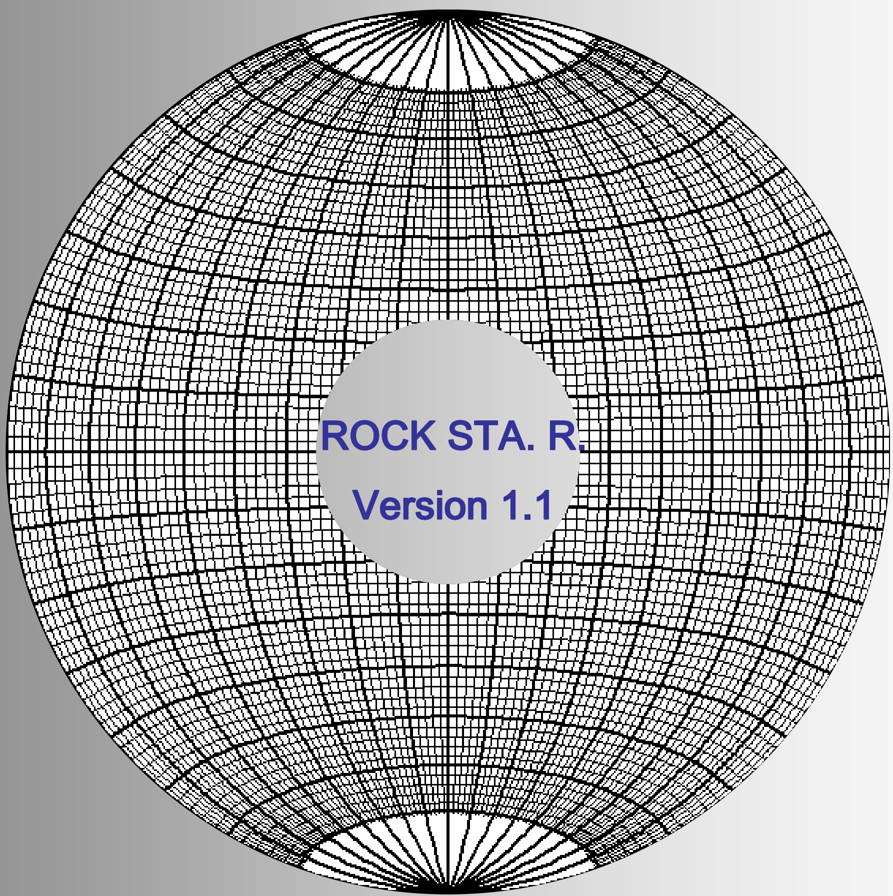
Rock Not Roll



ROCK STABILITY RECOGNITION MANUAL

CONTENTS

Rock Not Roll

ROCK STA. R.
Version 1.1

1 INTRODUCTION

ROCK STA. R. is a program which refers to stereonet projections of rock masses, according to Schmidt’s method. Other methods have been used too, for specific operations such as dispersion and analysis tools. See the relative references later in this manual.

ROCK STA. R. is designed to work on Windows operating systems. It is required having a screen analysis greater than 1140 x 870 (Width x Height).

2 INSTALLATION

To install ROCK STA. R. on your computer, follow the next simple steps:

1. Insert the CD into the CD-ROM.
2. Double click on the setup .exe icon, to begin the installation
3. Follow the installation instructions. During installation you will be asked to enter a serial number. Enter the serial number located on Read Me.txt file you will find in the CD and press the install button.
4. Proceed until the installation is complete, by clicking the finish button, you will find following the installation steps. If restarting your computer is required, you can do it now.

Congratulations! You have installed successfully ROCK STA. R. and you are ready to use it.
Navigate to the path “Start → All Programs → Rock Not Roll” and click on the ROCK STA. R. icon to start the program.

If you are familiar with stereonet projections, you can skip the next chapter and go directly to WORKING WITH ROCK STA. R. chapter.

3 CONCEPT OF STEREOGRAPHIC PROJECTIONS – THEORY

3.1 PLANE GEOMETRY

Assume that there is a horizontal plane and a vector normal to it, with a direction downwards, just like figure 1. The vector is called "pole" of the plane.

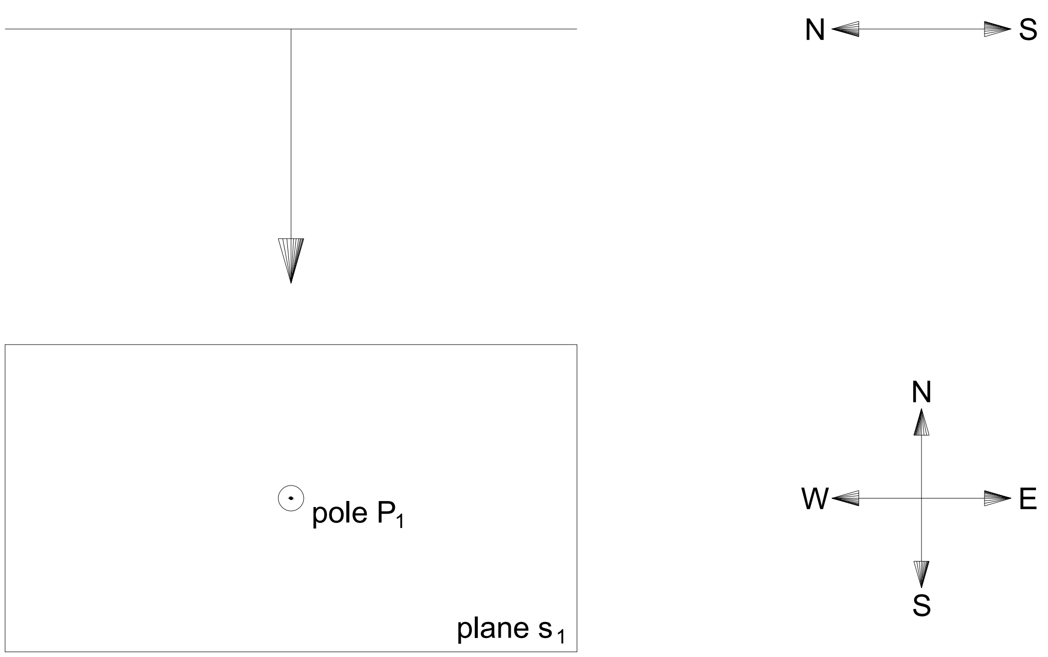


Figure 1: Horizontal plane with its pole.

If the plane inclines at an angle of φ^o to the horizontal in such a way that the pole tends to approach the South and, the pole and South belong to the same plane, then the angle φ_1 between the plane and the horizontal is called "inclination of the plane" and the angle φ_2 between the pole and the horizontal is called "inclination of the pole".

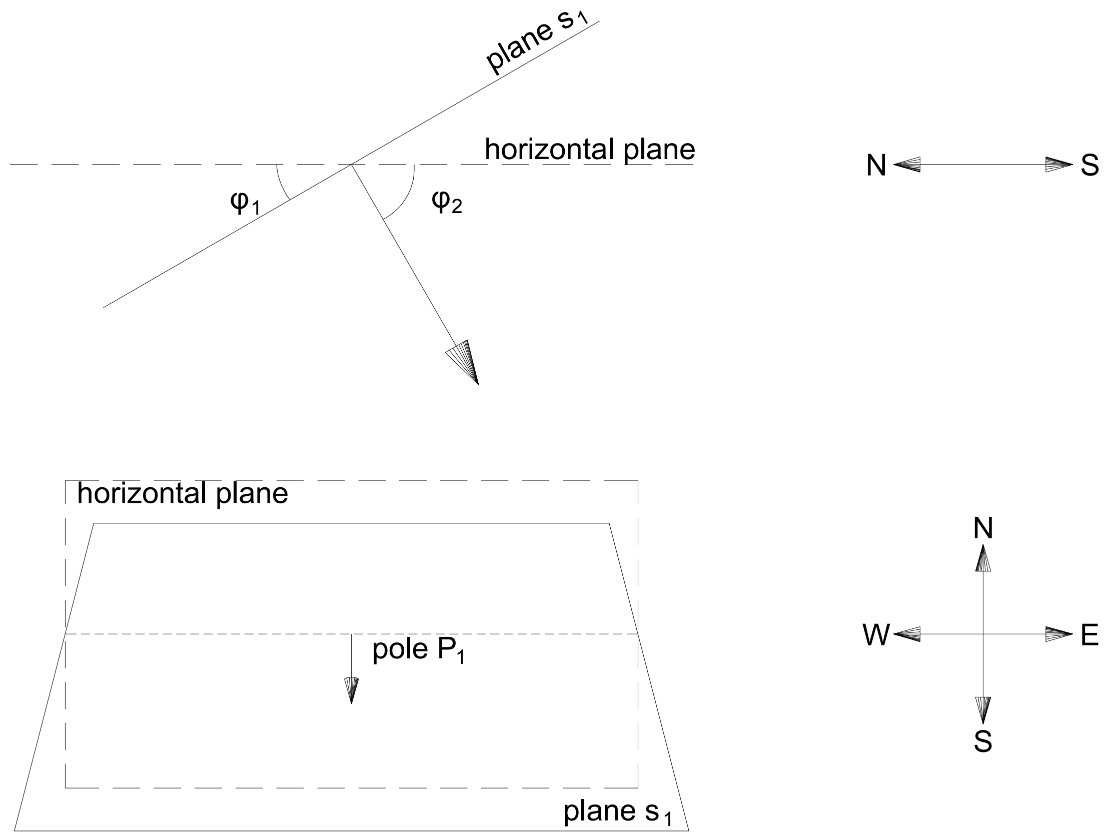
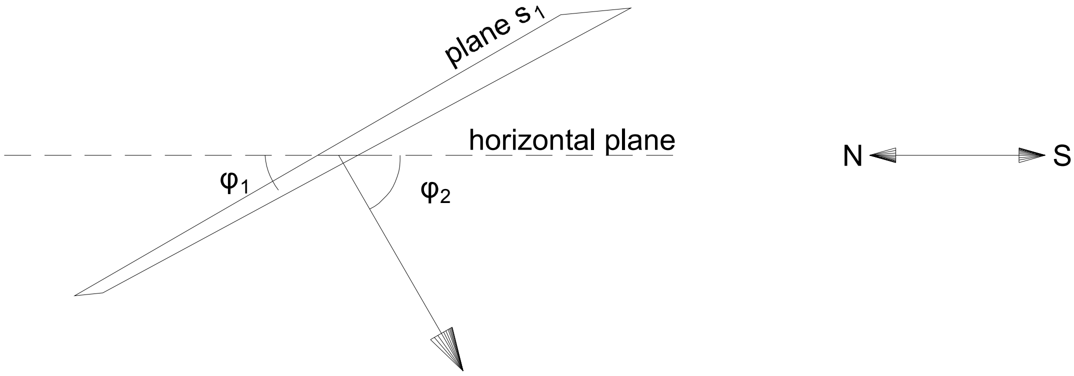


Figure 2: Inclined plane with its pole.

It can be easily seen that $\varphi_1 + \varphi_2 = 90^o$.

If the plane inclines at an angle of 90^o to the horizontal, coincides with the South direction.

If the inclined plane turns at an angle of ψ^o, to the east, then it is defined then the direction of the pane is ψ^o to the East and it is written as "N ψ^o E".



