

FRANC3D Training Workshop: Part 4

FRANC3D User Interface

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Drs. Paul “Wash” Wawrzynek, Bruce Carter,
Tony Ingraffea and Omar Ibrahim

Workshop Agenda

- Part 1: Introduction to Fatigue and Damage Tolerance
- Part 2: Introduction to Fracture Mechanics Analysis
- Part 3: Introduction to FRANC3D
- **Part 4: FRANC3D User Interface**
- Part 5: Finite Element (FE) Model Import
- Part 6: Crack Insertion
- Part 7: Static Crack Analysis & SIF Computation
- Part 8: SIFs from FE Analysis
- Part 9: Crack Growth
- Part 10: SIF History & Fatigue Life
- Part 11: Miscellaneous Topics

FRANC3D User Interface

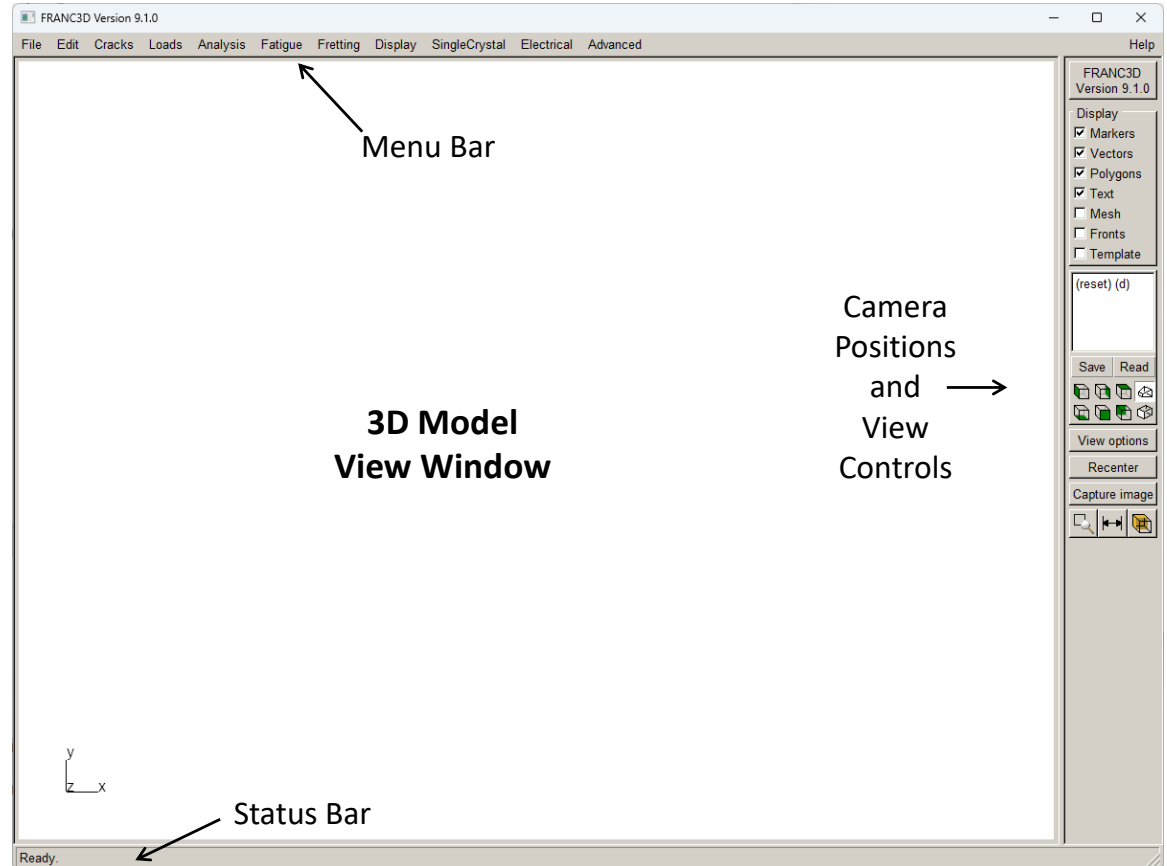
- FRANC3D Main Window
- 3D View Manipulation
- Menus
- Preferences
- FRANC3D Files
- FRANC3D Session Log

FRANC3D Main Window

The view manipulations are:

- Rotate (left mouse button, no keyboard keys)
- Pan (center mouse button or wheel, no keyboard keys)
- Zoom/Spin (right mouse button, no keyboard keys)
- Front Clip (center mouse button or wheel plus shift key)
- Back Clip (right mouse button or wheel plus shift key)

These defaults can be modified in the Preferences.



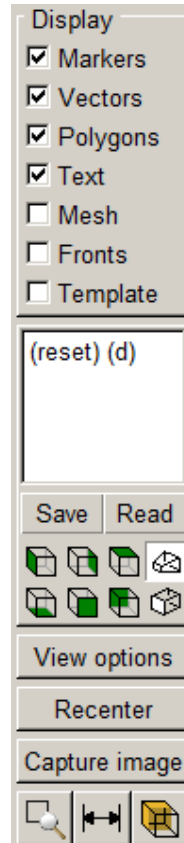
3D View Manipulation

Graphical Element Toggles

Named Camera Positions

Preset Camera Positions

View Options



View options: displays a dialog that allows one to change the rotation, pan and zoom speeds.

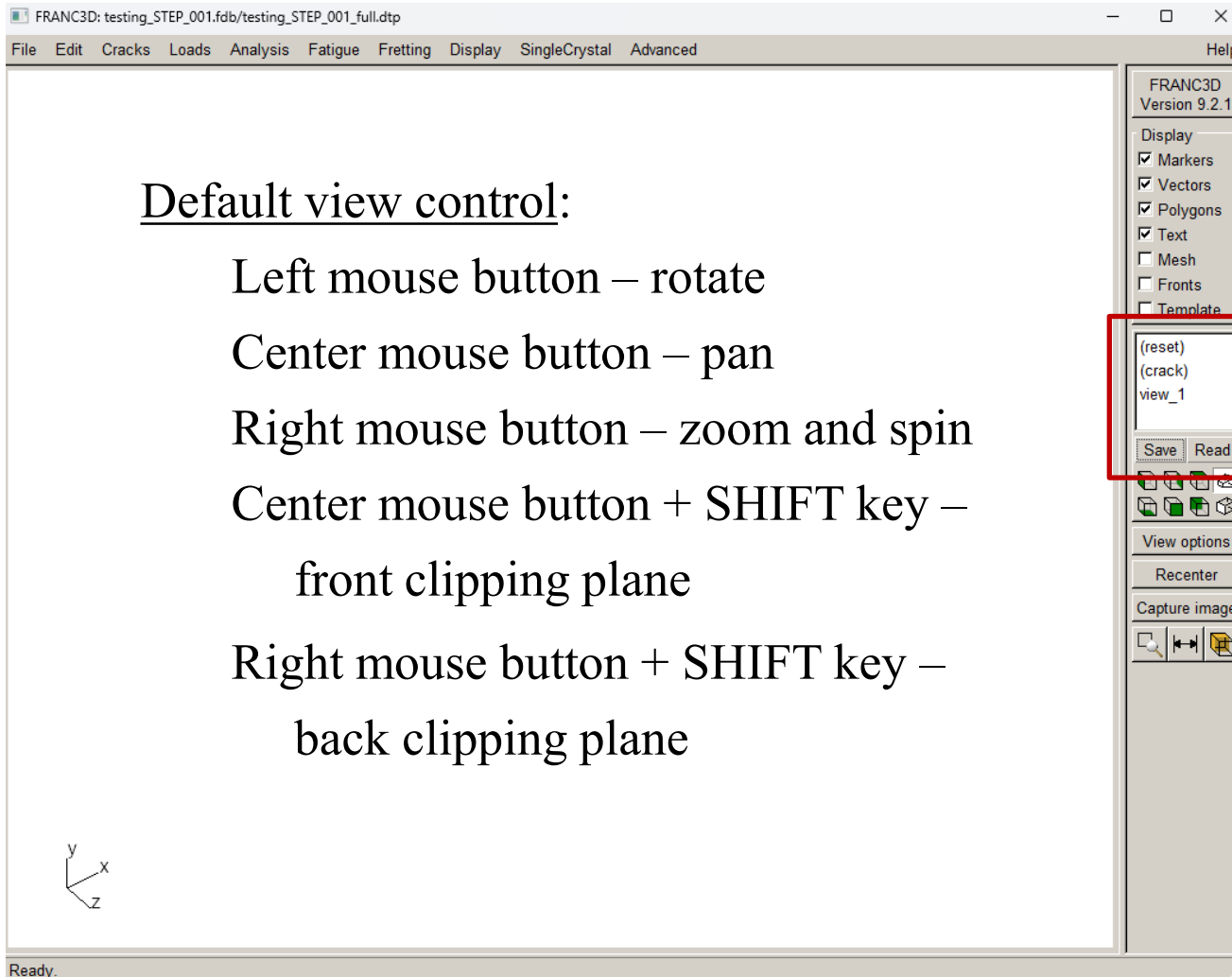
Recenter: allows one to change the center of rotation.

