Introduction to

SolidWorks

Construction Studies
Table of Contents

Table of Contents ............................................................................................................. 1
Strip Foundation .................................................................................................................. 1
   Introduction ......................................................................................................................... 2
   Learning Intentions .............................................................................................................. 2
   Modelling the Subsoil .......................................................................................................... 3
   Modelling the Concrete Foundation ...................................................................................... 7
   Modelling the Blockwork below Ground ............................................................................. 11
   Modelling the Cavity Fill ..................................................................................................... 15
   Modelling the Hardcore ..................................................................................................... 16
   Modelling the Sand Blinding .............................................................................................. 19
   Modelling the Radon Barrier .............................................................................................. 20
   Modelling the Soap Bar ...................................................................................................... 22
   Modelling Blockwork above Ground .................................................................................. 24
   Modelling Damp Proof Course .......................................................................................... 29
   Modelling the Insulation ................................................................................................... 31
   Assembling the Parts ......................................................................................................... 37
Strip Foundation

Introduction

Solid Works is a valuable tool that can be used in the teaching and learning of Construction Studies.

The purpose of this lesson is to use some of the basics of SolidWorks to show the component parts in a foundation detail. You will practice how to create parts, and how to assemble the parts.

Learning Intentions

On completion of this exercise you will be familiar with:

- The various sketch commands.
- Using the extrude commands.
- Using Linear Pattern.
- Adding appearances to parts.
- Creating an assembly.
To begin, create a Folder called **Strip Foundation**.
Save all files into this folder.

**Part Modelling the Subsoil**

Open a new part.
Save Part as **Subsoil**.

Create a new sketch on the **Front Plane**.

Using the line command draw the shape shown.
Note the position of the origin.

Add the dimensions.
Select **Offset Entities** and offset the shape by 150mm outwards.
Reverse the direction if necessary.
Close the ends using the line command.
Accept the sketch.

Draw another sketch on the **Top plane**.

Use the **line** command draw the shape shown, starting at the origin. Add the dimensions.
Accept this sketch also.

In the features commands select **Swept Boss/Base**.
Select the **first sketch** as the profile and the **second sketch** as the path.
Accept.
Select the face shown and select sketch.

Press the space bar on the keyboard and select **Normal To**.

With the face still highlighted select **Convert Entities**.

A rectangle is now drawn on this face, shown in black.

Accept the sketch.

Select **Extrude Boss/Base** in the features commands.

For direction, select the down arrow highlighted and select **Up To Vertex**.
Select the edge shown as the vertex.

Accept.

**Appearance**

Apply a red sandstone appearance to the Part.

Save.
Part modelling Concrete Slab

Open a new part.

Save Part as “Concrete Foundation”.

Create a new sketch on the Top Plane.

Select the line command, and starting at the origin, draw the shape to the dimensions shown.

Select offset entities and offset by 1050mm.

Use the line command to close the ends.

Exit the sketch.

Select Extrude Boss/Base and Extrude by 350mm.

Drawing the Steel Reinforcement

Select the face shown and select sketch.

Press the spacebar and Normal To, in order to look directly at the sketch plane.
Draw a circle, add the dimensions as shown on the bottom left of the surface.

Accept the sketch. Select **Extrude Boss/Base** by 15mm.  
**Note**: Tick the box beside Direction 2 and add a distance of 4440mm for distance 2.  
Untick the box for **Merge results** as shown.

Select Hidden Lines Visible mode to see the result.

**Note**: We can use **Linear Pattern** in the Features commands to draw additional bars.  
Select **Linear Pattern**.  
Select the bottom edge of the concrete as the direction.
Select **Up to reference**. Select the face shown as the reference.

Offset the last bar by **60mm** from this reference face.

Select the number of bars to be **5**.

Repeat the process at the other end.
Appearance

Apply a dark concrete appearance to the part.

Apply a stainless steel appearance to the Bars.

Save.
Blockwork below ground.

Open a new part.

Save Part as “Blockwork below ground”.

Create a new sketch on the Front Plane.

Select the Corner Rectangle command. Draw the rectangle near the origin as shown.

Click on the bottom line of the rectangle and holding down the shift key select the origin also. Release the shift key and select the coincident relation that appears on the ghost toolbar.

Add the following dimensions.

Draw a Centreline vertically from the origin.

Select Mirror Entities. Select the four lines of the rectangle to mirror. Select the centreline as the line to mirror about.
Accept.

Select the Top Plane to draw a new sketch.

Using the line command draw the lines shown. Add the dimensions.