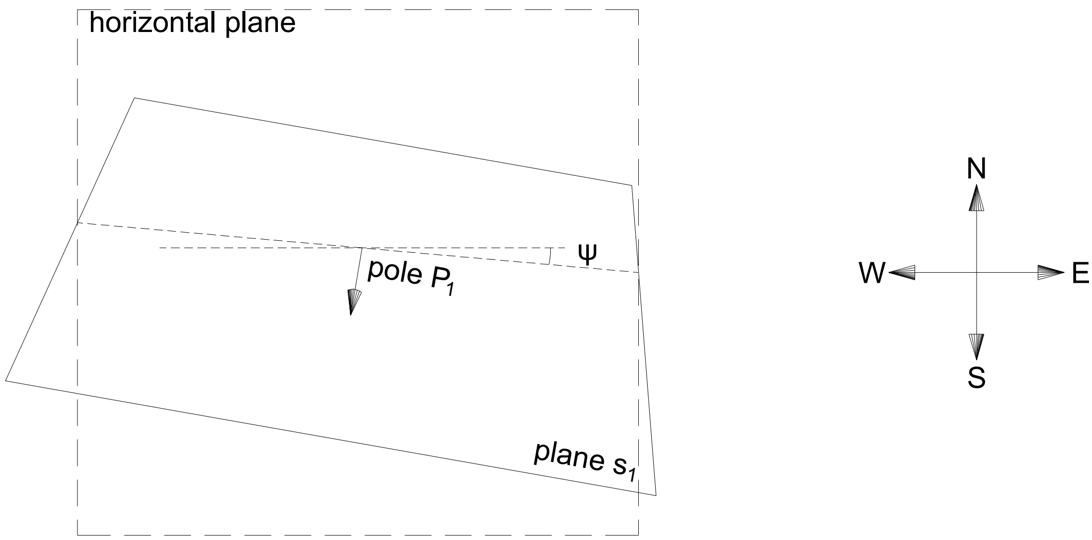


Figure 3: Inclined and turned plane with its pole.

Any plane's geometry in space can be described by these two aforementioned numbers, Inclination and Direction. If φ=Inclination and ψ=Direction, these two elements can be written in a format like this:

φ^o, N ψ^o E, or (the most usual) φ^o /ψ^o.

It's a common tactic to use poles if someone wants to refer to planes, because poles are linear elements and thus, easier to use them.

It's easy to convert a plane's inclination and direction to pole's inclination and direction and vice-versa, by using the following formulas:

$Plane_{Inclination} = 90 - Pole_{Inclination}$

$Plane_{Direction} = 180 + Pole_{Direction}$

<u>Example</u>

A plane with geometry $25^o/037^o$ has a pole with geometry $65^o/245^o$.

3.2 STEREOGRAPHIC PROJECTION (SCHMIDT METHOD)

3.2.1 CONSTRUCTION OF THE EQUAL AREA STEREOGRAPHIC NET

Assume that there is a sphere divided in meridians and parallels. This sphere is called crystallographic sphere.

Schmidt projection which is also called "equal area projection", projects the lower hemi-sphere of the crystallographic sphere, on a plane surface which is tangent to the lower point of the sphere.

Every point of the meridians and parallels of Schmidt projection is the intersection of the plane's surface and a circle which has as center the tangent point of the surface and the sphere and as radius the segment AB, where A is the center of the sphere and B is the point on the sphere.

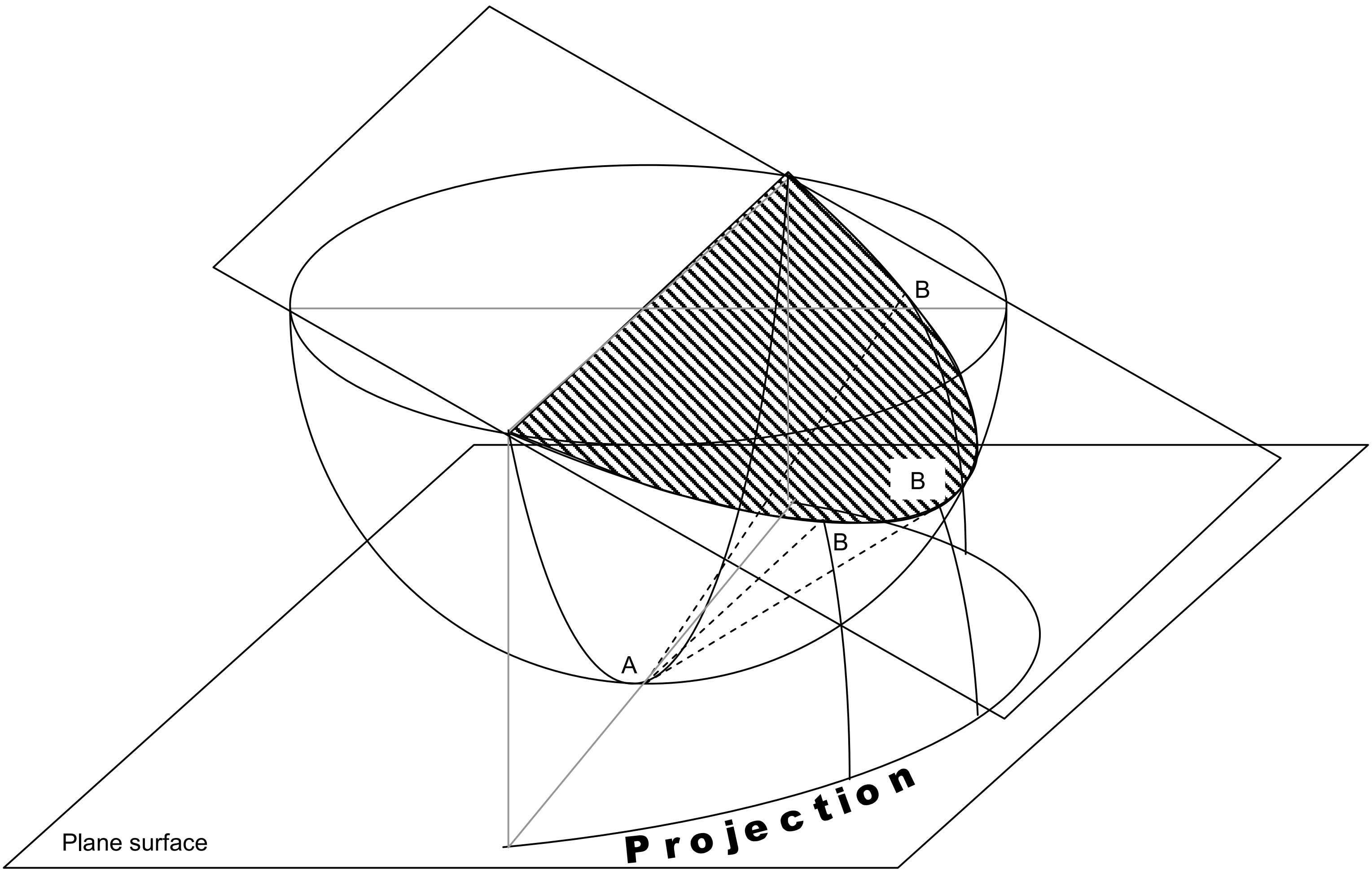


Figure 4: Projection of a plane on the plane surface.

The projection of all the meridians and parallels with angle 2° one to the other creates the Schmidt stereographic projection.

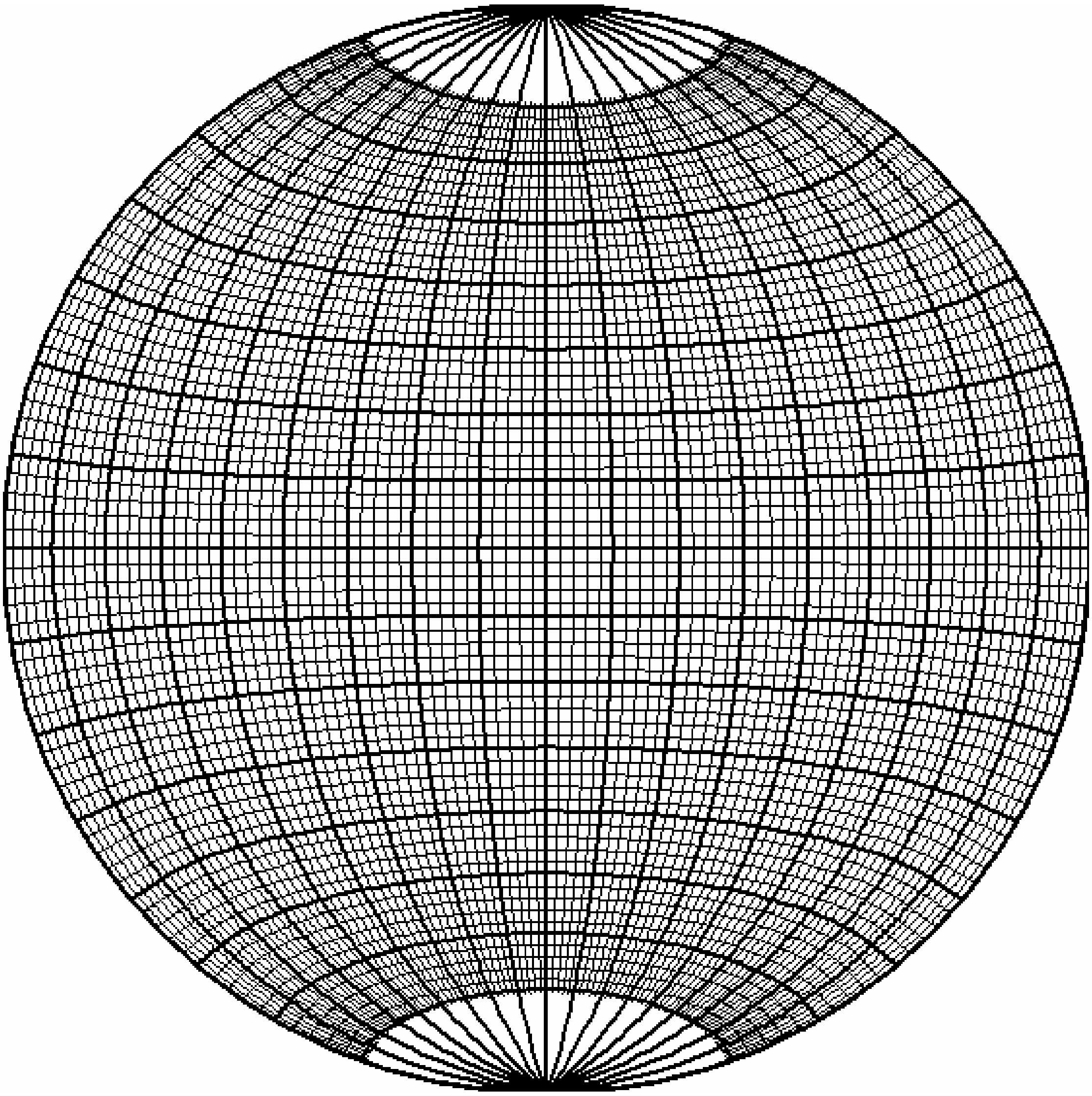


Figure 5: Schmidt Stereographic Projection.

3.2.2 PLOTTING ON THE SCHMIDT STEREOGRAPHIC PROJECTION

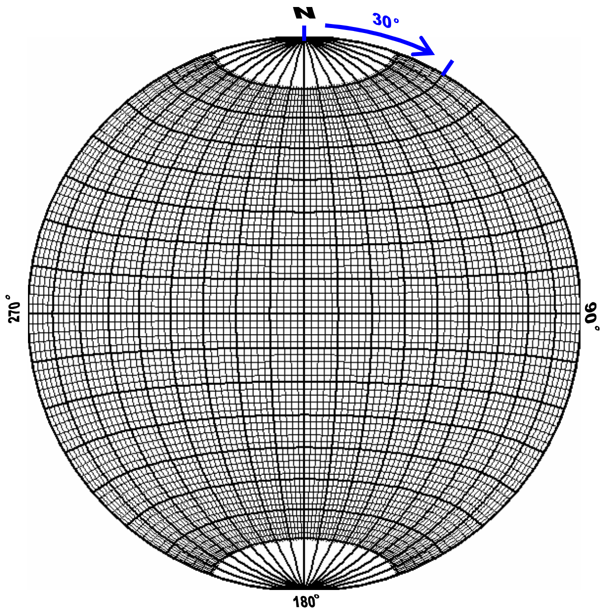
Plotting a line

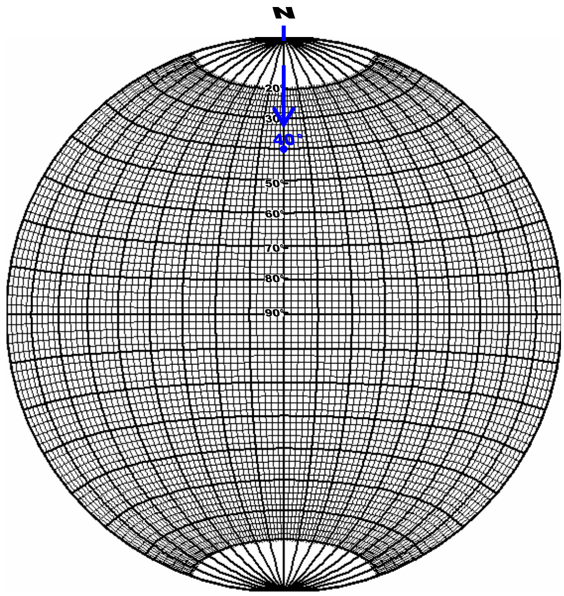
A line passing through the center of the crystallographic sphere intersects its lower hemi-sphere to a point, thus the stereographic projection of a line is a point.