Capture: Displays the Save File As dialog. The current view of the model is captured and saved to either a .png or .jpg file.

Camera Position

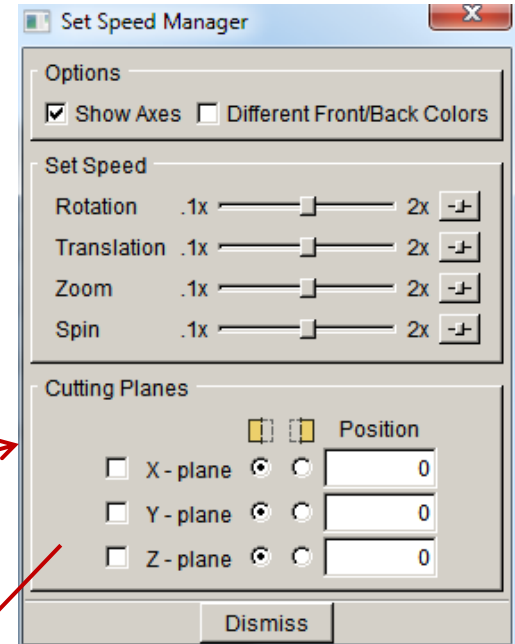
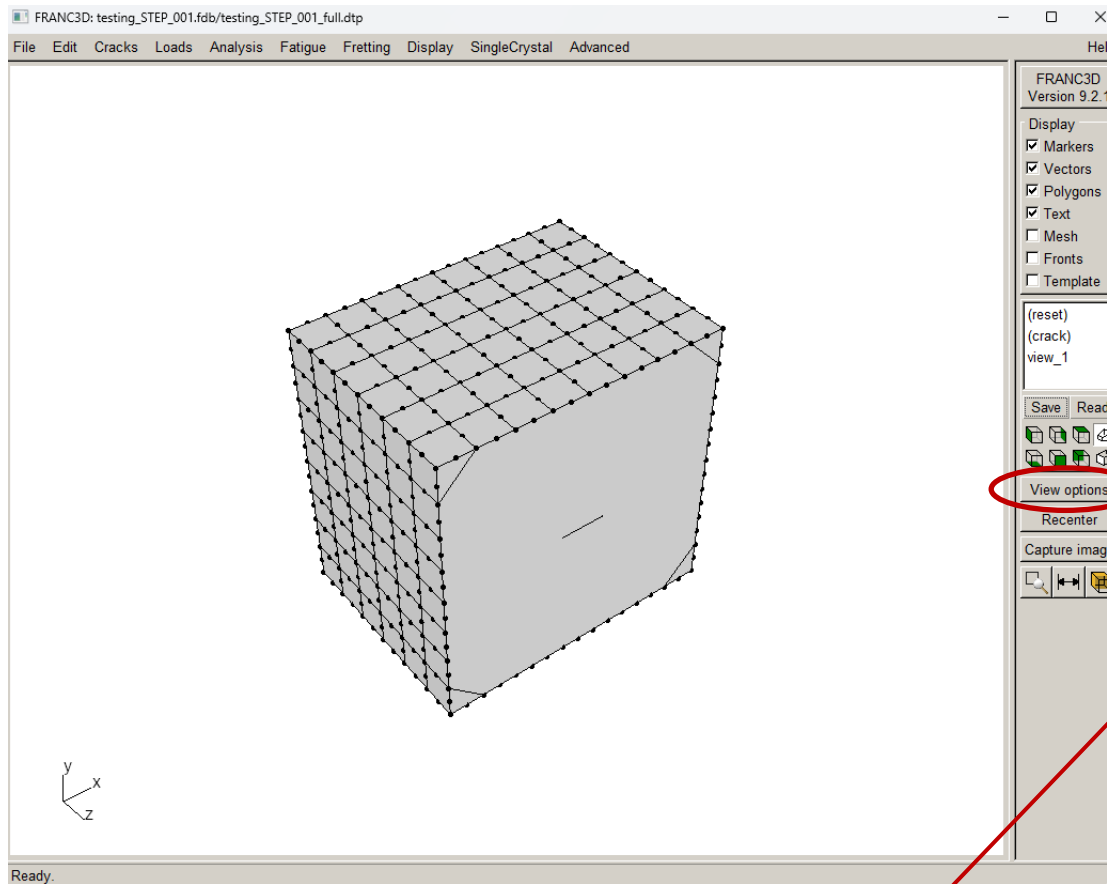
Default view control:

- Left mouse button – rotate
- Center mouse button – pan
- Right mouse button – zoom and spin
- Center mouse button + SHIFT key – front clipping plane
- Right mouse button + SHIFT key – back clipping plane



Saved camera positions provide way to quickly change to different views.

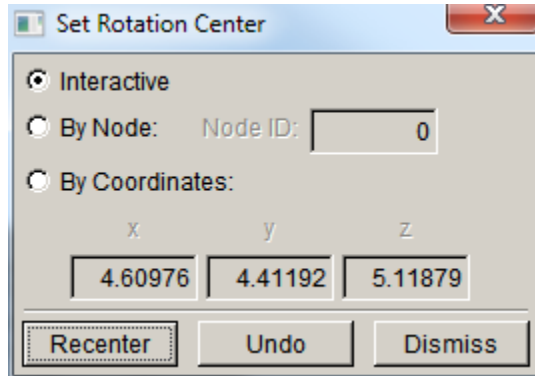
View Options



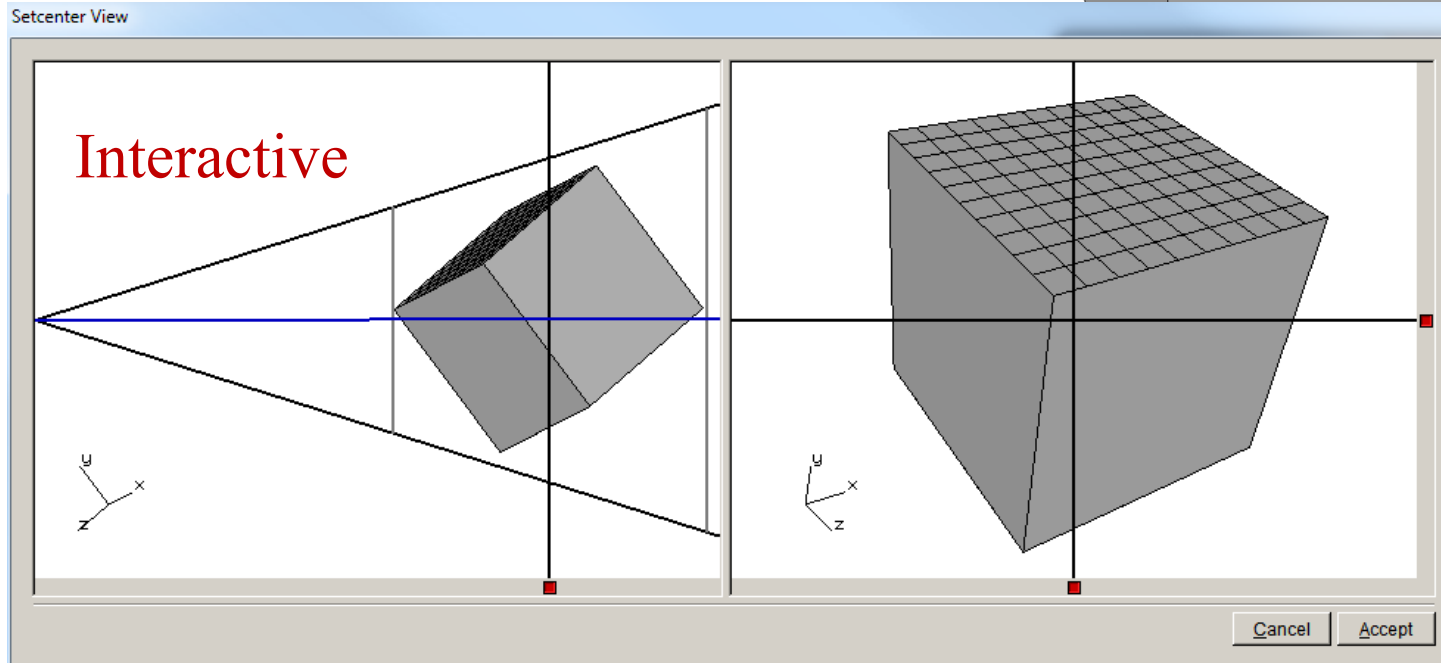
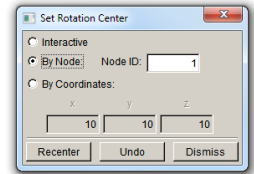
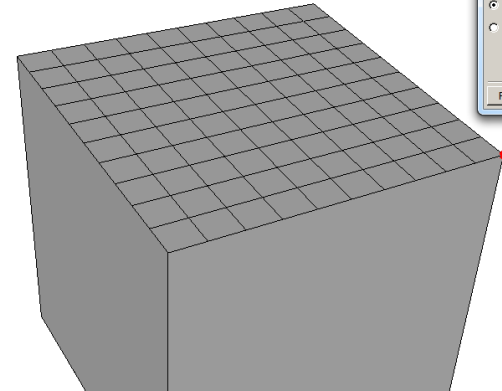
Allows user to cut away a portion of the model based on cutting planes aligned with the global Cartesian axes.

