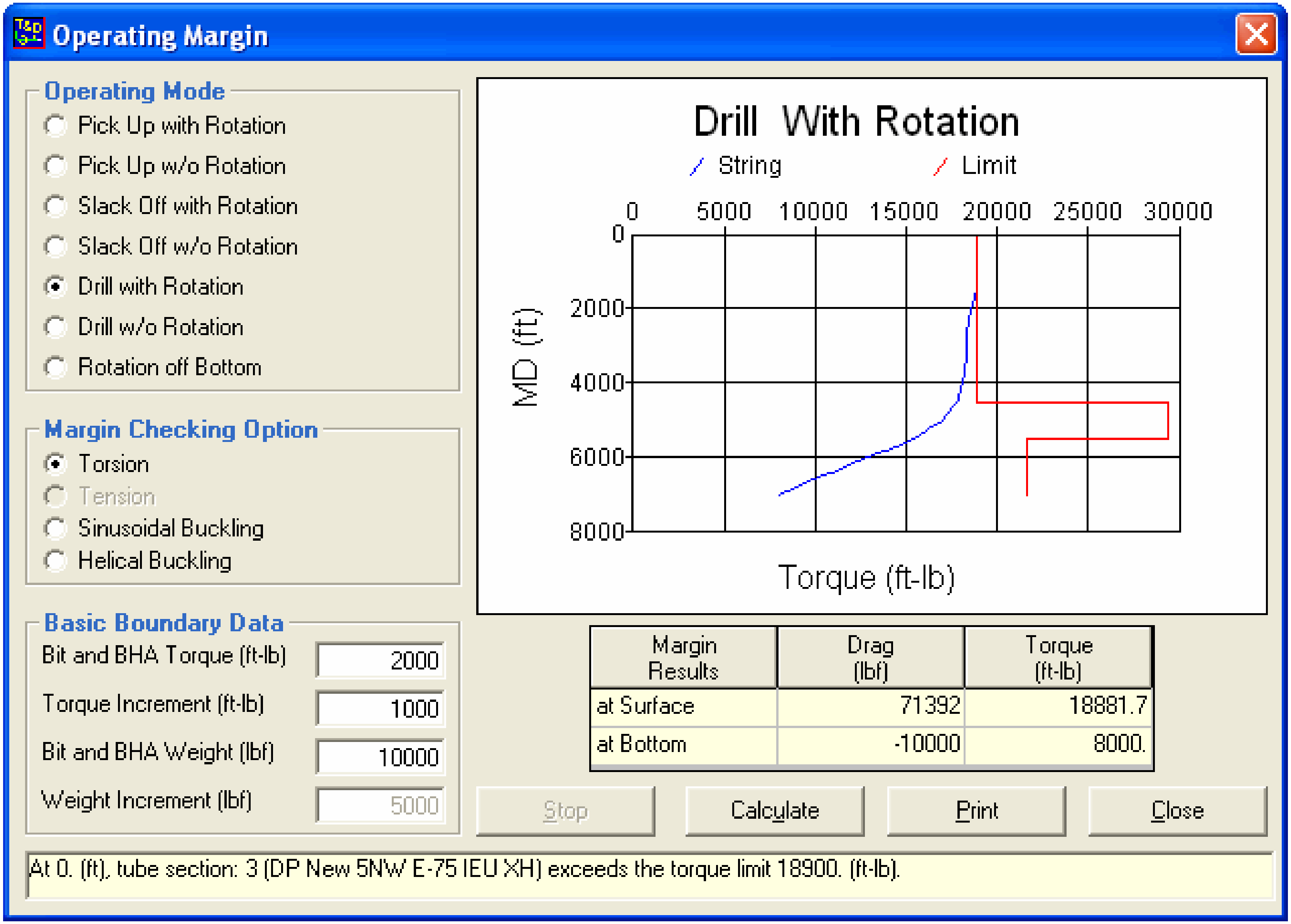
