Slide 1:
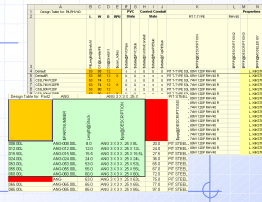
SolidWorks Design Tables
Demystified

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

Slide 2:

Design Tables Demystified:
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
  - Website online Sept. 2003.
  - New home Sept. 2006.

- Develop Design Tables for:
  - Configurable product lineups.
  - Various sizes sizes, capacities and options.

Slide 3:

Design Tables Demystified:
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.

Slide 4:

Design Tables Demystified:
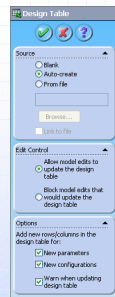What can a design table Control?

- 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.

Slide 5:

Design Tables Demystified:
Simple Process

- Create a new design table

　Create Model → Create a few Configs → Insert Design Table → Edit Design Table → Add or Modify Configs → Close Design Table → Model Updated

- Add configurations in the future

　Edit Design Table → Copy Existing Line to New Line → Verify Data in All Cells → Close Design Table → Model Updated

Slide 6:

Design Tables Demystified:
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.
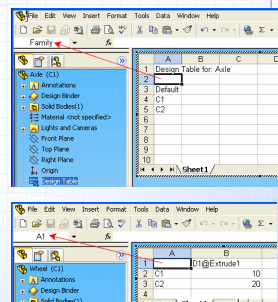   - Useful for defining "template" ahead of time.

Design Tables Demystified: Inserting a design table?

- ◆ Edit Control

  - n Allow model edits.....
    - w Bi-Directional control
    - w Allows model changes to update the embedded design table the next time it's opened.
  - n Block model edits.....
    - w Uni-Directional control
    - w Prevents changes to features that are controlled by the design table.

- ◆ Options - Add rows/columns.....

  - n New parameters / New configurations
  - n Next edit of design table, SolidWorks asks if new parameters or configurations should be added.
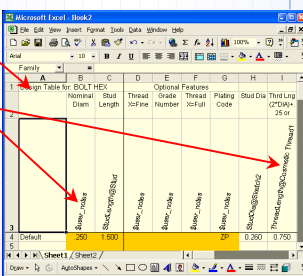 - n Warn when updating design table. SolidWorks prompt you when your change affects the design table.

Design Tables Demystified: Parts of a Design Table

- ◆ Empty cell named "Family"

  - n Only one can exist.
  - n "Family" cell can be in any row or column
  - n Automatically created when inserting a Blank or Auto Create Design Table

- ◆ Manually created table

  - n Name a cell "Family" or....
  - n Design Table must begin in cell A1 and cell A1 must be blank.
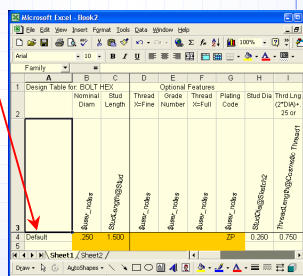

Design Tables Demystified: Parts of a Design Table

- ◆ Rows:

  - n Every row above the header row will be ignored.

  - n Design table parameters must be placed in the header row.

  - n The header row is the row that contains the "Family" cell.

Design Tables Demystified: Parts of a Design Table

- ◆ Columns:

  - n Configuration names must be in header column.

  - n Header column is the column that contains "Family" cell.

  - n Start immediately under "Family" cell.
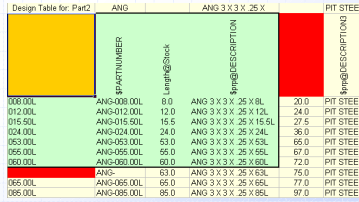
Design Tables Demystified: How SolidWorks Scans The Design Table

- ◆ Only the currently active worksheet, in Excel, will be scanned by SolidWorks.

  - n Additional worksheets can be used for lookup tables, comments or calculations

- ◆ Only Values are read

  - n Equations/Formulas stay in Design Table and are for Excel use only.

- ◆ Blank Cells

  - n The SolidWorks software stops evaluating the data when it reaches a row or column that has an empty header cell.
  - n The space outside these boundaries can be used for lookup tables, comments or calculations.

Design Tables Demystified: How SolidWorks Scans The Design Table

- ◆ Graphical:

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

Slide 1

Design Tables Demystified:
Design Table Parameters

- ◆ $user_notes or $comments — Comment column
  - n Add comments.
  - n User entered values.
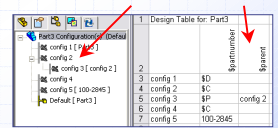 - n Formula that is referenced from many different cells.

