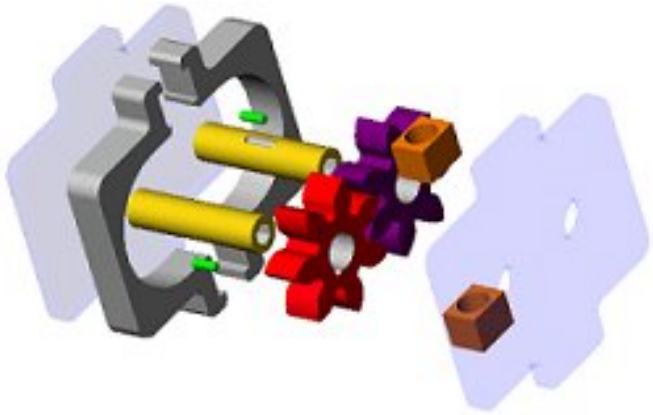
Solid Modeling & Basic Design Intent



Why Solid Modeling & Design Intent?

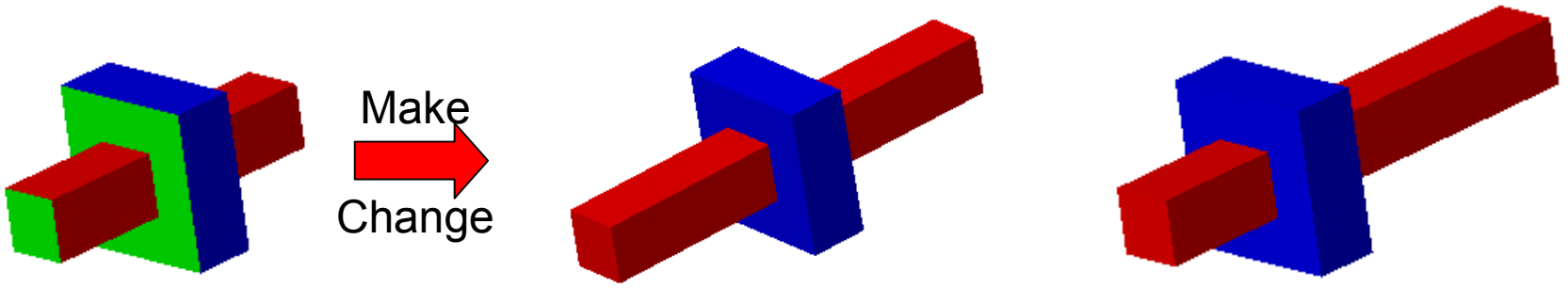
Why Solid Modeling?

- Design is a process of constant change and iteration
- 98% of all machines are now designed/made using Solid Modeling (SM)
- SM allows designers to make large/sweeping changes with little re-work of prints

Why Design Intent?

- To minimize re-work, the computer must know what you intend
- Design Intent = How you wish the design/model to be (even if changed)
- You MUST THINK AHEAD & build design intent into your model
- You MUST NAME ALL OF THE 3D FEATURES IN YOUR MODEL TREE

EX. Design Intent = Parts Remain Symmetric & Design Change = Length



INITIAL DESIGN **INTENT MAINTAINED** **INTENT NOT MAINTAINED**

Solid Modeling is 90% design intent and 10% knowing the program

A large part of your SM grades will be based on use of proper design intent

Symmetric Design Intent (DI) For Parts & Assemblies

Purpose:

- Demonstrate need for DI & give practice in Part-Assembly design intent

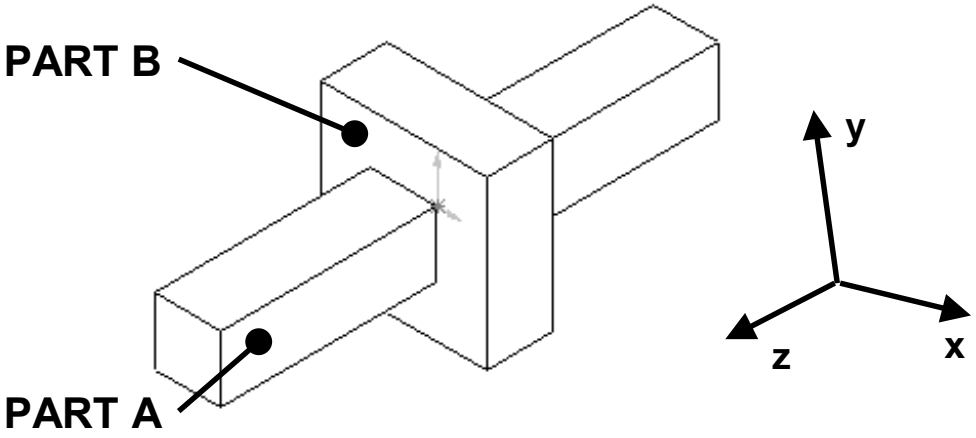
Today's Exercise:

- You will given the part and assembly files for a CAD model with poor design intent
- You will see the effects of poor DI
- You will correct the design intent

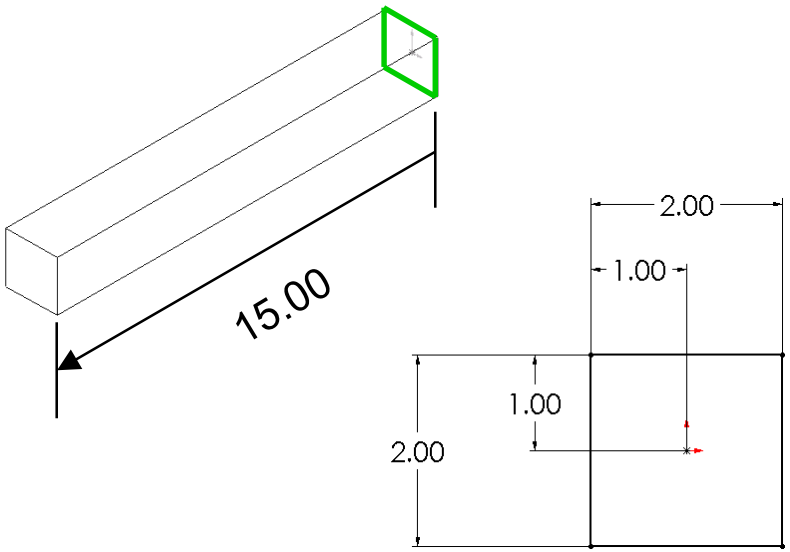
Why you need this:

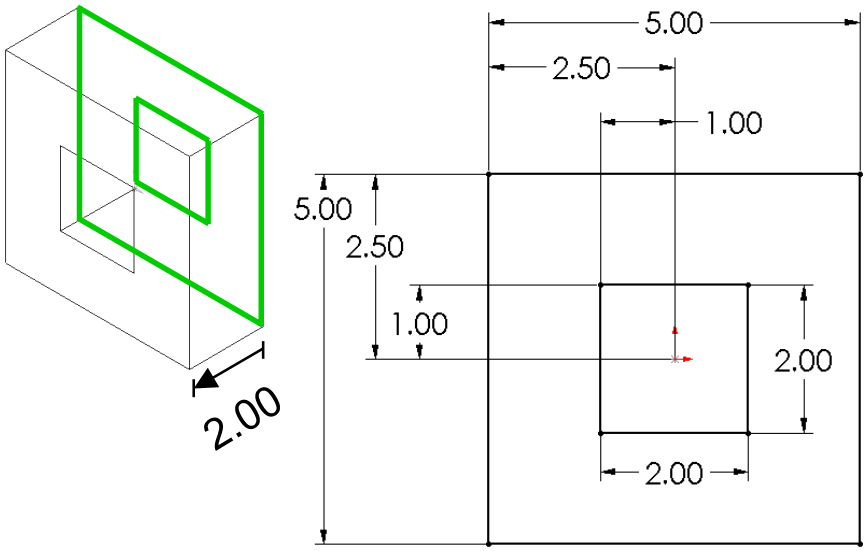
- Similar to the design intent required for GEAR PUMPS
- Will save you hours on future projects at MIT

Design intent for this CAD model: A & B are symmetric about X,Y,Z axes



How the Parts Were Built





PART A:

Blind Extrusion

Depth = 15 inches

Note how the sketch is centered

PART B:

