Directional Calculations

Disclaimer

These tools and materials are provided 'as is' without warranties of any kind, express or implied.

Please verify the tools provided by this application by yourself before you use them. Ensure you understand the impact of using these tools.

Any use you choose to make of these tools & materials is undertaken by you entirely at your own risk.

Note:

This app was created with an educational proposal to help students and teachers of drilling engineering and has no intention of replace the professional software provided by directional companies. It is also an useful tool for other professionals in the oilfield, such as technicals and engineers.

Thanks
**Directional Terms**

- **KOP** - Kick Off Point
- **BUR** - Build Up Rate
- **DOR** - Drop Off Rate
- **DLS** - Dog leg Severity
- **RC** - Radius of Curvature
- **INC** - Inclination, Drift
- **TVD** - True Vertical Depth
- **MD** - Measured Depth
- **VS** - Vertical Section
- **CL** - Course Length = MD2 - MD1
- **N/S** - North / South coordinate
- **E/W** - East / West coordinate
- **TR** - Turn Rate
- **HD** - Horizontal Displacement
- **CD** - Closure Distance (= HD)
- **AZI** - Azimuth

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![Diagram](image-url)
Informations on the app

Version: 2.0

This app is applied in the oil well drilling and provides a useful tool to make the calculations more common in directional drilling to help students, drillers, technicians, drilling engineers and other professionals of Oil and Gas industry.

- Calculates the survey parameters between two survey stations using the five methods (tangential, tangential balanced, minimum curvature, radius of curvature and average angle)
- Calculates the parameters of the 2D wells (types I, II and horizontal)
- Calculates the parameters of a 3D section (changing of the inclination and azimuth between the sections)
- Calculates the projection of the Horizontal Departure on the target azimuth (vertical section)

iCloud:
- Enabled if iCloud available on device
- Auto saves to restore when open again.
- Shares the same data on devices (iPhone, iPod Touch and iPad)
- Tap on button to get data edited on the other device

2D Wells:
- On landscape, tap on titles to edit values
- Edit parameters from Top to Bottom

3D Section Calculations:
- First, Select a option to edit parameters: BUR/INC and TR/AZI.
- Check for informations on popover view (info button)
- Calculations with the Minimum Curvature Method.

Portfolio: Visit our website for other Oil & Gas Apps at: http://www.wellcontrol.com.br
Use this tool to calculate wells without changing the azimuth. Use the templates for Well Type I, II and Horizontal.

1. Select the Length Unit: Meter or Foot
2. Click on Well Type button on Main Menu
3. Edit parameters from top to bottom
Well Type I - Build and Hold

Example
1. Start a build up 2.0 deg/100ft at 7,600 ft
2. Stop build up to inclination = 30 deg
3. Hold until Target at 12,000 ft / 120 deg

1. Select Length Unit = FOOT
2. Set KOP = 7600
3. Set BUR = 2
4. Set INC = 30
5. Set Azimuth = 120
6. Set MD = 12000

With iPad on horizontal position (landscape), tap on titles to edit parameters.
Well Type II - Build-Hold-Drop-Hold

**Example**

1. Start a build up 2.0 deg/100ft at 7,600 ft
2. Stop build up to inclination = 30 deg
3. Hold until 12,000 ft @ direction 240 deg
4. Drop inclination to 10 deg @ 2.5 deg/100 ft
5. Hold until Target at 14,000 ft

1. Select Length Unit = FOOT
2. Set KOP = 7600
3. Set BUR = 2
4. Set INC = 30
5. Set Slant MD = 12000
6. Set DOR = -2.5
7. Set Final INC = 10
8. Set MD = 14000
9. Set Azimuth = 240

With iPad on horizontal position (landscape), tap on titles to edit parameters.
Horizontal Well

Example

1. Start a build up 3.0 deg/100 ft at 7,600 ft
2. Stop build up to inclination = 90 deg
3. Hold until Target at 12,000 ft / 330 deg

With iPad on horizontal position (landscape), tap on titles to edit parameters.
Calculations between two survey stations

1) **TANGENTIAL:**

\[
\begin{align*}
\Delta N/S &= \Delta MD \times \sin (\theta_1) \times \cos (\theta_2) \\
\Delta E/W &= \Delta MD \times \sin (\theta_1) \times \sin (\theta_2) \\
\Delta TVD &= \Delta MD \times \cos (\theta_2)
\end{align*}
\]

