



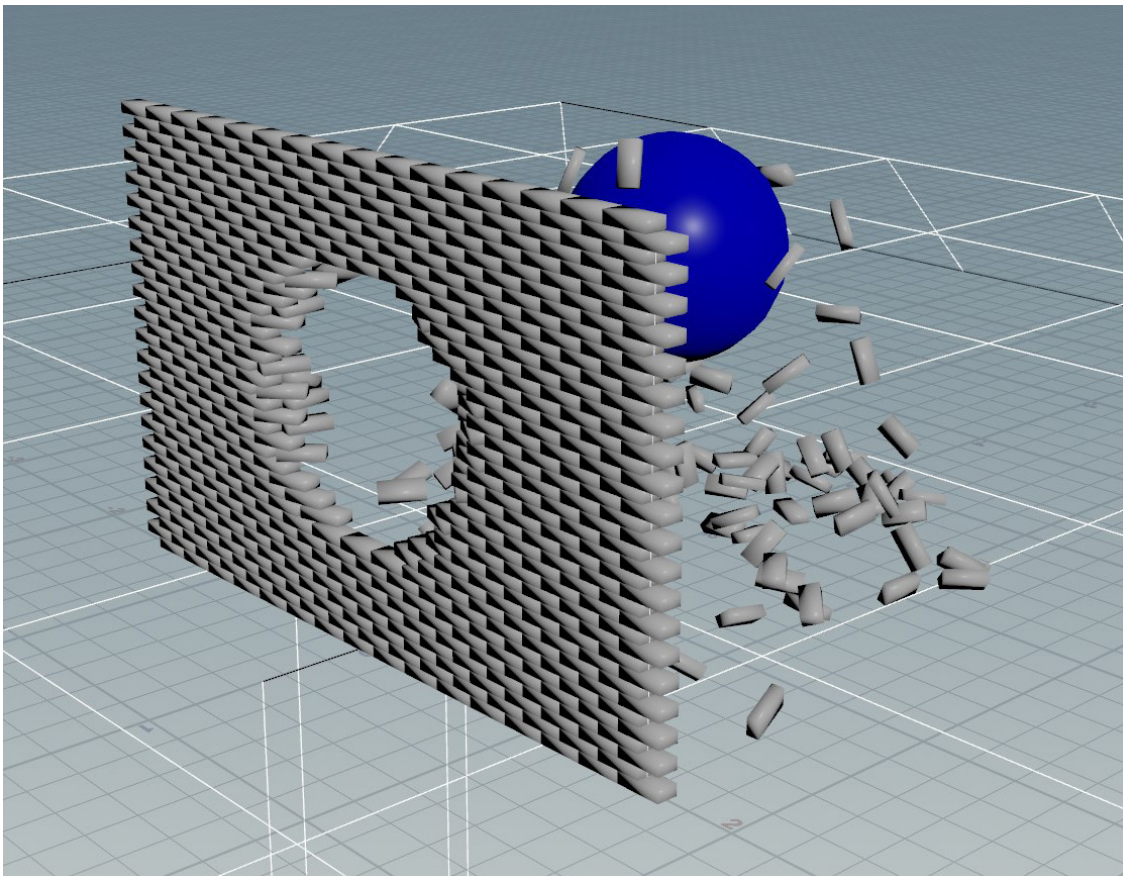
## Curriculum-in-a-Box | Lesson 5 | Guided Work

# BRICK WALL

Students are now asked to follow-along with the teacher as they build something in Houdini. For this lesson, students will learn how to use one of Houdini's simplest simulation tools, Rigid Body Dynamics (RBD). During the course of this exercise, you'll import a brick wall model, prep it for simulation by adding attributes, animate a "wrecking ball" that will break the wall, add Glue Constraints to hold the wall together, and then run the simulation to see the results. Simulation is one of the key areas for which Houdini is used professionally, and after this exercise, your students should have a better understanding of the steps that go into it.

