C&R TECHNOLOGIES

Tips and Tricks

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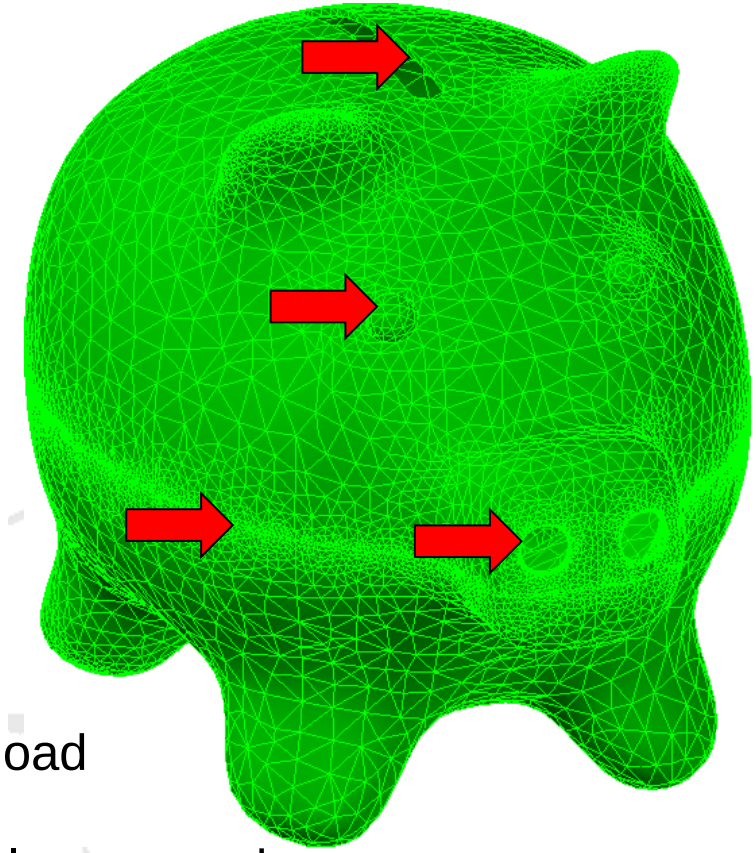
Improving Graphics Speed

Thermal Desktop Settings and AutoCAD options

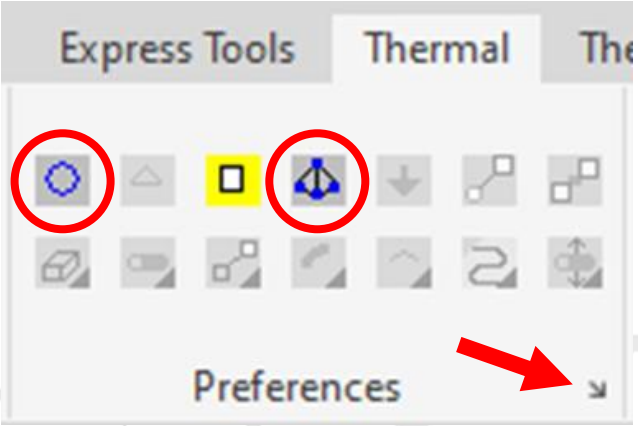
Problem Description

- Models are becoming extremely large
  - Model summary
    - Nodes: 26500
    - Mid-side nodes: 135073
    - Surface elements: 46588
    - Solid elements: 85278
- First question to ask: Is it necessary?
  - Remove unnecessary details
    - Groove at seam
    - Small rounds
    - Small features (depending on requirements)
  - Model as a thin shell or sweep through thin bodies
  - Curved elements add mid-side nodes and increase graphics load
    - Curved elements with fine resolution are usually unnecessary
  - For general trends and early estimates, perhaps a sphere is close enough
  - Exclude unnecessary CAD geometry from the thermal model DWG
    - Pipe centerlines and parts meshed with TD Mesher are all that must be included



