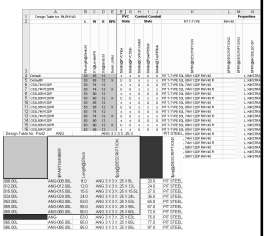
# SolidWorks Design Tables Demystified



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Lenny's SolidWorks Resources
http://www.lennyworks.com/solidworks

## Who am I?

- Product Designer
  - Engineering since 1982.
  - Cad user since 1991.
  - SolidWorks user since 1998.
- CAD Administrator
  - 20+ people on site.
  - Advise other sites.
- Interested in simplifying my job.
  - Make my computer do some of my work for me.
- SMART User Group
  - Active member since group started in 1999.
- Lenny's SolidWorks Resources website.
  - Online Sept. 2003.
  - New home Sept. 2006.
- Develop Design Tables
  - Configurable product line-ups.
  - Various sizes sizes, capacities and options.

## What is covered here.

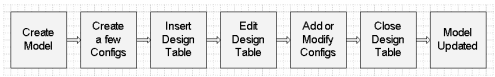
- BASICS:
  - Configurations
  - What is a Design Table?
  - What can a Design Table control?
  - Working with Design Tables
    - Creating your first Design Table.
    - Adding to existing Design Tables.
- INTERMEDIATE:
  - Feature based configuration naming.
  - Configuration Specific Properties.
  - Design Table appearance.
- ADVANCED:
  - Using Excel to automated your designs.

## What can a design table Control?

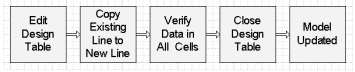
- Parts Only.
  - Feature state
  - Configuration of base or split part
- Assemblies Only
  - Component state
  - Mate state
  - Referenced Configuration
  - Expand in BOM
  - Display State
  - Assembly feature state (cuts)
- General Parts and Assemblies.
  - Dimension values
  - Tolerance type
  - BOM part number
  - Configuration Specific Properties
  - Model color
  - Linear and Radial Pattern Spacing and Instances
- Advanced Parts and Assemblies.
  - Derived Configurations.
  - Lighting state.
  - Equation state.
  - Sketch relationship state.
  - Mass Properties.
  - Center of Gravity.

## Simple Process

- Create Design Table




- Add Configurations in Future




## Inserting a design table?

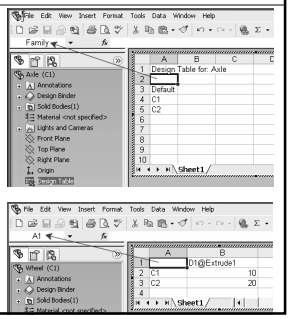
- Source
  - Blank.
    - Inserts blank a design table into model.
    - User can select what features design table will control.
  - Auto create.
    - Useful when you have multiple configurations that represent features that are to be controlled by the design table.
    - Manually create a few configurations ahead of time.
    - User can select what features design table will control.
  - From file.
    - External Excel file.
    - Import into model after creation.
    - Useful for defining "template" ahead of time.

## Inserting a design table?

- Edit Control
  - Allow model edits.....
    - Bi-Directional control
    - Allows model changes to update the embedded design table the next time it's opened.
  - Block model edits.....
    - Uni-Directional control
    - Prevents changes to features that are controlled by the design table.
- Options - Add rows/columns.....
  - New parameters / New configurations
    - Next edit of design table, SolidWorks asks if new parameters or configurations should be added.
  - Warn when updating design table.
    - SolidWorks prompt you when your change affects the design table.


## Parts of a Design Table

- Empty cell named "Family"
  - Only one can exist.
  - "Family" cell can be in any row or column
  - Automatically created when inserting a Blank or Auto Create Design Table
- Manually created table
  - Name a cell "Family" or....
  - Design Table must begin in cell A1 and cell A1 must be blank.

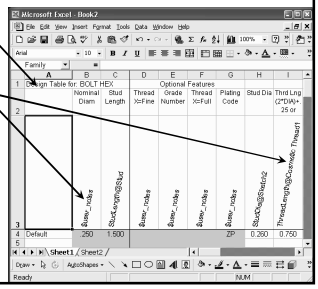






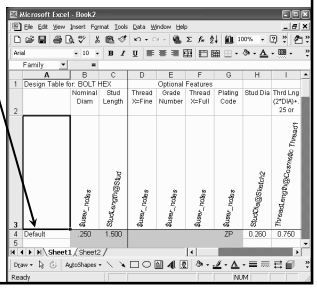
## Parts of a Design Table

- Rows:
  - Every row above the header row will be ignored.
  - Design table parameters must be placed in the header row.
  - The header row is the row that contains the "Family" cell.