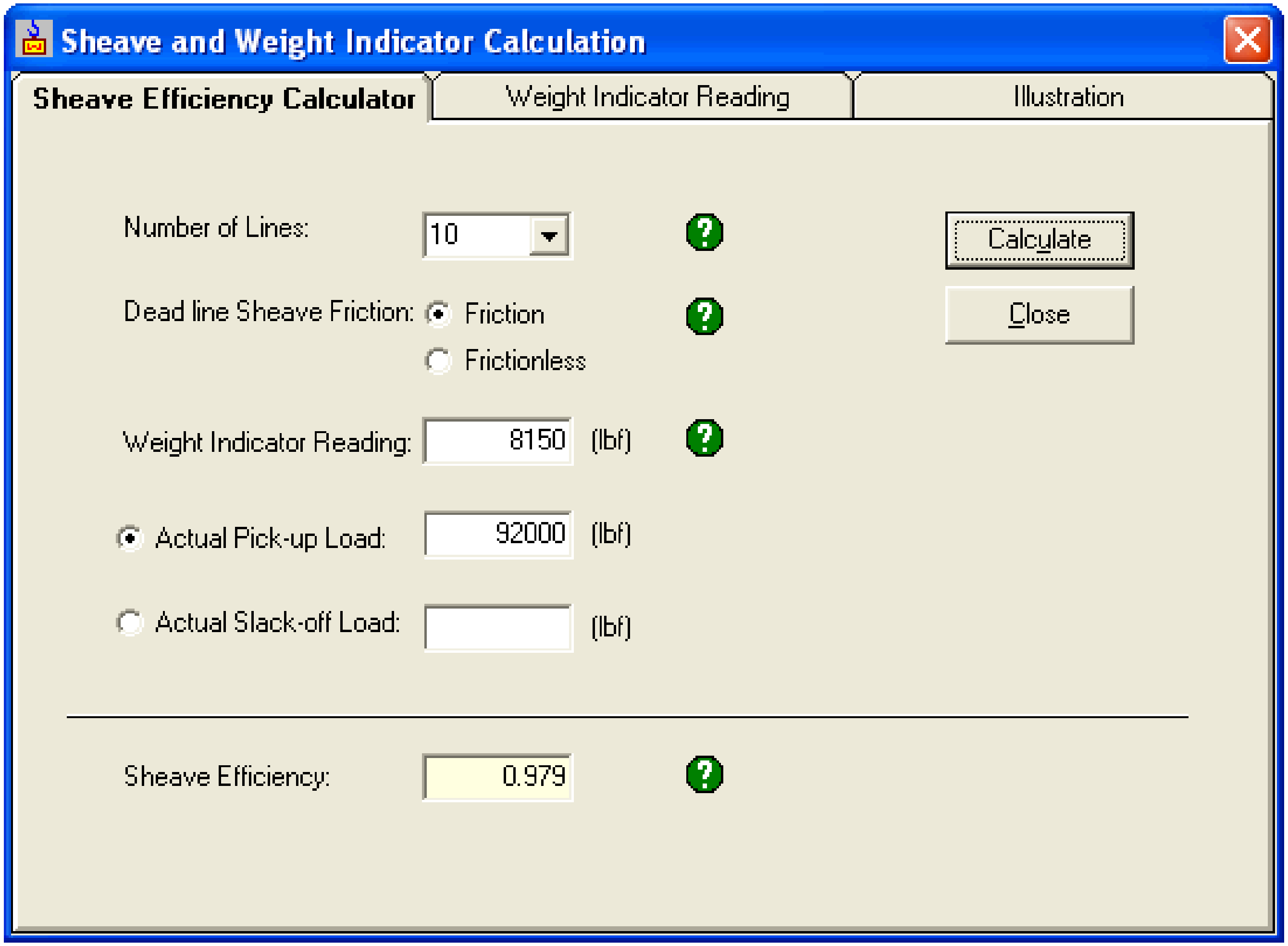