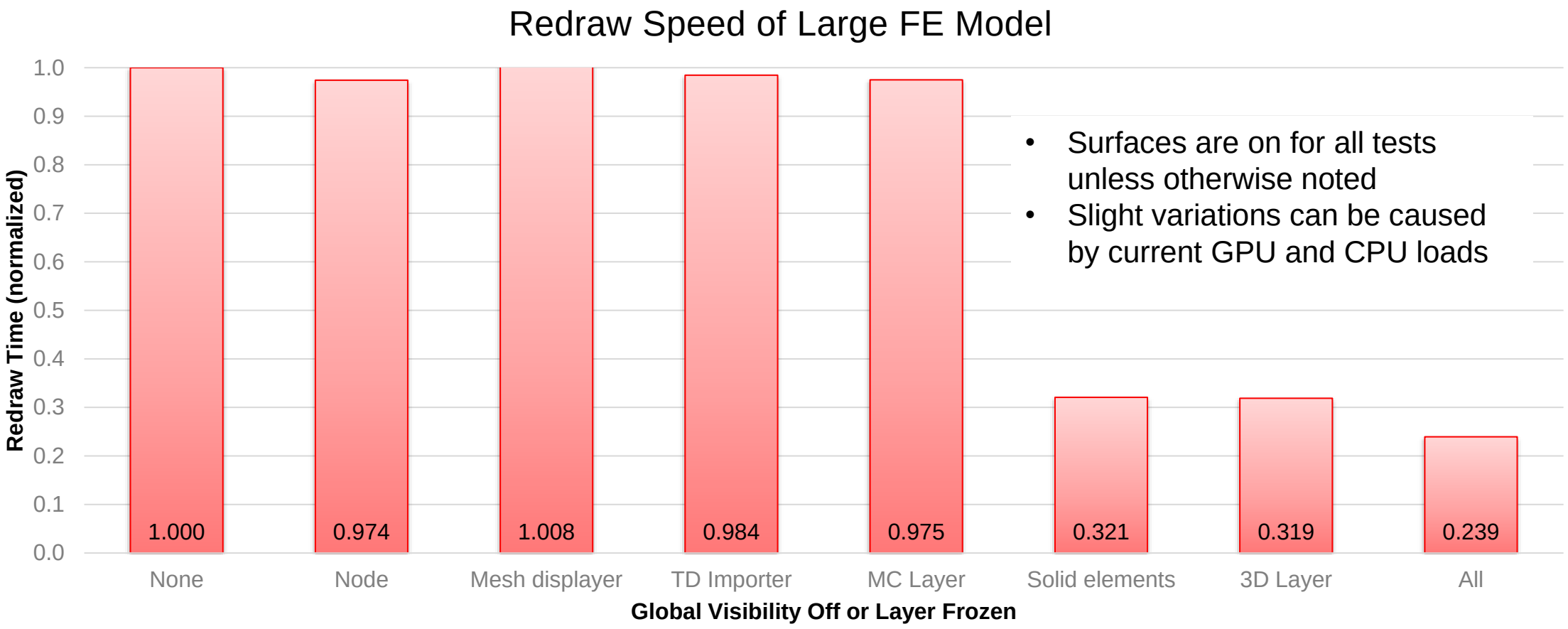
Graphics Settings

- Global visibility (user preferences) turns off all objects of a given type
  - **TD/RC nodes** turns off nodes defined by surfaces and solids
  - **Solid finite elements** turns off all finite-element solid elements
  - **Mesh importers/displayers** turns off mesh controllers
  - **TD Direct importers** turns off TD Direct bounding boxes



- Layer visibility
  - Freezing layers is the best way to turn off layer visibility
  - TD Direct and TD Mesher meshes use layers
    - **TDFEM_2D*** layer contains surface elements and associated nodes
    - **TDFEM_3D*** layer contains solid elements and associated nodes that aren't on the 2D layer
    - **TDFEM_MC*** layer contains the mesh controller
    - **TDFEM_PRT*** layer contains the meshed part for TD Mesher
  - Each mesher or mesh importer has its own set of layers
    - Use layer manager to control layers of each mesher or importer
    - Use the Mesher commands to control layers for all meshers or importers