Blind Extrusion

Depth = 2 inches

Note how the sketch is centered

How the Parts Were Located In Assembly

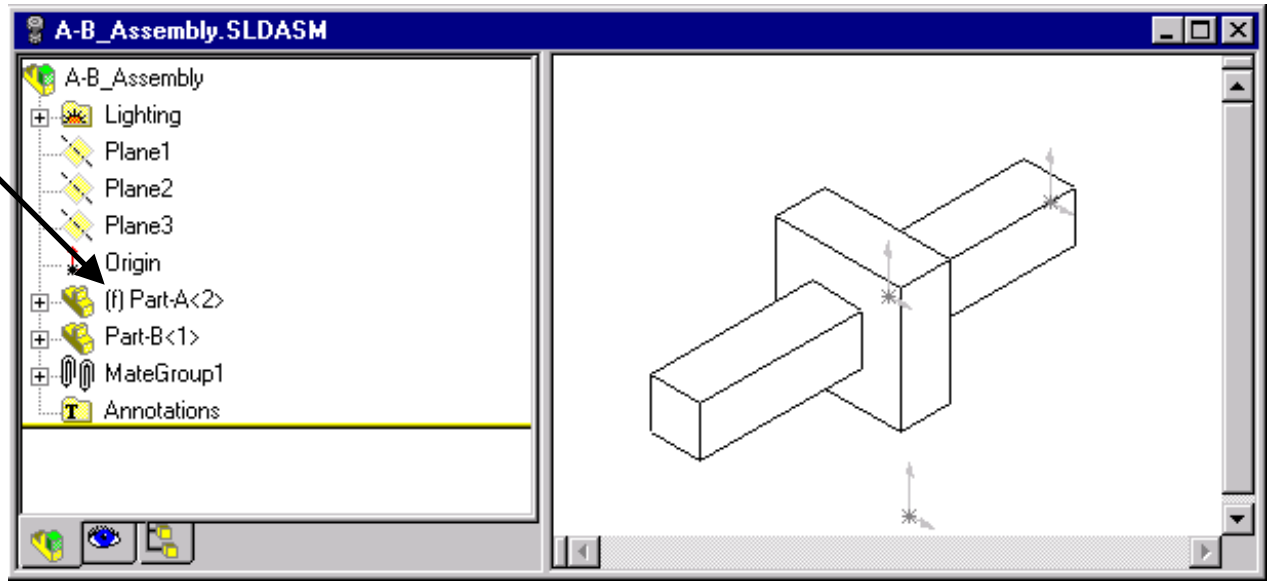
Putting parts into assembly file:

- Unfortunately, SolidWorks may “fix” the first part placed into an assembly. When SolidWorks does this, the first part (in this case Part A) is ARBITRARILY fixed in the 3D space of the assembly file.

- This is POOR SOLID MODELING PRACTICE!!!!

- DO NOT TRY TO FIX THIS NOW, we will fix it momentarily

The (f) before Part-A shows that it is arbitrarily fixed



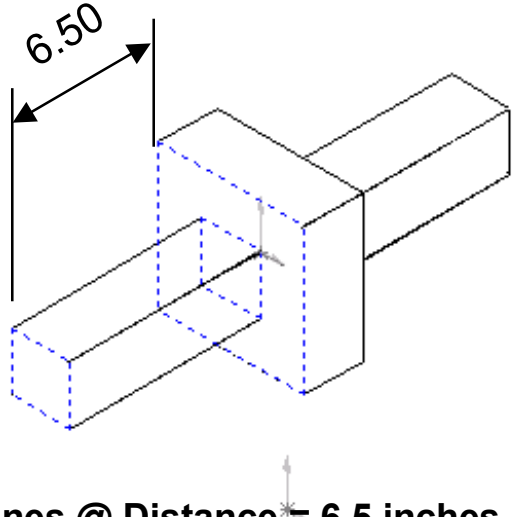
How the Parts Were Mated

The parts were mated as shown below:

- You can see details on how the parts were mated by:
  - Clicking on the “+” sign to the left of the MateGroup1 icon in the feature tree
  - Then Left Click ONCE on the mates to see which planes were mated (I.e. below)
  - As you click through the mates, they will highlight the mated planes/features
  - The planes below should be highlighted as you click through

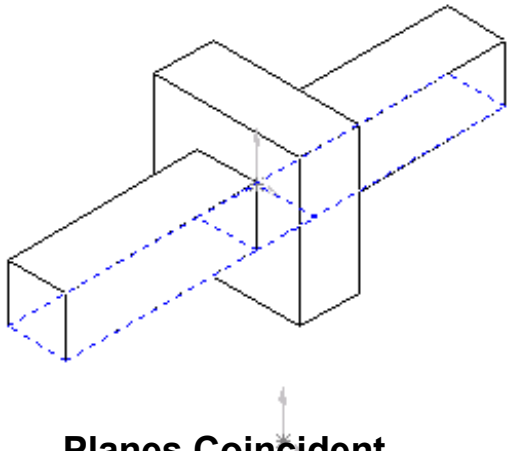
- In the next steps, we will see why these mates reflect POOR DESIGN INTENT

1



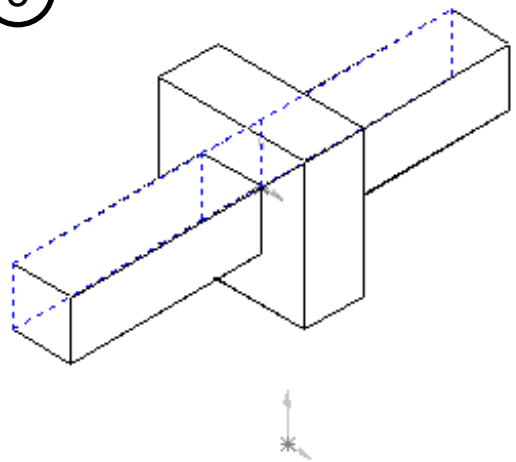
Planes @ Distance = 6.5 inches
Initially makes the two parts symmetric

