Software Development for Well Planning

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Abstract: Well path and casing design are one of the main tasks in petroleum drilling operation. An accurate and suitable well path and casing design are not only resulted in budget saving, but also in safety operation. This computer software has been developed on Microsoft Visual Basic and AutoCAD program, named WPD. WPD software work well and has a good accuracy when compared the calculation results with those of manual calculations. WPD can help in casing design and casing selection by graphical method as well. Moreover this study has been generated various casing size databases according to the API standard in digital format, which is very useful and convenient for using.

I. Introduction

Drilling or digging for oil has occurred in one way or another for hundreds of years. The Chinese, for instance, invented a bamboo rig to obtain oil and gas for lighting and cooking. In 1859, oil came spurting out of the ground from a well 69.5 feet deep in Titusville, Pennsylvania. Colonel Drake had just gone down in oil prospecting history. But although this initiated industrial oil well drilling, a large number of wells had been drilled long before to produce water, brine and even naphtha for caulking boats, and for lighting and medicinal purposes.

By the name of a well (borehole) is meant a cylindrical mine opening made too small forman's access there to, the diameter of the opening being many times less than its length. The beginning of the well is called its mouth, collar or well-head, the cylindrical surface is termed the wall or hole shaft (bore), and its floor the bottom hole. The distance from the mouth to the bottom hole along the axis of the borehole shaft is the length of the well, while the projection of its axis onto the vertical plane represents the depth of the well. The wells are sunk as straight, slanted or horizontal boreholes. As regards their purpose, boreholes drilled for geological exploration ofthe region, search for prospecting and exploitation of deposits are classified into key or stratigraphic, extension or-outpost, structure-exploratory, reconnaissance, prospecting production and special boreholes.

Structure-exploratory boreholes serve the purpose of a thorough investigation into the structures encountered in drilling of key and extension holes and of drawing up a program for exploratory-prospecting drilling into these structures. The results of the structure-exploratory drilling and of geophysical investigations are utilized in studying the mode of occurrence, determining the age and physical properties of the rocks making up the column, precisely marking the reference or key horizons, and in compiling structural (subsurface) maps.

Producing wells are drilled into a completely prospected deposit developed for exploitation. The category of producing wells includes not only the wells through which oil or gas is recovered (producing wells proper), but also the wells which help to effectively develop the defining more exactly the reservoir behavior (drive) and the extent of possible recovery of oil from individual sections of the pool, ascertaining and accurately delimiting the boundaries of producing fields.

Injection wells serve the purpose of edge and inter-field boundary injection of gas or air into the producing reservoir in order in the formation pressure. Observation wells are put down to affect a regular control over changes in the pressure, over the position of the water-oil, gas-water and gas-oil contacts during the operation of the reservoir.

Well planning is perhaps the most demanding aspect of drilling engineering. It requires the integration of engineering principles, corporate or personal philosophies, and experience factors. Although well planning methods and practices may vary within the drilling industry, the end result should be a safely drilled, minimum-cost hole that satisfies the reservoir engineer's requirements for oil/gas production.

The skilled well planners normally have three common traits. They are experienced drilling personnel who understand how all aspects of the drilling operation must be integrated smoothly. They utilize available engineering tools, such as computers and third-party recommendations, to guide the development of the well plan. And they usually have an investigative characteristic that drives them to research and review every aspect of the plan in an effort to isolate and remove potential problem areas.

II. Materials and Methods

2.1Software developing concepts

Computer software was developed for two main objectives, 1) casing design and casing selection, and 2) wellbore trajectory design and well planning. Therefore the developed software was designed and developed into two main modules in order to meet objectives of the study.The first module consists of pressure and load calculation, results of pressure and load calculation display, and casing selection part, respectively.The second module consists of wellbore trajectory and well planning assisting part. Results from the first module, including pressure and load, and selected casing will be used for wellbore trajectory design which are displayed in from of picture. In this module well trajectory pattern, kick off point, vertical depth, measured depth, radius of curvature, and horizontal departure from rig location can be adjusted to meet the user satisfaction.The developed software had been created on the basis of high results accuracy and user friendly. Some unavailable data had been assumed according to the general practice and API specifications.

2.2 Software developing

This topic describes the concept and steps were used in the software development for well planning and casing design under various geological conditions and petroleum engineering requirements. The software hereafter is called WPD. The proposed system is based on the known analytical solutions and theories, but does not based on the heuristic knowledge, inference procedure and experience of well planning expert backed up by the rationale and logic. The concepts and steps include problem analysis, flowchart developing, programming, software testing, conclusion and discussion, respectively.