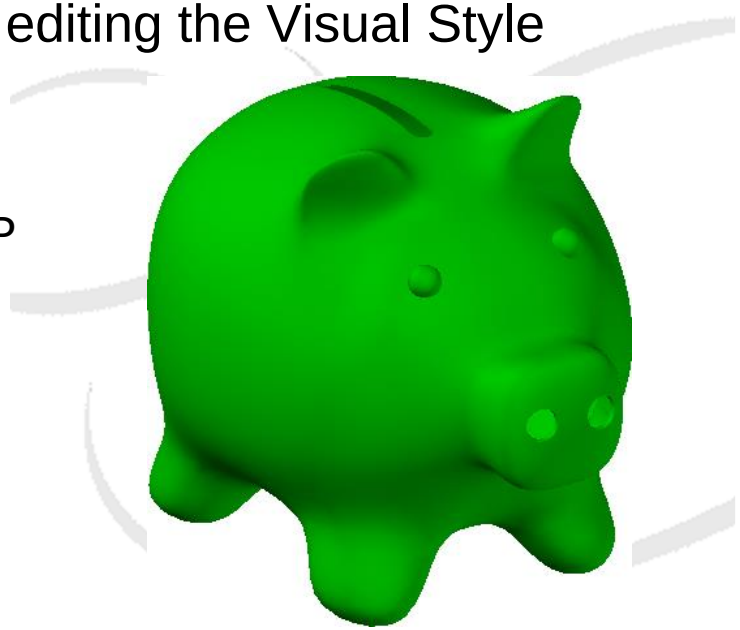
Timed Study
Using THERMAL visual style



- Surfaces are on for all tests unless otherwise noted
- Slight variations can be caused by current GPU and CPU loads