## Parts of a Design Table

- Columns:
  - Configuration names must be in header column.
  - Header column is the column that contains "Family" cell.
  - Start immediately under "Family" cell.




## SolidWorks Scan: Design Table

- Only the currently active worksheet, in Excel, will be scanned by SolidWorks.
  - Additional worksheets can be used for lookup tables, comments or calculations
- Only Values are read
  - Equations/Formulas stay in Design Table and are for Excel use only.
- Blank Cells
  - The SolidWorks software stops evaluating the data when it reaches a row or column that has an empty header cell.
  - The space outside these boundaries can be used for lookup tables, comments or calculations.

## SolidWorks Scan: Design Table

- Graphical:
  - Gold - Named "Family" - Start of scanning Design Table
  - Lt. Green - What is scanned by SolidWorks
  - Red - Blank cells – Ignore and don't scan this, or beyond.
  - Other - Ignored

| Design Table for: Part2 | ANG | | ANG 3 X 3 X .25 X | | PIT STEEL |
|---|---|---|---|---|---|
| | $P@PARTNUMBER | $prp@Stock Length | $prp@DESCRIPTION | | $prp@DESCRIPTION2 |
| 008.00L | ANG-008.00L | 8.0 | ANG 3 X 3 X .25 X 8L | 20.0 | PIT STEEL |
| 012.00L | ANG-012.00L | 12.0 | ANG 3 X 3 X .25 X 12L | 24.0 | PIT STEEL |
| 015.50L | ANG-015.50L | 15.5 | ANG 3 X 3 X .25 X 15.5L | 27.5 | PIT STEEL |
| 024.00L | ANG-024.00L | 24.0 | ANG 3 X 3 X .25 X 24L | 36.0 | PIT STEEL |
| 053.00L | ANG-053.00L | 53.0 | ANG 3 X 3 X .25 X 53L | 65.0 | PIT STEEL |
| 055.00L | ANG-055.00L | 55.0 | ANG 3 X 3 X .25 X 55L | 67.0 | PIT STEEL |
| 060.00L | ANG-060.00L | 60.0 | ANG 3 X 3 X .25 X 60L | 72.0 | PIT STEEL |
| | ANG- | 63.0 | ANG 3 X 3 X .25 X 63L | 75.0 | PIT STEEL |
| 065.00L | ANG-065.00L | 65.0 | ANG 3 X 3 X .25 X 65L | 77.0 | PIT STEEL |
| 085.00L | ANG-085.00L | 85.0 | ANG 3 X 3 X .25 X 85L | 97.0 | PIT STEEL |

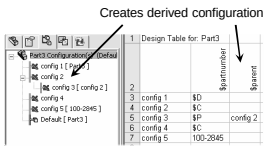
Colors are for chart reference only.

## Design Table Parameters

- $user_notes or $comments - Comment column
  - Add comments.
  - User entered values.
  - Formula that is referenced from many different cells.
- $partnumber - Part number used in BOM
  - Possible Values
    - $d or $document - Use document number
    - $c or $configuration - Use configuration name
    - $p or $parent - Use parent configuration name (Derived configurations only)
    - Any text - Custom text used as part number.
    - <blank> - Configuration name
- $never_expand_in_bom
  - Yes = Will NOT add sub-components to BOM.

## Design Table Parameters

- $parent - Parent config name
  - Creating derived configurations only.
  - Cannot be used to modify relationship between parent and derived configuration.



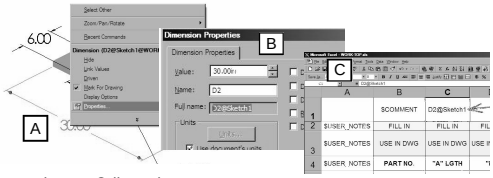

- $configuration@compname<inst> - Config referenced.
  - What configuration of the component is referenced

## Design Table Parameters

- $state@.....
  - Parts Only
    - $state@featurename - Suppress / Unsuppress features
  - Assemblies Only
    - $state@compname<inst> - Suppress / Resolve components
    - $state@matename - Suppress / Unsuppress mates
  - Parts & Assemblies
    - $state@lightname - Suppress / Unsuppress lighting
    - $state@relation@sketch - Suppress / Unsuppress sketch relation

## Design Table Parameters

- D2@Sketch1, D1@Distance1 or D1@Angle1
  - Value of this dimension/angle or mate in this configuration.
  - Pink dimensions indicate that they are driven by the Design Table.