2.2.1 Problem analysis

Problem analysis is a primary step for a computer software development which identifies statement of problem, solution, procedure and result. The problem analysis can be divided into five sub-topics as software requirement, input data, output, variable declaration, and procedure, respectively.

2.2.2 Flowchart

This part shows and explains the flowchart of WPD software developing. The main process includes data input, input checking, calculation, data base in SQL server linking, and output checking. These components sometimes work concurrently. The system uses forward chaining strategy. The input data are compiled and subjected to rules and conditions to obtain specific answers. This approach is appropriate general data because the WPD records various data and be designed to simply use.

2.2.3 WPD Software

Source codes of WPD software both for the main menu and sub-menu in each module.

2.2.4 Software system development

The WPD software system development can be divided to into three phases; 1) system shell development, 2) system control development and 3) data base system development, respectively. In general, the system shell is used as the software structure. The system control directs the paths and flows of the software. The data base stores the rules and conditions of statistic theories.

III. Results and Discussion

WPD working produce

This part demonstrates procedures to use the WPD software. Upper, middle, and lower button on the main page are pressure caculation, casing selection, and wellbore trajectory design commands respectively. Step by step for using this software will be described as follows.

Step 1

In Parameter view page (Figure 1) user input required data for the collapse pressure and burst pressure calculation, then click calculate button to calculate the collapse and burst pressure. User can change or clear data by clicking the clear button below input data box

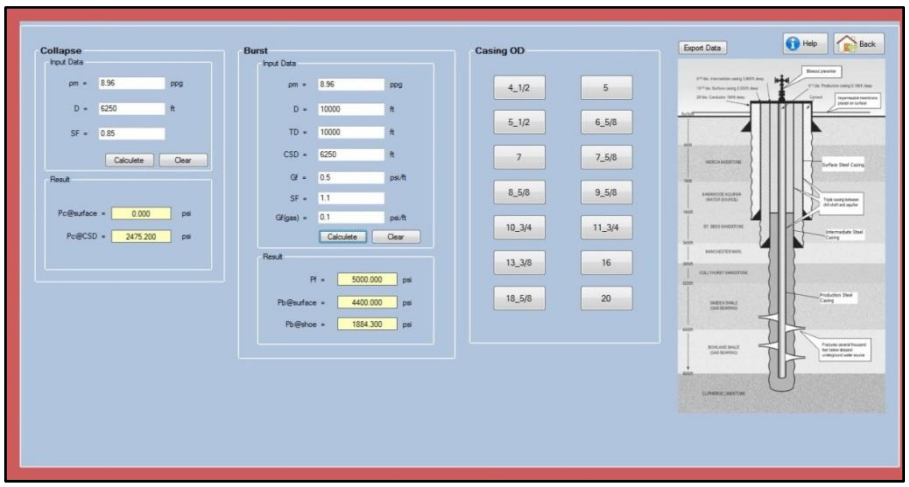

Figure 1 Parameter view page of the WPD software

After the results of the collapse pressure and burst pressure are displayed. Select the satisfied casing outside diameter from the casing OD field where user can select casing outside diameter sizes from the given list of OD. Then the selected casing is displayed graphically as showed in Figure 2.