Control the speed of rotation, translation and zooming when “moving” the model with the mouse.

Recenter: ctrl key + left mouse button

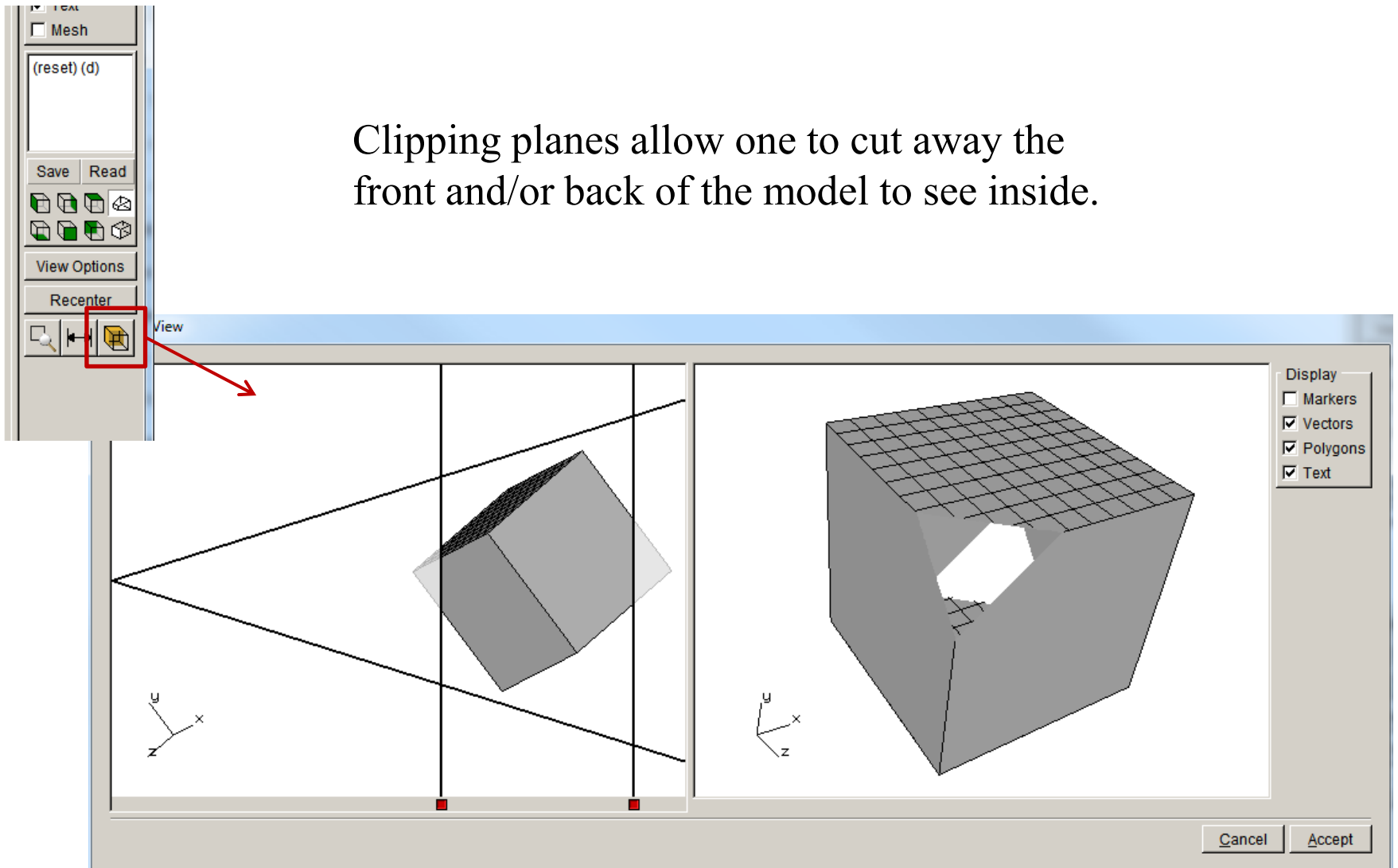


Default center of rotation is the center of the model.

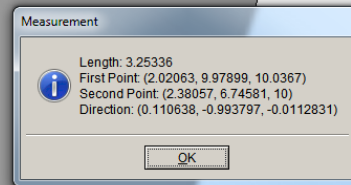
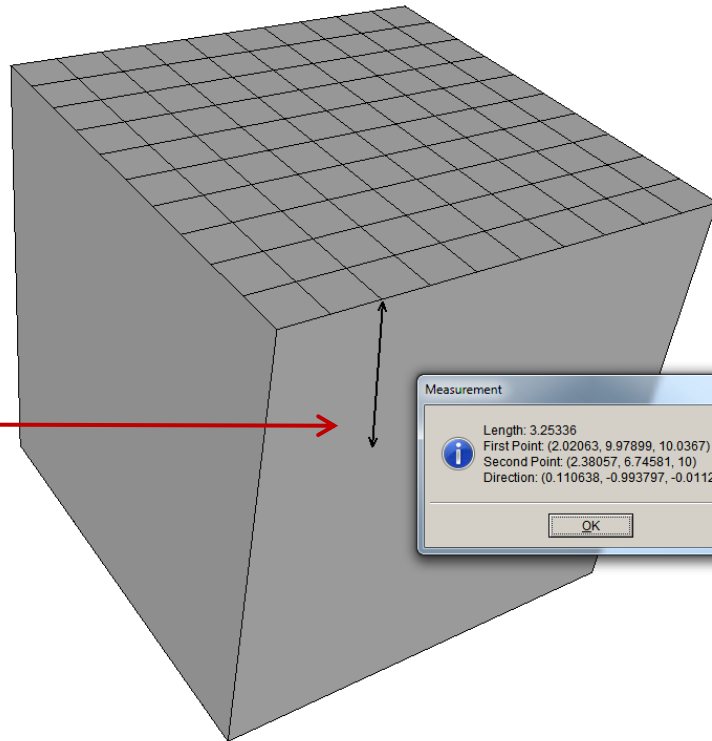
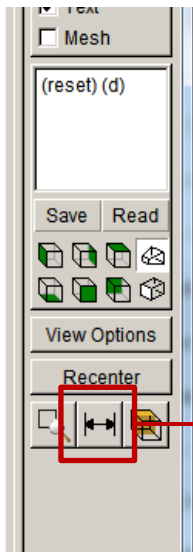


Clipping Planes

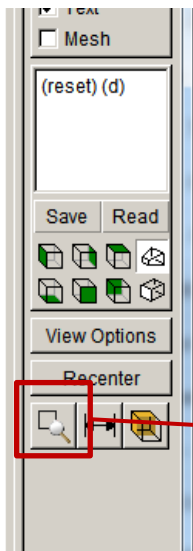
Clipping planes allow one to cut away the front and/or back of the model to see inside.