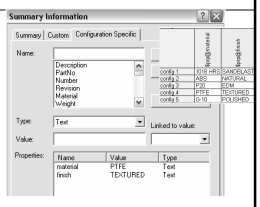

- Tolerance@dimension<param>
  - Type and value of tolerances of dimension/angle or mate.

## Design Table Parameters

- $show@compname<inst> - Visibility of component
  - Before and including SolidWorks 2005
  - Obsolete in SolidWorks 2006. See $displaystate.
- $displaystate - New in SolidWorks 2006
  - Display states of components
    - Visibility (Hide/Show)
    - Display Mode (Shaded, Wireframe, Hidden Lines Removed, etc...)
    - Component Color and Texture
    - Transparency
  - Caution:
    - Must be predefined and exist in configuration before it can be reference by the Design Table.
    - Same DisplayState name can exist in many configurations and have different component states (appearance).

## Design Table Parameters

- $prop@.....
  - Define property name and values of Configuration Specific Properties.
- $color
  - 32bit Integer derived from Red/Green/Blue color values.




| | $color |
|---|---|
| config 1 | 255 |
| config 2 | 5544 |
| config 3 | 78767 |
| config 4 | 45 |
| config 5 | 1344 |

| Color | Red | Green | Blue | Integer |
|---|---|---|---|---|
| Black | 0 | 0 | 0 | 0 |
| Red | 255 | 0 | 0 | 255 |
| Orange | 255 | 128 | 0 | 33023 |
| Green | 0 | 255 | 0 | 65280 |
| Blue | 0 | 0 | 255 | 16711680 |
| Purple | 255 | 128 | 255 | 16744447 |
| Turquoise | 0 | 255 | 255 | 16776960 |
| White | 255 | 255 | 255 | 16777215 |

## Design Table Parameters

- $sw-mass
  - Define Mass Property for this configuration.
  - Value as seen in the Mass Properties dialog box.
- $cog
  - Define Center of Gravity for this configuration.
  - X, Y and Z coordinates.
  - Value as seen in the Mass Properties dialog box.
- <instances>
  - <*> Apply to instances
  - <1-4> Range of instances
  - <1,4,6> Nonconsecutive instances
  - <1-2,4,6-8> Combinations separated by commas

## Simple Excel functions

- Cell References
  - Relative (E2) vs. Absolute ($E$2)
- Equations/Formulas
  - Excel equations/formulas are more powerful and flexible than SolidWorks native equations.
  - SolidWorks reads cell “Values” not “Formulas”.
  - Math functions +, -, *, /
  - Boolean operations And, Or, etc..
  - Value Comparison =, <, >, <>
- Linking cells
  - This cell equals that cell.
  - Useful when multiple components reference same configuration.

## Simple Excel functions

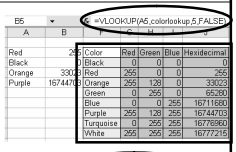
- Appearance
  - Hiding columns or rows to hide clutter
  - Splitters / Freeze Frame
    - Views of your worksheet
  - Double click between columns to auto fit columns to cells
  - Format cells to wrap or rotate text.
- Painting cells for Color-Coding
  - Define “safe” cells for users to edit.
  - Visually define relationships within Design Table

## Intermediate Excel functions

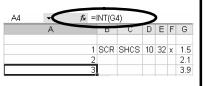
- Concatenate or &
  - Stringing pieces of text together.
- Text
  - Apply a text format to numerical values.
    - 1.25 becomes 001.250
- Other
  - Conditional statements If, then, else
  - Nested statements

## More Excel functions

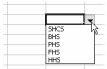
- Lookup Tables
  - Get a value, search a range, retrieve a new value.
  - Obtain new value based on nominal input values.
  - Examples:
    - Hardware
    - Structural shapes




- Other
  - INT or TRUNC
  - ABS




- Data Validation
  - Drop down list limits input.