Assume that there is a line with geometry 40°/030°. To plot this line, follow the following steps:

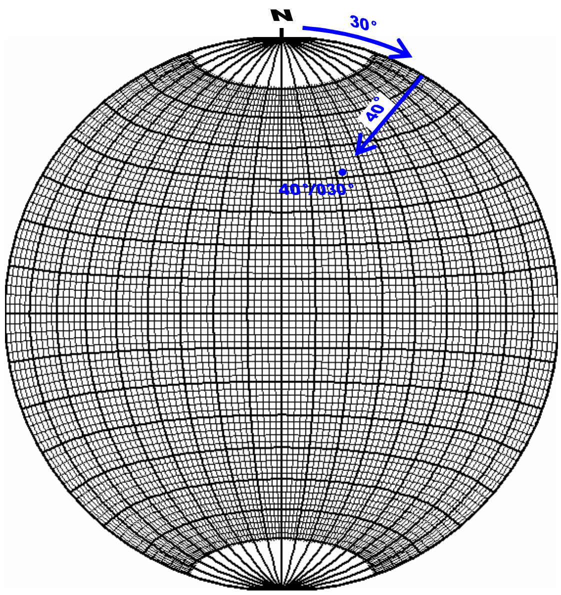
- Put a tracing paper on the Schmidt net.

- Put a mark on the North (upper point of the circle), outside the circle.
- Count 30^o clockwise to the circuit of the circle and put a mark on it.





- Rotate the tracing paper round the center of the circle, until it coincides to the North mark.
- Count 40^o by moving inside the circle and put a mark on it.
- Rotate the tracing paper round the center of the circle, until it goes back to its initial place.

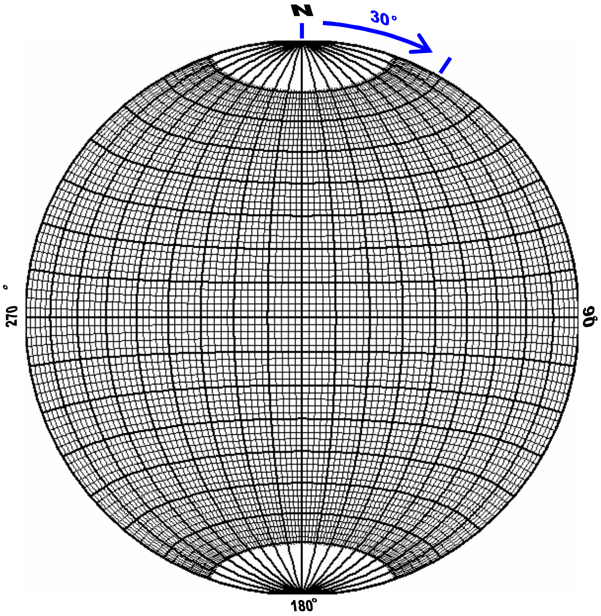


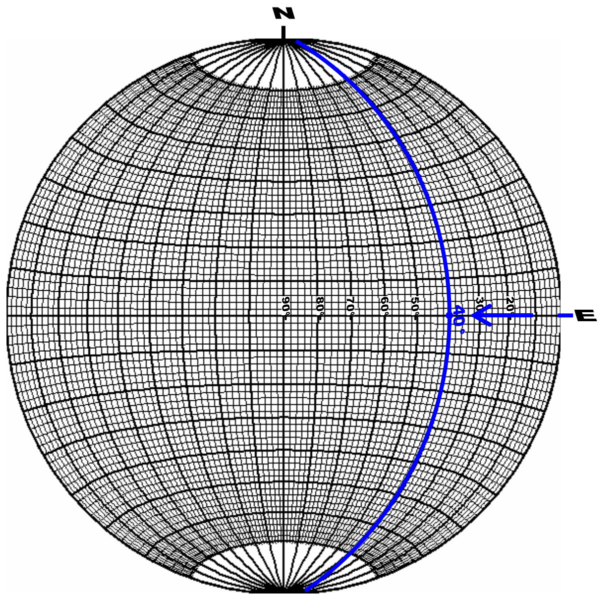
<u>Plotting a plane</u>

The projection of a plane is similar to the projection of a line except that a plane passing through the center of the crystallographic sphere intersects it in a great circle, and thus, the stereographic projection of a plane is a curve.

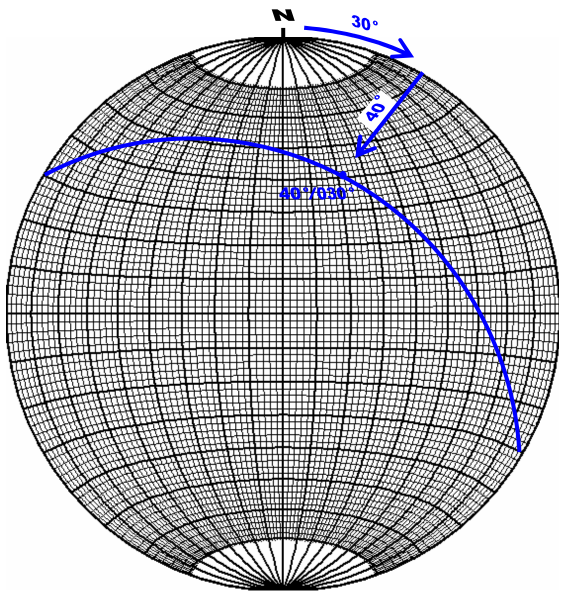
Assume that there is a plane with geometry 40°/030°. To plot this plane, follow the following steps:

- Put a tracing paper on the Schmidt net.
- Put a mark on the North (upper point of the circle), outside the circle.
- Count 30° clockwise to the circuit of the circle and put a mark on it.





- Rotate the tracing paper round the center of the circle, until it coincides to the East.
- Count 40° by moving inside the circle and put a mark on it.
- Draw the great circle that is passing through this mark.
- Rotate the tracing paper round the center of the circle, until it goes back to its initial place.



3.2.3 STATISTICAL ELABORATION OF GEOLOGICAL DATA

Schmidt stereographical projection has a wide application to statistical elaboration of tectonical analysis problems, because of its advantage to keep the area of the plotted shapes.

For the statistical analysis, the poles of the planes are used.

More specifically:

- Every geological data is plotted on the Schmidt net.
- The net inscribes in a square.
- The square is divided in one hundred (usually) smaller squares, ten in each row.
- Two small circles with diameter equal to the length of the side of each small square are drawn, which are connected in between them with a line, with length equal to the big square, creating the shape showed on the right of figure 6.

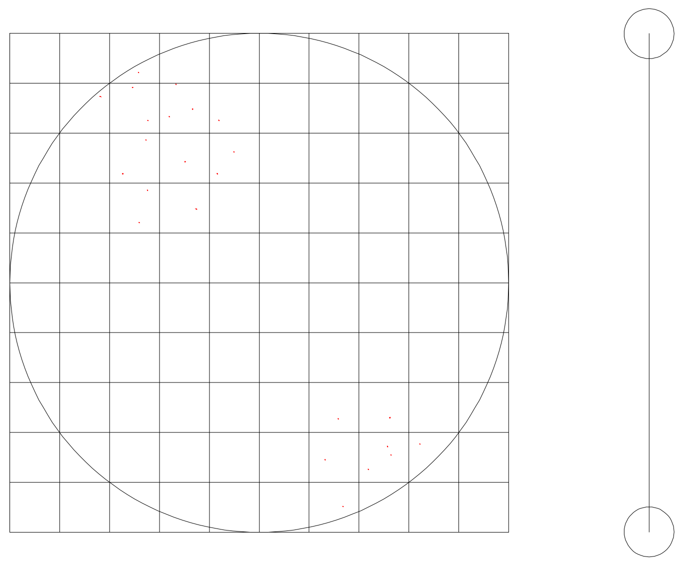


Figure 6: Left: Schmidt net inscribed in the square.
Right: The shape that is created connecting two small circles with a line. (circle diameter=side of small square, line length = side of big square)

To draw the density (contours) of the plotted data, use the following method:

- Place the center of a small circle to every vertex, every middle of side and every center of the small square, in such a way that the line of the shape passes through the center of the big circle, as shown in the following figure:

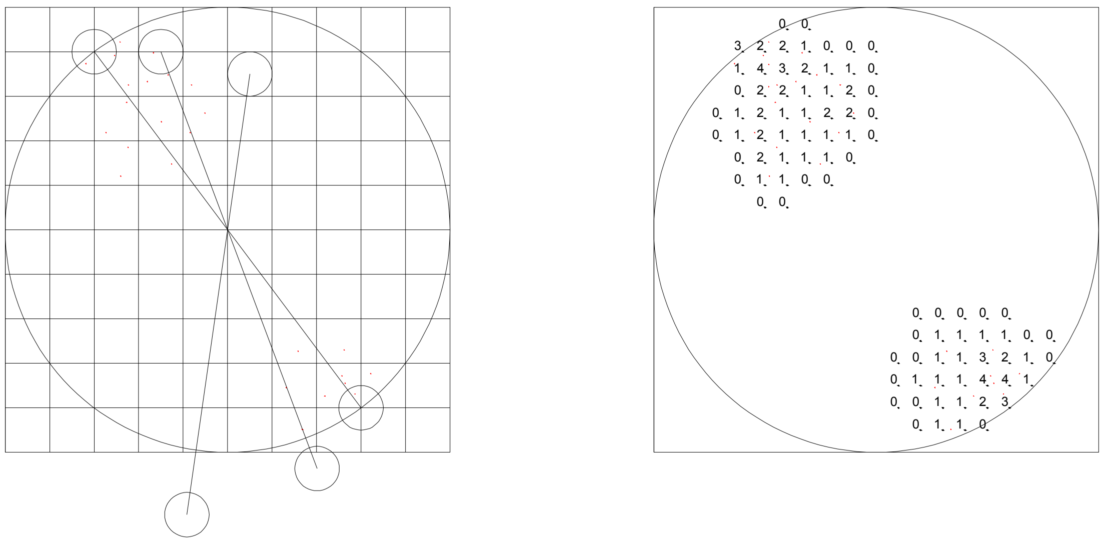


Figure 7: Left: Placing the shape.
Right: The check points, after counting the poles

- Count every pole plotted inside the two circles and write this number near the centers of the two circles. When you finish you will get a figure like this showed on the right of figure 7.
- Before the contours are drawn, the noted numbers have to be converted to percent (%) contours. This can be done using the following equation:

$$x_n = \frac{y_n}{i} * 100$$

Where x_n = the percent of density of the n-th
y_n = the noted number
i = the number of measurements

For example, in figure 7, i=26, thus for

$y_n = 1 \rightarrow x_n \simeq 3.85$
$y_n = 2 \rightarrow x_n \simeq 7.69$
$y_n = 3 \rightarrow x_n \simeq 11.54$
$y_n = 4 \rightarrow x_n \simeq 15.38$

- Now that the contours percent calculated, it's easy to draw the desirable contour, by joining points with equal noted numbers. If the desired contour is an integer and x_n is a decimal number and vice-versca, the curve of the contour will be passing between two neighbour points. If the curve of the contour intersects the Schmidt net to a point, then the curve continues to the antidiametrical point of the intersected point.