Measure & Box Zoom

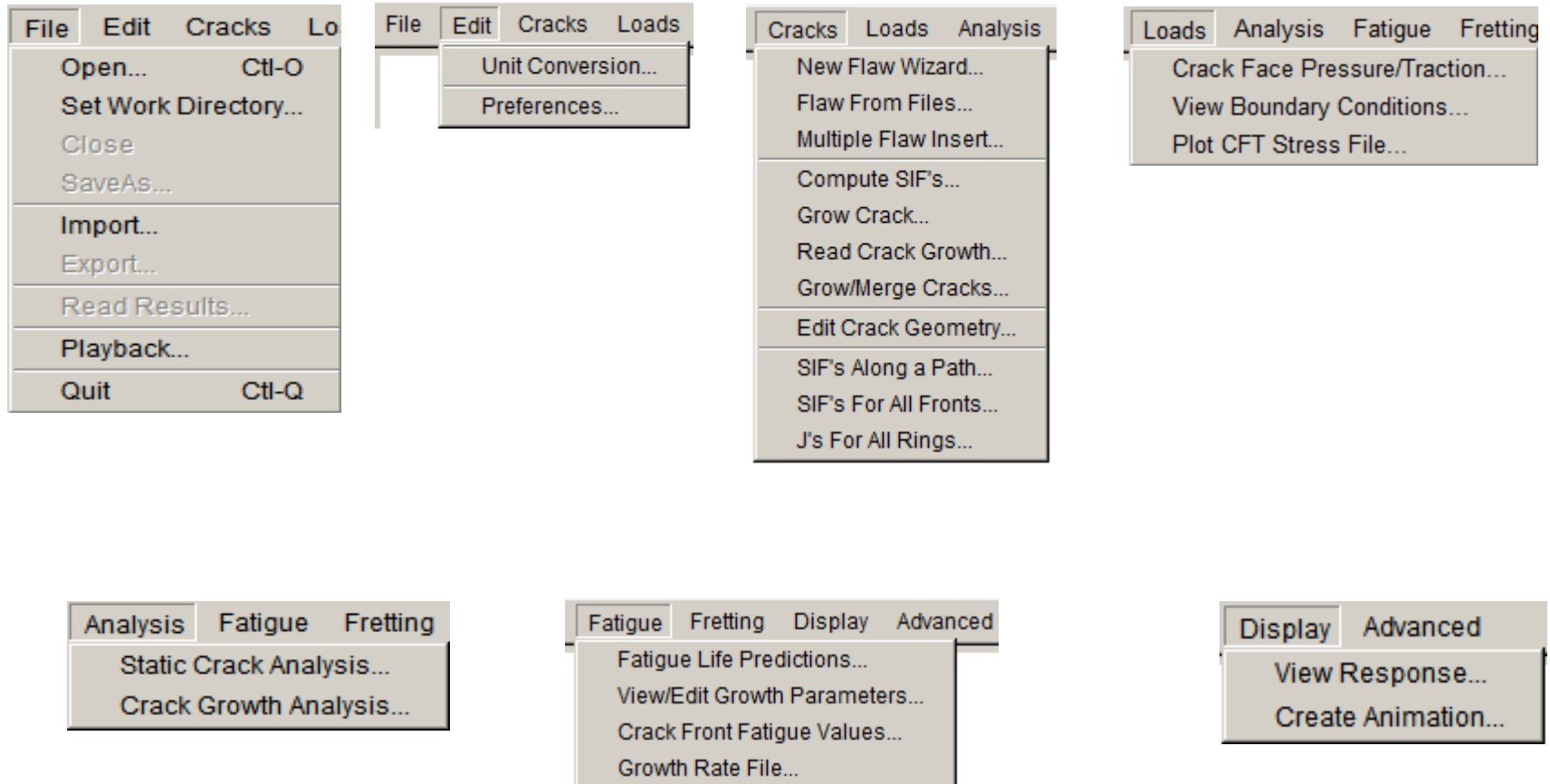


Measurement tool gives the length on the surface or the coordinates for a single point (if you don't drag the mouse).

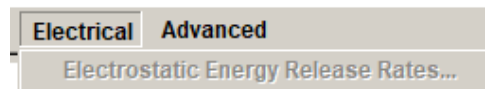
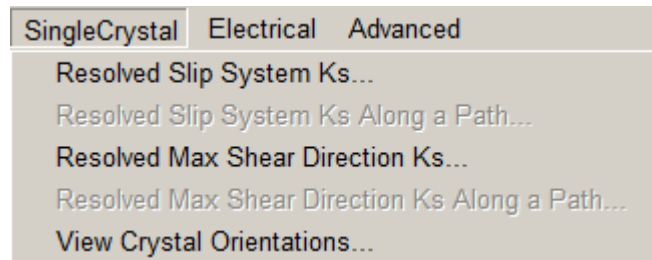
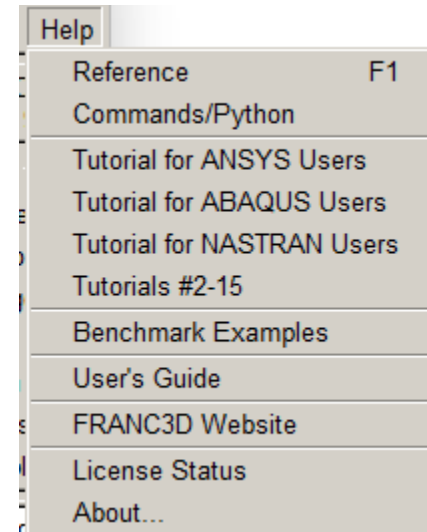
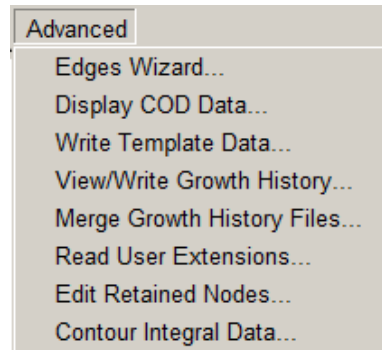
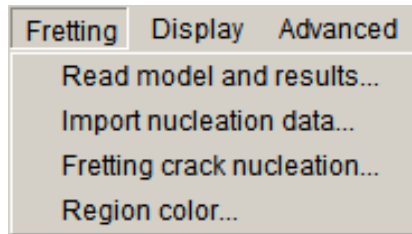


Box zoom tool allows one to drag a box to zoom in on a region of the model.

Menus



Menus



Preferences Tabs

- Selecting the Edit → Preferences menu item invokes the Preferences dialog, which allows one to set program-wide configurations.

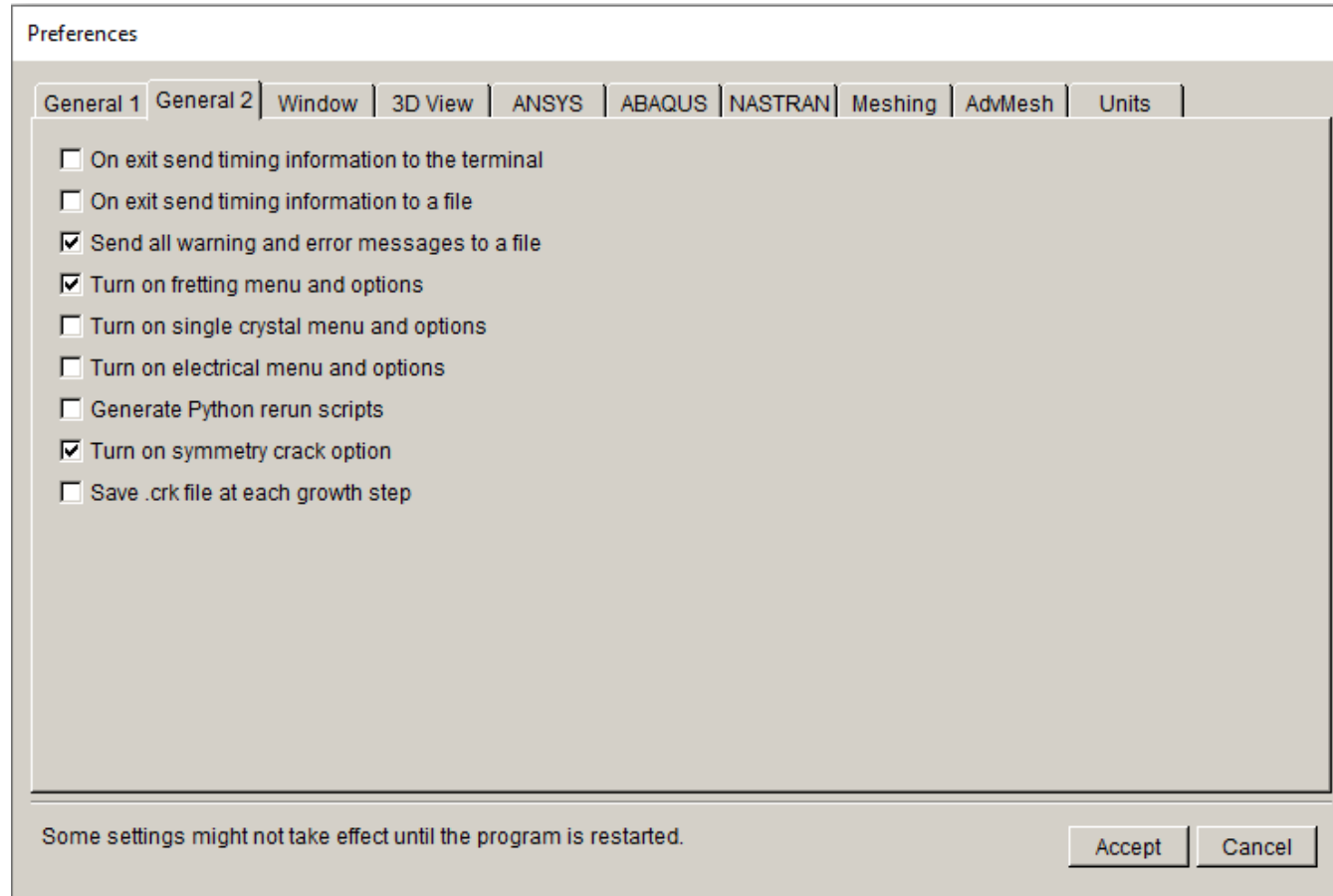
The screenshot shows the 'Preferences' dialog box with the 'General 1' tab selected. The dialog has a title bar 'Preferences' and a tabbed interface with the following tabs: General 1, General 2, Window, 3D View, ANSYS, ABAQUS, NASTRAN, Meshing, AdvMesh, and Units. The 'General 1' tab contains the following settings:

- Fallback Directory:** C:\bruce (with a 'Browse' button)
- Help File Directory:** C:\Users\bruce\Desktop\franc3d_v80_docs (with a 'Browse' button)
- ☐ Suppress directory box in file selection (speed access to network drives)
- ☐ Double size graphics for high resolution screens
- Available FE input:** ☒ ANSYS ☒ ABAQUS ☒ NASTRAN
- Default FE input:** ☐ ANSYS ☒ ABAQUS ☐ NASTRAN
- FE Input Checks:** ☐ Turn on DoCheck option for FE import
- FRANC3D/RLM License:** ☒ Release license during FE analysis
- NASGRO user defined XML material library**
- Library File:** (empty text box with a 'Browse' button)

At the bottom of the dialog, there is a message: 'Some settings might not take effect until the program is restarted.' and two buttons: 'Accept' and 'Cancel'.