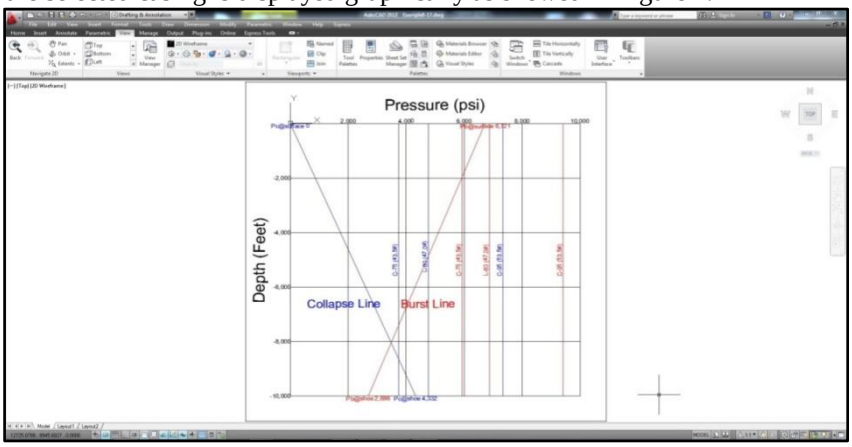

Figure 2 Graphically display of casing outside diameter on AutoCAD program

Step 2

In casing selection page (Figure 3) user can fill in the details of the casing, depth, and size of required casing. User can also select grade of casing to be used in the borehole at the required depth from the table on the left of the page. The full table can be opened using the open file button. Data is then sent and displayed in Microsoft Office Excel file. Tension load can be calculated in the tension field by filling in required data. User can report the input data by clicking the Export data view button to report data in form of the Microsoft Office Word file.

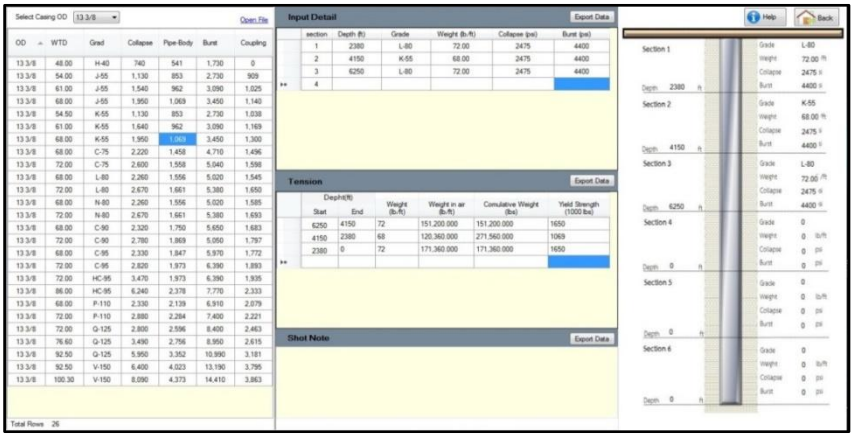

Figure 3 Casing selection page view in the WPD software

Step 3

In Wellbore trajectories view page user can choose wellbore trajectories from 3 standard templates, including build-and-hold trajectory (Type J) (Figure 4), Build-and-hold-and-drop trajectory (Type S) (Figure 5), and Build-and-hold and partial drop trajectory (Modified S) (Figure 6). User can also input required data to calculate the radius of curvature, maximum inclination angle, depth, and horizontal departure along the buildup portion up to the end of the build. The value and wellbore type design of the drill holes are displayed beside. Users can perform detailed design wellbore trajectory graphically through AutoCAD by clicking open file button as depicted in Figure 4.

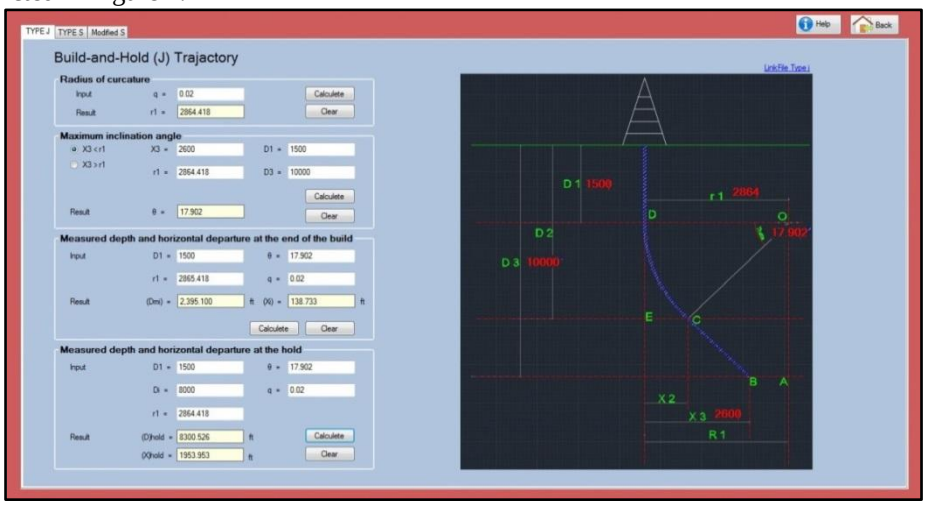

Figure 4 Wellbore design for Build-and-hold trajectory (Type J) on Data View page of the WPD software