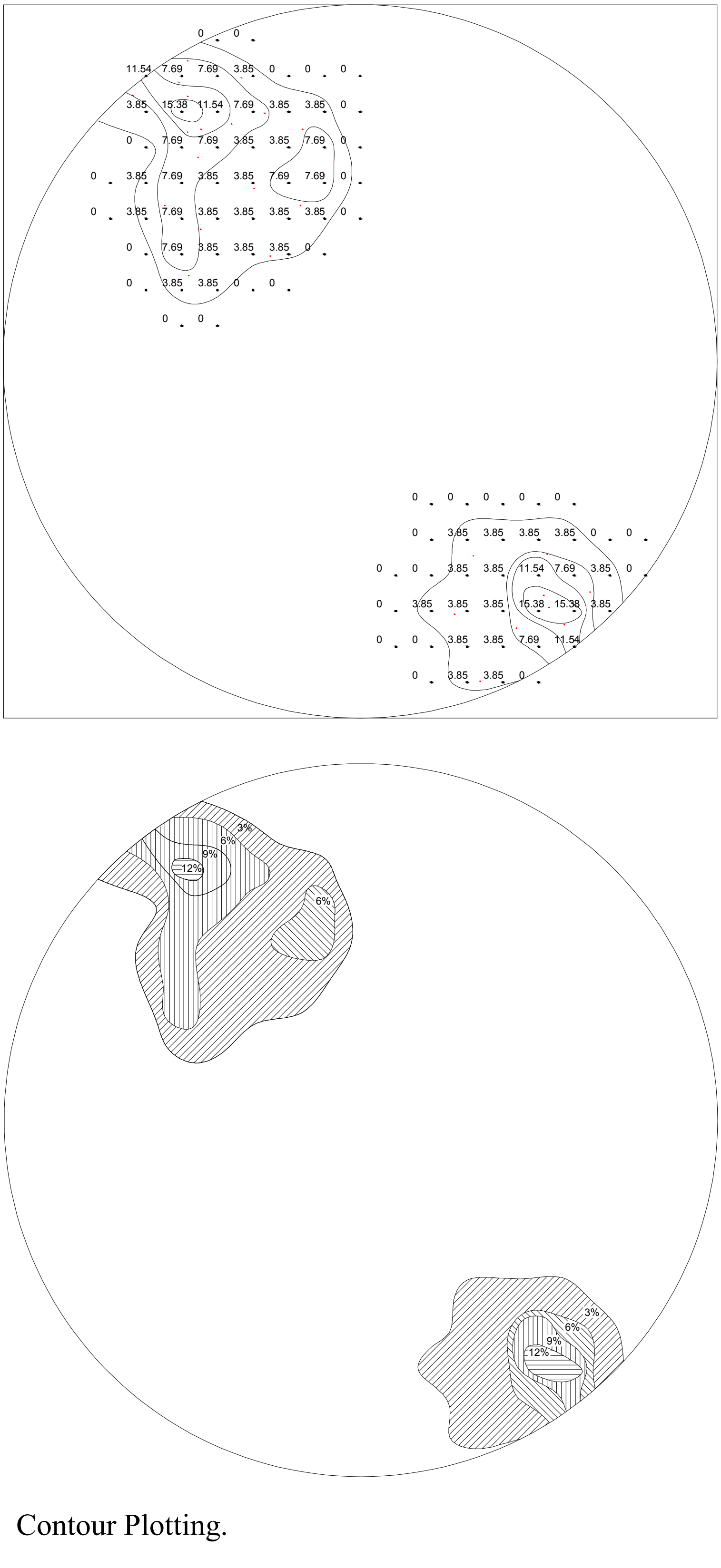


Figure 8: Contour Plotting.

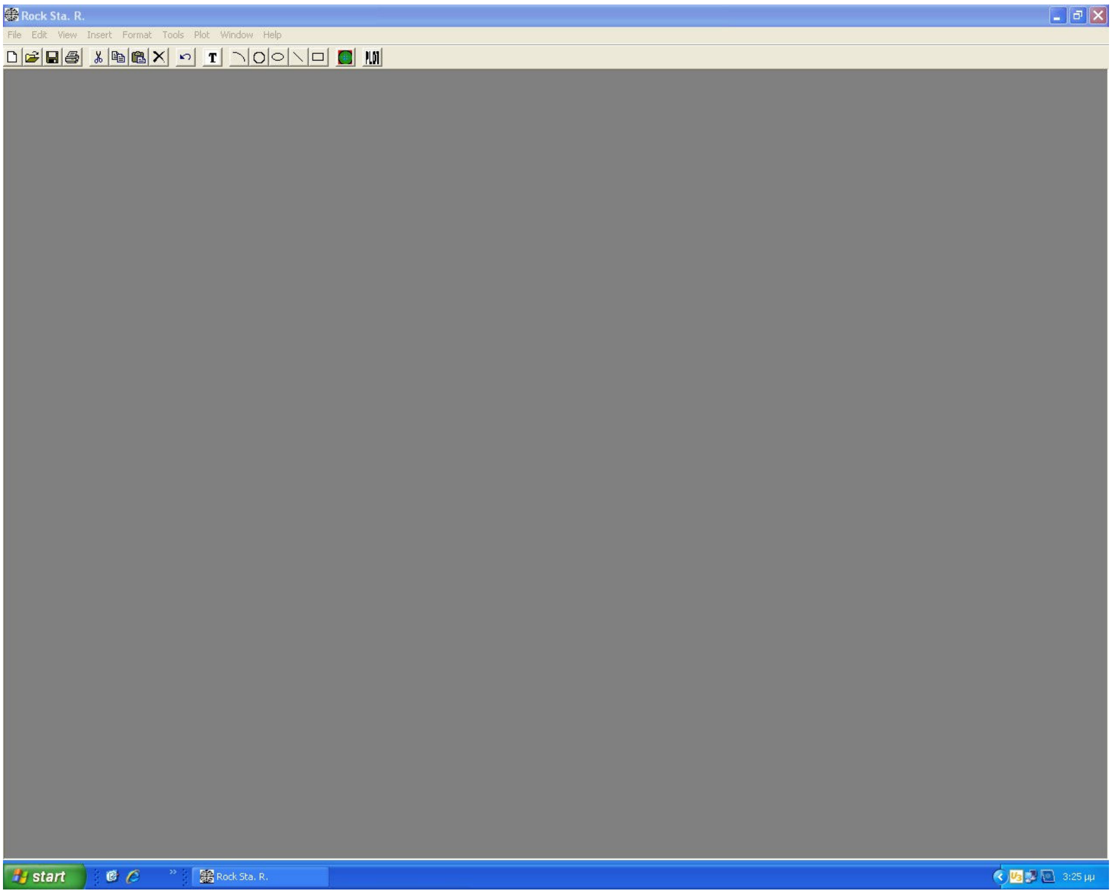
4 WORKING WITH ROCK STA. R.

4.1 GENERAL

In the following pages, this manual illustrates the features of the program, by using an INEXISTENT example. Before you proceed, it is necessary to mention the following limitations:

- "ROCK NOT ROLL" does not take any responsibility for damages may be caused by the use of the program. The design of a cut, mine or any other structure in rock and semi-rock masses, is exclusively the engineer's responsibility.
- In ROCK STA. R., you can copy, paste and delete data only in columns.
- Anything putted on the picture (e.g. pictures, lines etc) cannot be copied.
- ROCK STA. R. does not plot weighted contour.
- In automatic mode of contours, the stereographic sphere cannot be filled with color

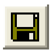
If you have already started the program, your screen should look like the following:



On the top of the screen, under the menu bar, there is an icon bar consisted of seventeen icons – shortcuts. The full path of each one is given below:

 File → Add New

 File → Open

 File → Save

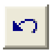
 File → Print

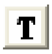
 Edit → Cut

 Edit → Paste

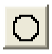
 Edit → Copy

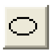
 Edit → Delete

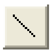
 Edit → Undo

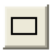
 Insert → Text

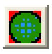
 Insert → Arc

 Insert → Circle

 Insert → Ellipse

 Insert → Line

 Insert → Rectangle

 Tools → Options

 Plot → Plot

Additionally, you can make your work faster, by using the following shortcut-key combinations:

Ctrl + o	equals to:	File → Open
Ctrl + s	equals to:	File → Save
Ctrl + c	equals to:	Edit → Copy
Ctrl + v	equals to:	Edit → Paste
Ctrl + x	equals to:	Edit → Cut
Ctrl + z	equals to:	Edit → Undo
Del	equals to:	Edit → Delete

Example

Assume that a cut is going to be constructed with a 3:1 (ver : hor) inclination (this equals to 72^o approximately) and a N250^{o}E direction (this equals to 250^o direction). Thus, the geometry of the cut equals to 72^o/250^o.

The area of the cut constitutes from limestone with an internal friction angle φ=40^o.

A geologist has been collected the data given in the following table:

Table 1: Planes' Geometry

Discontinuity Set	Plane Inclination	Plane Direction
Stratum	55	320
Stratum	35	355
Stratum	36	332
Stratum	51	341
Stratum	52	351
Stratum	41	354
Stratum	53	324
Stratum	54	326
Stratum	45	333
Stratum	51	339
Stratum	50	345
Stratum	42	334
Stratum	41	321
Stratum	49	340
Stratum	44	347
Stratum	38	349
Stratum	43	351
Stratum	52	326
Stratum	40	333
Stratum	39	353
Stratum	55	342
Stratum	55	349
Stratum	46	327
Stratum	45	330
Stratum	54	323
Stratum	40	353
Stratum	50	338
Joint1	64	020
Joint1	60	005
Joint1	49	035
Joint1	54	024
Joint1	50	040
Joint1	48	021
Joint1	60	019
Joint1	69	066
Joint1	58	050
Joint1	51	042
Joint1	56	035
Joint1	49	039
Joint1	63	026
Joint1	53	028
Joint1	52	032

Discontinuity Set	Plane Inclination	Plane Direction
Joint1	46	027
Joint2	46	154
Joint2	68	162
Joint2	65	155
Joint2	60	160
Joint2	55	132
Joint2	45	151
Joint2	48	149
Joint2	51	146
Joint2	62	159
Joint2	59	156
Joint2	62	152
Joint2	52	156
Joint2	49	160
Not Classified Joint	52	118
Not Classified Joint	15	006
Not Classified Joint	24	124
Not Classified Joint	71	099

If you want to use Beeline columns (the first three columns) for instant plot of the poles of the planes, you first have to convert the above "plane values" to "pole values". This can be done simply by using the following formulas:

$B_{Inclination} = 90 - P_{Inclination}$

$B_{Direction} = 180 + B_{Direction}$

For this example, we will do the conversion. The values for instant pole plotting are given in the following table:

Table 2: Poles' Geometry

Discontinuity Set	Pole Inclination	Pole Direction
Stratum	35	140
Stratum	55	175
Stratum	54	152
Stratum	39	161
Stratum	38	171
Stratum	49	174
Stratum	37	144
Stratum	36	146
Stratum	45	153
Stratum	39	159
Stratum	40	165
Stratum	48	154
Stratum	49	141
Stratum	41	160
Stratum	46	167
Stratum	52	169
Stratum	47	171
Stratum	38	146
Stratum	50	153

Discontinuity Set	Pole Inclination	Pole Direction
Stratum	51	173
Stratum	35	162
Stratum	35	169
Stratum	44	147
Stratum	45	150
Stratum	36	143
Stratum	50	173
Stratum	40	158
Joint1	26	200
Joint1	30	185
Joint1	41	215
Joint1	36	204
Joint1	40	220
Joint1	42	201
Joint1	30	199
Joint1	21	246
Joint1	32	230
Joint1	39	222
Joint1	34	215
Joint1	41	219
Joint1	27	206
Joint1	37	208
Joint1	38	212
Joint1	44	207
Joint2	44	334
Joint2	22	342
Joint2	25	335
Joint2	30	340
Joint2	35	312
Joint2	45	331
Joint2	42	329
Joint2	39	326
Joint2	28	339
Joint2	31	336
Joint2	28	332
Joint2	38	336
Joint2	41	340
Not Classified Joint	38	298
Not Classified Joint	75	186
Not Classified Joint	66	304
Not Classified Joint	19	279

From the menu bar select File → Add New.