## Examples:

- Hardware
  - Concatenate and Text formatting
    - Consistent formatting of custom configuration name and properties.
    - Feature/Dimension based configuration names.
    - Visually appealing and easy to follow
      - .500-13 X 1.50 vs. .5-13 x 1.5
      - .375-18 x 1.25 vs. .375-18 x 1.25
  - Lookup tables
    - What varies based on nominal
      - Head height
      - Head Flats
    - Standard vs. Heavy
      - Nested lookup formula

## Examples:

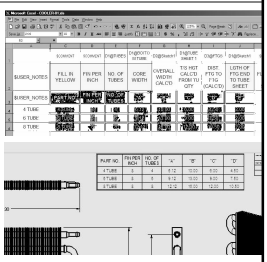
- Structural Shapes: C-Channels, I-Beams, W-Beams, etc...
  - Concatenate and Text formatting
    - Consistent formatting of custom configuration name and properties.
    - Feature/Dimension based configuration names.
  - Lookup tables
    - Nested lookup formula
      - Search based on 2 nominal values: SIZE and WEIGHT
    - What varies based on nominal
      - Height
      - Leg Length
      - Web Thickness
      - Leg Thickness

## Example: Semi-Automated

- Multiple Levels of Assembly can have separate Design Tables.
  - Design table embedded into each configured component.
  - Configuration must exist in component before it can be referenced in the parent assembly.
  - Feature/Dimension based configuration names.
    - Easy to define what configuration of the component is needed, without any reference to part numbers.
  - Color code cells to defined areas users can safely modify.
    - Visually understandable.
  - User copies a row, then edits cells to build new configuration.

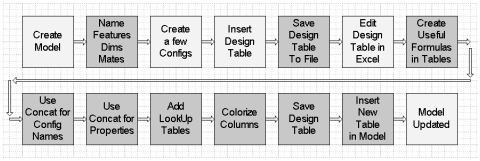
## Inserting table in drawing:

- How To:
  - Open Design Table in Excel.
  - Highlight and copy (ctrl C) the portion of the design table to be inserted into the drawing as a tabulated chart.
  - Paste table into drawing.
  - Grab the corners and drag to resize the table.

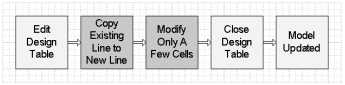


## Advanced Process

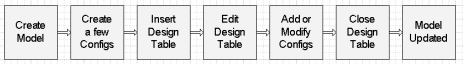
- Create Automated Design Table




- Add Configurations in Future

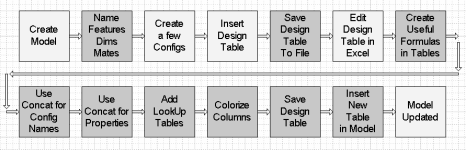



## Simple Process (Reviewed)




- Advantages:
  - Simple to create
  - User only needs a little knowledge of Excel.
- Disadvantages:
  - Very "Basic"
  - Low automation
  - User must know all data to be entered.

## Advanced Process (Reviewed)




- Advantages:
  - More automation.
  - Intelligence in model.
  - User knowledge
    - Excel – Little
    - Product - Little
- Disadvantages:
  - User knowledge
    - Creation and Maintenance requires more knowledge and experience with Excel and Design Tables.

## What if the Design Table Fails:

- The SolidWorks software stops processing a design table if it reaches invalid parameters in a cell.
  - Referenced component or component config. does not exist.
    - Configurations in sub-components must exist before you can reference them in the parent assembly.
  - Referenced feature, dimensions or mates do not exist.
- Check spelling and syntax.
  - Must be exact.
  - Use automated techniques or copy/paste when possible.
- Configurations in rows after point of "fail" will not be added.
  - Save Design Table outside of SolidWorks then insert.

## The model was not updated:

- Look for and eliminate duplicate configuration names.
  - All configuration names must be unique.
  - Last defined instance of duplicated configuration name takes precedence.
- Look for and eliminate duplicate Design Table Parameters.
  - All Design Table Parameters must be unique.
  - Last defined instance of duplicated parameter takes precedence.
- Look for blank spaces in "Parameter Row"
  - SolidWorks will not scan columns after it finds a blank space in this row.
- Check geometry in the model.
  - Did changes cause sketch, feature or mate errors?

## Tips: Plan Ahead

- Impose limits on what variations are acceptable in the model.
  - Limits number of configurations
  - Limits number of Design Table columns
- Define procedures (Best Practices)
  - Provides consistency.
  - Baseline for creating new Design Tables.
  - Easier for others to understand.
  - Other users know what to expect.
- Start small and work your way up.
  - Create and test small portions of Design Table before continuing to larger portions.
  - Start with a "basic" Design Table, then add automation later.