2



Planes Coincident

3

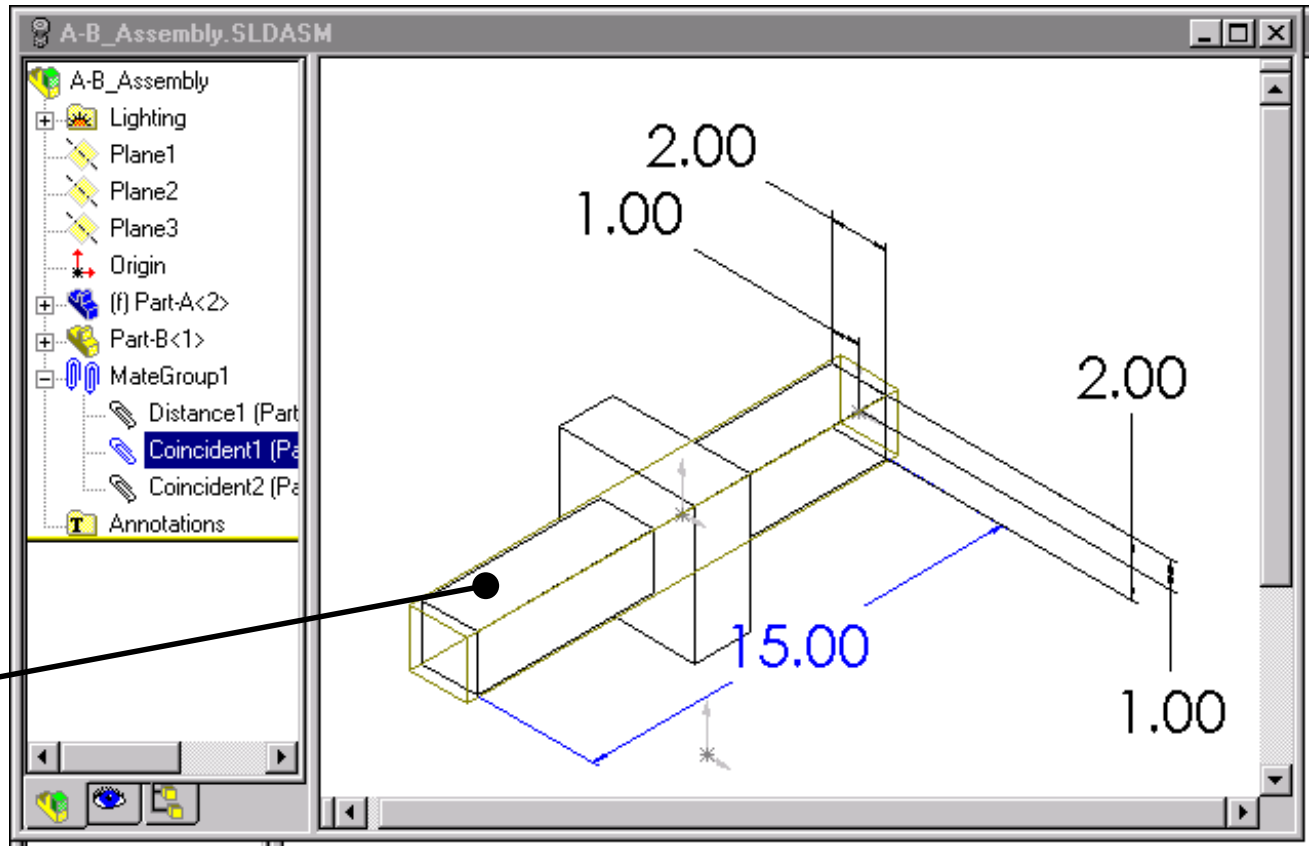


Planes Coincident

Results of Poor Design Intent

Changing Model Dimensions

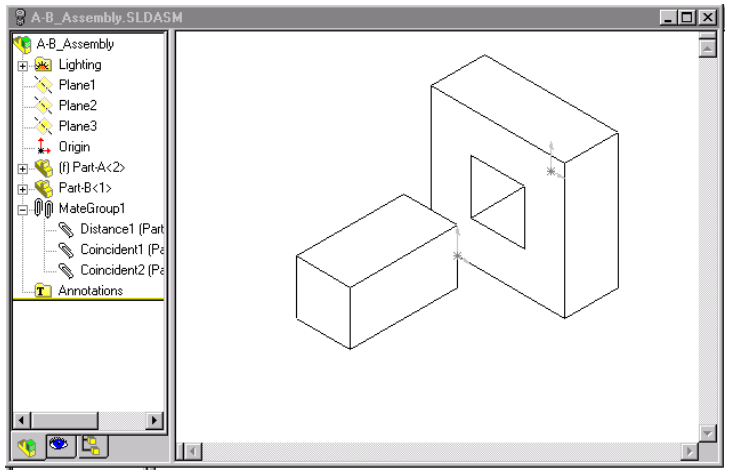
- Make sure you are working on **A-B_Assembly.sldasm**, Not a part file
- Set the view type to: No Hidden Lines
- Double Click on Part A (long skiny part) in the window to see its dimensions
- Change the 15.00 inch dimension to 4 inches
- Rebuild the model



Results of Poor Design Intent

Changing Model Dimensions

- Part A is no longer centered in Part B!!!! The design intent is not maintained.



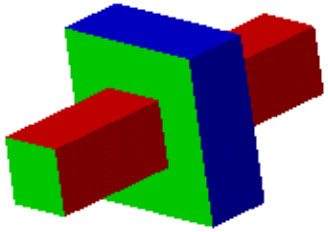
- Spend ~ 3 Minutes changing other dimensions and extrusion depths in parts A and B (by double clicking on the parts as on the previous slide).

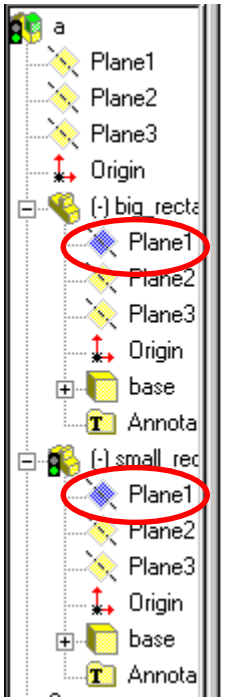
- You will be able to see how the design intent is not preserved.

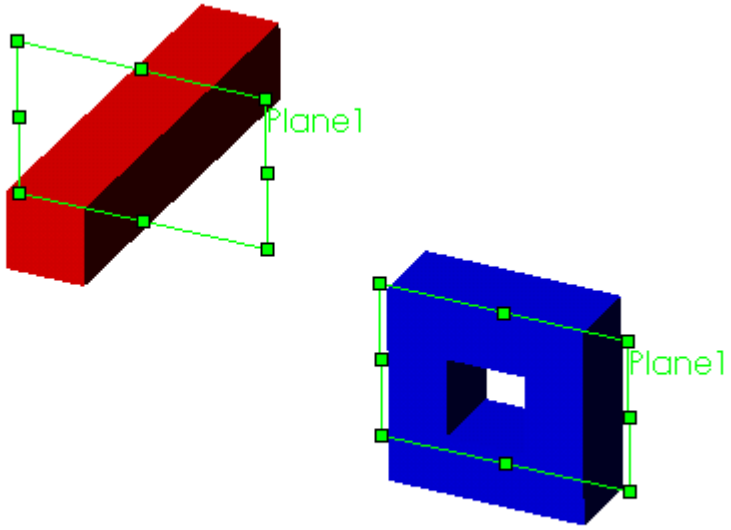
- Next we will fix the model in real time on the screen so that the proper design intent is preserved.

- If you finish early, think about how you would fix the model. There is a hint on the next slide. Call me if you figure it out.

Symmetric Design Intent in Assemblies

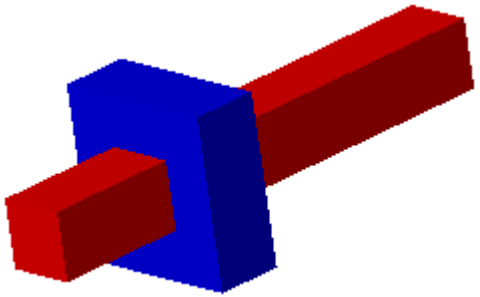






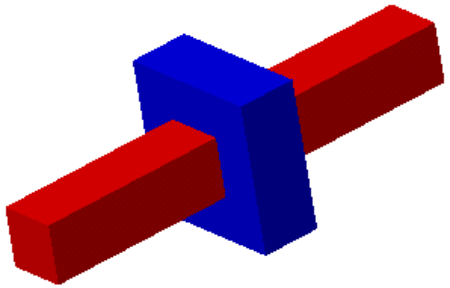
MATING FACES AT A DISTANCE:

INCORRECT

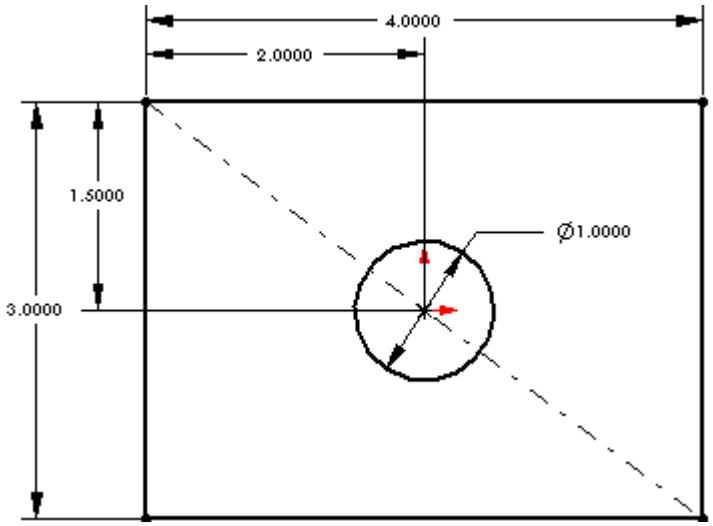


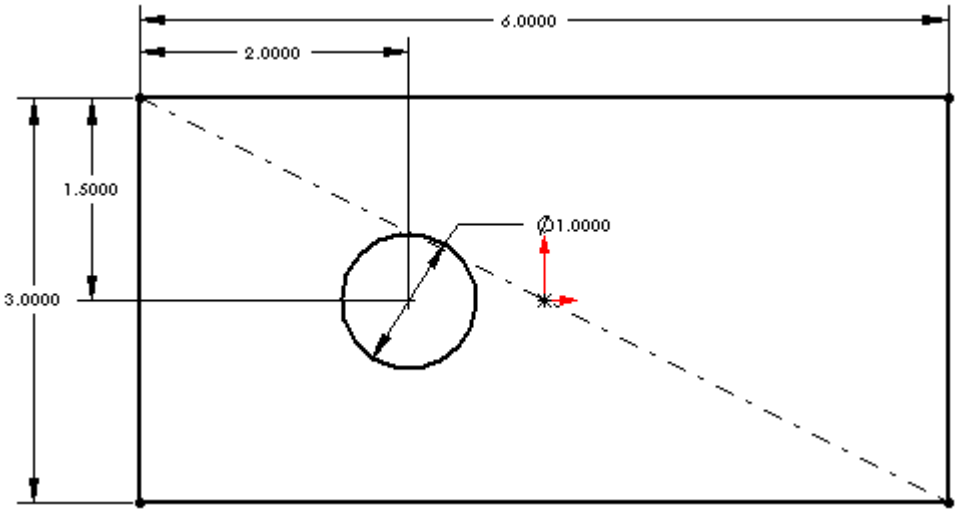
MATING DEFAULT PLANES

CORRECT

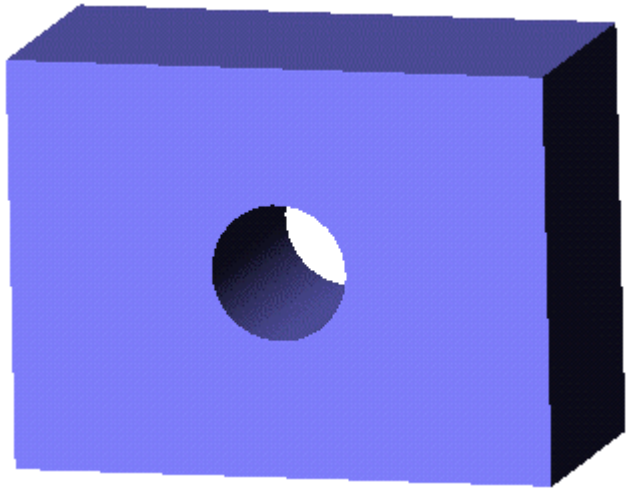


Centered Design Intent in Parts - Why?

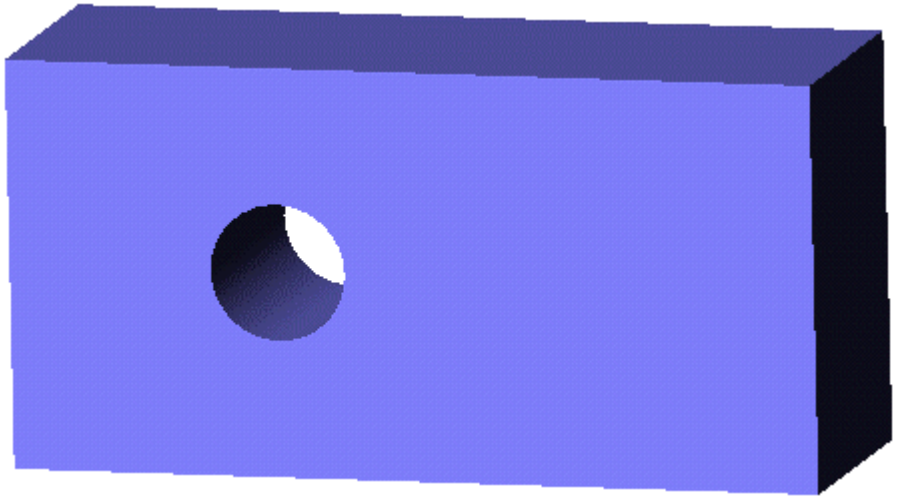




Original Intent Was to Have Hole Centered



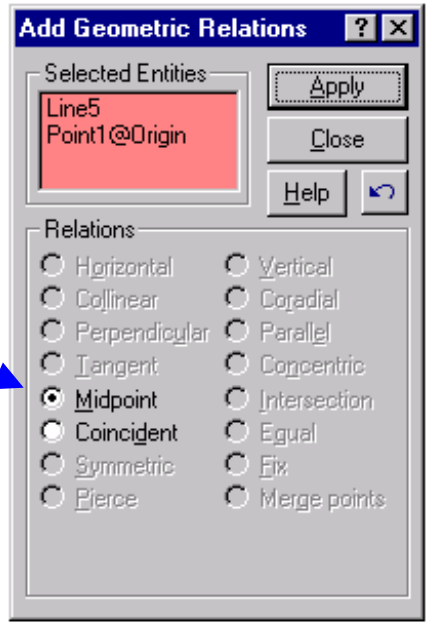
Intent Not Maintained During Design Change

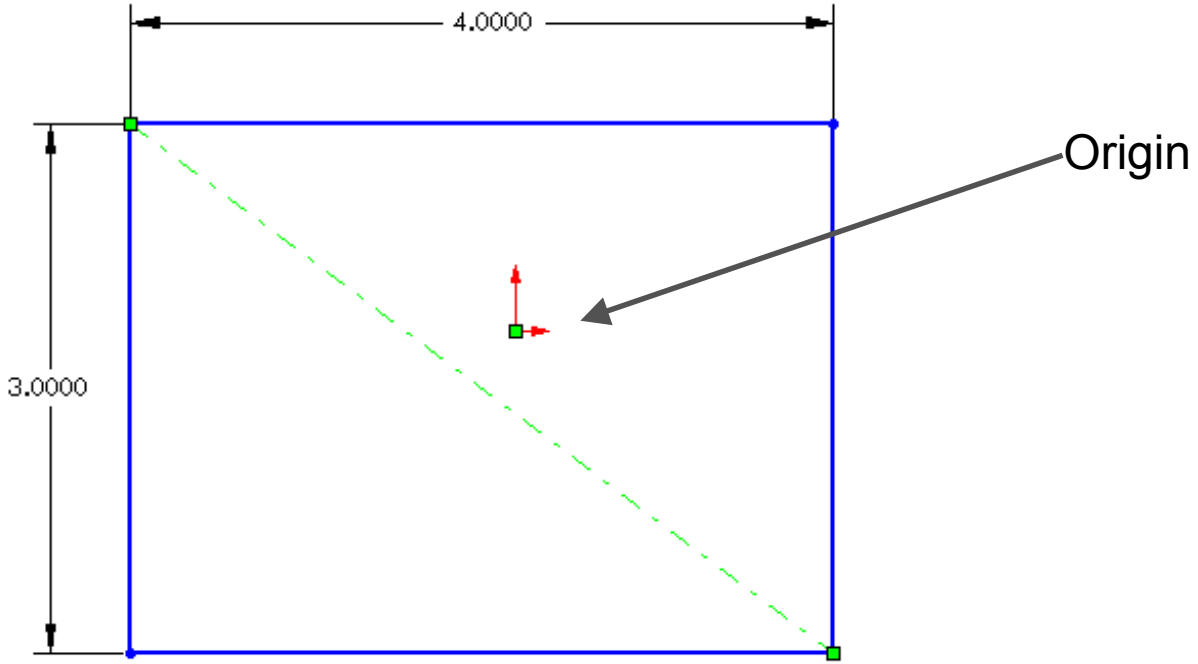


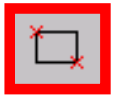
You would have to re-edit the sketch to fix!

Centered Design Intent in Parts/Sketches

CLASS EXERCISE: ALL BUTTONS ARE IN THE SKETCHING TOOL BAR





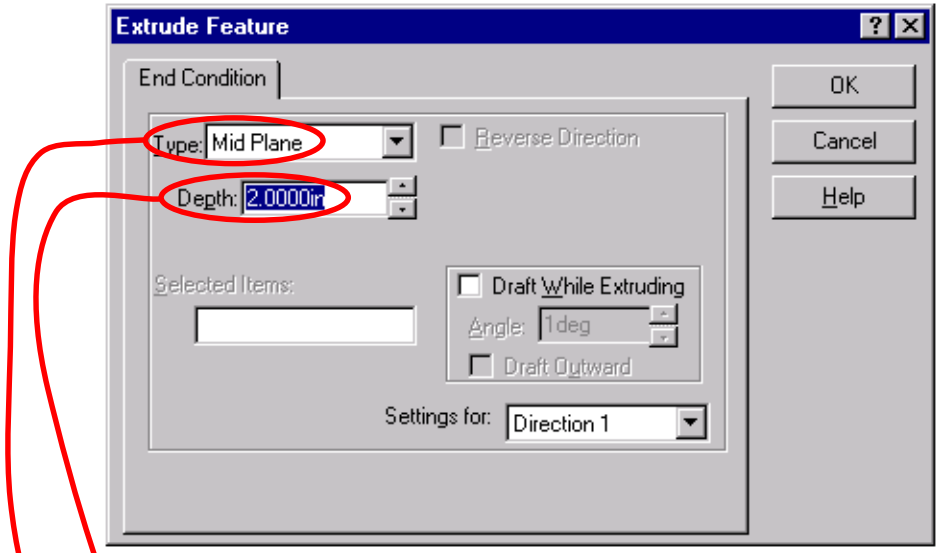
STEP 1: Sketch a box  roughly centered about the origin