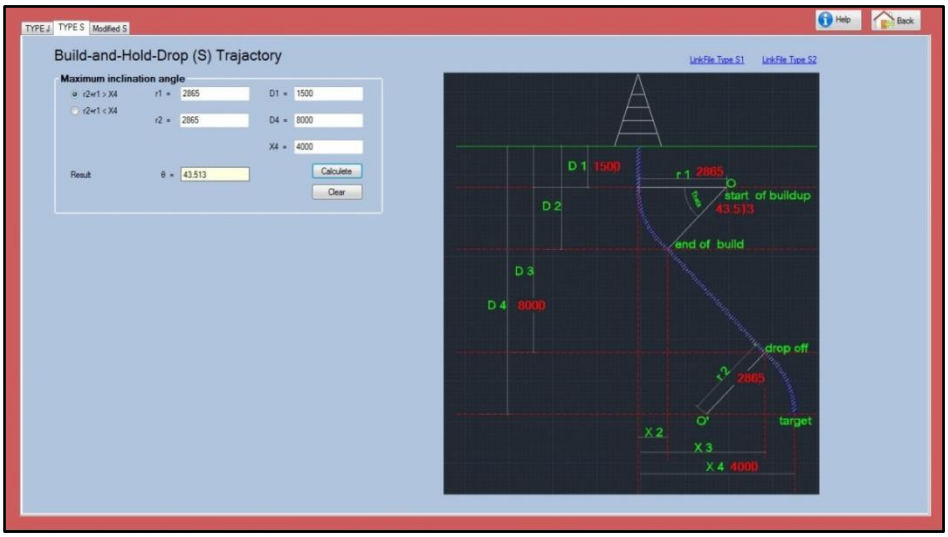

Figure 5 Wellbore design for Build-and-hold-and-drop trajectory (Type S) on Data View page of the WPD software

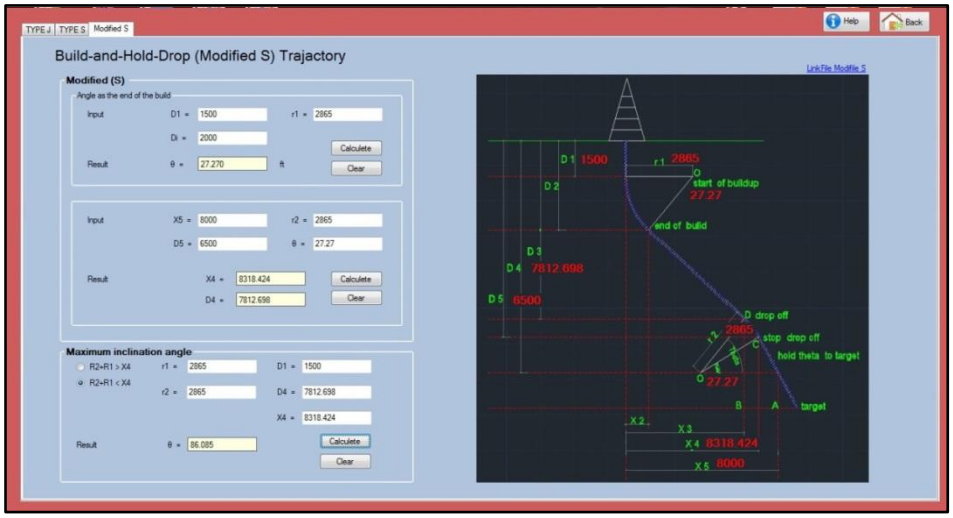

Figure 6 Wellbore design for Build-and-hold and partial drop trajectory (Modified S) on Data View page of the WPD software