## Tips: Preparing Models

- Name features as they are created
  - SolidWorks setting: Name feature on creation
- Rename dimensions and mates that will be controlled by the design table.
  - Easier to find in assembly and design table.
- Incorporate Feature/Dimension based configuration names.
  - Useful when users insert model into assembly.
    - User does not need to know part numbers.
  - Easy to reference from design table in parent assembly.
- Predict effects on your model(s).
- Resolve all components in assembly

## Tips: Excel

- Use Excel for all equations and dimension linking.
  - Only need to debug the Design Table.
- Use "Concatenate" or "&" in Excel
  - Build configuration names and custom file properties.
- Use "Text" in Excel
  - Format numbers to a consistent number of characters.
- Use Excel's LookUp tables.
  - Builds intelligence into the design table.
  - Next user does not need as much knowledge of the product.

## Tips: Excel

- Color code cells.
  - Defined areas that other users can safely modify.
- Format cells
  - Vertically aligned text in Header Row
  - General instead of Text
    - Allows you to use formulas
  - Refrain from merging cells
    - Unknown results

## Tips: Design Table Files

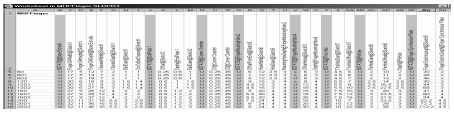
- Save/Backup design tables external from model.
  - Edit externally and then import into model.
  - Single Design Table can be used to drive many models.
  - Use as template for creating new Design Table.
- When inserting from file, refrain from linking to external file.
  - Link must be exact.
  - Moving or deleting linked file will affect SolidWorks.

## Tips: More.....

- If Excel thinks your dimension names are email addresses
  - Excel Setting:
    - Tools, Autocorrect Options, Autoformat as you type
    - Turn off the internet and network paths with hyperlinks.
    - Not available in some versions of Excel.
  - [CTRL] - Z

## How much is too much?

- Someone else is going to need to understand what you have created.
  - Document complex formulas for the less Excel clever.
  - Color Coding helps user understand what they can safely modify, and can be used to identify relationships.



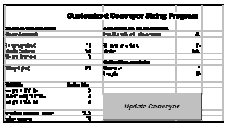
- You need to understand and remember what you created.
- Before you start – PLAN AHEAD
  - Impose limits on what variations are acceptable in the model.

## Design Tables is NOT KBE:

- Design Tables
  - You can build intelligence into the Design Table.
    - Lookup Table, Equations, etc.....
  - Design Tables can only work on one component at a time.
- Knowledge Based Engineering (KBE)
  - Can modify components at all levels.
  - Makes unique components from existing components.
    - Does not create or use configurations.

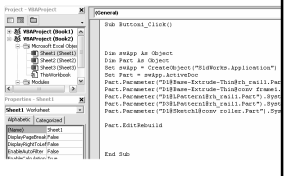
## Alternatives:

- Embedded Form in Spreadsheet
  - Embed an Excel spreadsheet into a SolidWorks document
  - Excel spreadsheet is not creating configurations, but is updating your model
  - You can use all the power of Excel and Visual Basic for Applications




## Alternatives:

- Visual Basic for Applications (VBA)
  - You don't really have to be a programmer to do this.
  - Copy the syntax and replace dimension names and math operations.
  - Use Excel functions to calculate, and VBA to transfer the dimension values to SolidWorks.
  - It's not as complicated as it looks.



## Resources for learning more?

- SolidWorks Help File
  - Directions for creation and use.
  - Summary of Design Table Parameters.
    - List of "codes" recognized in design tables.
- SolidWorks Online Tutorials
  - Design Tables
    - Similar to old "40 Minute Running Start."
- Excel Help File
  - Help on using Excel's functions to automate your design tables.
- SolidWorks VAR's/Resellers
  - Training classes & night schools.

## Thanks to:

Most content from this presentation is from:

Advanced Design Tables and Excel Automated Designs

By Matt Lombard, Charlottesville SolidWorks User Group

Additional thanks to:
- Darren Henry, SolidWorks
- Sean Adams, Burleigh Instruments
- Eddie Cyganik, Enidine
- Jim Sculley, WSI

## SolidWorks Design Tables Demystified

## Thank You!

Lenny's SolidWorks Resources
has moved to
http://www.LennyWorks.com/solidworks