### WHAT STUDENTS WILL LEARN

- How to build a simulation from scratch
- How to prepare geometry for an RBD simulation
- How to add Glue Constraints to hold RBD pieces together
- How to add an animated collider to a simulation



## PART ONE

# Setup Project and Add Attributes

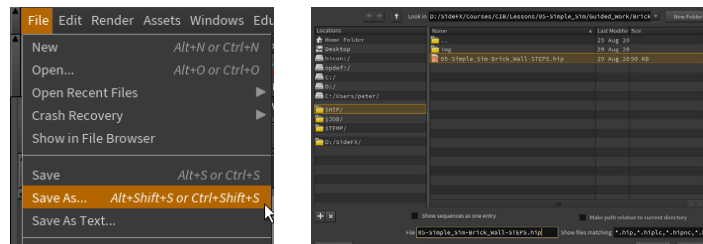
In this first section of the assignment, you will show your students how to set up their project, import a brick wall from disk, adjust its attributes to be ready for simulation, and create a proxy mesh that the simulation will run on.

### 1. Set up your Project Directory

- Download the *CIB\_Lesson05.zip* file and unzip it, then place it in the *documents>HoudiniProjects* directory.
- Open Houdini and from the **File** menu, choose **Set Project**.
- Navigate to the *CIB\_Lesson05* directory and press **Accept**.

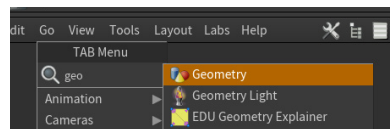
### 2. Save your Scene File

- From the File menu, choose **Save As**.
- Make sure you are in the *CIB\_Lesson05* directory, give the **File** a name and press **Accept**.

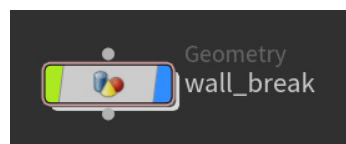


### 3. Set up the Geometry Network

- Press Tab in the Network View, start typing *geo*, then select **Geometry**.

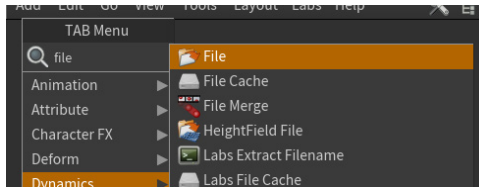


- Click in the Network View to place the node.
- Double-click the *geo1* name and change it to something like *wall\_break*.
  - This will be a container for the geometry that you create.

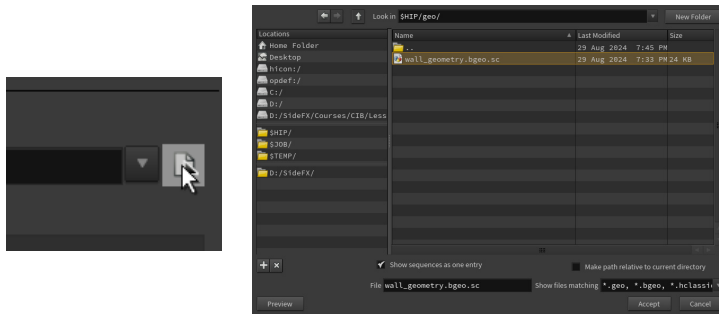


## 4. Import brick wall geometry

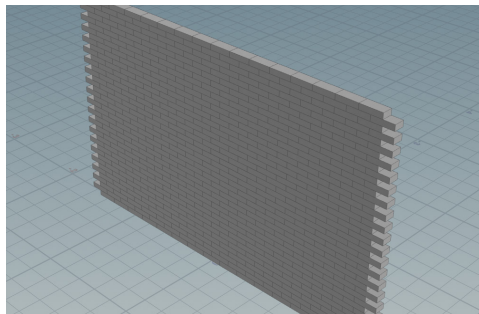
- Double-click the *wall\_break* node to dive inside.
- Press **Tab** in the Network View, type *file*, and press **Enter**.
- Left-click to place the node.



- In the Parameter Pane, open the **File Chooser** using the button.
- In the **File Chooser**, open the *geo* folder and select *wall\_geometry.bgeo.sc*.

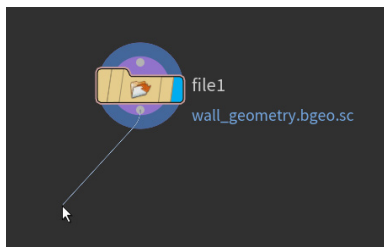


- Press the **Accept** button.