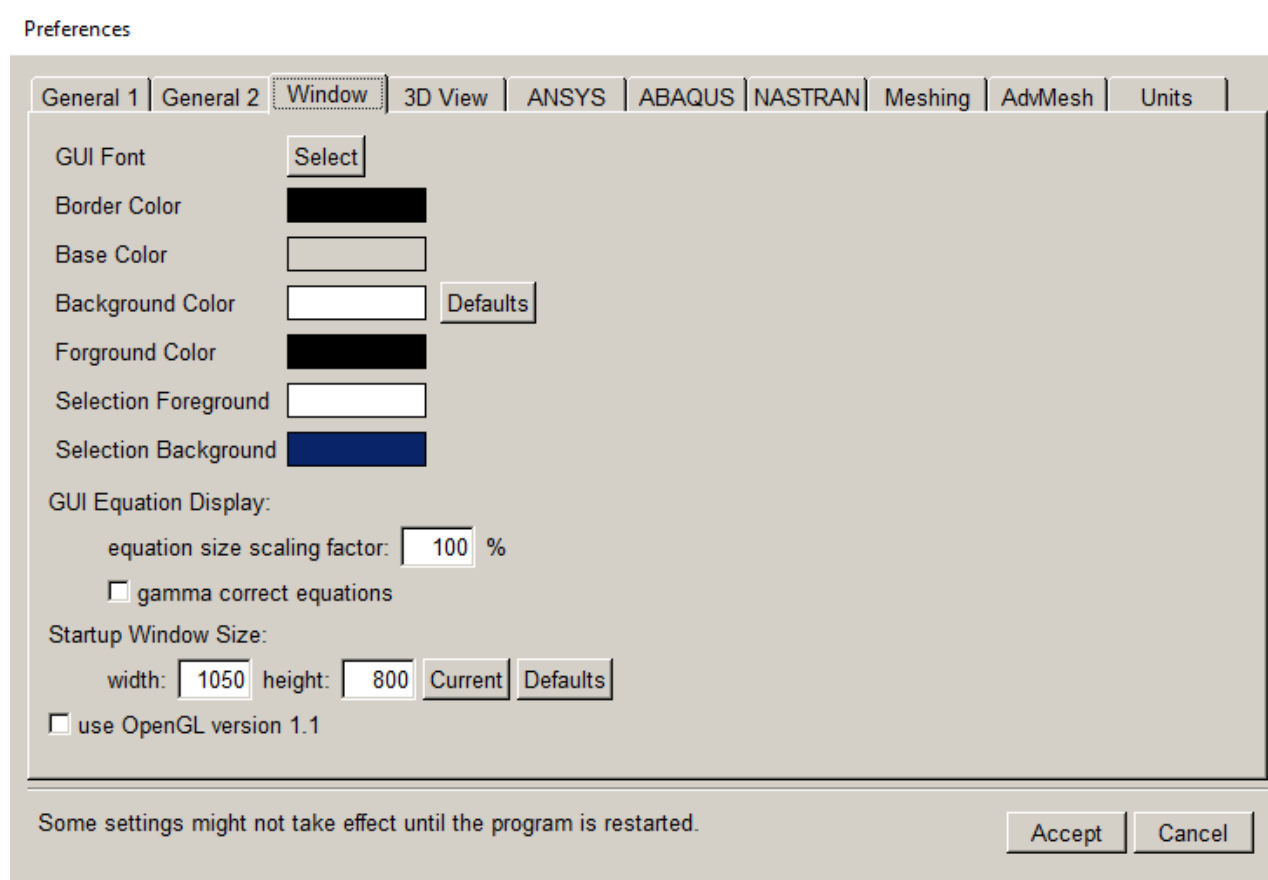
Preferences Tabs

- General 2 Tab



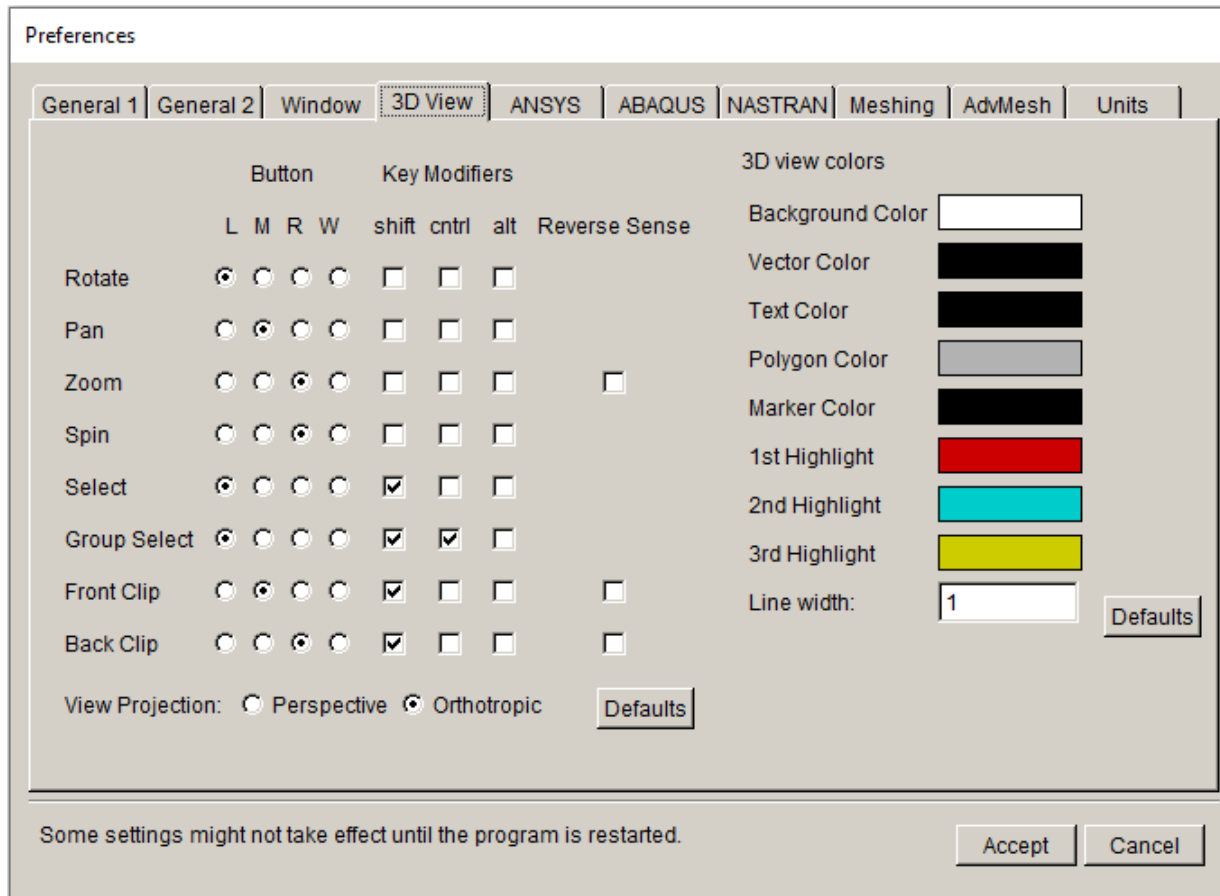
Preferences Tabs

- Window Tab



Preferences Tabs

- 3D View Tab



Preferences Tabs

- ANSYS Tab

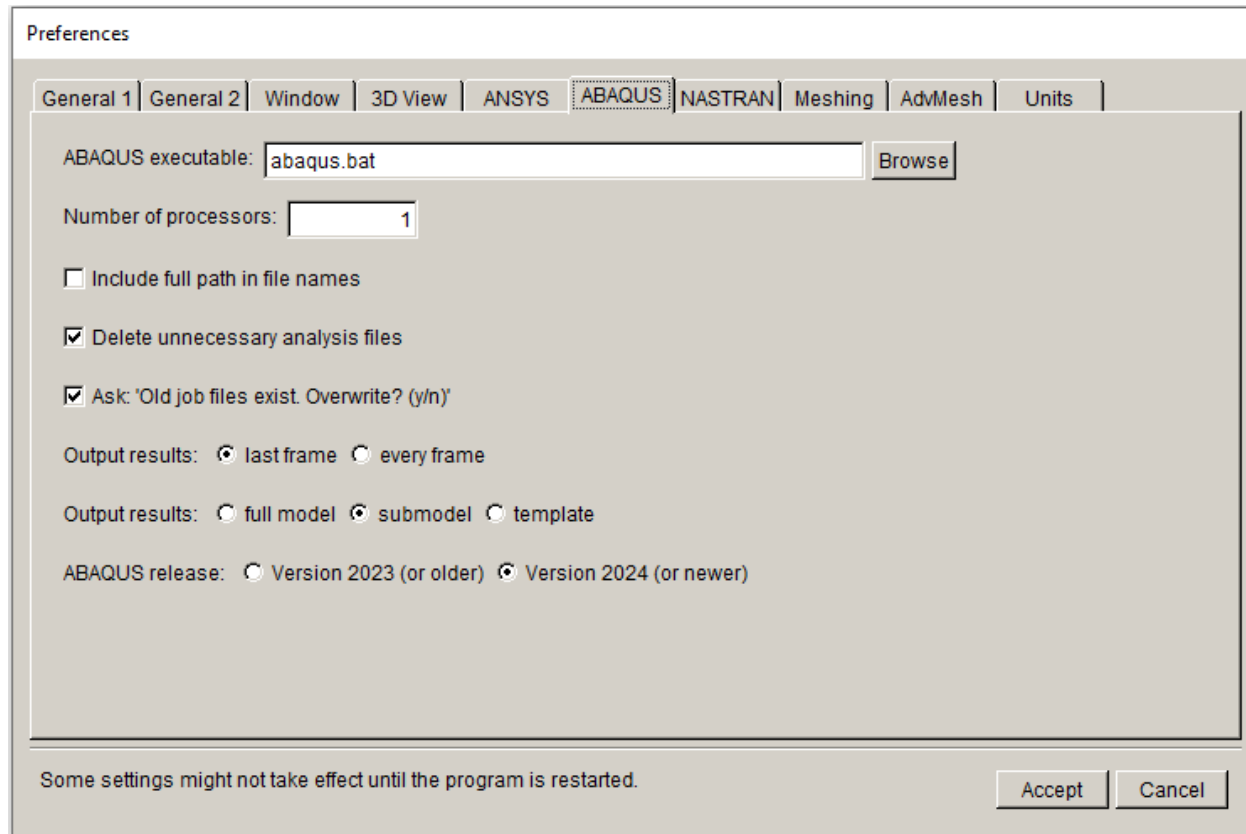
The screenshot shows the 'Preferences' dialog box with the 'ANSYS' tab selected. The dialog has a title bar 'Preferences' and a tabbed interface with the following tabs: General 1, General 2, Window, 3D View, ANSYS (selected), ABAQUS, NASTRAN, Meshing, AdvMesh, and Units. The ANSYS tab contains the following settings:

- ANSYS executable:
- ANSYS license:
- Job name: ☒ none ☐ cdb name ☐ specify jobname:
- Total memory: Database memory: (0 lets ANSYS choose)
- Number of processors: ☐ Use -dis: ☐ no -mpi ☐ -mpi pcmpi ☐ -mpi intelmpi ☒ -mpi openmpi
- ☐ Add to command:
- ☐ Include full path in file names
- ☒ Delete unnecessary analysis files
- Output results: ☒ last substep ☐ every substep
- Output results: ☐ full model ☒ submodel ☐ template

At the bottom of the dialog, there is a message: 'Some settings might not take effect until the program is restarted.' and two buttons: 'Accept' and 'Cancel'.