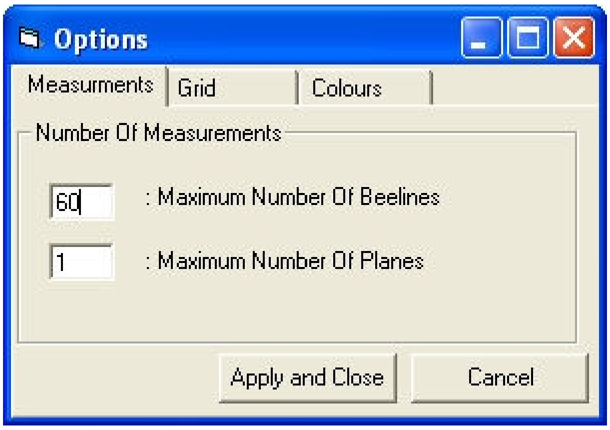
A new work form will appear on your screen.

4.2 INSERT PROJECT TITLE

On the upper left corner of the form, there is a text box which is writing “Project Title:”. You can type there the project title which it will be repeated in each page when you will print your project.

4.3 INSERT NUMBER OF MEASUREMENTS

The first thing you have to do when you open a new work form is to insert the number of measurements you will use. In our case, the number of measurements is 60, so from the menu bar select Tools → Options → go to the Measurements tab and type 60 in the "Maximum Number Of Beelines" text box.



At this time, this is the only thing we want to change, so click on "Apply and Close" button to confirm the changes.

4.4 PLOT DATA

The next step is to copy and paste the given data into the created text boxes. As mentioned at the beggining of this chapter, this can be done that only by copying and pasting one column each time.

After doing that, you are ready to plot the data and see the stereonet projection in the picture at the up and right corner of the form.

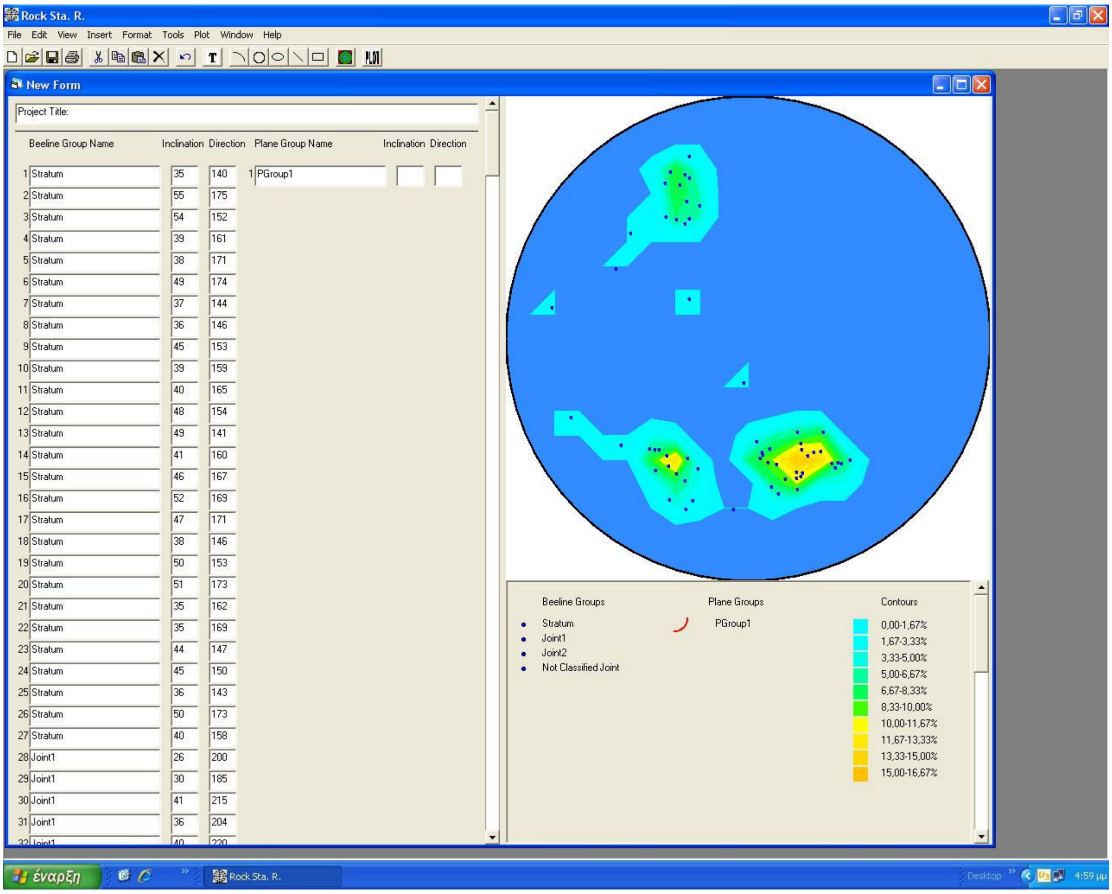
You can choose between three visible projections or a combination of them. Click on the "Plot" option from the file menu.

By default you will see three checked options:

- Beelines : Plots the data written in the "Beelines" columns (the first three columns).
- Planes : Plots the data written in the "Planes" columns (the last three columns).
- Contours : By default plots the contours created from the beelines data.

Don't uncheck any of the check option and click on the last option, which is "Plot".

At this time, your screen should look like this:



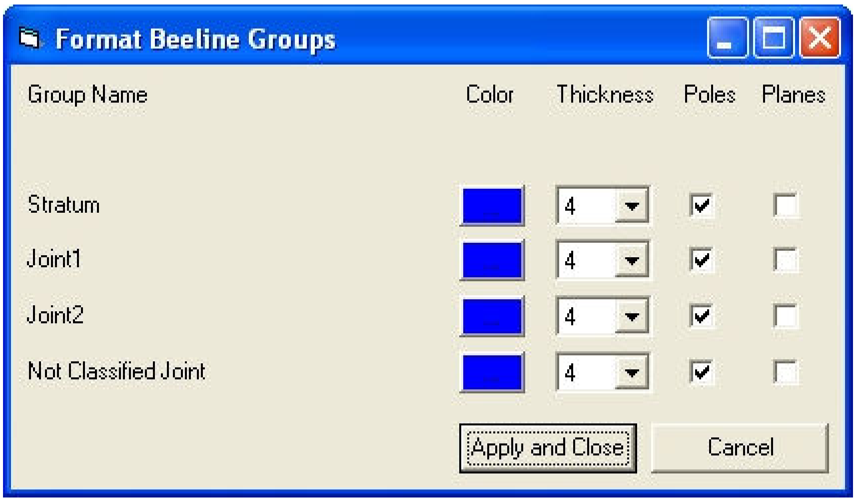
The planes plot shows nothing at this moment, because no data has been entered in the "planes" columns until now.

4.5 FORMAT BEELINE GROUPS

As you can see, all the discontinuity sets of the beelines are blue by default (all the discontinuity sets of the planes are also red by default).

Let's change some colors to see the discontinuity sets more clearly. From the menu bar select Format → Image → Beeline Group.

A window like this will appear on your screen:



Keep the color of the stratum as it is and make its thickness a little bit bigger, e.g. 5. Click on the color of each joint group and select the desired color, e.g. black for joint1, red for joint2 and green for the unclassified joints. If you wish to see the stereonet projection of each plane from a desired group, simply check the relative check box.

Click on "Apply and Close" button to confirm the changes.

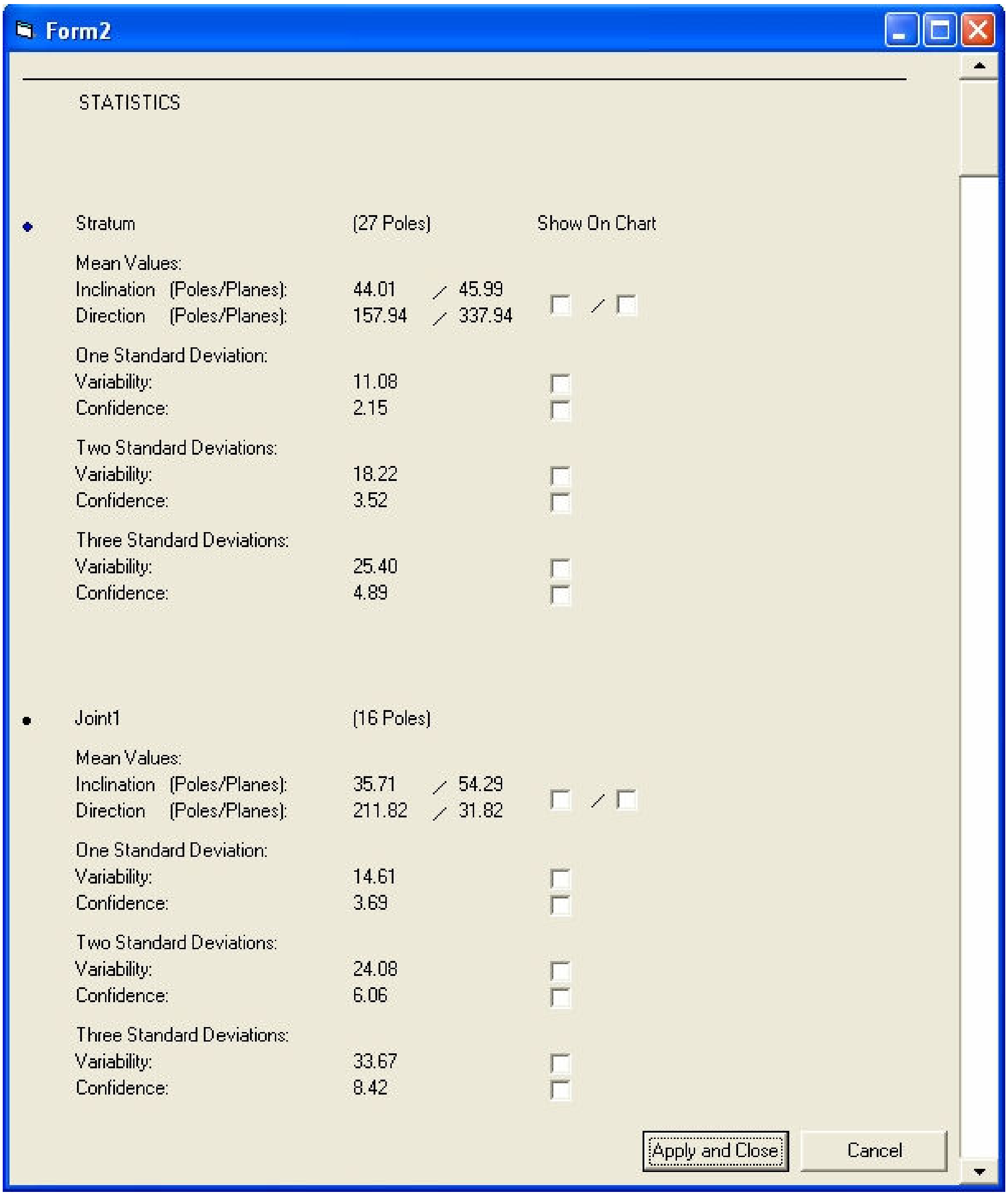
Now, press again the Plot → Plot from the menu bar to refresh the picture.

4.6 STATISTICS

After formatting and plotting your data, it is time to see some statistics and put them on your projection.

From the menu bar select View → Statistics.