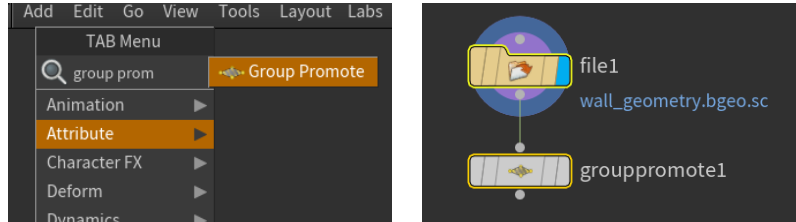


## 5. Promote a point group to a primitive group

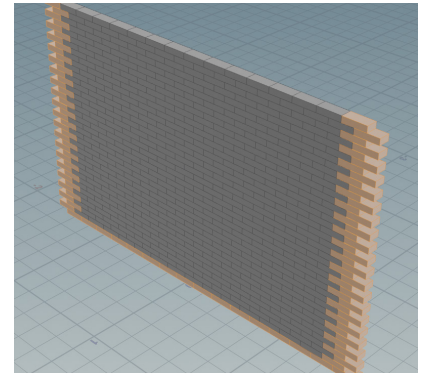
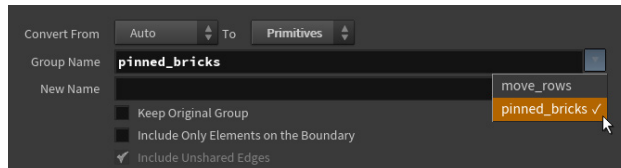
- Left-click on the *File* node's output dot.
  - You will now have a wire that follows your cursor and is connected to the output dot.



- Press **Tab** in the Network View, type *group prom*, and press **Enter**.

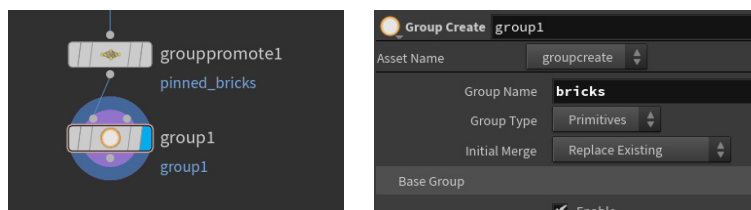


- A new *Group Promote* node will be placed in your Network View and will be connected to the *File* node.
- You can move the new node in order to keep your network organized. You should see the node snap into alignment with the positions of the other nodes that are already in the network.
- Click the right-most section of the *Group Promote* node to move the blue Display Flag.
  - This allows us to visualize what the *Group Promote* node is doing. The Display Flag is a cornerstone of using Houdini because it lets you visualize the result of all nodes that were placed before the one with the Display Flag.
  - If your *Group Promote* node isn't highlighted in yellow, click on the center of it in the Network View.
- In the Parameter Pane, change the **Convert To** drop-down to **Primitives**.
- Using the arrow next to the parameter, change the **Group Name** to *pinned\_bricks*.



## 6. Add all bricks to a primitive group

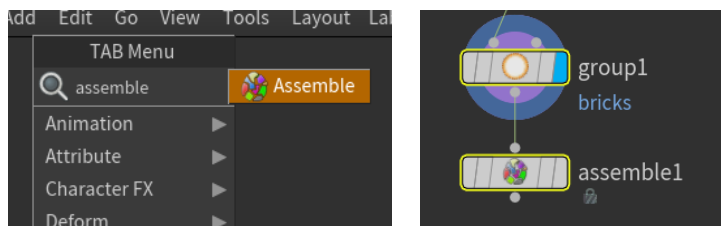
- Left-click on the *Group Promote* node's output dot.
- Press **Tab** in the Network View, type *group*, and press **Enter**.
- In the Parameter Pane, change the **Group Name** to *bricks*.



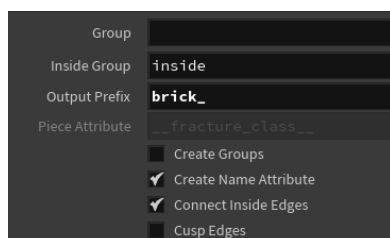
- This will put all primitives into a group for later use.

## 7. Create a unique name attribute for each brick

- Left-click on the *Group* node's output dot.
- Press **Tab** in the Network View, type *assemble*, and press **Enter**.