Sensitivity Analysis is an important output utility. This screen can be used to test the sensitivity of hook load and torque to each important parameter. This analysis can quickly demonstrate which parameter(s) must be most precisely measured and controlled in the field.



The **Operating Margin** utility is another useful tool. This screen calculates the exact range of acceptable operational parameters with respect to tension, torsion, sinusoidal buckling, and helical buckling limits.

DDRAG



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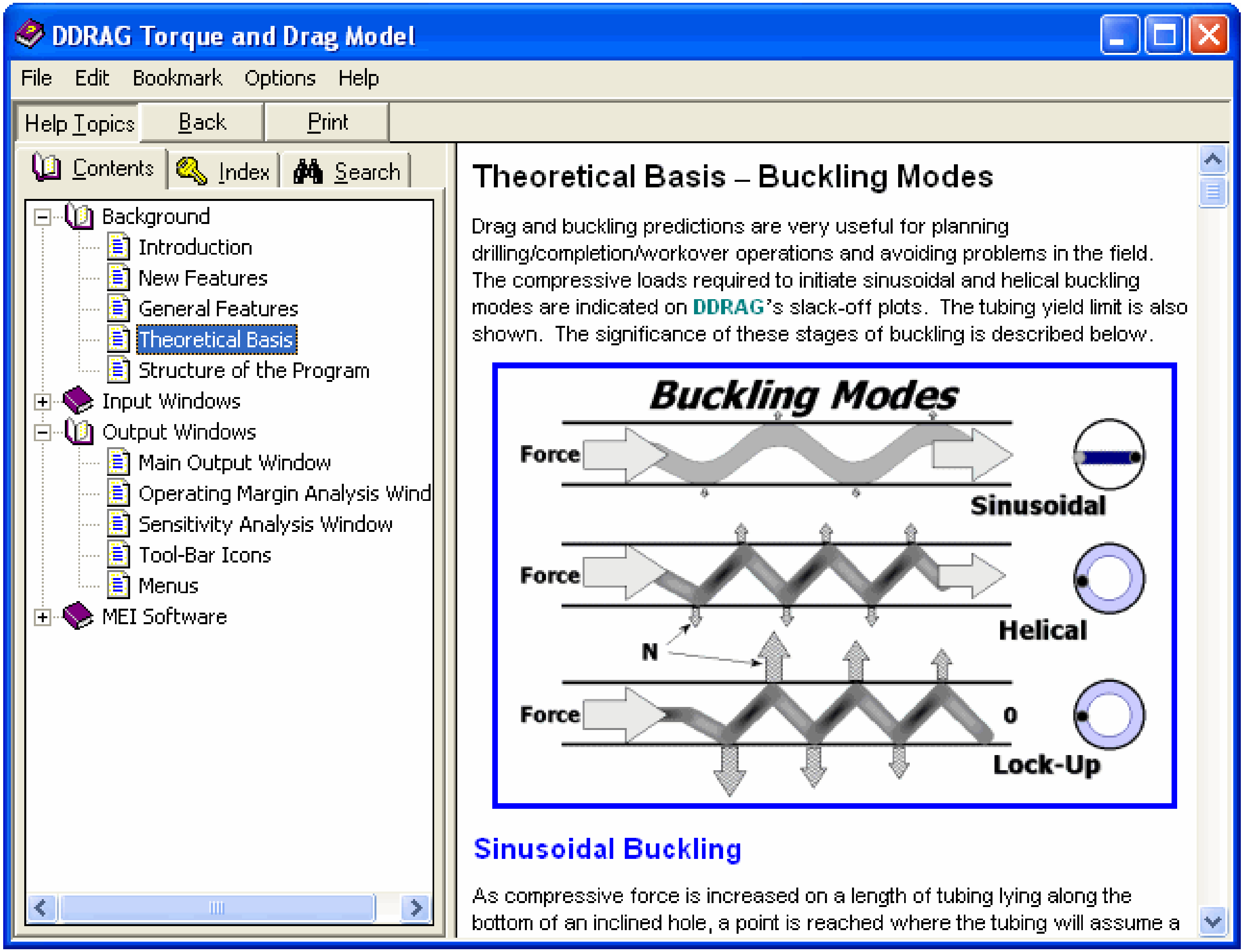
The **Sheave and Weight Indicator** utility is provided for calculating sheave efficiency based on weight-indicator readings and actual loads, or calculating actual pick-up and slack-off loads based on weight-indicator readings and sheave efficiency.



A comprehensive **On-Line Help System** is also provided. Tips on program operation, program structure, and basic theoretical background are immediately available at the click of a button.