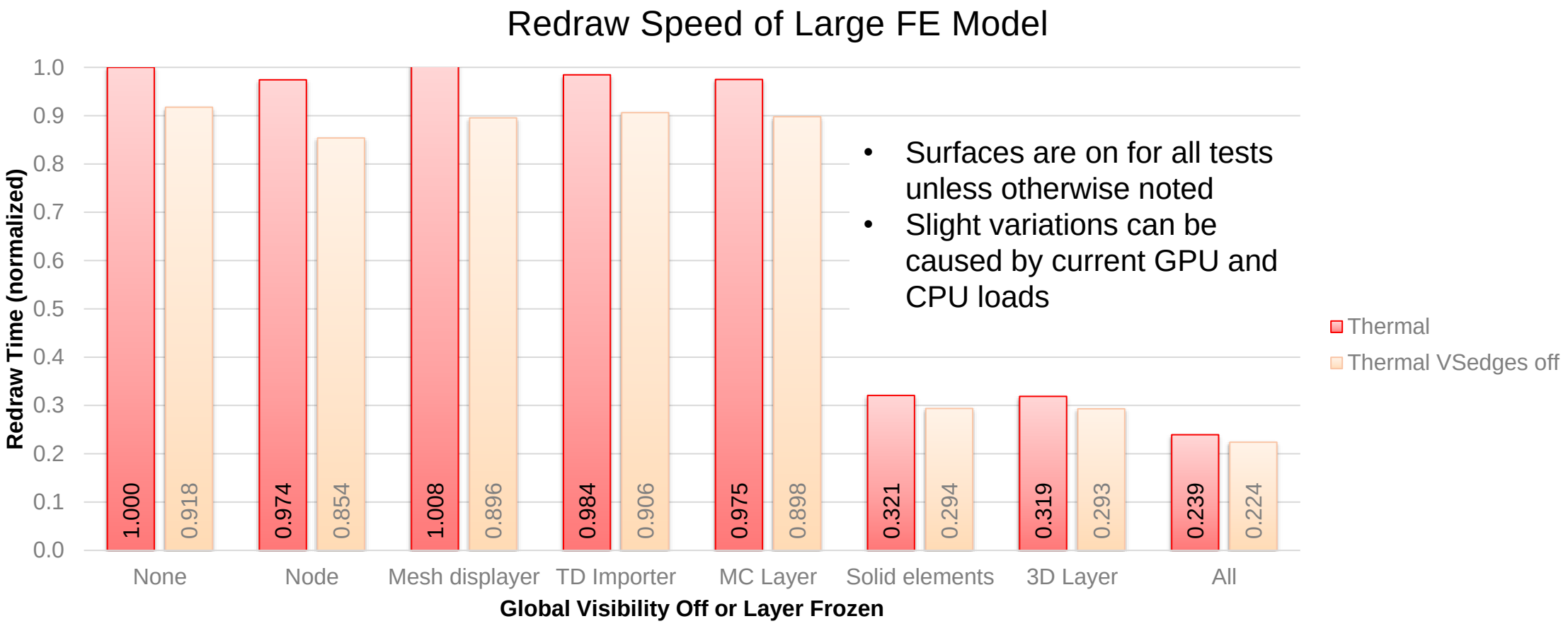
Visual Style Edges

- Drawing element edges takes time
  - Visual style edges can be turned off temporarily
    - VSEDGES = 0 or the icon in the toolbar
    - Can be applied to any shaded visual style
    - When visual styles are reapplied (selected or postprocessing refreshed), the edges will return
  - Visual style edges can be turned off permanently using by editing the Visual Style
    - Use Visual Style Manager (type VSM)
    - Under Edge Settings, choose None for Show
    - Edit any visual style, including THERMAL and THERMAL_PP



Timed Study

THERMAL vs. THERMAL with Edges Off



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AutoCAD Graphics Updates

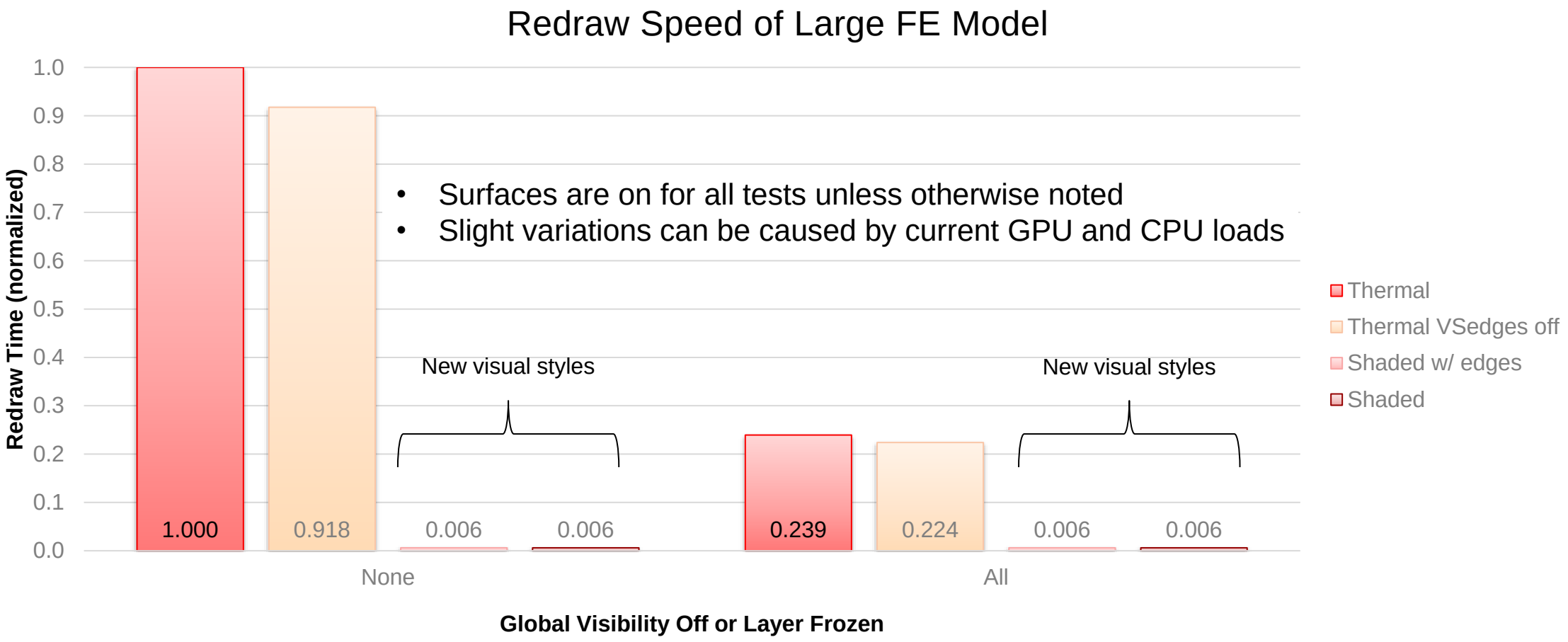
- AutoCAD 2023 has improved some of the built-in visual styles

