SolidWorks
WORLD 2008

# Design Tables Demystified

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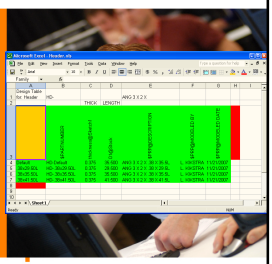


INSPIRED to Design

**Lenny's SolidWorks Resources:**
**http://www.LennyWorks.com/SolidWorks**
**Blog: http://designsmarter.typepad.com/lennyworks/**

## 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.
- Productivity Gains - I want to:
  - Simplifying my job.
  - Make my computer do more work for me.
  - Get the most out of the tools I use to do my job.
- Certified SolidWorks Professional (CSWP)
- SolidWorks User Group
  - SMART (SolidWorks Milwaukee Area Resource Team)
  - http://www.smart-wi.com
  - Active member since 1999.
- Lenny's SolidWorks Resources
  - Online since Sept. 2003.
  - Free Macros, Tips & Tricks
- LennyWorks Blog
  - Since 2007
- Design Tables
  - Configurable product line
  - Size, Capacity, Options



## What is covered here.

- BASICS:
  - Configurations
  - Design Table
- INTERMEDIATE:
  - Configuration naming.
  - Configuration Specific Properties.
  - Design Table appearance.
- ADVANCED:
  - Excel to automated Design Tables



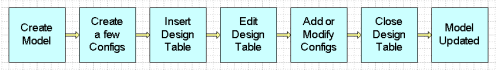
## What can a design table Control?

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

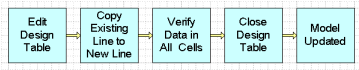


## Simple Process

- Create a new design table




- Add configurations in the future



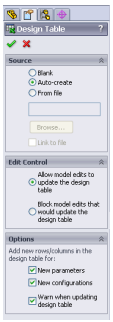



## Inserting a design table?

- Source
  - Blank.
  - Auto create.
  - From file.

## Inserting a design table?

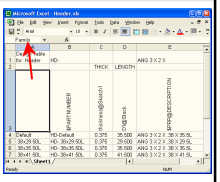
- Edit Control
  - Allow model edits…..
  - Block model edits…..
- Options - Add rows/columns…..
  - New parameters / New configurations
  - Warn when updating design table.

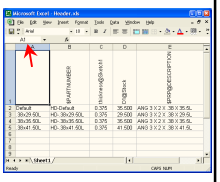





## Parts of a Design Table

- Automatically Created
  - Via SolidWorks
  - Empty cell named “Family”
- Manually created table
  - External table
  - Then imported.

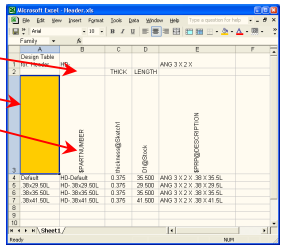






## Parts of a Design Table

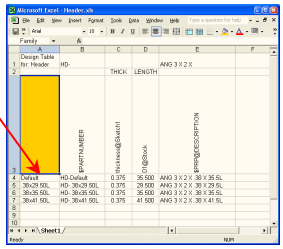
- Rows:
  - Rows above the header row.
  - The header row.
  - Parameters in header row.





## Parts of a Design Table

- Columns:
  - Configuration names in first column.
  - Start immediately under “Family” cell.
  - Data in columns correspond to parameters in header.





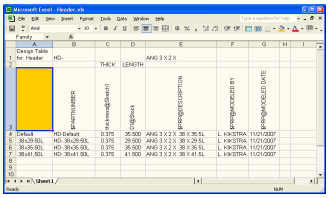
## How SolidWorks Scans The Design Table

- Only the currently active worksheet will be read in.
- Only values are read.
- Blank cells are ignored.



## How SolidWorks Scans The Design Table

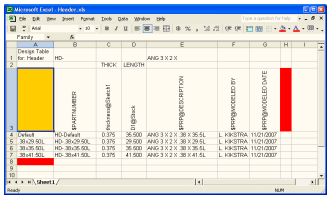
- Graphical:
  - Gold - Named “Family” cell - Start of Design Table



Colors are not required, and are for explanation only.

## How SolidWorks Scans The Design Table

- Graphical:
  - Gold - Named "Family" cell - Start of Design Table
  - Red - Blank cells - Don't scan this cell, or beyond.

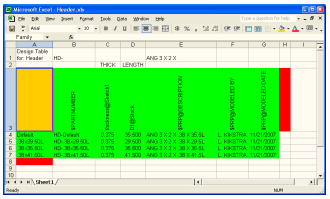


Colors are not required, and are for explanation only.