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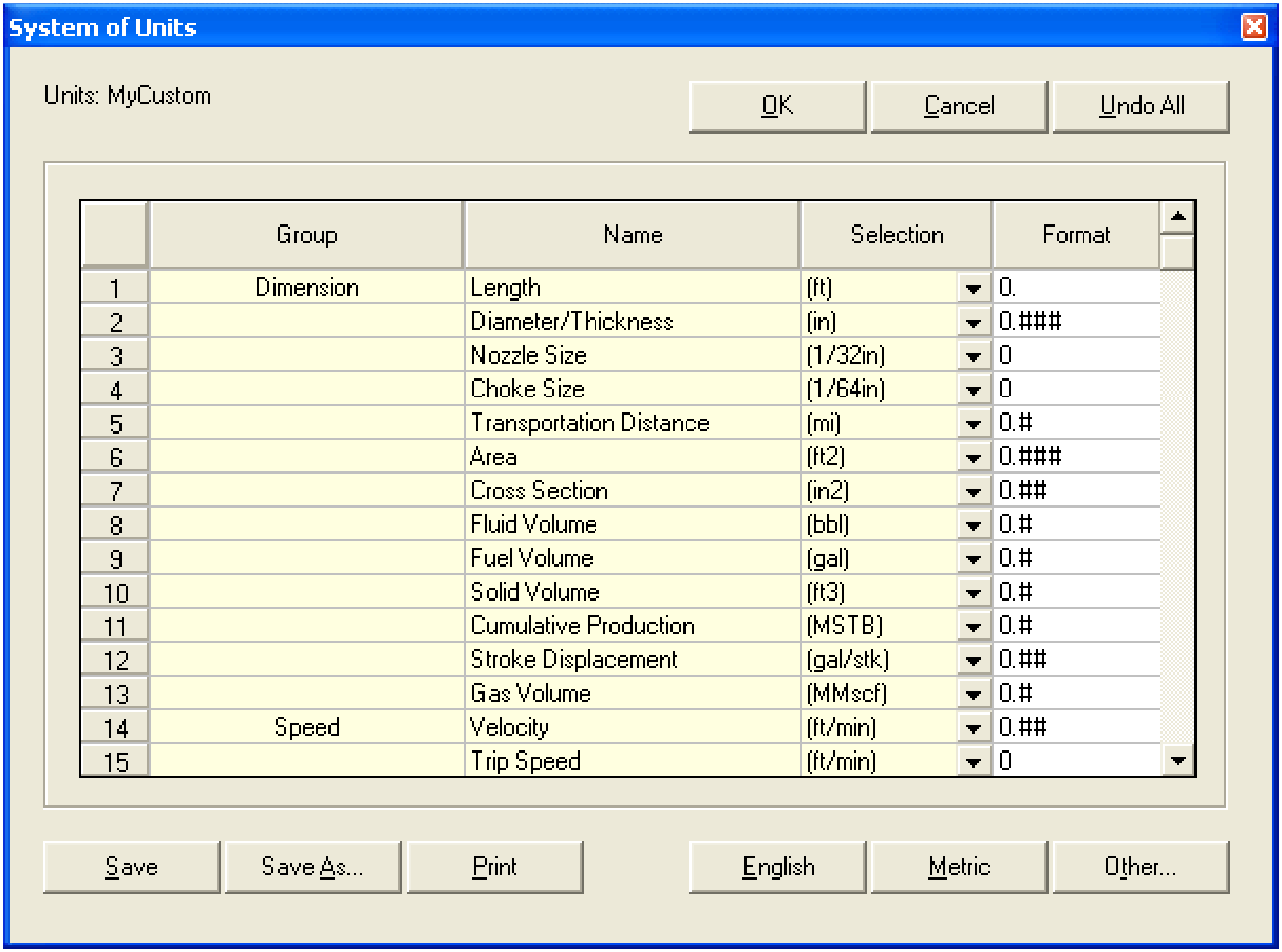
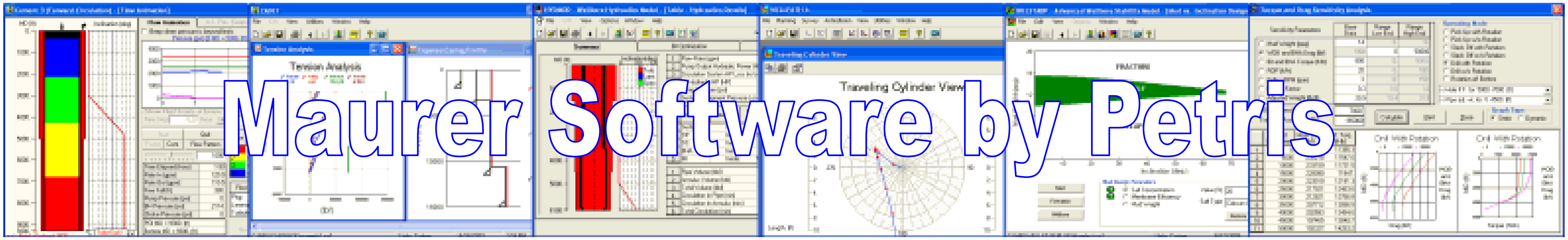


	Group	Name	Selection	Format
1	Dimension	Length	(ft)	0.
2		Diameter/Thickness	(in)	0.###
3		Nozzle Size	(1/32in)	0
4		Choke Size	(1/64in)	0
5		Transportation Distance	(mi)	0.#
6		Area	(ft2)	0.###
7		Cross Section	(in2)	0.##
8		Fluid Volume	(bbl)	0.#
9		Fuel Volume	(gal)	0.#
10		Solid Volume	(ft3)	0.#
11		Cumulative Production	(MSTB)	0.#
12		Stroke Displacement	(gal/stk)	0.##
13		Gas Volume	(MMscf)	0.#
14	Speed	Velocity	(ft/min)	0.##
15		Trip Speed	(ft/min)	0

DDRAG

Units for input and output displays are easy to select and customize. Choose between the default metric or English systems, or a custom combination of units (for example, depth in meters, hole size in inches). Custom systems are saved and automatically recalled in future sessions.



Thanks for your interest in DDRAG

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