- ◆ $partnumber — Part number used in BOM
  - n Possible Values
    - w $d or $document — Use document number
    - w $c or $configuration — Use configuration name
    - w $p or $parent — Use parent configuration name
    - w (Derived configurations only)
    - w Any text — Custom text used as part number.
    - w <blank> — Configuration name

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

Slide 2

Design Tables Demystified:
Design Table Parameters

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

  Creates derived configuration

- ◆ $configuration@compname<inst> — Configuration referenced.
  - n What configuration of the component is referenced
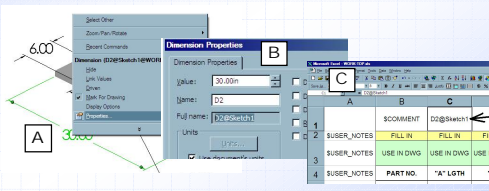
Slide 3

Design Tables Demystified:
Design Table Parameters

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

Slide 4

Design Tables Demystified:
Design Table Parameters

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

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

Slide 5
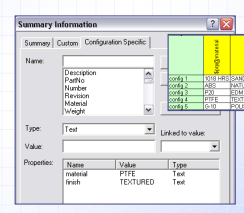
Design Tables Demystified:
Design Table Parameters

- ◆ $show@compname<inst> — Visibility of component
  - n Before and including SolidWorks 2005
  - n Obsolete in SolidWorks 2006. See $displaystate.

- ◆ $displaystate — New in SolidWorks 2006
  - n Display states of components
    - w Visibility (Hide/Show)
    - w Display Mode (Shaded, Wireframe, Hidden Lines Removed, etc...)
    - w Component Color and Texture
    - w Transparency
  - n Caution:
    - w Must be predefined and exist in configuration before it can be reference by the Design Table.
    - w Same DisplayState name can exist in many configurations and have different component states (appearance).

Slide 6

Design Tables Demystified:
Design Table Parameters

- ◆ $prop@.....
  - n Define property name of Configuration Specific Properties.

- ◆ $color
  - n 32bit Integer derived from Red/Green/Blue color values.

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 Tables Demystified: Design Table Parameters

❖ $sw-mass

    n Define Mass Property for this configuration.
    n Value as seen in the Mass Properties dialog box.

❖ $cog

    n Define Center of Gravity for this configuration.
    n X, Y and Z coordinates.
    n Value as seen in the Mass Properties dialog box.

❖ <instances>

    n <*>   Apply to instances
    n <1-4>   Range of instances
    n <1,4,6>   Nonconsecutive instances
    n <1-2,4,6-8> Combinations separated by commas

Design Tables Demystified: Design Table Parameters

❖ $hw-size@...   - New in SolidWorks 2008
    n Hole Wizard size

Design Tables Demystified: Simple Excel functions

❖ Cell References

    n Relative (E2) vs. Absolute (E2)
    n Hybrid   ($E2)   (E$2)

❖ Equations/Formulas

    n Excel equations/formulas are more powerful and flexible than SolidWorks native equations.
    n SolidWorks reads cell "Values" not "Formulas".
    n Math functions   +, -, *, /
    n Boolean operations   And, Or, etc..
    n Value Comparison   =, <, >, <>

❖ Linking cells

    n This cell equals that cell.
    n Useful when multiple components reference same configuration.

Design Tables Demystified: Simple Excel functions

❖ Appearance

    n Hiding columns or rows to hide clutter
    n Splitters / Freeze Frame
        w Views of your worksheet
    n Double click between columns to auto fit columns to cells
    n Format cells to wrap or rotate text.

❖ Painting cells for Color-Coding

    n Define "safe" cells for users to edit.
    n Visually define relationships within Design Table
    n Visualization for user. Not required for SolidWorks or Excel.

Design Tables Demystified: Intermediate Excel functions

❖ Concatenate or &

    n Stringing pieces of text together.

❖ Text

    n Apply a text format to numerical values.
        w 1.25 becomes 001.250

❖ Other

    n Conditional statements   If, then, else
    n Nested statements

Design Tables Demystified: More Excel functions

❖ Lookup Tables

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

❖ Other

    n INT or TRUNC
    n ABS

❖ Data Validation

    n Drop down list limits input.
        w Security – Excel Macro

Design Tables Demystified: Examples:

- ◆ Hardware

    - n Concatenate and Text formatting
        - w Consistent formatting of custom configuration name and properties.
        - w Feature/Dimension based configuration names.
        - w Visually appealing and easy to follow
            - n .500-13 X 1.50   vs.   .5-13 x 1.5
            - n .375-18 x 1.25   vs.   .375-18 x 1.25

    - n Lookup tables
        - w What varies based on nominal
            - n Head height
            - n Head Flats
        - w Standard vs. Heavy
            - n Nested lookup formula

Design Tables Demystified: Examples:

- ◆ Structural Shapes: C-Channels, I-Beams, W-Beams, etc...