## How SolidWorks Scans The Design Table

- Graphical:
  - Gold - Named "Family" cell - Start of Design Table
  - Red - Blank cells - Don't scan this cell, or beyond.
  - Green - Scanned by SolidWorks
  - Everything outside of Green area will be ignored



Colors are not required, and are for explanation 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

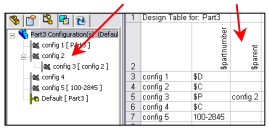
- $never_expand_in_bom
  - Yes = Will NOT add sub-components to BOM.



## Design Table Parameters

- $parent - Parent configuration name
  - Creating derived configurations only.
  - Cannot be used to modify relationship between parent and derived configuration.
  - Parent configuration must exist before creating derived configuration.

Creates derived configuration




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



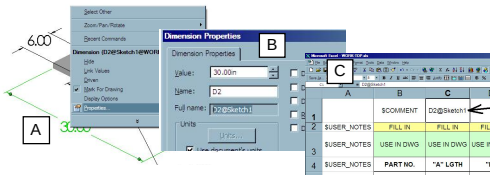
## Design Table Parameters

- $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.

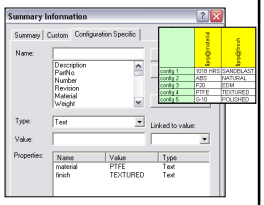
## Design Table Parameters

- $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 of Configuration Specific Properties.
- $color
  - 32bit Integer derived from Red/Green/Blue color values.




| | $color |
|---|---|
| config 1 | 255 |
| config 2 | 6544 |
| 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 | 16744703 |
| 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



## Design Table Parameters

- $hw-size@… - New in SolidWorks 2008
  - Hole Wizard size



## Simple Excel functions

- Cell References
  - Relative (E2) vs. Absolute ($E$2)
  - Hybrid ($E2) (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
  - Hide clutter
  - Splitters / Freeze Frame
  - Resize cells.
  - Wrap or rotate text.
- Painting cells for Color-Coding
  - Define “safe” cells to edit.
  - Visually relationships
  - Visualization for user.

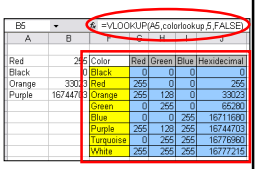
## Intermediate Excel functions

- 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

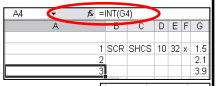


## More Excel functions

- Lookup Tables
  - How it works:
    - Get a value
    - Search a range
    - Retrieve a new value.
  - Nominal sizes.
  - Examples:
    - Hardware
    - Structural shapes




- Other
  - INT or TRUNC
  - ABS




- Data Validation
  - Drop down list limits input.
    - Security – Excel Macro




## 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



## Rules of Thumb

- Multiple Levels of Assembly.
  - Separate Design Table for each configured component.
  - Each Design Table can only control one component.
    - Only current assembly level.
  - Component configuration must exist before referencing in parent.
  - Referenced names must match exactly.
    - Feature Manes
    - Dimension Names
    - Mate Names
    - Component Names



## Example: Basic SolidWorks/Excel Functionality

- Semi-Automated.
  - Open Design Table.
  - Edits and verify data in each cell of new row.
    - Can copy and edit similar row.
  - Close Table and new configuration in built.

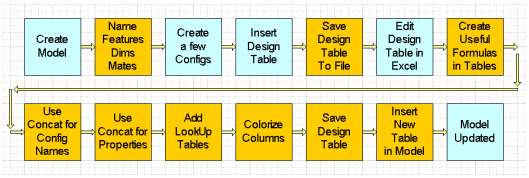
## Example: Intelligent Design Tables

- Automated Added.
  - Open Design Table.
  - Copies a row.
  - Edits cells that change.
    - Built-In Intelligence updates remainder of rows.
      - Feature/Dimension based configuration names.
      - Excel formulas automatically build cell values.
  - Close Table and new configuration in built.