**DLOG LEG SEVERITY** (degree/100 ft)

\[
DLS = 100 \times |MD \times [\sin(\theta_1) \times \sin(\theta_2) + \sin(\theta_1) \times \cos(\theta_2)] + \cos(\theta_1) \times \cos(\theta_2)]|
\]

2) **BALANCED TANGENTIAL:**

\[
\begin{align*}
\Delta N/S &= \Delta MD/2 \times [\sin (\theta_1) \times \cos (\theta_1) + \sin (\theta_2) \times \cos (\theta_2)] \\
\Delta E/W &= \Delta MD/2 \times [\sin (\theta_1) \times \sin (\theta_1) + \sin (\theta_2) \times \sin (\theta_2)] \\
\Delta TVD &= \Delta MD/2 \times [\cos (\theta_1) + \cos (\theta_2)]
\end{align*}
\]

3) **MINIMUM CURVATURE:**

\[
\begin{align*}
\Delta N/S &= \Delta MD/2 \times [\sin (\theta_1) \times \cos (\theta_1) + \sin (\theta_2) \times \cos (\theta_2)] \times RF \\
\Delta E/W &= \Delta MD/2 \times [\sin (\theta_1) \times \sin (\theta_1) + \sin (\theta_2) \times \sin (\theta_2)] \times RF \\
\Delta TVD &= \Delta MD/2 \times [\cos (\theta_1) + \cos (\theta_2)] \times RF
\end{align*}
\]

\[B = \cos (\cos (\theta_2 - \theta_1) - (\sin (\theta_1) \times \sin (\theta_2) \times (1 - \cos (A_2 - A_1)))) \] (in radians)

\[RF = 2/8 \times \tan B/2\]

4) **RADIUS OF CURVATURE:**

\[
\begin{align*}
\Delta N/S &= |MD \times [\cos (\theta_1) - \cos (\theta_2)] \times (\sin (\theta_2) - \sin (\theta_1))] / [(\theta_2 - \theta_1) \times (A_2 - A_1)] \\
\Delta E/W &= |MD \times [\cos (\theta_1) - \cos (\theta_2)] \times (\cos (\theta_2) - \cos (\theta_1))] / [(\theta_2 - \theta_1) \times (A_2 - A_1)] \\
\Delta TVD &= |MD \times [\sin (\theta_2) - \sin (\theta_1)] / [(\theta_2 - \theta_1)]
\end{align*}
\]

Angles in radians. \(A (deg) \times PI / 180 = \) radians

**DLOG LEG SEVERITY** (degree/100 ft).

\[
DLS = |\cos (\cos (\theta_1) \times \cos (\theta_2)) + (\sin (\theta_1) \times \sin (\theta_2) \times \cos (A_2 - A_1))] \times (100 \div MD)
\]

5) **ANGLE AVERAGING:**

\[
\begin{align*}
\Delta N/S &= \Delta MD \times \sin (\theta_1+\theta_2)/2 \times \cos (A_1+ A_2)/2 \\
\Delta E/W &= \Delta MD \times \sin (\theta_1+\theta_2)/2 \times \sin (A_1+ A_2)/2 \\
\Delta TVD &= \Delta MD \times \cos ((\theta_1+\theta_2)/2)
\end{align*}
\]

**Dog Leg Severity** is calculated by method “Radius of Curvature” on methods 2, 3, 4 and 5.
Calculations between two survey stations

### Survey Data 1
- Measured Depth: 7500 ft
- Inclination \( I_1 \): 10 deg
- Azimuth \( A_1 \): 50 deg

### Survey Data 2
- Measured Depth: 7600 ft
- Inclination \( I_2 \): 13 deg
- Azimuth \( A_2 \): 45 deg

#### Calculation Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>( \Delta TVD ) ft</th>
<th>( \Delta HD ) ft</th>
<th>( \Delta N/S ) ft</th>
<th>( \Delta E/W ) ft</th>
<th>DLS</th>
<th>BUR</th>
<th>TRN</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangential</td>
<td>97.44</td>
<td>22.50</td>
<td>15.91</td>
<td>15.91</td>
<td>3.16</td>
<td>3.00</td>
<td>-5.00</td>
<td>100.00 ft</td>
</tr>
<tr>
<td>Balanced Tangential</td>
<td>97.96</td>
<td>19.91</td>
<td>13.53</td>
<td>14.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Curvature</strong></td>
<td><strong>97.98</strong></td>
<td><strong>19.92</strong></td>
<td><strong>13.54</strong></td>
<td><strong>14.61</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radius of Curvature</td>
<td>97.98</td>
<td>19.93</td>
<td>13.46</td>
<td>14.69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angle Averaging</td>
<td>97.99</td>
<td>19.94</td>
<td>13.47</td>
<td>14.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3D Well Section Calculations