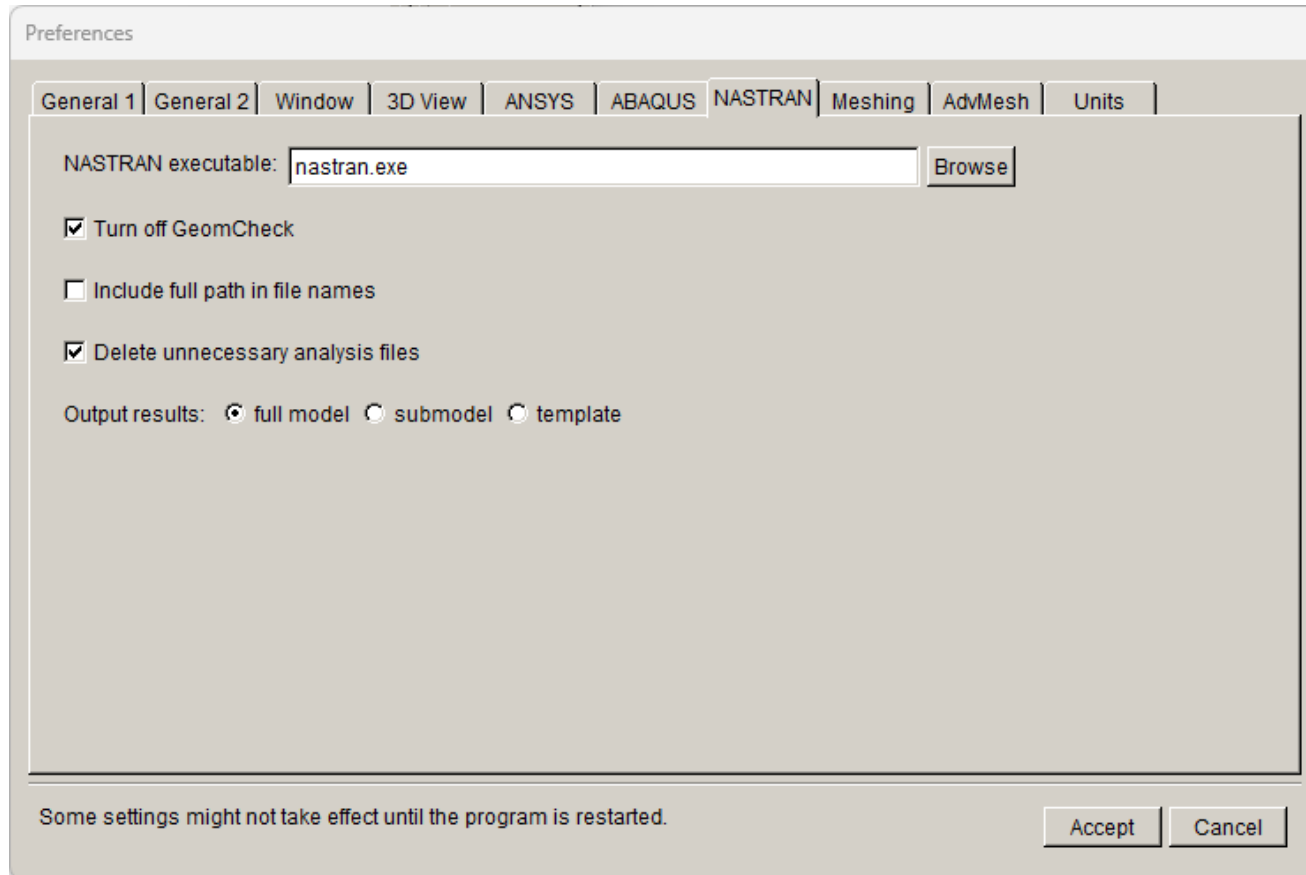
Preferences Tabs

- ABAQUS Tab



Preferences Tabs

- NASTRAN Tab



Preferences Tabs

- Meshing Tab

The screenshot shows the 'Preferences' dialog box with the 'Meshing' tab selected. The dialog has a title bar 'Preferences' and a tab bar with the following tabs: General 1, General 2, Window, 3D View, ANSYS, ABAQUS, NASTRAN, Meshing (selected), AdvMesh, and Units. The Meshing tab contains the following settings:

Setting	Value
Number of element rings in template:	3
Number of circumferential elements:	8
Progression ratio:	1
Maximum aspect ratio:	2
Maximum volume elements:	1000000
Maximum backtrack restarts:	4
Template elements:	☒ wedge+brick ☐ all brick ☐ all tet
Use quarter points:	☒
Constrain bricks (for all brick):	☒
Do coarsen crack mouth	☒
Do crack proximity refinement	☒
Do not coarsen more than uncracked mesh	☒
Volume mesh using:	☒ FRANC3D ☐ ANSYS ☐ ABAQUS
ANSYS or ABAQUS volume meshing:	☐ write files only

Some settings might not take effect until the program is restarted.

