

# General Heterogeneity of the Static Model

How to add heterogeneity to a layer-cake model

# General Heterogeneity

Use general heterogeneity

General heterogeneity filename  
generalheterogeneity\_Horizontal Toughness general heterogenei... Browse

HETEROGENEITY PROPERTIES

Heterogeneity properties	
1	Horizontal fracture toughness

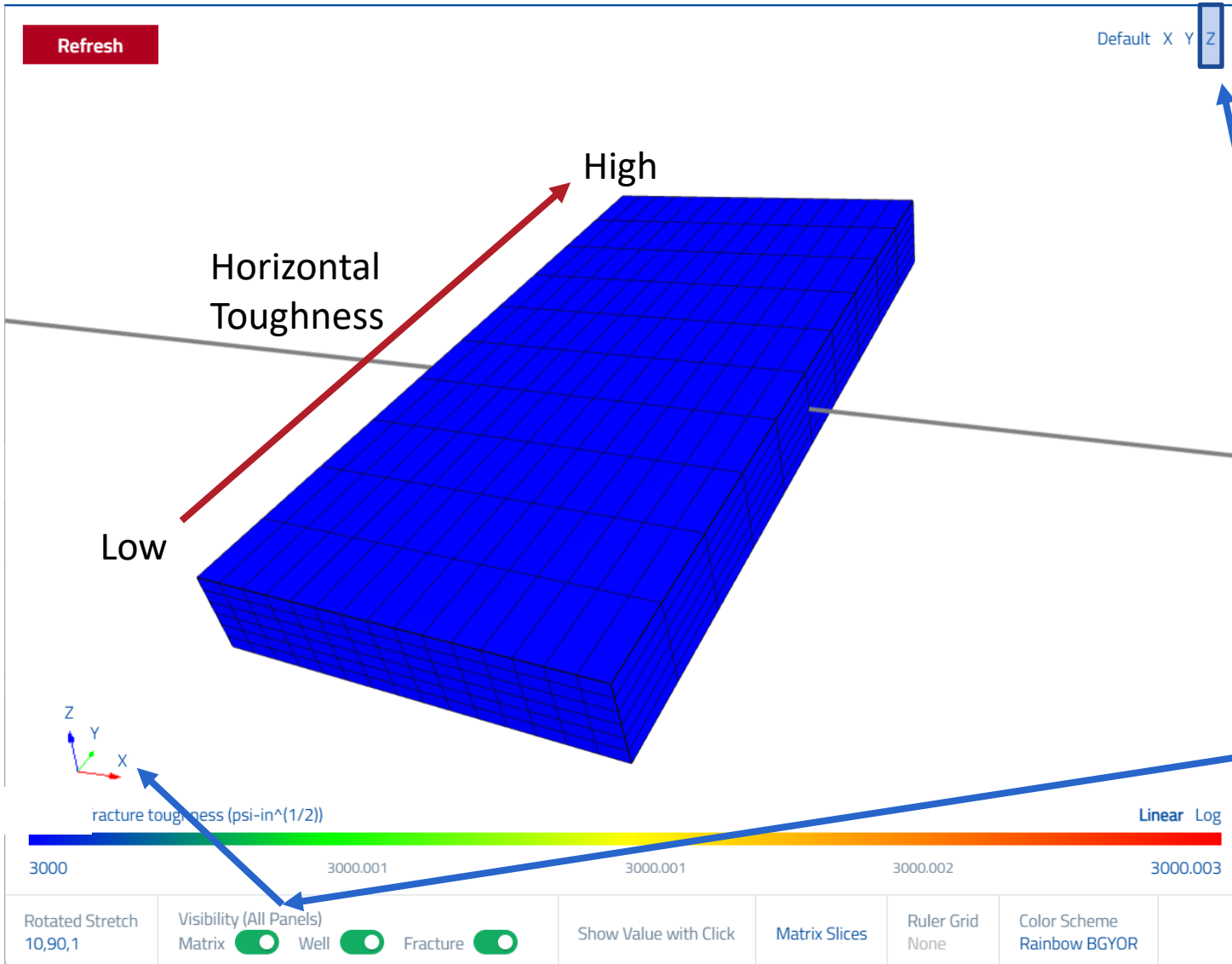
Heterogeneity can be specified in a layer cake model by selecting the 'general heterogeneity' option in the static model and initial conditions tab.

You will need to create a text file to specify EVERY single matrix element of the parameter that you intend to introduce heterogeneity.