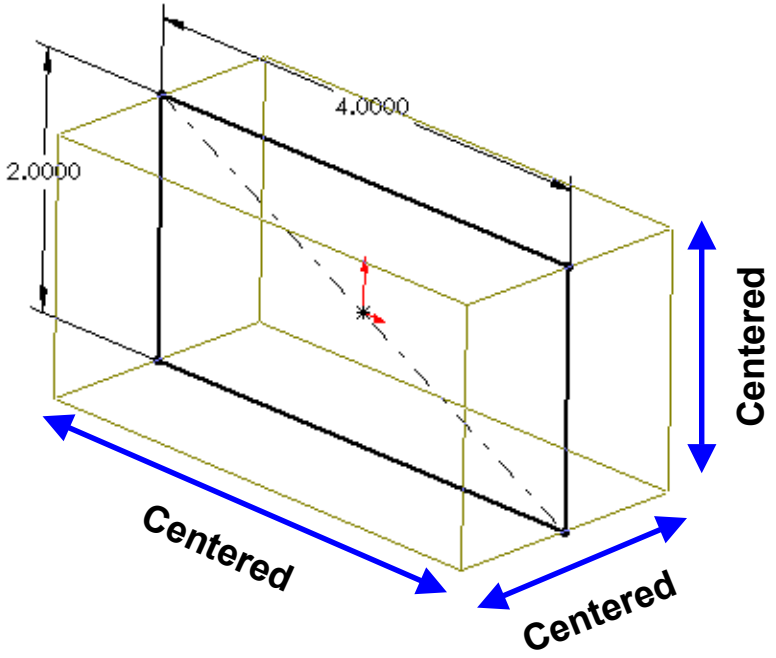
STEP 2: Dimension the width and length of the box as shown above

STEP 3: Draw a Center Line  from one corner to an opposing corner

STEP 4: Use ADD RELATION  to constrain the Origin and Mid-point of the CL

Centered Design Intent in Parts/Sketches





Mid-Plane Extrusions center an extruded piece about its sketch plane

STEP 5: Extrude as a **MID-PLANE Extrusion** @ **Depth = 2 inches** (Note This step centers about the 3rd plane)

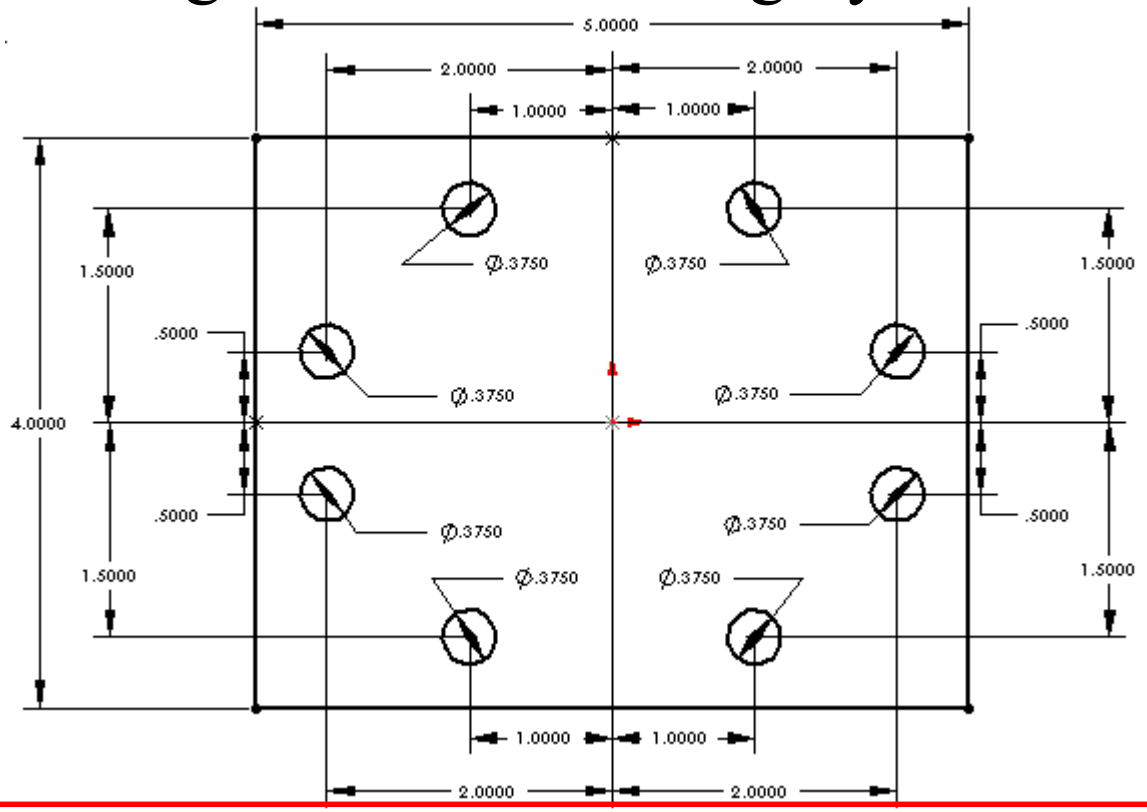
STEP 6: Click OK, then click on Planes 1,2,3 in the feature tree window to see if part is centered

RESULTS: You should now have a part centered about the origin in **ALL 3 DIRECTIONS**