  "… includes the new cross platform 3D graphics system, leveraging all the power of modern GPUs and multi-core CPUs to offer a smooth navigation experience for much larger drawings"

  – Autodesk Help article **3D Graphics (What's New in 2023)**

  - Available with **Shaded** and **Shaded with Edges** visual styles in Model view
  - Postprocessing viewports cannot use the new graphics system
    - The THERMAL_PP visual style will follow the same behavior as THERMAL on previous slides
  - AutoCAD 2023 is compatible with Thermal Desktop 6.2 and 6.3
  - In user preferences (v6.3)
    - Option to choose Shaded or Shaded with Edges when using Thermal Desktop toolbar
    - Option to set Shaded and Shaded with Edges similar to THERMAL

Timed Study
AutoCAD 2023 Fast Options



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Some Recommendations

- Turn off global visibility of objects that aren't currently required
  - TD/RC Nodes, heaters and heat loads, conductors, contactors, ties, and so on
- When viewing an entire FE model
  - Turn off all objects except mesh displayers and change the display preferences of mesh displayers to Shaded Exterior faces
  - THERMAL redraw normalized time = 0.21
- When viewing a portion of the FE model and you need to see solid elements
  - Turn off all objects except solid elements and hide interior faces (RcHideSolidIntFace)
    - Hide interior faces after turning off what you don't want to see
  - THERMAL redraw normalized time = 0.24

New Right-Click Tricks

Right-clicking

- Clicking the right mouse button can perform certain behaviors
  - Behavior will change based on
    - What is selected
    - Which window is active
  - Often opens a “context menu”

- Right-Click Tricks Video
  - https://crtech.com/training/videos
    - Login is required
    - Enter “right click” as key words
    - Or scan QR Code below

- Already covered in the video
  - Right-click customizations
  - Use properties of the selected object as Default for new objects
  - Review case set overrides
  - Open case sets on the comments page
  - View faces of contactors graphically
  - Use radiation analysis group faces for conductors and contactors
  - Select free edges for edge contactors
  - Access Network element logic (NEL) operators, symbols, and constants
  - Explode domain tag sets in an object list
  - Save Model Browser output to a text file
  - Create XY plot of symbol from a solution