The available properties (with correct spelling and capitalization) are: **Initial water saturation, Initial oil saturation, Initial pressure, Initial temperature, X-Permeability, Y-Permeability, Z-Permeability, Biot coefficient, Stress, Initial porosity, Dual porosity matrix permeability, Dual porosity initial fracture porosity, Dual porosity shape factor, Young's modulus, Poisson's ratio, Horizontal fracture toughness, Vertical fracture toughness**

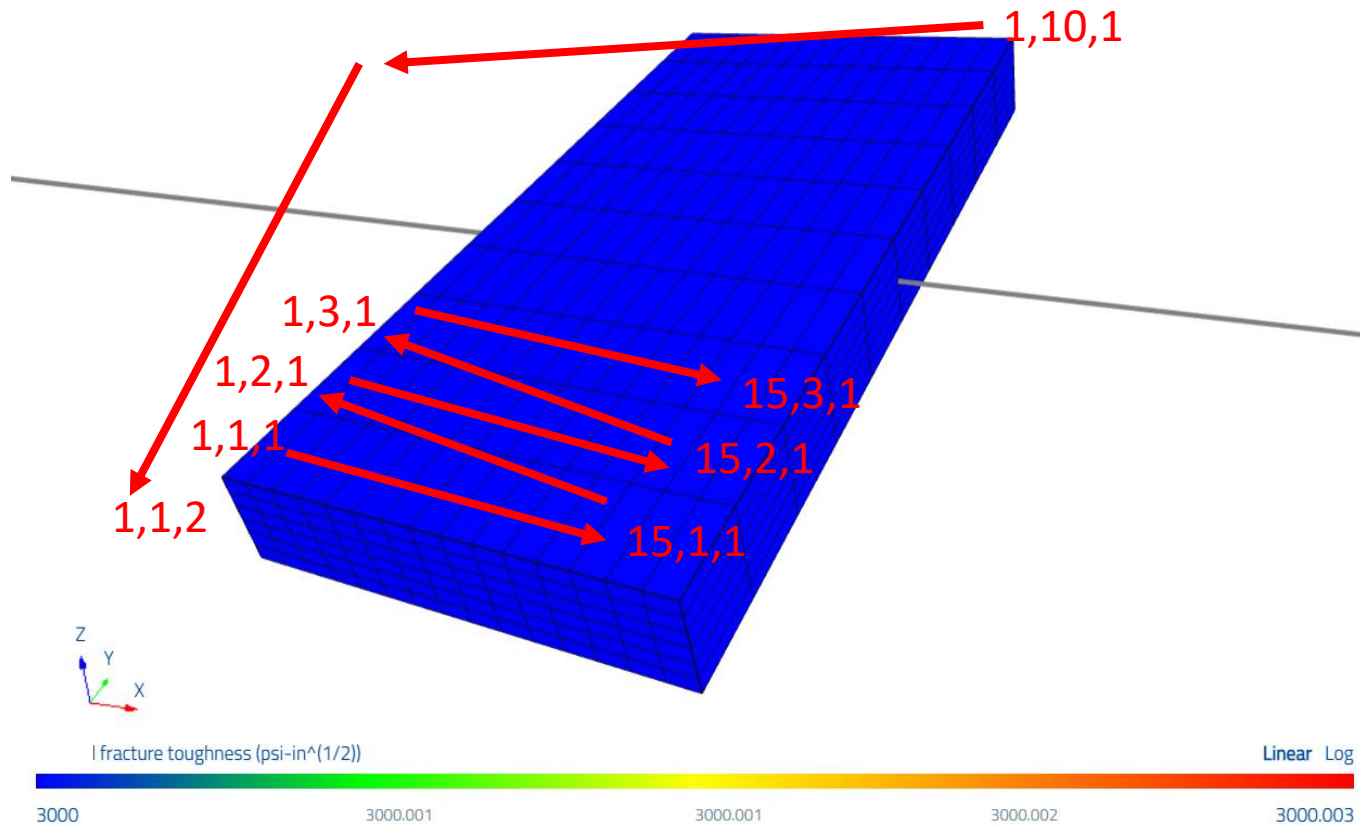
# General Heterogeneity

Our goal is to vary the horizontal toughness across the  $Sh_{max}$  direction.