Symmetric Design Intent: Mirroring Symmetric Parts

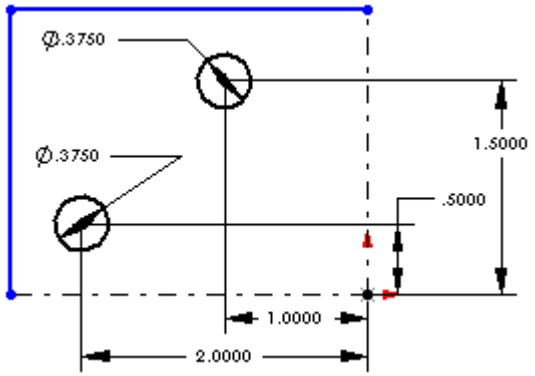
26 Dimensions

This is poor practice

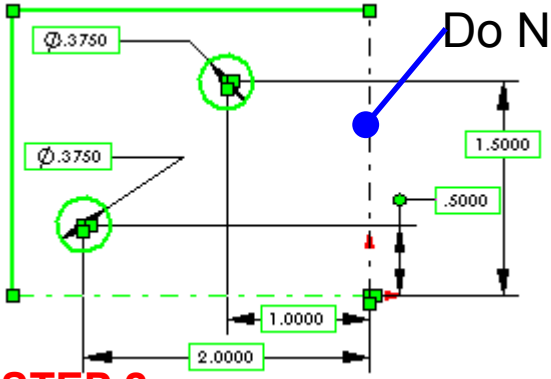


C Line

Mirror



STEP 1:
DRAW THE FOLLOWING

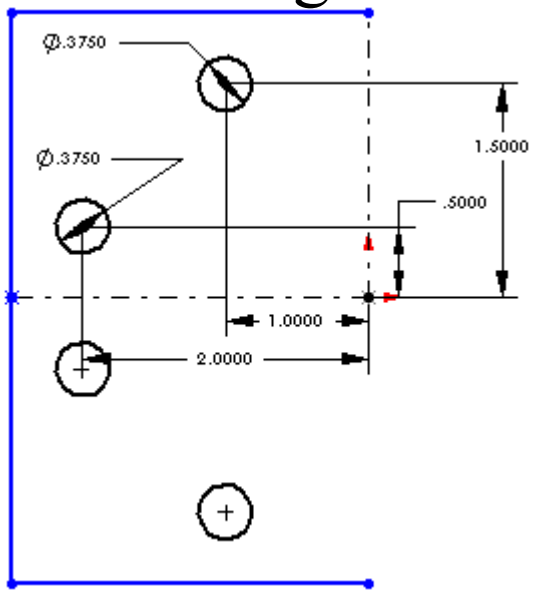


Do Not Select

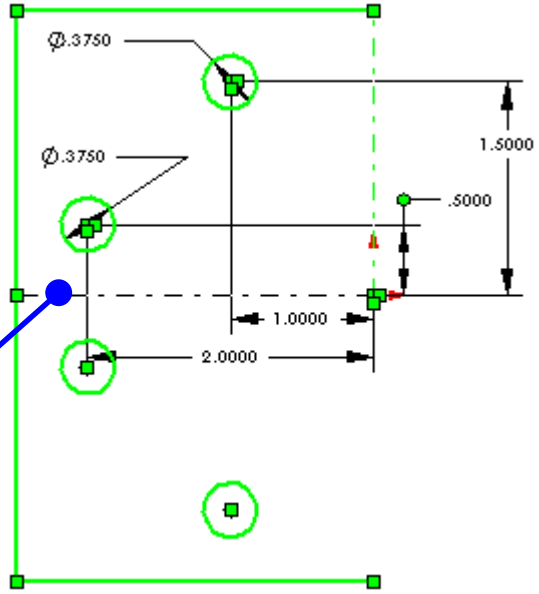
STEP 2:
SELECT & MIRROR

Symmetric Design Intent: Mirroring Symmetric Parts

RESULT OF STEP 2

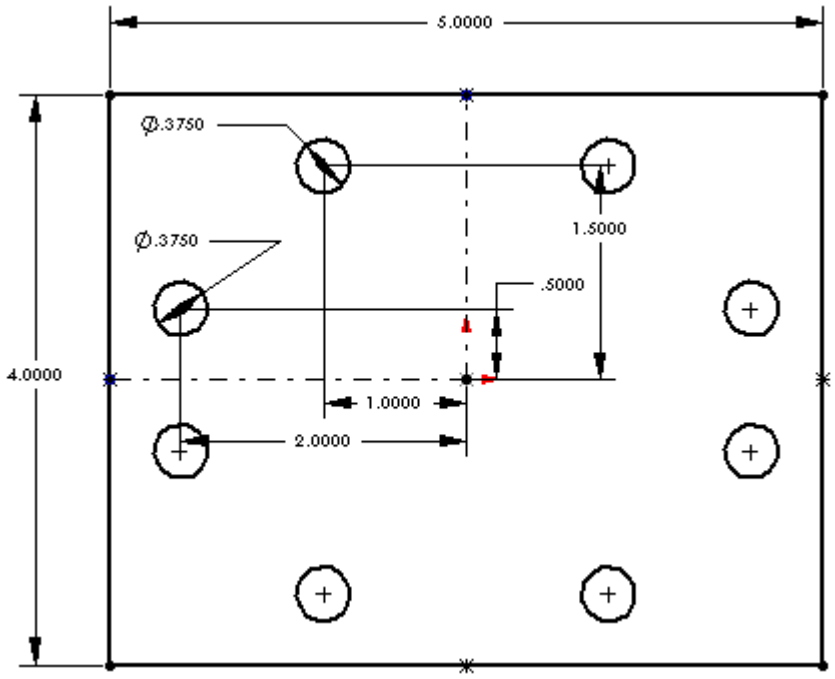


STEP 3: SELECT & MIRROR

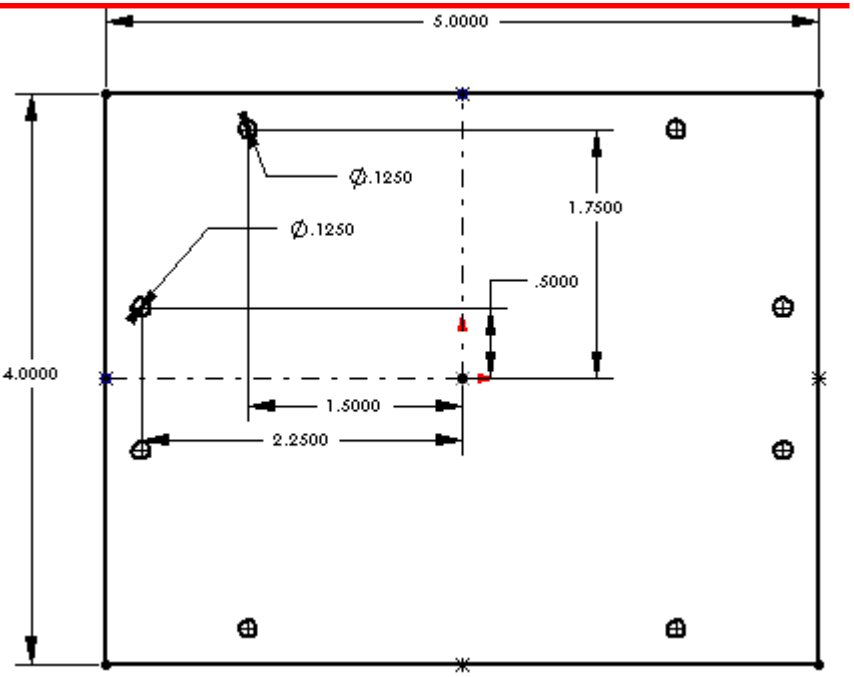


Do Not Select

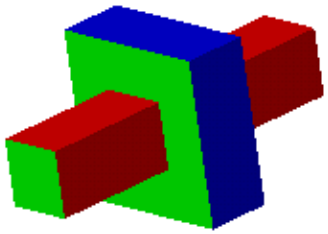
STEP 4: DIMN SIDES

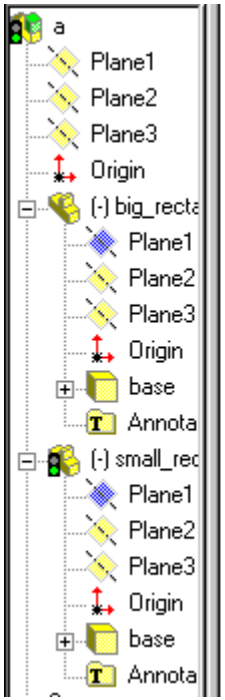


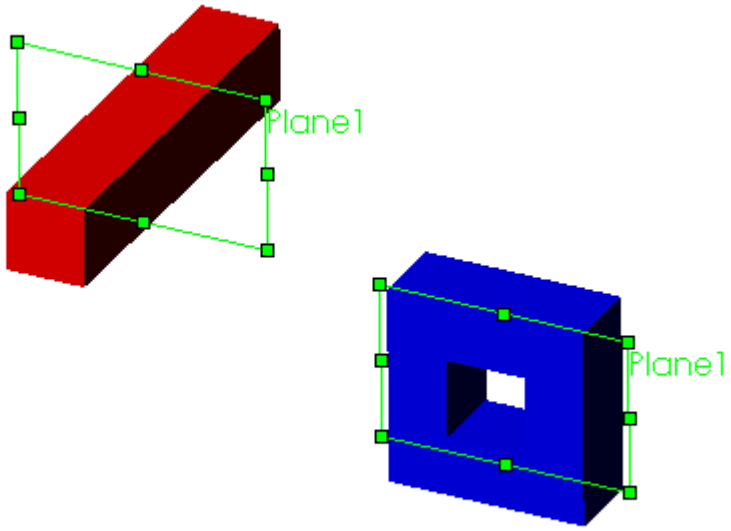
Make Changes



Symmetric Design Intent in Assemblies

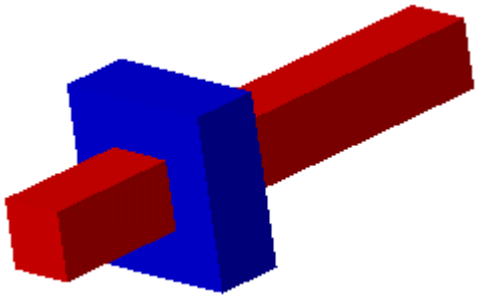






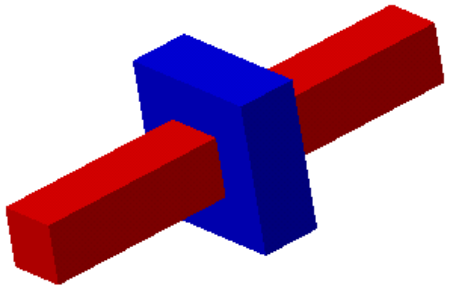
MATING FACES AT A DISTANCE:

INCORRECT

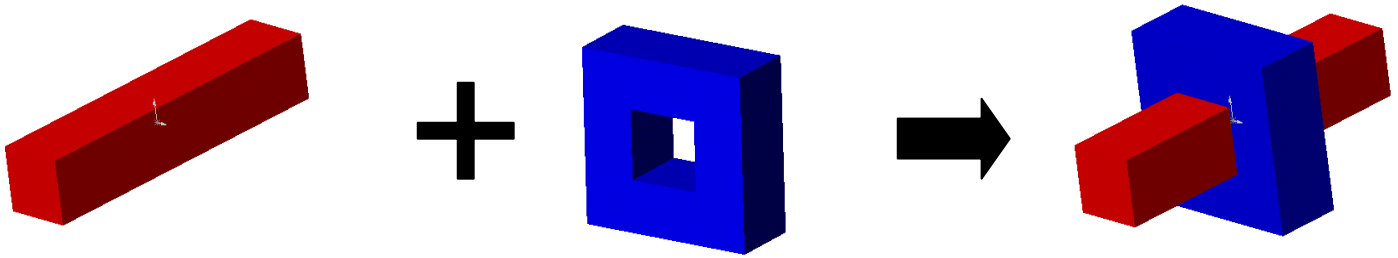


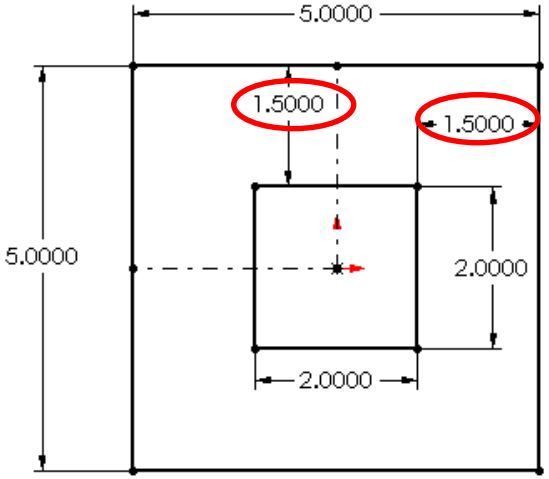
MATING DEFAULT PLANES

CORRECT



Symmetric Design Intent Parts & Assemblies





USING DIMENSIONS

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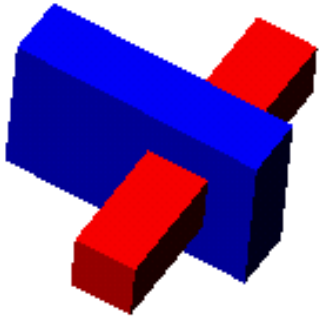
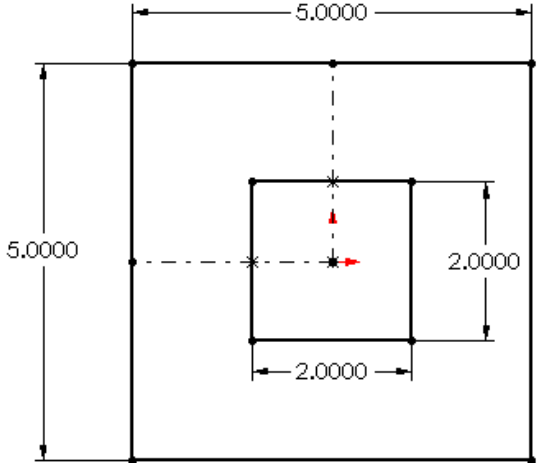
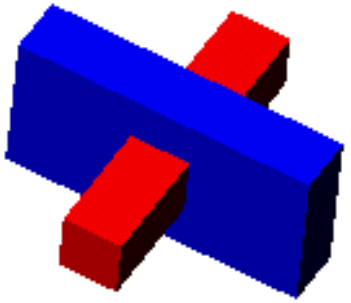


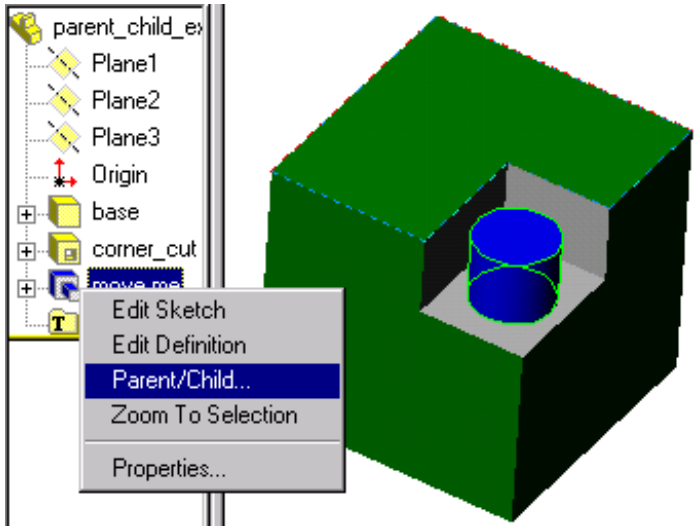


USE RELATIONS TO FORCE INTENT

CORRECT



Parent - Child Relationships & Changing Design Intent



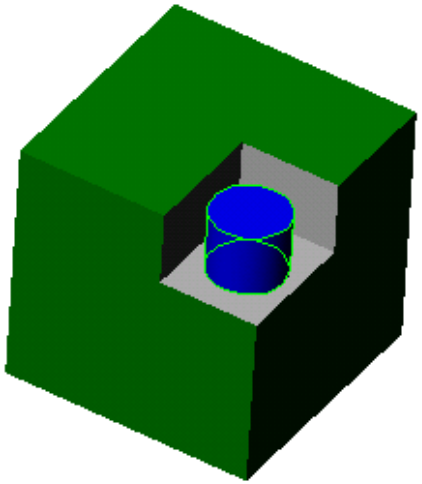
base

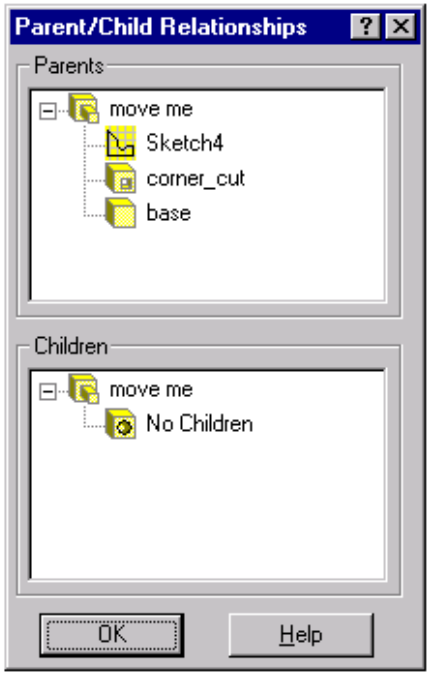
corner cut

move me

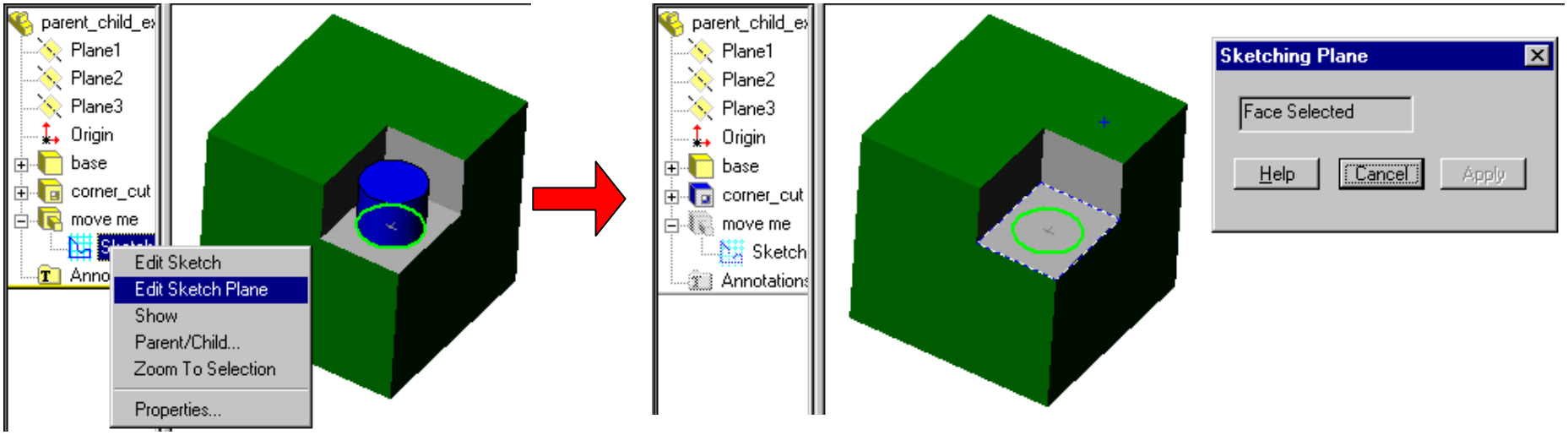
1. “move me” sketch is on the surface of the corner_cut, so it is a child of the corner cut