Accept the sketch.

In the features commands select Sweep.

Click on sketch 1 as the profile to sweep and sketch 2 being the path.

In the design tree click on sweep1 then press the F2 key on keyboard (Fn + F2 on some keyboards). Rename Mortar Bed.

Select the top surface of the Mortar Bed as shown.

Select the sketch command icon.

Press the space bar and select Normal To.

Holding down the shift key select the twelve external lines of the two mortar beds as shown.
Select Convert Entities.

These lines are now transferred onto the new sketch. Accept the sketch and select **Extrude Boss/Base** in the features commands.

Extrude by **215mm** and **untick the box Merge Results**. This will keep the two bodies separate.

**Appearance**

Expand the **Stone** folder and select **Paving**. Select **Light Concrete**.
Select the mortar bed on the drawing and apply it to the body as shown.

Left click on the surface. Select the copy appearance icon on the ghost toolbar that appears.

Click on the other mortar bed and select the Paste Appearance icon.

Select the Body icon to paste the appearance onto.

Apply a **Dark Concrete** appearance to the blockwork.

Save.
Cavity Fill

Open a new part.
Save Part as “Cavity Fill”

Create a new sketch on the Top Plane.
Draw the lines shown. Add the dimensions.
Select Offset Entities and set the distance to 150mm inside.

Use the line command to close the ends.
Accept the sketch.

Select Extrude Boss/Base in the Features commands and Extrude by 675mm.

Appearance
Apply a Sandstone appearance to the part.

Save.
Hardcore Layer

Open a new part.

Save Part as “Hardcore 1”.

Create a new sketch on the Top Plane.

Draw the rectangle shown.

Exit the sketch and extrude by 150mm.

Select the underside of the part and sketch the following “L” shape.

Add the dimensions.

Exit the sketch.

Extrude by 310mm.

Select the Fillet command.

Add a 1000mm fillet to the edge shown.
Appearance

Add a granite appearance to the part.

Save.

To draw the second layer of hardcore open “Hardcore1”.
Select File, Save As and name it as “Hardcore2”.

In the design tree right click on Boss Extrude 2. Select delete. Select Yes to confirm the feature to delete.
Delete the associated sketch in the same way.

In the design tree, right click on Boss-Extrude1 and select edit sketch.

Double click on the dimensions on the screen to change as follows.

Accept the sketch.

Save.
Sand Blinding

Open “Hardcore2”. Select File, Save As and save the part as “Sand Blinding”.

In the design tree right click on Boss-Extrude1 and select the Edit Feature icon.

Change the extrude distance to 40mm.

Right click on Boss-Extrude1 again and select the edit sketch icon.

Double click on the dimensions on the screen and change the dimensions as follows.

Accept the sketch.

Appearance

Apply a Sand appearance to the part.

Save.
Radon Barrier

Open a new part.
Save Part as “Radon Barrier”.

Create a new sketch on the Front Plane.
Using the line command draw the following sketch.

Select Offset Entities and offset the sketch by 2mm outwards.

Use the line command to close the ends.

Accept the sketch.

Select the Top Plane to draw another sketch. Select the line command and draw the shape shown. Start from the origin.
Use Normal To when drawing the sketch.

Accept the sketch.
In the Features commands select the **Sweep** Command.

Accept.

Select the face shown and select the sketch icon. Select Normal To.

Select the **corner rectangle** command and draw a rectangle starting from the origin.

Add a 2mm dimension to the rectangle height.

Accept the sketch.

Select **Extrude Boss/Base**.

In direction window select up to vertex.

Select the vertex as shown.

Accept.
**Appearance**

Apply a **Red, Medium gloss, Plastic** to the part.

Add a **1000mm fillet** to the front corner shown.

Save.

**Soap Bar**

Open a new part.

Save Part as “**Soap Bar**”.

Create a new sketch on the **Top Plane**.

Use the **line** command draw the lines shown.

Select offset entities and offset by **100mm** to the inside of the lines.

Use the **line** command to close the sketch.

Accept the sketch and extrude by **10mm**.
Rename the extrude as “Mortar” in the design tree.

Select the top surface to draw another sketch.
Select Normal To.

With the top surface highlighted select convert entities.

Accept the sketch and Extrude by 140mm.

**Note:** Untick the Merge result box.

In the design tree rename the extrude as “Blocks”.
Appearance

Apply a **light Concrete** appearance to the mortar.

Apply a **dark concrete** appearance to the blocks.

Save.

Blockwork (outer leaf first row above ground level).