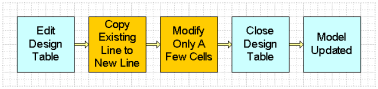


## Advanced Process

- Create Automated Design Table

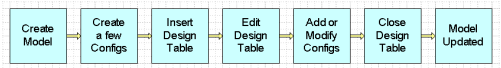



- Add Configurations in Future





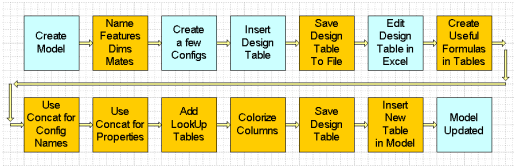

## Simple Process (Reviewed)




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



## Advanced Process (Reviewed)

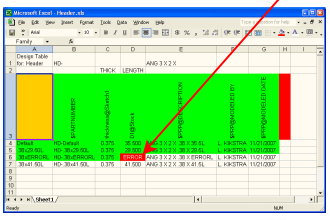



- Advantages:
  - More automation.
  - Intelligence in model.
  - Knowledge level: End user
    - Excel - Little
    - Product - Little
- Disadvantages:
  - Creation and Maintenance requires more knowledge and experience.
  - Knowledge level: Creator
    - Excel - High
    - Product - High



## What If The Design Table Fails?

- What happens?
  - The SolidWorks stops processing a design table if it reaches invalid values in a cell.
  - Scan of Design Table is not completed.
  - User is warned of problem.





## What If The Design Table Fails?

- Possible causes:
  - Referenced object does not exist.
  - Incorrect data.
- Check spelling and syntax.
  - Use 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!

- Eliminate duplicate configuration names.
  - Last defined instance of duplicated configuration name takes precedence.
- Look for and eliminate duplicate Design Table Parameters.
  - Last defined instance of duplicated parameter takes precedence.
- Look for blank spaces in “Parameter Row”
  - Is something ignored?
- Check geometry in the model.
  - Did changes cause geometry error?



## Tips - Plan Ahead

- Impose limits
  - Keeps design table manageable.
- Define procedures (Best Practices)
  - Provides consistency.
  - Provides improved understanding.
- Start small and work your way up.
  - Create and test small portions.
  - Start with a “basic“ Design Table.
  - 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.
  - 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.
  - One place to debug formulas.
- Use “Concatenate” or “&” in Excel
  - Automatically 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.
  - Visual
  - For next user.
- Format cells
  - Aligned text.
  - General type.
  - Refrain from merging cells
    - Unknown results.



## Tips - Design Table Files

- Save/Backup design tables external from model.
  - Archive your design tables.
- When inserting from file, refrain from linking to external file.
  - Link must be exact.
  - Moving or deleting linked file will affect SolidWorks.

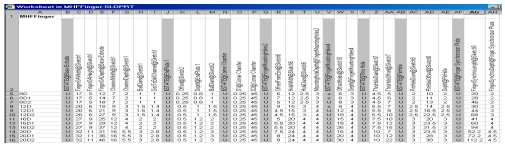
## Tips - More……

- 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
    - Undo hyperlink only if it was just added.



## How much is too much?

- Other people need to understand the Design Table.
  - Document formulas.
  - Color Coding for visualization.



- CAN YOU UNDERSTAND AND REMEMBER WHAT YOU CREATED? AND WHY?.
- Before you start – PLAN AHEAD
  - Impose limits on what variations are acceptable in the model.



## Design Tables Are 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.



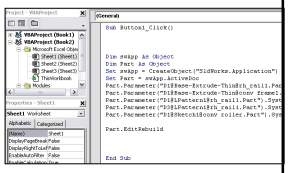
## Alternatives

- 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

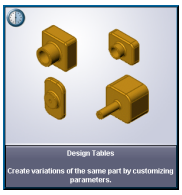
- Visual Basic for Applications (VBA)
  - You don't really have to be a programmer to do this.
  - Copy the syntax and replace dimension names and math operations.
  - Use Excel functions to calculate, and VBA to transfer the dimension values to SolidWorks.
  - It's not as complicated as it looks.





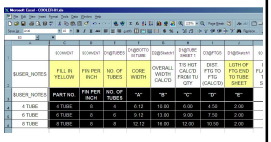
## Resources for learning more?

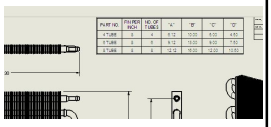
- SolidWorks Help File
  - Directions for creation and use.
  - Summary of Design Table Parameters.
    - List of "codes" recognized in design tables.
- SolidWorks Online Tutorials
  - Design Tables
    - Part of the old "40 Minute Running Start."
- Excel Help File
  - Help on using Excel's functions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



## 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.







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Questions?

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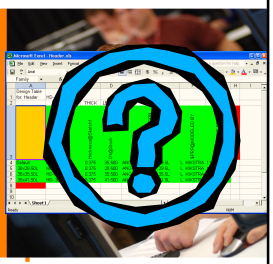
**RITE-HITE Products Corporation**
**Milwaukee, WI**



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