A window like this will appear on your screen:



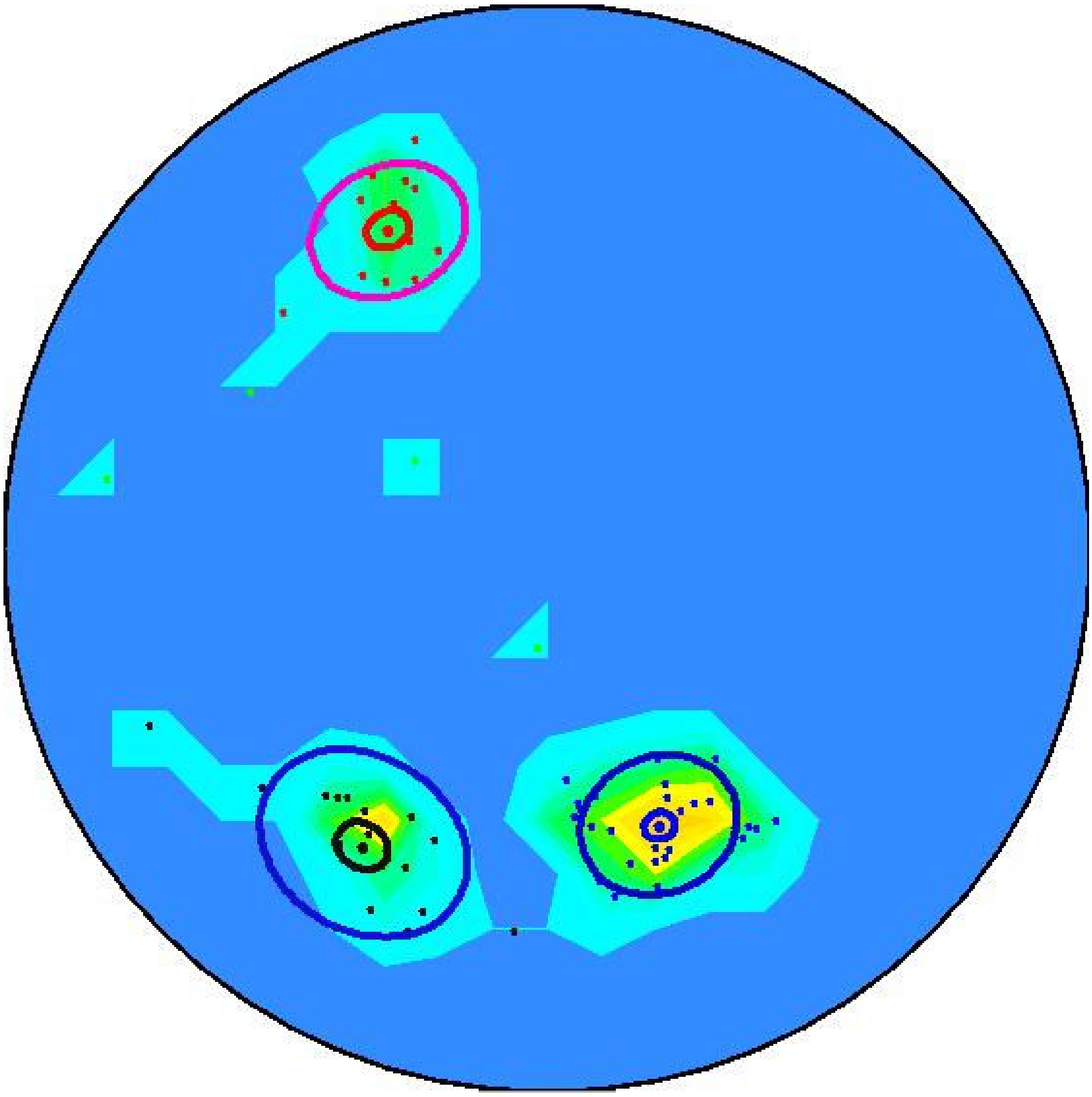
The available statistics of each group are shown and they are:

- Number of poles.
- Inclination of the mean pole and the corresponding plane.
- Direction of the mean pole and the corresponding plane.
- One, two and three standard deviations for variability and confidence cones according to Fisher's method for desperation on a sphere.

You can scroll up and down with the scroll bar to see the statistics for all groups.

For all groups except the “not classified joint” group, click on the check boxes to activate the mean values of poles and the variability and confidence cones for the one standard deviation.

Click on “Apply and Close” button to confirm the changes.
Press the Plot → Plot from the menu bar to refresh the picture.
Your picture should now look like this:



As you can see, confidence cones (projected as small ellipses) have the same color as the previous selected color for each beeline group, while variable cones have a little different color, so it can be distinguished in more complicated projects.

You can now add the mean planes of your discontinuity sets on your plot.
From the menu bar select Tools → Options, go to the Measurements tab and type 3 in the "Maximum Number Of Planes" text box.
Click on "Apply and Close" button to confirm the changes.
In the three text boxes that have been created, type the mean plane values that you have seen in the statistics form.

Mean Stratum	46	338
Mean Joint 1	54	032
Mean Joint 2	55	153

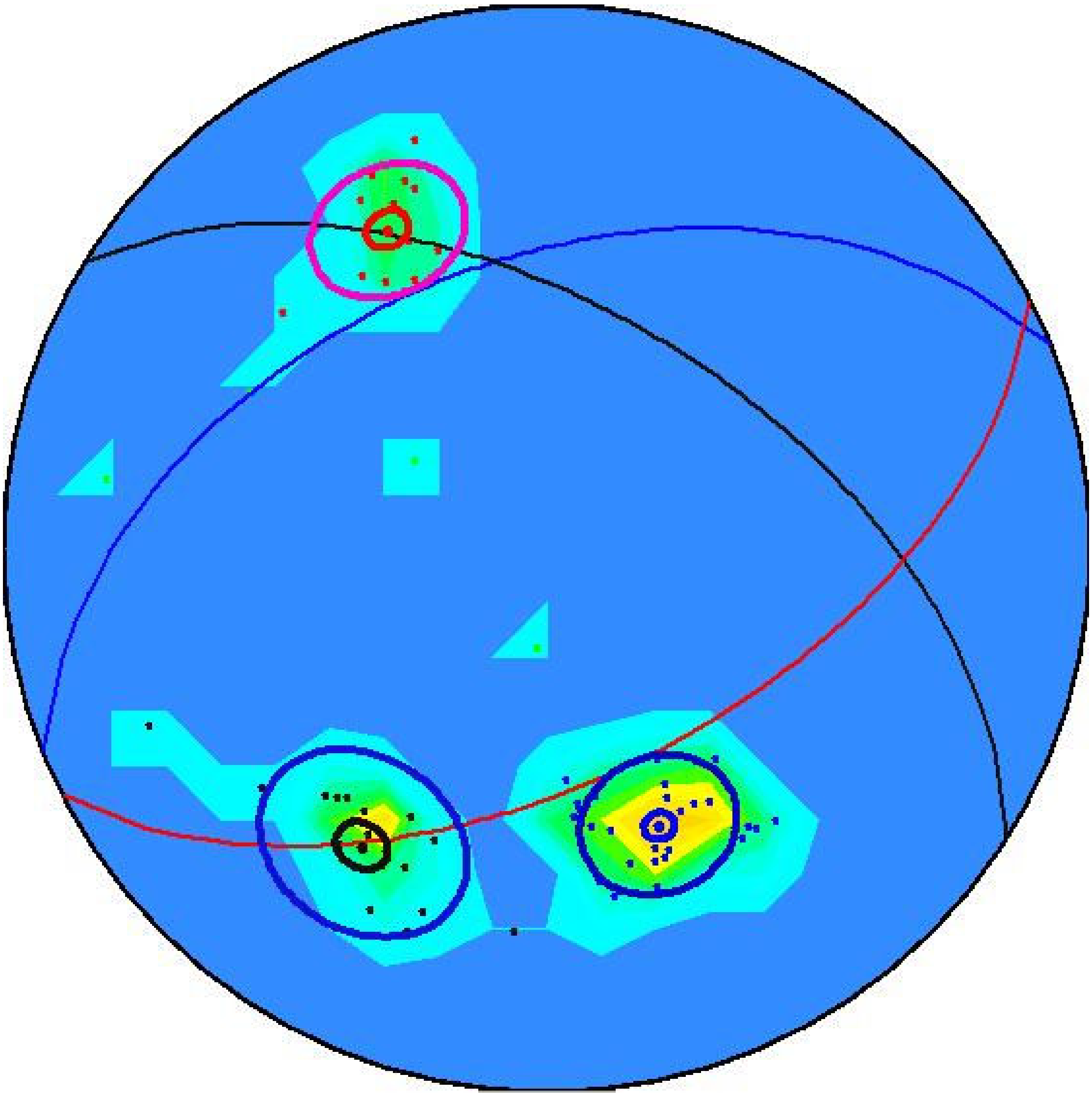
4.7 FORMAT PLANE GROUPS

As mentioned before, the three plane groups that they have been created, have red color by default, so before you refresh your stereonet projection select Format → Image → Plane Group, from the menu bar.

Change the colors of Mean Stratum to blue, Mean Joint 1 to black and Mean Joint 2 to red in the same way that you did when you formatted the Beeline groups. Check the relative check box of each Plane group if you wish to see it on the stereonet projection.

Click on "Apply and Close" button to confirm the changes.
Press the Plot → Plot from the menu bar to refresh the picture.

Your picture now may look like the following:

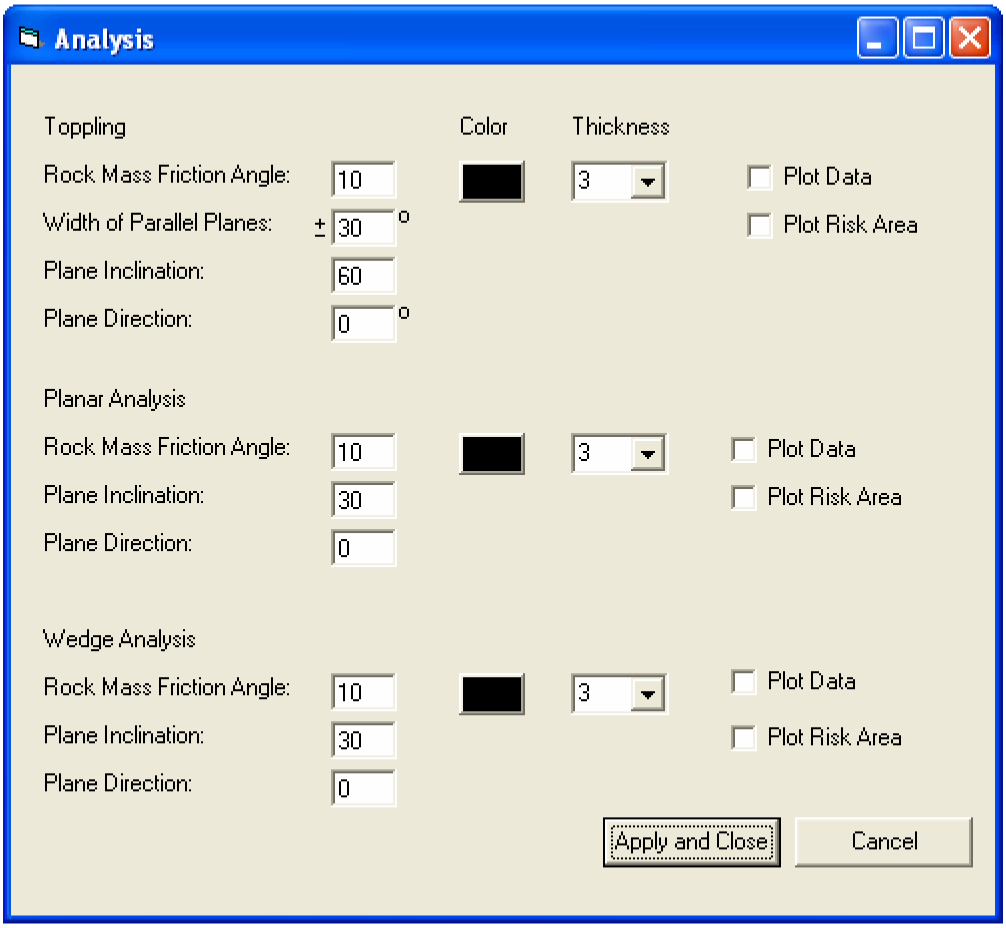


4.8 TOPPLING, PLANAR, WEDGE ANALYSIS

Now that you have your data plotted, it is time to check if the cut will be stable or if there is a toppling, planar sliding or wedge sliding risk.

From the menu bar select Edit → Analysis…

The following form will appear on your screen:



As you can see, there are three groups of inserting data for the corresponding checks.

Toppling check requires:

Rock Mass Friction angle:	In the specific example this value equals to 40°.
Width Of Parallel Planes:	This is the "bandwidth" of angles, that when a rock block "faces" the cut, is suspected for toppling. In general, for several authors this value varies between 15° and 30°. For this example leave the default value of 30°.
Plane Inclination:	Is the inclination of the cut. In the specific example this value equals to 72°.
Plane Inclination:	Is the direction of the cut. In the specific example this value equals to 250°.