Open **Soap Bar** part.

Select File, Save as. Save as “**Outer leaf first row above ground**”.

Right click on **mortar** in the design tree. Select the edit sketch icon.

Change the dimensions as shown.

Accept the sketch.

Right click on **Mortar** in the design tree again. Select, edit feature.

Change the extrusion to **8mm**.

Accept.
Right click on the **Block** in the design tree and select the edit feature icon.
Change the extrusion to **215mm**.

**Save.**

**Blockwork outer leaf (second row above ground)**

Open “**outer leaf first row above ground**” part.
Select **File, Save as**. Save as “**Outer leaf second row above ground**”.
Right click on mortar in the design tree. Select edit sketch.
Change the dimensions as shown.
Accept the sketch.

Select the **edit mortar feature** icon. Change the extrude to **9mm**.

**Save.**
Blockwork outer leaf (third row above ground)

Open “outer leaf second row above ground” part.
Select File, Save as. Save as “Outer leaf third row above ground”.
Right click on mortar in the design tree.
Select edit sketch.
Change the dimensions as shown.
Accept the sketch.

Select edit mortar feature. Change the extrude to 10mm.

Inner leaf Blockwork (Brick row above soap bar)

Open “Soap Bar” part.
Select File, Save as. Save as “Brick row above soap bar”.
Right click on mortar in the design tree. Select the edit sketch icon.
Change the dimensions as shown.
Accept the sketch.
Select the edit mortar feature icon. Change the extrude to **8mm**.

Select the **Block** in the design tree. Select the edit feature icon and change the distance to **65mm**.

Save.

**Inner leaf Blockwork (Block row above brick)**

Open “**brick above soap bar**” part.

Select **File, Save as**. Save as “**Inner leaf. Second row above ground**”.

Right click on mortar in the design tree. Select the edit sketch icon.

Change the dimensions as shown.

Accept the sketch.
Right click on the mortar feature icon and change the depth to 9mm.

Select block in the design tree and select the edit feature icon. Change the distance to 215mm.

Save.

Repeat the process for the third and fourth row. Use the following measurements.

**Third row inner leaf.**

Mortar depth is 10mm. Accept. Save.

**Fourth row inner leaf.**

Accept. Save.
Stepped DPC inner

Open a new part.
Save the part as “Stepped DPC”
Use the line command to draw the sketch shown on the Front Plane.
Select offset entities and offset upwards by 1mm.

Use the line command to close the sketch.
Accept the sketch.
Select the Top Plane and draw the sketch shown.
Accept.
Select Swept Boss/Base in the features commands.
Select sketch1 as the profile and sketch2 as the path.

Accept.

Appearance
Apply a Medium gloss, plastic, blue to the part.
Save.

**DPC Outer Leaf**

Open a new part.

Save the part as “DPC Outer leaf”.

Use the **Corner Rectangle** command to draw the sketch shown on the **Front Plane**.

Add the following dimensions.

Accept the sketch.

Select the **Top Plane** and draw the following sketch.

Accept.

In the Features command select **Swept Boss/Base**.

Select sketch1 as the profile.

Accept.

**Appearance**

Apply a **Medium gloss, plastic blue** to the part.

Save.
**Vertical Floor Insulation**

Open a New Part.

Save the part as “**Vertical floor insulation**”.

Use the **Line** command to draw the sketch shown on the **Top Plane**.

Add the following dimensions.

Accept the sketch.

**Extrude by 250mm**

**Appearance**

Apply a **Solid, Yellow** appearance to the part.
Apply **matte silver** to the faces.

Save.

**Floor Insulation**

Open the “**Sand Blinding**” part.

Select **File, Save as** and save as “**Floor Insulation**”.

Click on Boss extrude in the design tree.

Select the edit sketch icon.

Change the dimensions as follows.

Select the edit feature icon and change the distance to **100mm**.
Appearance.
Apply a yellow appearance to the part and a matte silver appearance to the upper and lower faces as shown.
Save.

Concrete Floor
Open the “Floor Insulation” part.
Select File, Save as and save as “Concrete Floor”.
Click on Boss extrude in the design tree.
Select the edit sketch icon. Change the dimensions as follows.
Accept the sketch.

Select the edit feature icon and change the distance to 150mm.

Appearance
Apply a Wet Concrete appearance to the part.

Save.
Cavity Wall Insulation

Open the “Vertical Floor Insulation” part.
Select File, Save as and save as “Cavity Wall Insulation”.
Click on Boss extrude in the design tree.