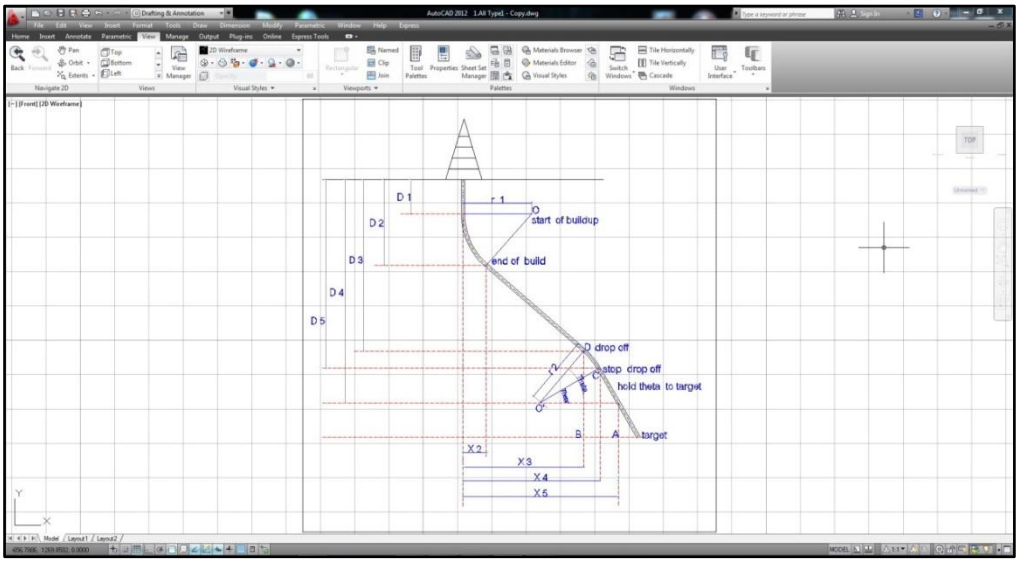

Figure 7 Designed wellbore trajectory view page on AutoCAD program

WPD software has a help section for user and can be achieved by clicking Help button (Figure 8). In this section user can find some hints for any question concerned with the software and it also has some statistics theory in brief as a user guide.

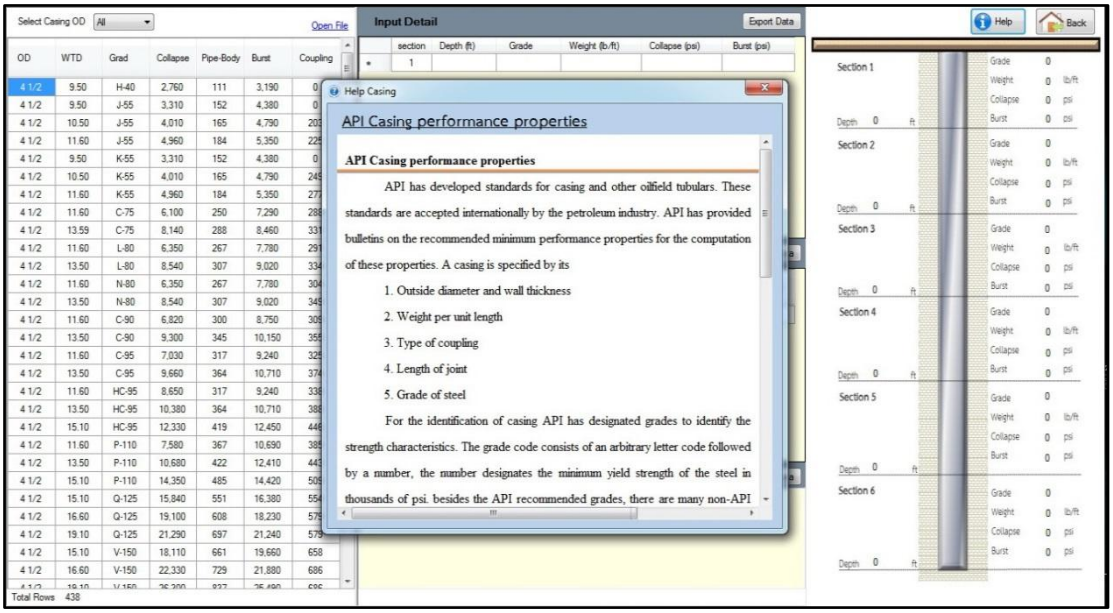

Figure 8 Help view page of the WPD software showing software handling, calculation and statistic theories

IV. Conclusions

WPD software had been developed for casing design and selection, and wellbore trajectory design assistance. Therefore, WPD consists of two main modules: 1) casing design and casing selection module, and 2) wellbore trajectory design module. In casing design and casing selection module the collapse pressure, burst pressure, and tension load are calculated using conventional equations and displayed in form of graph which can be used for casing selection in the next step. In wellbore trajectory design module user can choose the trajectory path form the three standard trajectory templates as J, S, and modified S type. Result from the first module will be used as essential data, e.g. casing size and grade, in this step

To examine the efficiency and accuracy of WPD, results from WPD calculations were compared to the results from manual calculations. Comparison results indicated that results of WPD and manual calculation were not different. This can be assured that the WPD software can be used effectively with a satisfied accuracy.