Accept Cancel

Preferences Tabs

- AdvMesh Tab

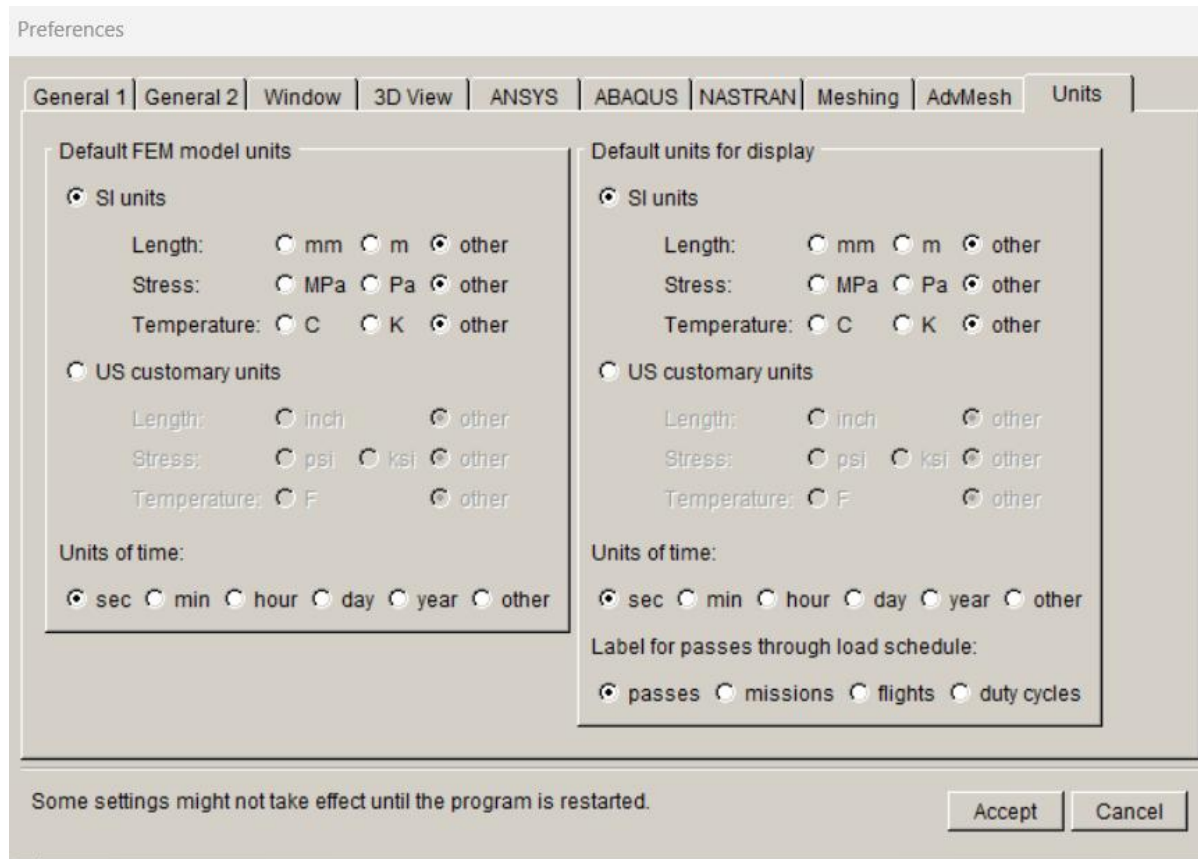
The image shows a software preferences window titled "Preferences". It has a tabbed interface with the following tabs: General 1, General 2, Window, 3D View, ANSYS, ABAQUS, NASTRAN, Meshing, AdvMesh (which is the active tab), and Units. The AdvMesh tab contains five settings, each with a label, a text input field, and a description:

Setting	Value	Description
Surface Max Internal Element Ratio:	20	Ratio of the maximum element size allowed in the interior of a surface mesh to the maximum element size on the boundary.
Surface Density Decay Ratio:	1.4	Nominally the maximum size ratio between two adjacent elements in a surface mesh.
Surface Curvature Refinement Factor:	0.523	If r is the local minimum principal radius of curvature, then the local maximum ideal element size will be $r * \text{SurfCurvatureRefineFactor}$, or this is the maximum secant angle an element will span for this r .
Surface Curvature Refinement Limit:	0.25	The maximum ratio between the nominal local element size and a reduced size set due to local surface curvature.
Surface Crack Front Decay Ratio:	2	The ratio at which adjacent element sizes can increase as one moves from a crack front to a nearby surface.

At the bottom of the dialog, there is a message: "Some settings might not take effect until the program is restarted." and two buttons: "Accept" and "Cancel".

Preferences Tabs

- Units Tab: set default units for the FE model and for display



Preferences

- Preferences are stored in a database that is read when FRANC3D is started.
- Some Preference settings might not take effect until the program is **restarted**, so if you change settings, it is best to quit and restart.

FRANC3D Files

.fdb – FRANC3D restart file

stores crack geometry, growth model, SIF history,
reference to other files described below

.cdb/.inp/.bdf – original uncracked FE model and cracked FE model files

.dtp – results file with displacements, temperatures, contact pressures

.crk – crack geometry

.log – GUI session log file contains FRANC3D commands

.fcg – fatigue crack growth data (SIF history and crack growth model)

STEP####.* – automatically named and numbered crack growth step files

FE analysis code files: *i.e.* .db & .rst for ANSYS, .odb for ABAQUS

Analysis Results

- **File** → **Read Results** menu item allows one to choose the analysis results file.
- For ANSYS, FRANC3D reads
 - *.dtp file (contains displacements, temperatures, contact pressure) that is created using the ANSYS APDL macro generated by FRANC3D
- For ABAQUS, FRANC3D reads
 - *.dtp file (contains displacements, temperatures, contact pressure) that is created using the FRANC3D generated ABAQUS Python script
- For NASTRAN, FRANC3D reads
 - *.pch file, which contains displacements; temperatures are based on the input temperature for the uncracked model

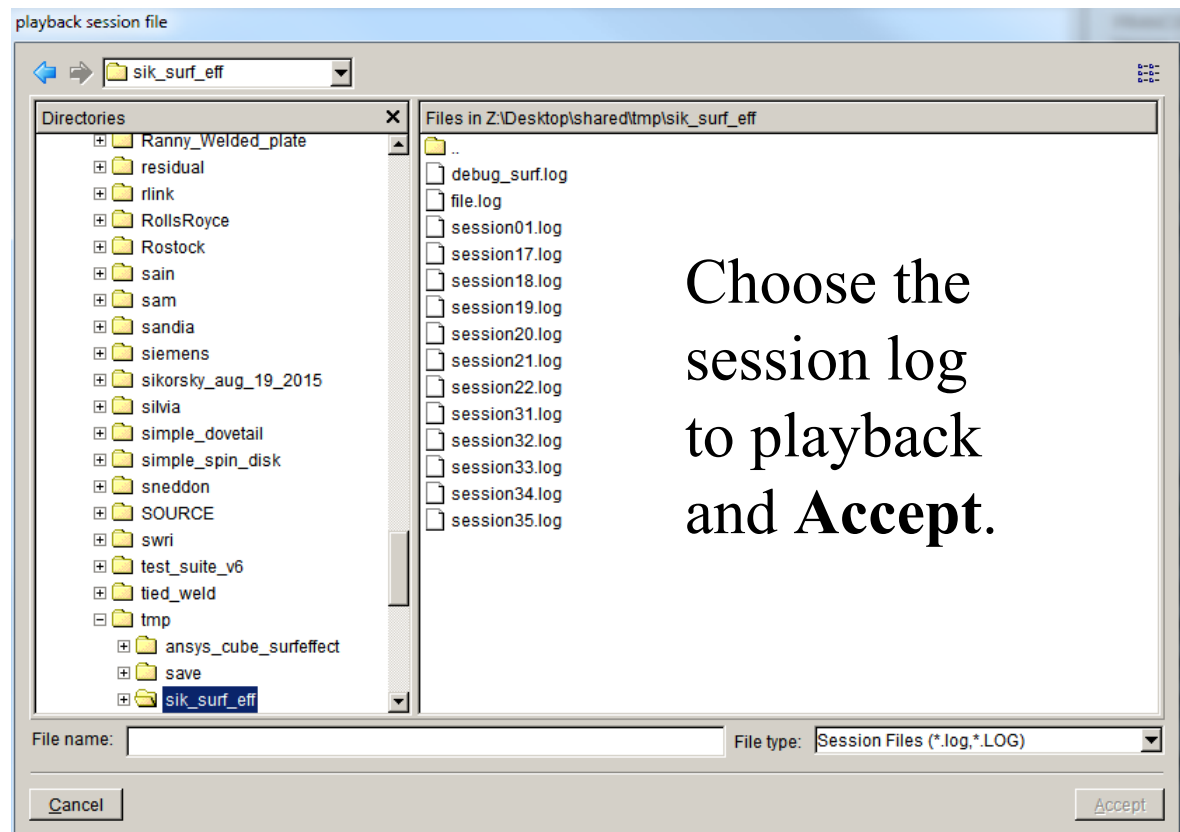
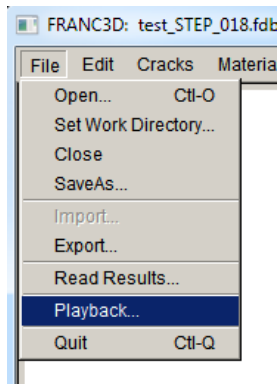
FRANC3D Session Log and Playback

A session###.log file is saved for each FRANC3D GUI session. As GUI commands are executed, each command is written to the session log. An example session:

```
OpenMeshModel(  
    model_type=ANSYS,  
    file_name='cube_orig.cdb',  
    retained_nodes_file='cube_orig_RETAINED.txt')  
  
InsertFileFlaw(  
    file_name='test.crk',  
    radius=0.0081)  
  
RunAnalysis(  
    model_type=ANSYS,  
    file_name='test.fdb',  
    flags=[TRANSFER_BC,NO_CFACE_TRACT,NO_CFACE_CNTCT],  
    connection_type=MERGE,  
    command="ANSYS222.exe" -b -p ansys -i "test.macro" -o "test.out")  
  
ComputeSif(  
    do_therm_terms=true,  
    ref_temp=71.6)
```

FRANC3D Session Log and Playback

The session can be played back in the GUI:
from FRANC3D menu, choose **File** → **Playback**



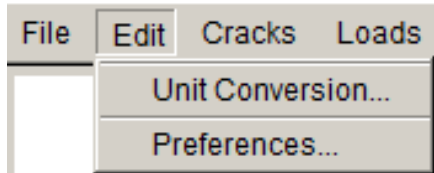
Choose the
session log
to playback
and **Accept**.