2. Corner cut sketch is on a face of the base, so it is a child of the base

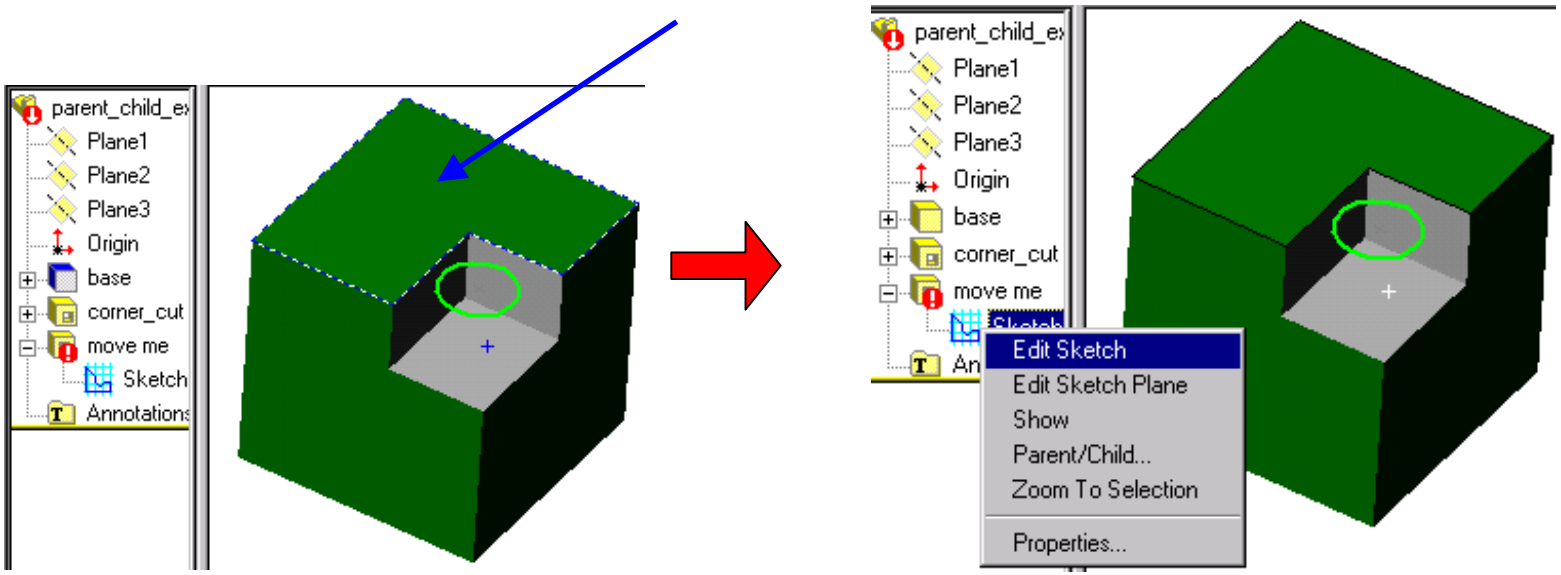




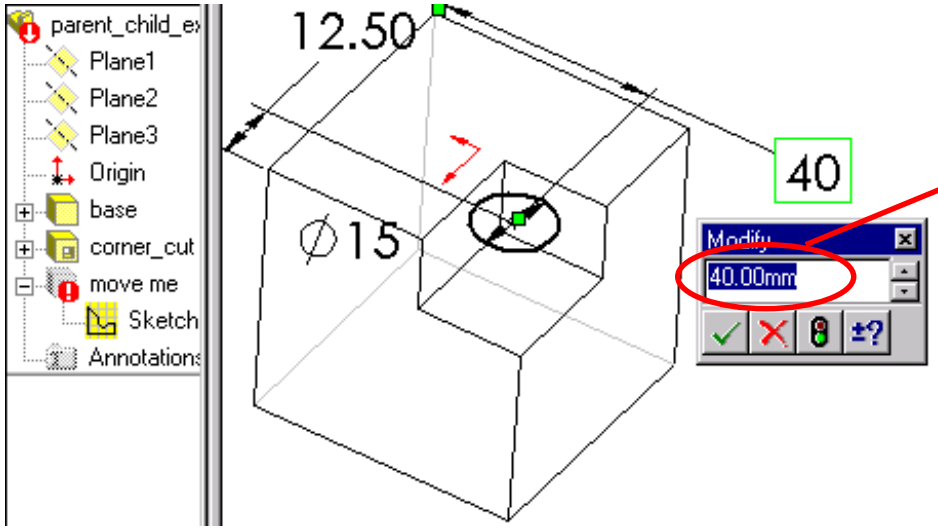
Parent - Child Relationships & Changing Design Intent



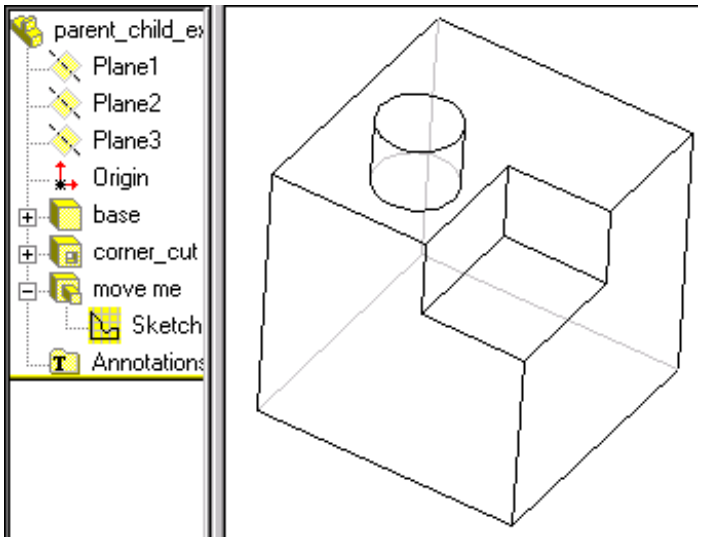
Select

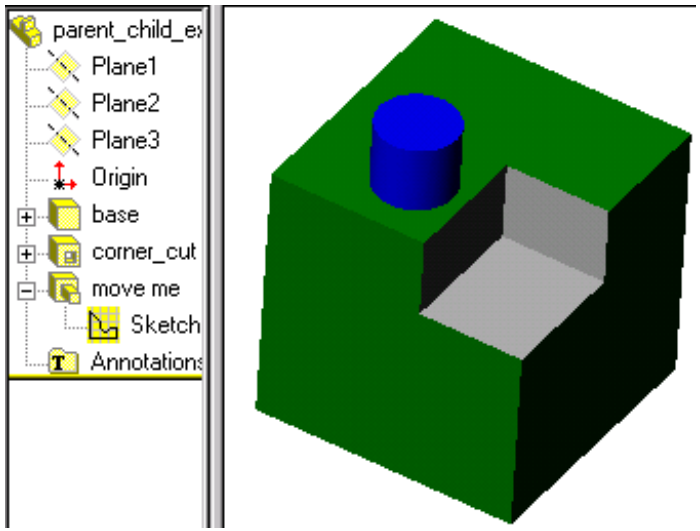


Parent - Child Relationships & Changing Design Intent



Change to 20 mm





Symmetric Design Intent in Assemblies: Exercise

1. **YOU SHOULD HAVE DOWNLOADED THE SHAFT AND GEAR FROM THE WEB SITE**
2. **MAKE THE KEY BY YOURSELF (0.0125" Diameter x 0.5" Long).**
3. **ASSEMBLE THE GEAR-KEY-SHAFT, THEN ASK ME TO CHECK OFF**