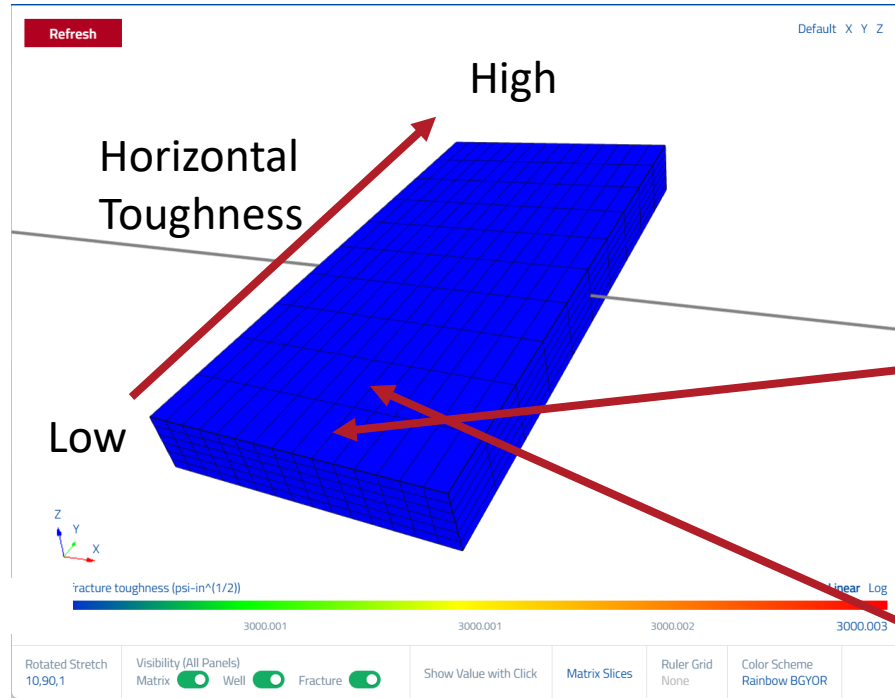
1. The size of the matrix is defined in the meshing tab. For our case, the number of elements for  $Sh_{min}=15$ ,  $Sh_{max} = 10$  and Vertical = 6, totaling 900 lines.
2. **REMEMBER!**  $Sh_{max}$  and  $Sh_{min}$  are not necessarily aligned with x, y coordinate system.
3. Click the 'Z' in the upper right corner to position the matrix in the coordinate system. This will give an aerial view from directly above with the x and y axis positioned correctly. Note that I have moved my matrix to show the z layers for clarity.
4. Hover over the visibility pane and choose 'axes' to show the direction of the x, y and z axes. This will help keep our numbering straight.

# General Heterogeneity – Assigning Properties



1. Start with the top layer.
2. The properties are specified from left to right in the x direction and from bottom to top in the y direction.
3. Each coordinate to the left corresponds to a line in the text file.
4. Work your way down the z direction in the exact same fashion.
5. It is best to create an excel file to help keep track of all the elements.

# General Heterogeneity – Create an Excel File



Horizontal Toughness			
	Matrix Coordinate		
Toughness Value	x	y	z
1000.00	1.00	1.00	1.00
1000.00	2.00	1.00	1.00
1000.00	3.00	1.00	1.00
1000.00	4.00	1.00	1.00
1000.00	5.00	1.00	1.00
1000.00	6.00	1.00	1.00
1000.00	7.00	1.00	1.00
1000.00	8.00	1.00	1.00
1000.00	9.00	1.00	1.00
1000.00	10.00	1.00	1.00
1000.00	11.00	1.00	1.00
1000.00	12.00	1.00	1.00
1000.00	13.00	1.00	1.00
1000.00	14.00	1.00	1.00
1000.00	15.00	1.00	1.00
1200.00	1.00	2.00	1.00
1200.00	2.00	2.00	1.00
1200.00	3.00	2.00	1.00
1200.00	4.00	2.00	1.00
1200.00	5.00	2.00	1.00
1200.00	6.00	2.00	1.00

Assigns the value of 1000 to the first row or x coordinates (y=1).

Starts over on the second row (y=2) and assigns a value of 1200.

Etc.

# General Heterogeneity – Create a text file

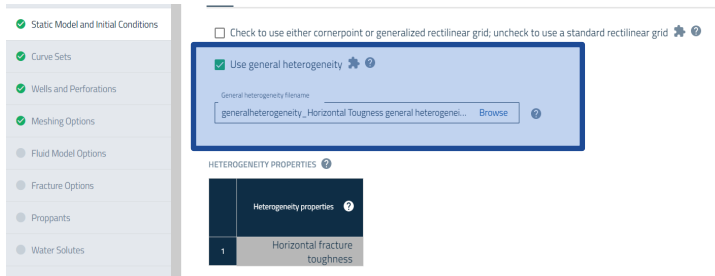
```
1 Horizontal fracture toughness
2 ***
3 1000
4 1000
5 1000
6 1000
7 1000
8 1000
9 1000
10 1000
11 1000
12 1000
13 1000
14 1000
15 1000
16 1000
17 1000
18 1200
19 1200
20 1200
21 1200
22 1200
23 1200
24 1200
25 1200
26 1200
27 1200
28 1200
29 1200
30 1200
31 1200
32 1200
```

- Copy and paste your excel file into a text file. Do not include the coordinates, just the values. The coordinates in the excel file are just there to help tracking.
- Ensure that all the parameters are listed first and in the order they appear in the file
- They must be spelled and capitalized correctly!
- Use \*\*\* to differentiate parameters.