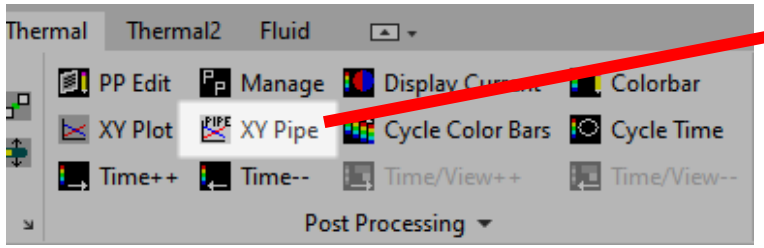
Additional Right-Click Tricks

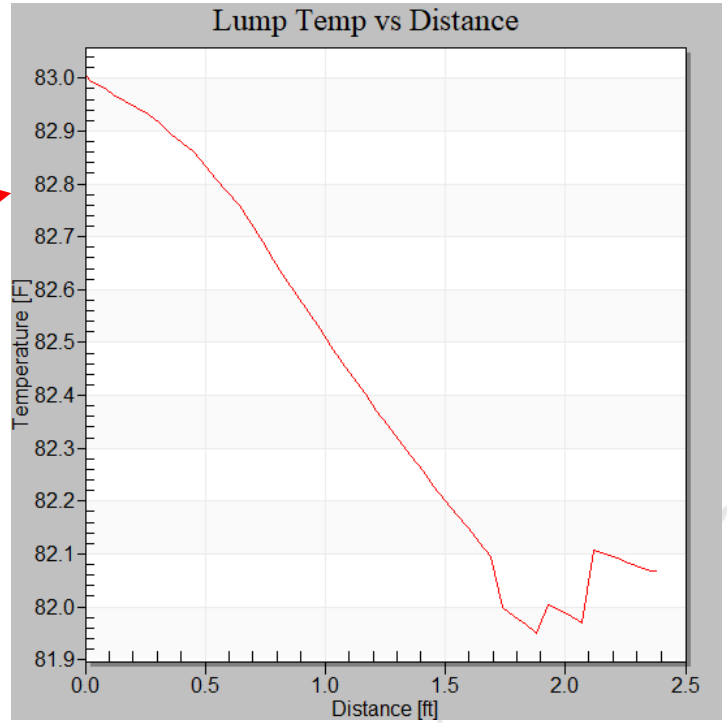
- In Model Browser Output frame
  - Change tree frame background color
  - Zoom selected object
  - Show analysis groups for selected radiation surfaces
  - Toggle Enabled status if not controlled by an expression
- Case Set Manager
  - Case Set comments are now displayed
- Object lists in conductors, contactors, and so on
  - Search the list for a text string

Plotting Node, Path, or Tie data along a Pipe

Plotting Pipe Values vs. Distance

- **XY Pipe** plots *lump* values as a function of distance along the pipe





- How do you plot other pipe data as a function of distance?

Two Powerful Tools Make This Possible

- **Network Element Logic** (NEL) makes writing the logic easier
  - You don’t need to know the IDs for network elements
- UDFAs are **User-Defined Fortran Arrays**
  - When sized for network elements (nodes, lumps, paths, conductors), their values become additional variables for those objects and can be postprocessed just as any other variable

NEL video

Advanced Logic video

Procedure

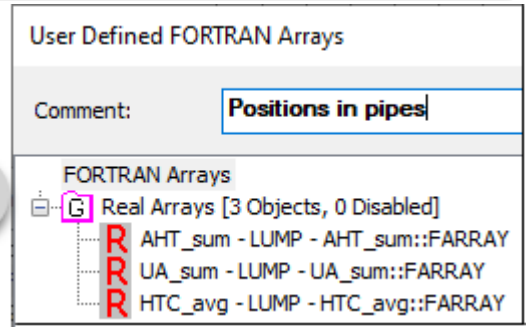
In the Logic Manager

1. Create lump-sized UDFAs
2. Add logic to FLOGIC 0 (time-dependent)
3. Add logic to OUTPUT CALLS before all submodels

Edit the pipe and Add Pipe-Level Tie Logic

4. Add logic to FLOGIC 2 (solution-dependent)

1



2

```
C Reset arrays to 0
        udra(AHT_sum)%ARV = 0.0
        udra(UA_sum)%ARV = 0.0
```