Planar check requires:

Rock Mass Friction angle:	In the specific example this value equals to 40^o.
Plane Inclination:	Is the inclination of the cut. In the specific example this value equals to 72^o.
Plane Inclination:	Is the direction of the cut. In the specific example this value equals to 250^o.

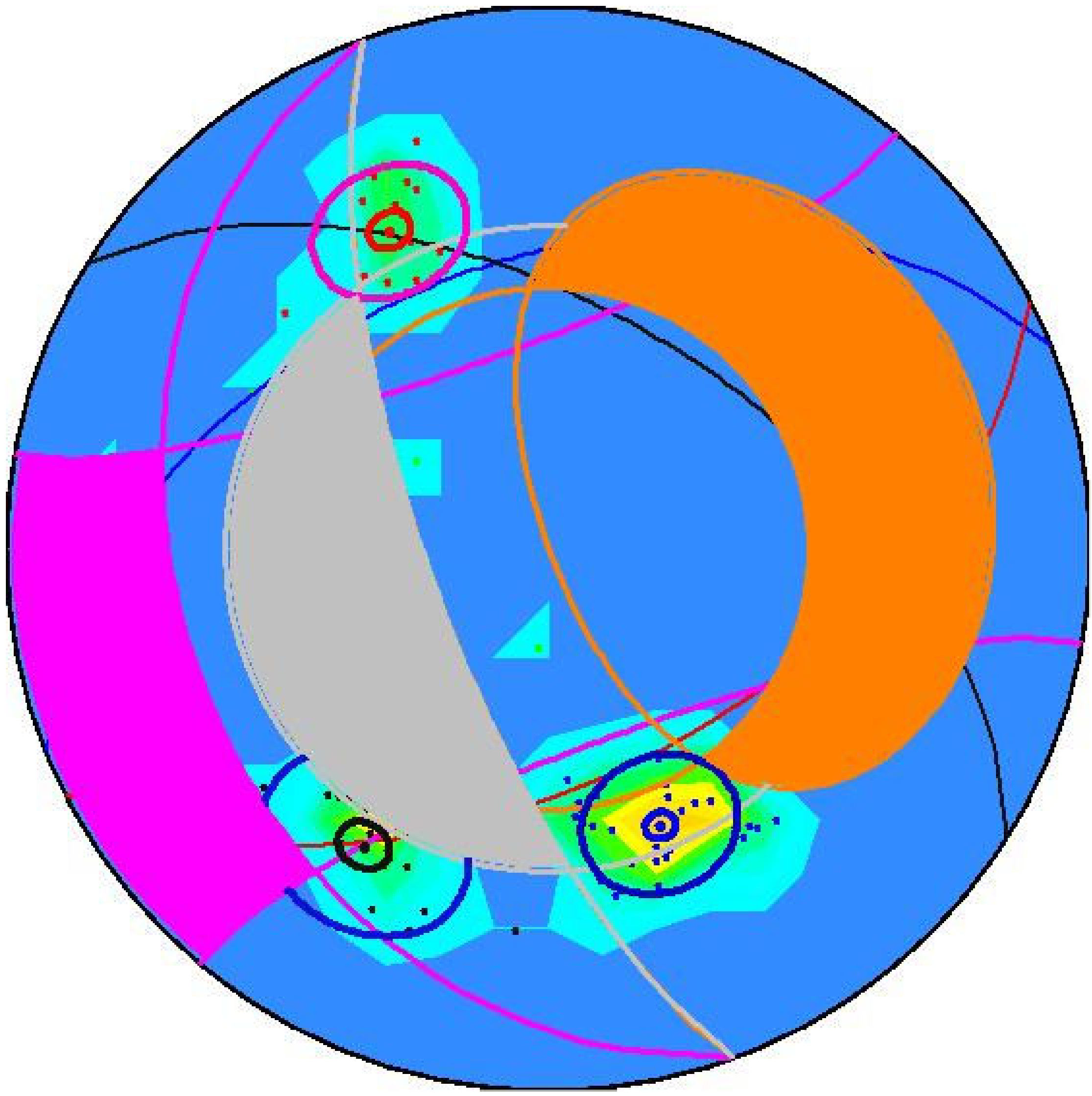
Wedge check requires:

Rock Mass Friction angle:	In the specific example this value equals to 40^o.
Plane Inclination:	Is the inclination of the cut. In the specific example this value equals to 72^o.
Plane Inclination:	Is the direction of the cut. In the specific example this value equals to 250^o.

Format the graphics that will be plotted by selecting magenta for toppling, orange for planar and gray for wedge analysis. Check all the boxes on the right side of the form.

Click on "Apply and Close" button to confirm the changes.
Press the Plot → Plot from the menu bar to refresh the picture.

The new picture now should look like the following:

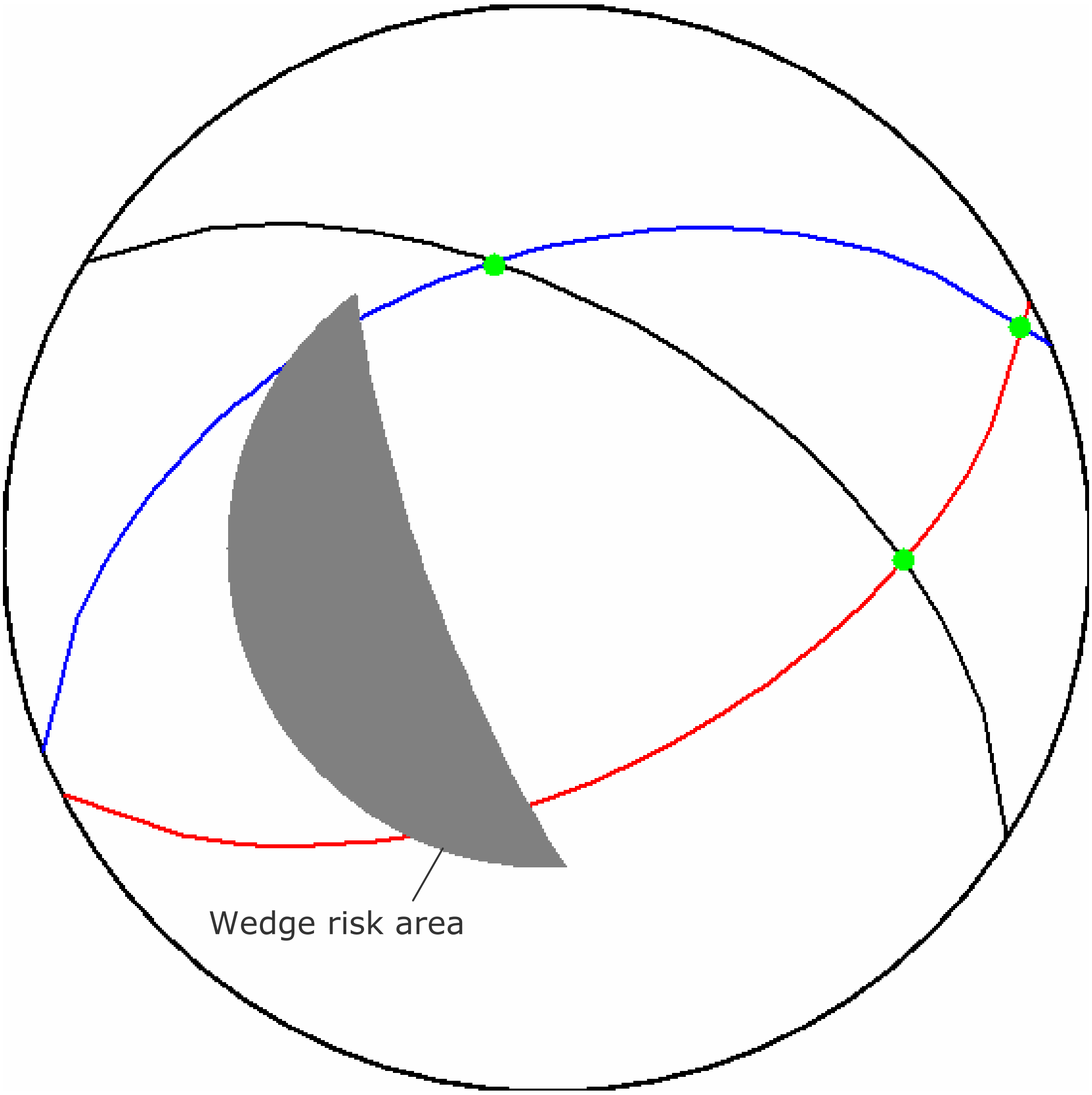


The filled areas in the picture correspond to the Plot Risk Area checks while the lines correspond to the Plot Data checks. Now that you know which area is which, you don't need the filled areas anymore, so you can reopen the analysis form, uncheck the Plot Risk Area check-boxes, and refresh your picture, so that you can see the poles plotted inside the risk areas.

Toppling analysis shows that only one pole from the joint set 1 and only one pole from the not classified joints are plotted in the toppling risk area, so there is a small potential risk for toppling.

Planar analysis shows that only one pole from the stratum set are plotted in the plane risk area, so there is a very small potential risk for plane sliding.

For wedge analysis, the trace of the discontinuity groups must first be specified. For this example the possible traces are the points where the plane plots cross each other and they are shown in the following figure as green circles.



Wedge analysis shows that no traces are plotted in the wedge risk area, so there is a very small potential risk for wedge sliding.

If many poles were plotted in the toppling and planar filled areas or the trace of two discontinuity sets was plotted in the wedge risk area, then further specific analysis would be required, using methodologies given by several authors.

WARNING!: This is only an inexistent example. In a real project it is exclusively in the engineer's judgment to decide whether a joint set is failure suspected or how many standard deviations there will be used for safety.

4.9 ADDING SHAPES

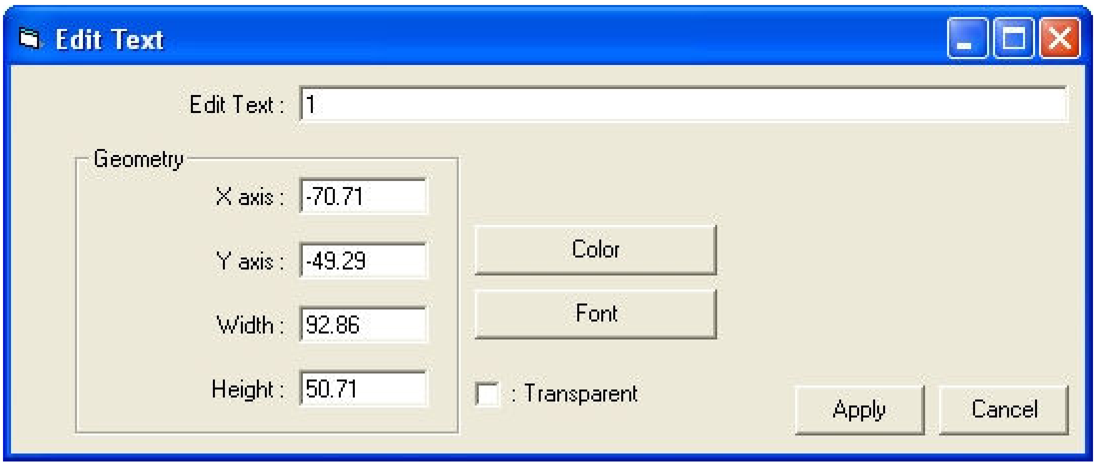
After hiding the risk areas from the analysis form, you will see that what is left is a complicated image, full of points, lines, and circles. You can insert some text and shapes, in order to improve your picture. For example, you can type in three text boxes toppling area, planar area and wedge area and show with lines the corresponding areas. This can be done by following steps:

From the menu bar select Insert → Text.

Note that while the mouse pointer is over your picture, the arrow converts to cross.

Click on the desired point of the picture to insert a start point and while you are holding down the mouse click, drag the mouse diagonally. Release the mouse click when you reach to the desired end point. A new text box will be created writing the number "1". Single-click on the created text box and select Format → Text from the menu bar.

The following form will appear on your screen:



The same result you will have if you double-click on the text box.