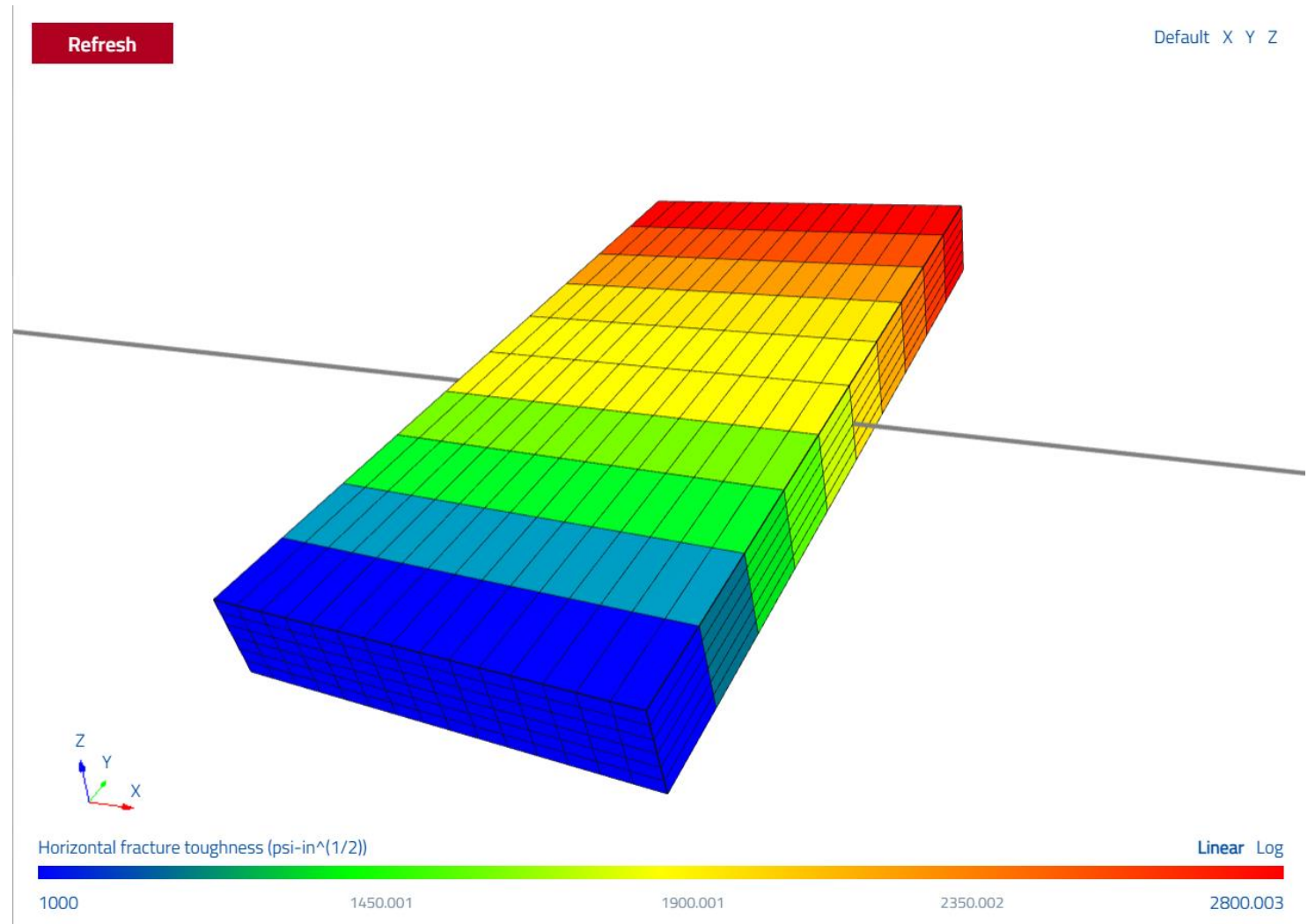
```
Initial porosity
Initial temperature
***
.05
.05
.05
.05
.05
.05
.05
.05
***
350
350
350
350
350
350
350
350
```

Example of multiple parameters

# General Heterogeneity



- Click the 'use general heterogeneity' button.
- Browse to the file and select.
- The parameter will show up in the properties table directly below.
- Verify in the UI preview panel that the values are correct.





# Thank You!

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Last updated Feb 2026