    - n Concatenate and Text formatting
        - w Consistent formatting of custom configuration name and properties.
        - w Feature/Dimension based configuration names.

    - n Lookup tables
        - w Nested lookup formula
            - n Search based on 2 nominal values: SIZE and WEIGHT
        - w What varies based on nominal
            - n Height
            - n Leg Length
            - n Web Thickness
            - n Leg Thickness

Design Tables Demystified: Example: Semi-Automated

- ◆ Multiple Levels of Assembly can have separate Design Tables.

    - n Design table embedded into each configured component.

    - n Configuration must exist in component before it can be referenced in the parent assembly.

    - n Feature/Dimension based configuration names.
        - w Easy to define what configuration of the component is needed, without any reference to part numbers.

    - n Color code cells to defined areas users can safely modify.
        - w Visually understandable.

    - n User copies a row, then edits cells to build new configuration.

Design Tables Demystified: Inserting table in drawing:

- ◆ How To:

    - n Open Design Table in Excel.

    - n Highlight and copy (ctrl C) the portion of the design table to be inserted into the drawing as a tabulated chart.

    - n Paste table into drawing.

    - n Grab the corners and drag to resize the table.

Design Tables Demystified: Advanced Process

- ◆ Create Automated Design Table

- ◆ Add Configurations in Future

Design Tables Demystified: Simple Process (Reviewed)

- ◆ Advantages:

    - n Simple to create

    - n User only needs a little knowledge of Excel.

- ◆ Disadvantages:

    - n Very "Basic"

    - n Low automation

    - n User must know all data to be entered.

Design Tables Demystified: Advanced Process (Reviewed)

Create Model	Name Features Dims Mates	Create a few Configs	Insert Design Table	Save Design Table To File	Edit Design Table in Excel	Create Useful Formulas in Tables
Use Concat for Config Names	Use Concat for Properties	Add LookUp Tables	Colorize Columns	Save Design Table	Insert New Table in Model	Model Updated

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.

Design Tables Demystified: 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.

Design Tables Demystified: 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?

Design Tables Demystified: 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.

Design Tables Demystified: 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

Design Tables Demystified: 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.

Design Tables Demystified: Tips - Excel

- Color code cells.
  - n Defined areas that other users can safely modify.

- Format cells
  - n Vertically aligned text in Header Row
  - n General type instead of Text type
    - w Allows you to use formulas.
  - n Refrain from merging cells
    - w Someone may accidentally unmerge cells.
    - w Unknown results.

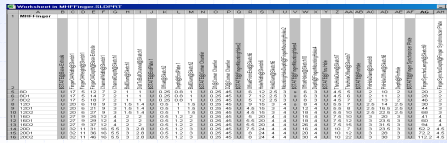## Design Tables Demystified: Tips - Design Table Files

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

Design Tables Demystified: Tips - More……

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

Design Tables Demystified: How much is too much?

- Someone else is going to need to understand what you have created.
  - n Document complex formulas for the less Excel clever.
  - n 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, and why.

- Before you start – PLAN AHEAD
  - n Impose limits on what variations are acceptable in the model.

Design Tables Demystified: Design Tables Are Not KBE

- Design Tables
  - n You can build intelligence into the Design Table.
    - w Lookup Table, Equations, etc........
  - n Design Tables can only work on one component at a time.

- Knowledge Based Engineering (KBE)
  - n Can modify components at all levels.
  - n Makes unique components from existing components.
    - w Does not create or use configurations.

Design Tables Demystified: Alternatives

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

Design Tables Demystified: Alternatives

❖ Visual Basic for Applications (VBA)

   n You don't really have to be a programmer to do this.

  n Copy the syntax and replace dimension names and math operations.

  n Use Excel functions to calculate, and VBA to transfer the dimension values to SolidWorks.

  n It's not as complicated as it looks.

Design Tables Demystified: Resources for learning more?

❖ SolidWorks Help File

  n Directions for creation and use.
  n Summary of Design Table Parameters.
    w List of "codes" recognized in design tables.

❖ SolidWorks Online Tutorials

  n Design Tables
    w Similar to old "40 Minute Running Start."

❖ Excel Help File

  n Help on using Excel's functions to automate your design tables.

❖ SolidWorks VAR's/Resellers

  n Training classes & night schools.

SolidWorks Design Tables Demystified

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