3

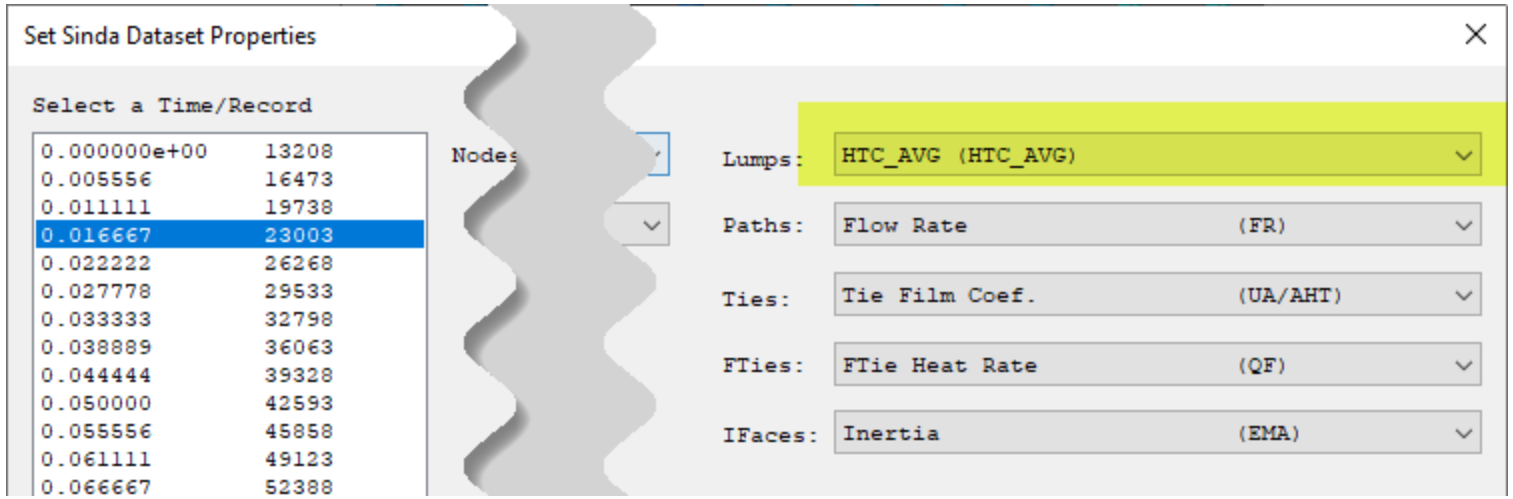
```
C calculate average HTC where area != 0
      where (UDRA(AHT_sum) % ARV .ne. 0.)
     .          UDRA(HTC_avg) % ARV
     .            = UDRA(UA_sum) % ARV
     .              / UDRA(AHT_sum) % ARV
```

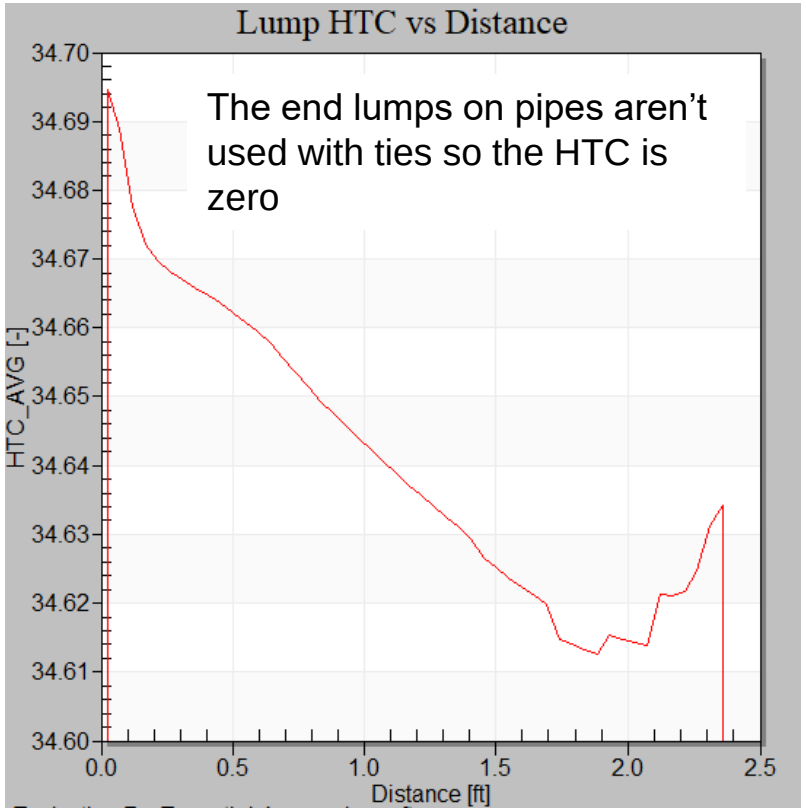
4

```
C Sum area and UA for all lumps in the pipe
      UDRA(AHT_sum) % arv(#loc_lump) = UDRA(AHT_sum) % arv(#loc_lump) + AHT#this
      UDRA(UA_sum) % arv(#loc_lump) = UDRA(UA_sum) % arv(#loc_lump) + UA#this
```