Select the edit sketch icon. Change the dimensions as follows.

Accept the sketch.

Select edit feature in the design tree.

Change the extrude height to 450mm.

Select the top surface of the part and select the sketch icon.
Select Normal To by using the space bar on the keyboard.
Select **Centreline** and draw the sketch from the midpoints of the end lines as shown.

Select the **Offset Entities**.

Click on both centrelines.

Add an offset of **12mm**.

Tick the box for **Bi-directional**.

Tick the box for **Cap ends** and **lines**.

Accept the sketch.

Select **Extrude cut** in the features commands.

Extrude cut by **10mm**.

Repeat the sketch on the underside.
Accept the sketch.
Select **Extrude Boss/Base**.
Extrude by **10mm**.

The process can be repeated in the two other yellow faces.

Save.

**Cavity Wall Insulation second layer**

Open the “Cavity wall insulation” part.
Select **File, Save as** and save as **“Cavity Wall Insulation layer 2”**.
Click on Boss extrude in the design tree.
Select the edit sketch icon. Change the dimensions as follows.
Assembly

All parts files for the foundation must be in the same folder.

On the top of the screen select **File, New**. Select **Assembly** in the SolidWorks document dialog box. Click **OK**.

In the window shown select browse. Select the “subsoil” Part. Select **Open**
Click **OK** in the property manager. The parts origin will snap to the origin on the screen.

Select **File, Save as** on the standard tool bar.

Save the assembly as “**Foundation Assembly**”.

Select **Insert Component** from the assembly tool bar. Select **Browse**.

Select **Concrete Foundation** and select **Open**. Click anywhere on the screen to bring in the part.

Select **Mate** from the assembly tool bar. Select the outside face of the Conc. Foundation and the inner face of the trench as shown.

Accept the **coincident** mate.
Repeat the process as shown.

Select the underside of the Conc. Foundation and the bottom of the trench for the final mate.

Accept.

Accept again to exit the mates command.

Select **Insert component**, **Browse** and select “**Blockwork below ground**” and select **Open**.

Select the thumb tack icon as shown. This allows a number of the same part to be entered. Select anywhere on the screen to drop the parts. Select the thumb tack again and accept.
Select the mate command and mate the blocks as shown.

Mate the bottom face of the blocks with the top surface of the concrete foundation.
Accept.

Select the two faces as shown.
Select the distance icon in the standard mates window.
Change the distance to **350mm**. Select the Flip direction box if necessary.
Repeat the process for the other end of the trench.

Accept.
Accept again to exit the Mates command.

Insert the “**Cavity Fill**” part.
Mate it with the inside face of the blockwork.
Mate the bottom of the fill with the top surface of the concrete.

Accept.

Insert “**Hardcore1**”
Mate the Hardcore1 with the inside blocks and mate it with the concrete foundation.
Accept.

Insert **“Hardcore2”**
Mate with top face of Hardcore1.
Mate with inside face of blockwork.

Accept.

Insert **“Sand Blinding”**
Mate with top of Hardcore2.
Mate with inside of blockwork.

Accept.

Insert **“Soap Bar”**
Mate the bottom of the soap bar with the top face of the inner blocks.
Mate the inside face of the soap bar with the inner face of the inner blocks

Accept.
Insert “Radon Barrier”
Add the relevant mates.
Accept.

Insert “Outer leaf first row above ground”
Add the relevant mates.
Accept.

Insert “Brick row above soap bar”
Mate with the top of radon barrier.

Note: Mate inner face with inner face of soap bar.
Accept.

Insert “Stepped DPC”
Mate with top of Brick.
Mate inside of stepped DPC with outside face of Radon Barrier as shown
Accept.

Insert “DPC outer”
Add the relevant mates.

Accept.

Insert “Inner Leaf second row above ground”, “Inner Leaf Third row above ground”, “Inner Leaf fourth row above ground”. Apply the relevant mates.

Accept.

Repeat the process for the outer rows of blocks.

Add the relevant mates.

Accept.

Insert “Vertical floor insulation”. Add the relevant mates. Accept.
Insert “**Cavity wall insulation**”.

Mate the inner surface with the outer leaf of the inner wall.

Mate the bottom surface with the top of the radon barrier as shown.

Accept.

Insert “**Cavity wall insulation2**”.
Add the relevant mates.

Accept.

Insert the “**Floor Insulation**”

Add the relevant mates.

Accept.

Insert the “**Concrete Floor**”. 
Add the relevant mates.

Accept.

The Assembly is Complete