The log file can also
be played back from a
Command/Terminal:

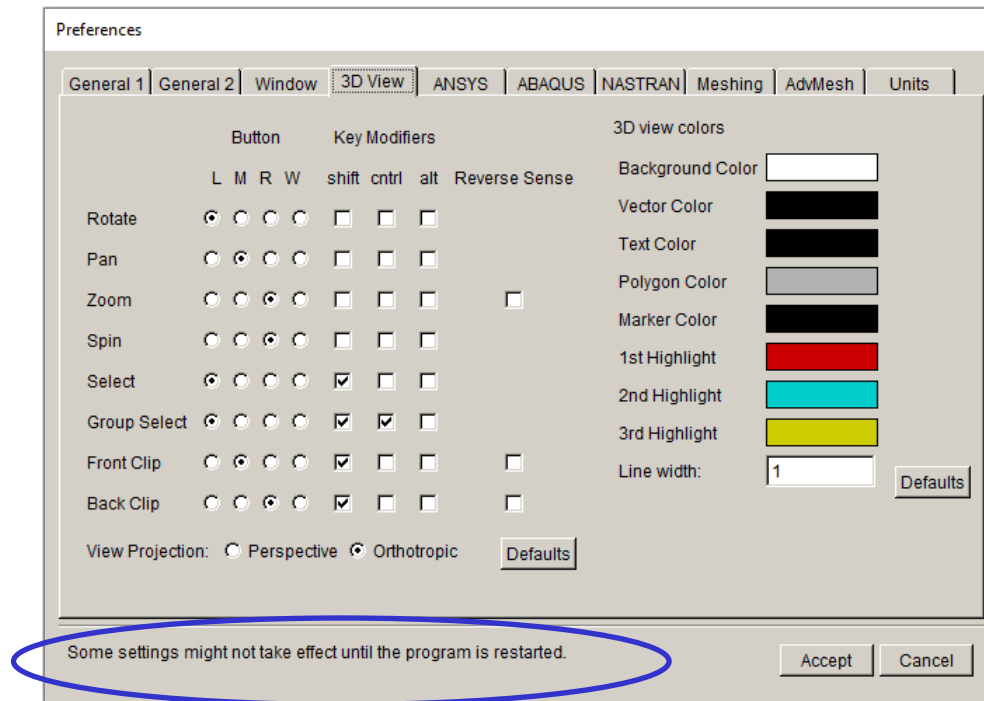
➤ `franc3d -batch ses.log`

Demo/Hands On (Homework): Set Preferences, Work Directory and Units

FRANC3D Tutorial 1 – before you start



Set your Preferences, **Accept** and then quit and restart FRANC3D.



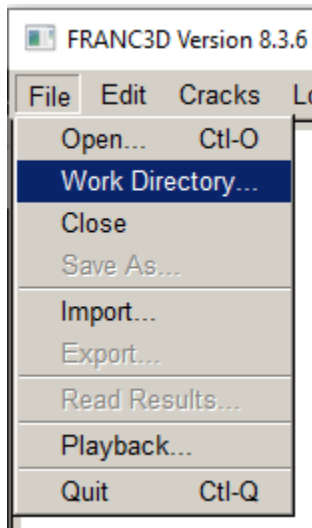
It is usually best to quit and restart the program after changing settings. Settings are saved to text file in user's home folder:

franc3d.ini for MS Windows

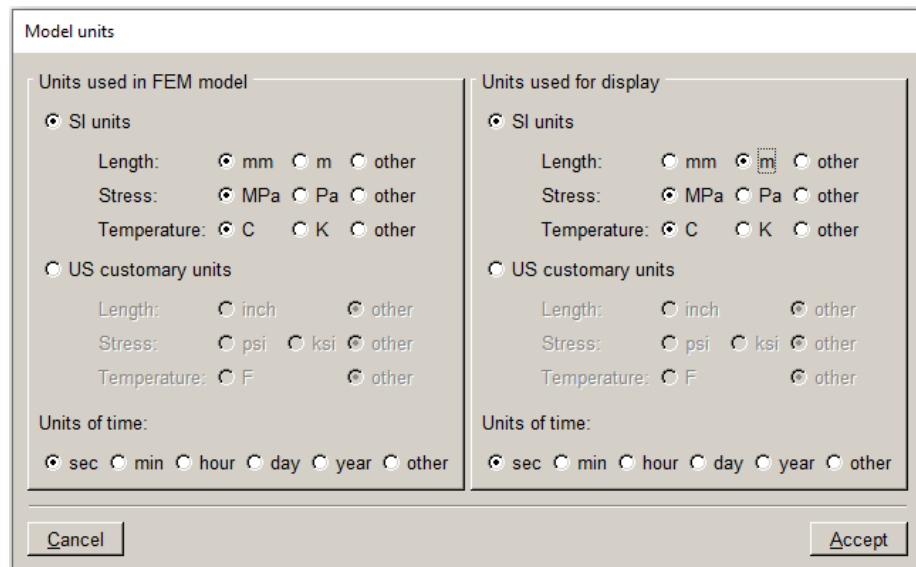
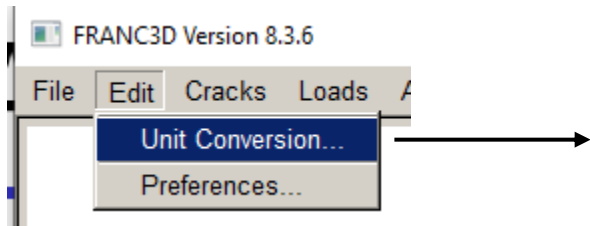
.franc3d.rc for Linux

FRANC3D Tutorial 1 – before you start

Set your Work Directory and your FE model units.



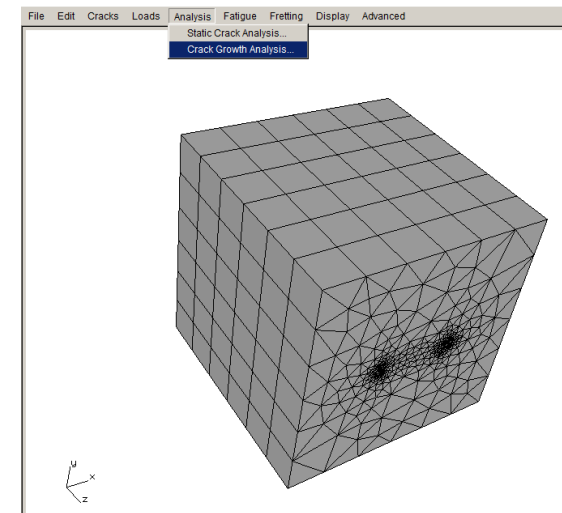
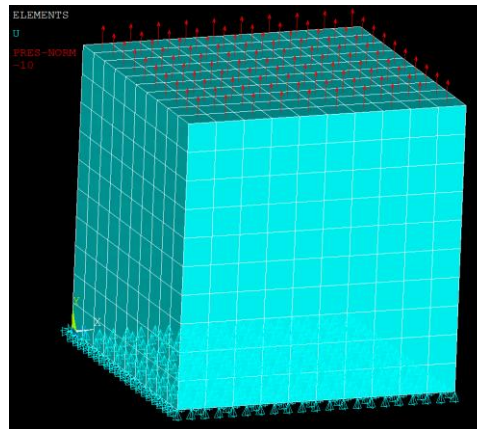
Use separate folders for each new model.
Lots of files are generated during analysis and growth.



Demo & Hands On (Homework): Download Tutorial Doc / Files

- FRANC3D Documentation:
 - FRANC3D/ABAQUS Tutorial
 - FRANC3D/ANSYS Tutorial
 - FRANC3D/NASTRAN Tutorial
 - FRANC3D/SIERRA Tutorial

Tutorial #1: Crack Insertion and Growth in a Cube



End Part 4