Postprocessing UDFAs

- You can select UDFAs saved with the results that are sized for an object
  - You can limit which UDFAs are saved with the results

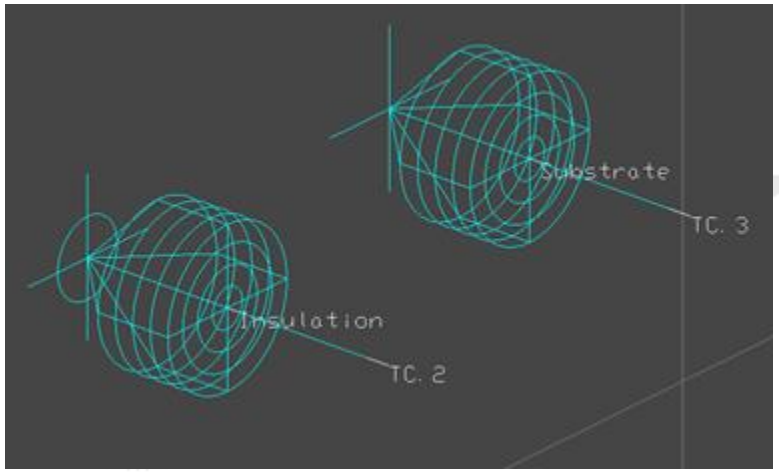




Temperature Measures

Measures Overview

- Primary purpose
  - Read the temperature of a location in a model regardless of node placement as a thermocouple or thermistor would in a real system
- Creating measures
  - **Create Measure** or **Measures from File** commands
    - For single, select location and set the size and options
    - An import file can have all settings included
  - **Update measures** to map to the surfaces
    - Crosshairs indicate mapped location
    - Circle indicates mapping to insulation
  - Check the summary files in the Map Data folder
  - Rotate for visibility



- Troubleshooting mapping
  - Wrong face selected: offset the measure slightly and update again
  - Wrong object selected: use groups or domains to limit the available objects

Measure Behavior

- SINDA Interface Options
  - **Output Register** selected generates a register in Sinda with temperature updated during solution
  - **Output Node** creates a node
    - **Use Conductor and Thermal Capacitance**
      - Unchecked
        - Boundary node generated with temperature updated during solution
        - Not connected to model
      - Checked
        - Node connected to thermal model is generated
        - Thermal capacitance = 0 creates an arithmetic node
  - None selected shows the interpolated temperature during postprocessing
- While postprocessing
  - The measure ID shows the interpolated temperature
  - The node ID shows the node temperature
    - The values may be different when capacitance is included

Recommended Uses

- Test data correlation (original intent)
  - Thermocouples are almost never located where a node exists in the model
  - Measures improve the correlation
- Heater or logic control
  - Use a measure as a heater sensor and place where the thermistor is located
- Optimization
  - A node's location may change if a surface's size changes
  - A measure stays in place unless attached to an assembly
- Thermal connections
  - Connecting to a measure's node is better than connecting to a specific node on a surface
  - A measure is more accurate than a contactor for a small object on a coarsely subdivided surface

Questions?

- When they come to you later, email support@crtech.com
- Register for our website to watch training videos and find additional tips
  - www.crtech.com