In the geometry group of data, X axis is the far left point of the text box and Y axis is the upper point of the text box. The edges of the picture have the following coordinates:

Upper left point: (X,Y) = (-100,-100)

Upper right point: (X,Y) = (100,-100)

Lower left point: (X,Y) = (-100,100)

Lower right point: (X,Y) = (100,100)

Make out the fields using the following values:

Edit Text: "Planar Risk Area"

X axis: 60

Y axis: -90

Width: 30

Height: 5

Check the "Transparent" text box.

Click on the color button and select the orange color.

Click on "Apply and Close" button to confirm the changes.

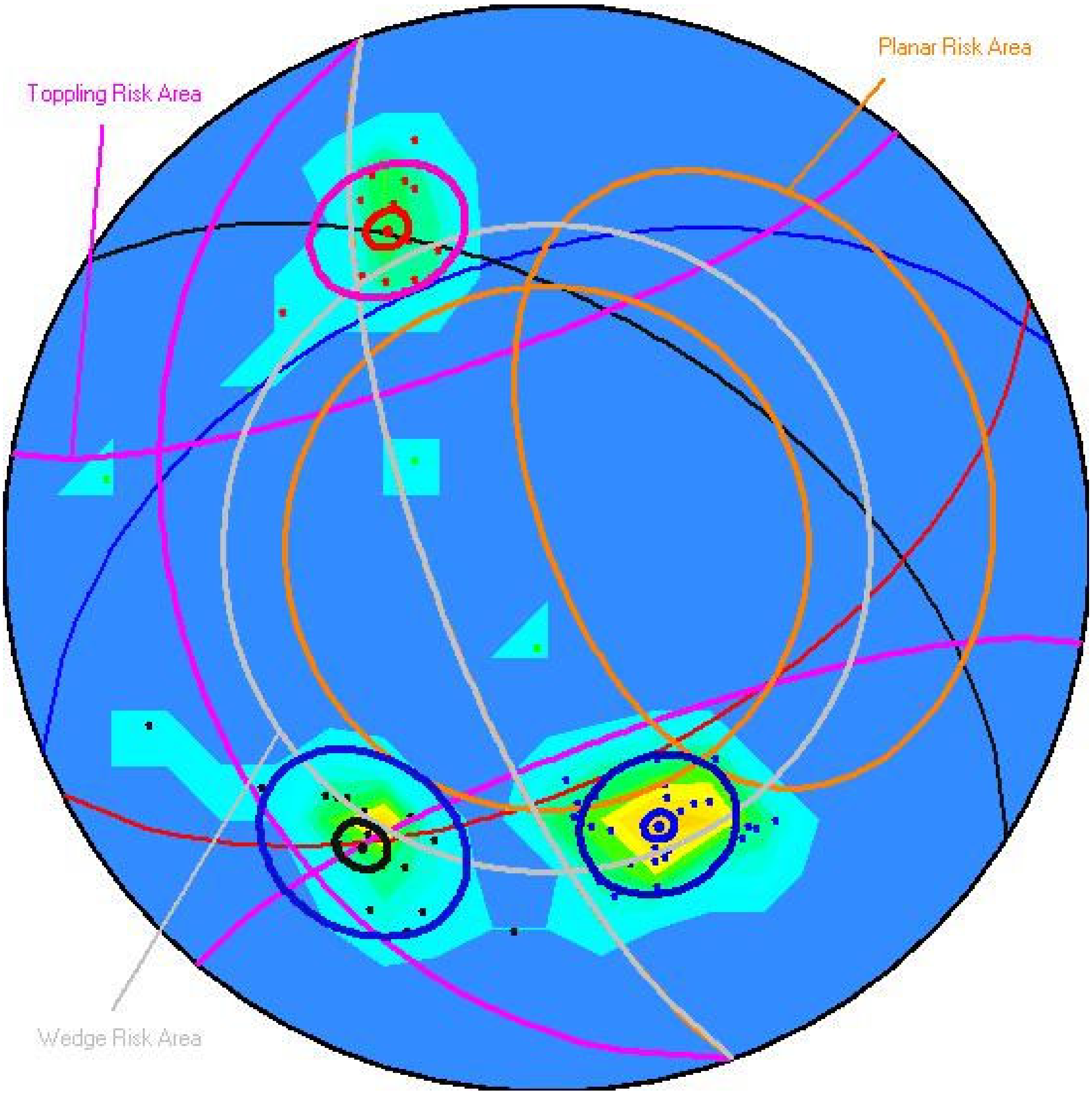
IMPORTANT: Before you repeat the procedure you must know that you cannot select as first point, a point that is over an existing shape, but you can move your shape later to any place by using the format forms. It's a promise that in the next version this choice will be available.

Repeat the procedure twice to create two more text boxes on the desired location, type "Toppling Risk Area" and "Wedge Risk Area" and turn them to magenta and gray colors respectively.

Then insert three lines in the same way you have inserted the text boxes and turn them to the corresponding colors. Notice that the line style is not available if the thickness is greater than 1.

All shapes can be drawn by clicking the mouse on the desired start point and dragging it until you reach the desired end point. There is only one exception in this rule and this is when you want to insert an arc in your picture. In this case you have to click with your mouse three times on the picture, one for the start point, one for the middle point and one for the end point.

The final image should look like the following:



4.10 PRINTING THE PROJECT

Your project is now ready for printing.

From the menu bar select File → Print Preview….

In the print preview form, select the desired printer and paper you want to use.

Additionally, there are three check boxes, giving you the choice to print some part of the set of results, in case you have already printed the whole set and you just want for example to add some text in your picture.

Click on “Apply and Close” button to confirm the changes.

From the menu bar select File → Print.

Your project should be printed.

4.11 EXTRA FEATURES

4.11.1 FORMATTING BACK GROUND AND STEREONET

In some cases such as printing on colored paper or incorporating the stereonet picture in another picture, there is a need to change the background colors of the picture. Additionally, you may need to present the stereonet grid and change its color. You can easily change individually, the background color of the stereonet or the external area of the picture, add a grid to the projection and change the meridians' color and the parallels' color.

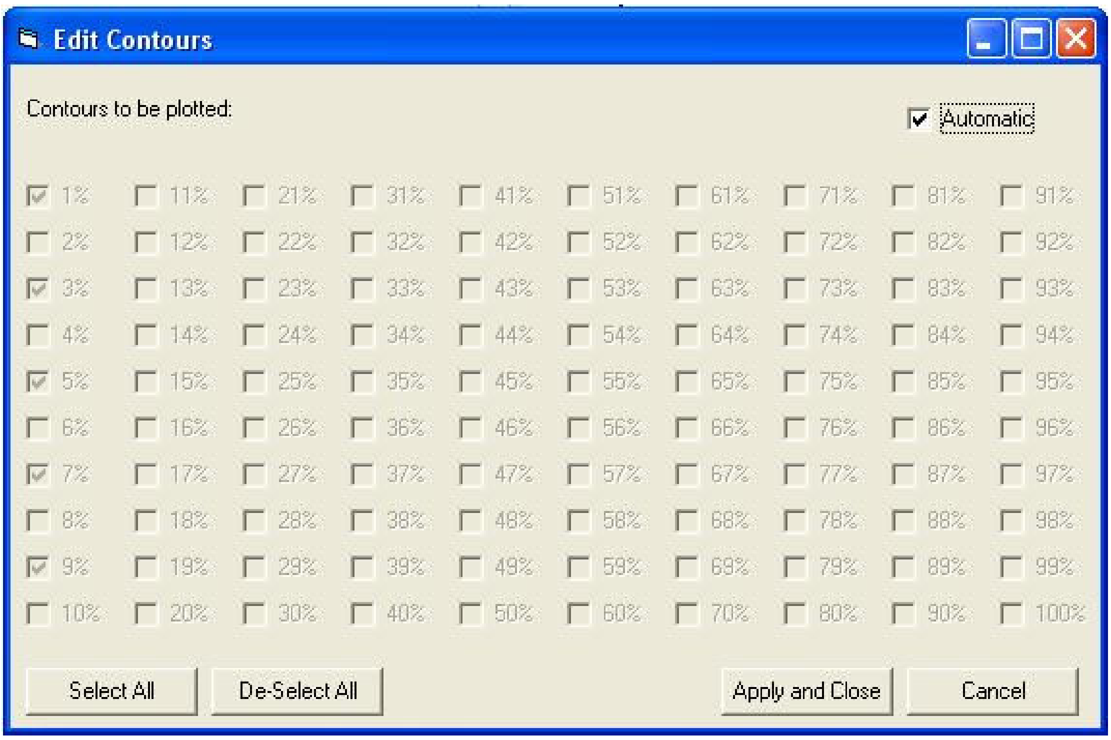
From the menu bar select Tools → Options….
The Options form will be appeared on your screen.
Select the Grid tab. By default, the Circle option is selected, which presents the perimeter of the stereographic sphere's projection.
Click on the Grid option to select the grid.
Select the Colors tab.
Change the color of the background, the sphere's projection, the meridians or the parallels, by clicking on the respective button and picking the desired color from the palette.
Click on "Apply and Close" button to confirm the changes.

TIP: Placing grid in the picture makes the program run slower, so if you want to make the grid visible when you are printing your project, it is better to finish with any other job and insert the grid just before your final plot.

4.11.2 PLOTTING AND FORMATTING A DESIRED CONTOUR

In cases that there is a critical contour percent or for any other reason there is an exact number of contours that must be plotted, you can leave the automatic contour mode and select the desired percents manually.
From the menu bar select Edit → Contours.

The Edit Contours window will appear on your screen:

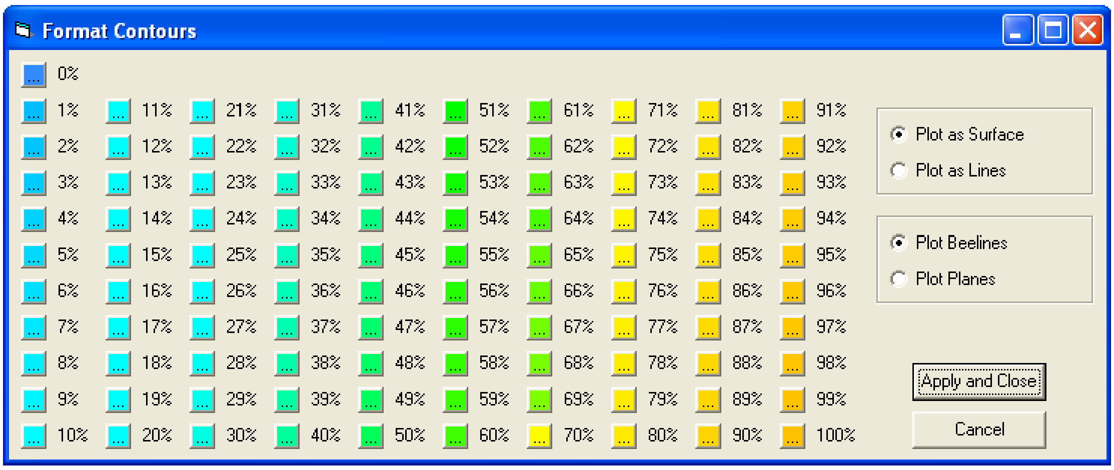


Uncheck the Automatic check box. By default, the 1%, 3%, 5%, 7% and 9% contours are selected. Press the "De-Select All" button to uncheck all the check boxes and check the desired contours.

Click on "Apply and Close" button to confirm the changes.

From the menu bar select Format → Image → Contours.

The Format Contours window will appear on your screen:



In this form you can see the default colors of the contours. Change the contours colors by clicking on the respective button and picking the desired color from the palette. Additionally, there are two more choices.
The first (upper) choice is to choose whether the contours will be plotted as lines (exactly like the automatic mode) or as surface.

The second choice is to choose whether the contour plot will be applied on the beelines groups or the planes groups.
Familiarize with these settings by selecting several combinations of colors and options and plotting them to see how the affect the projection.

TIP: Plotting many desired contours simultaneously makes the program run slower. A better approach in order to save time, instead of plotting many contours until you find the one you need, is to plot contours in automatic mode and after seeing the results from the legend, select the desire contour.

5 BIBLIOGRAPHY

Richard E. Goodman – Introduction to Rock Mechanics, 2nd_Edition