Parameters for example

Set the Previous Parameters
1. MD = 6000 ft, TVD = 5906.26 ft
2. Inc = 0 deg, Azimuth = 26.00 deg
3. N/S = 698.88 ft, E/W = 340.87 ft

Set the 3D Well Section Parameters
1. Inc = 37 deg
2. Azimuth = 55 deg
3. DLS = 4 deg / 100 ft

Set the Target Azimuth to calculate the Vertical Section
1. Set Target Azimuth = 0 deg

Minimum Curvature Method
### 3D Well Section Calculations

**Set the Previous Parameters**

1. **MD** = 6000 ft, **TVD** = 5906.26 ft
2. **Inc** = 0 deg, **Azimuth** = 26.00 deg
3. **N/S** = 698.88 ft, **E/W** = 340.87 ft

![3D Section Calculations](image)

<table>
<thead>
<tr>
<th>MD</th>
<th>6000</th>
<th>TVD</th>
<th>5906.26</th>
<th>INC</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azimuth</td>
<td>26</td>
<td>N/S</td>
<td>698.88</td>
<td>E/W</td>
<td>340.87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inclination</th>
<th>37 deg</th>
<th>MD</th>
<th>6925.00 ft</th>
<th>CL</th>
<th>925.00 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build Up R</td>
<td>4.000</td>
<td>TVD</td>
<td>6768.30 ft</td>
<td>ΔTVD</td>
<td>862.04 ft</td>
</tr>
<tr>
<td>Azimuth</td>
<td>55 deg</td>
<td>N/S</td>
<td>55.000</td>
<td>W</td>
<td>E</td>
</tr>
<tr>
<td>Turn Rate</td>
<td>3.135</td>
<td>N/S</td>
<td>864.32 ft</td>
<td>E/W</td>
<td>577.14 ft</td>
</tr>
<tr>
<td>DLS</td>
<td>4.000</td>
<td>CD</td>
<td>1039.30 ft</td>
<td>CD Az</td>
<td>33.733 deg</td>
</tr>
</tbody>
</table>

**Target Azimuth** = 0.00 deg, **Vertical Section** = 864.32 ft **New**
3D Well Section Calculations

Set the 3D Well Section Parameters

1. Inc = 37 deg
2. Azimuth = 55 deg
3. DLS = 4 deg / 100 ft
3D Well Section Calculations

Set the Target Azimuth to calculate the Vertical Section

1. Set Target Azimuth = 0 deg

Set Target to calculate Vertical Section = CD x Cos (Target Azimuth - CD Az)
# Directional Calculations for iPad

## 3D Well Section Calculations

<table>
<thead>
<tr>
<th>MD</th>
<th>6000 ft</th>
<th>TVD</th>
<th>5906.26 ft</th>
<th>INC</th>
<th>0 deg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azimuth</td>
<td>26 deg</td>
<td>N/S</td>
<td>698.88 ft</td>
<td>E/W</td>
<td>340.87 ft</td>
</tr>
</tbody>
</table>

### Instructions:

1. **Editing "BUR"**
   - Gets value in "MD" -> Calculates "INC"

2. **Editing "MD"**
   - Gets value in "BUR" -> Calculates "INC"

3. **Editing "INC"**
   - Gets value in "BUR" -> Calculates "MD"

4. **Editing "TR"**
   - Gets value in "MD" -> Calculates "AZI"

5. **Editing "MD"**
   - Gets value in "TR" -> Calculates "AZI"

6. **Editing "AZI"**
   - Gets value in "TR" -> Calculates "MD"

### Options:

- Set BUR, MD -> INC
- Set INC, MD -> BUR
- Set TR, MD -> AZI
- Set AZI, MD -> TR

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**Show / Hide**

**Select an option**
Set the Target Azimuth to calculate the Vertical Section:

projection of the closure distance on target azimuth

$$VS = CD \times \cos(az,\text{target} - az,\text{cd})$$
About

This app was developed based on our experience. There is no comparison with any other software.

Our goal was to create a low-cost application with the help of experts to share with drilling engineers, technicians, drillers, students and teachers of drilling engineering.

There is no intention to replace the professional softwares.

You can contribute with suggestions for improvements, correcting the translation to English, reporting bugs and spreading it to your friends.

Please visit our support url and see other applications for Oil & Gas for iPhone, iPod Touch, iPhone and Mac.