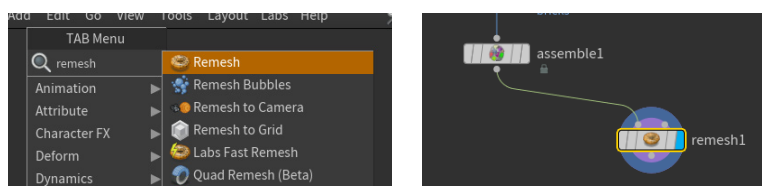


- In the Parameter Pane, change the **Output Prefix** to *brick*.

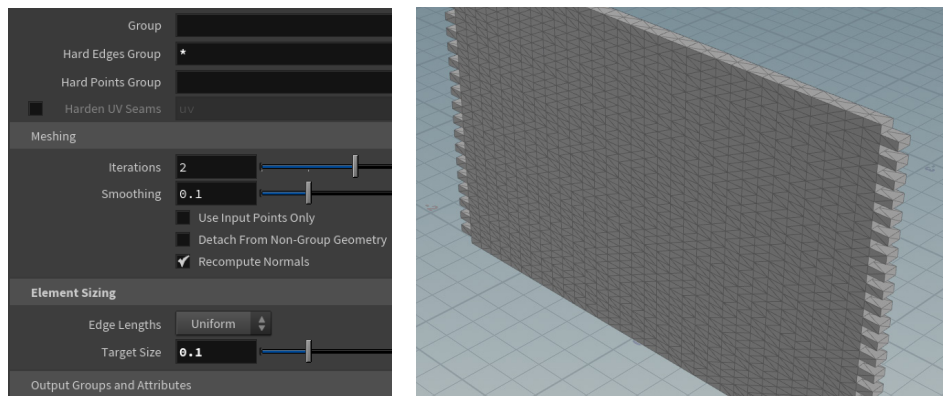


## 8. Create proxy geometry for the simulation

- Left-Click on the *Assemble* node's output dot.
- Press **Tab** in the Network View, type *remesh*, and press **Enter**.



- In the Parameter Pane, type a \* into the **Hard Edges Group** parameter.
- Change the **Target Size** to **0.1**.



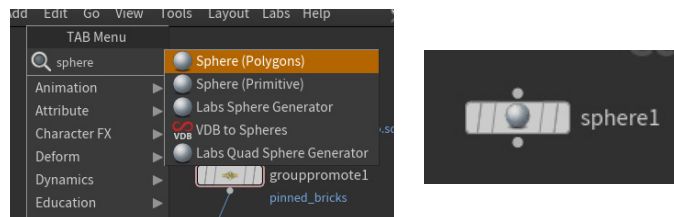
## PART TWO

# Animate a Wrecking Ball

The next step in this exercise will show your students how to create a simple keyframed animation of a swinging ball. You will also show them how to add a group and *name* attribute so that the geometry can be used properly within the simulation.

### 1. Create a sphere

- Press **Tab** in the Network View, type *sphere*, and press **Enter**.
- **Left-click** to place the node.

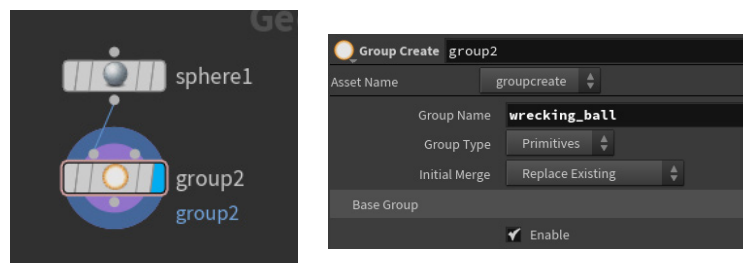


- In the Parameter Pane, change the **Center** to **0, 1, and 0**.



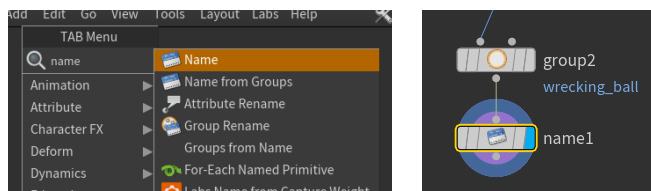
### 2. Add a primitive group for the wrecking ball

- **Left-click** on the *Sphere* node's output dot.
- Press **Tab** in the Network View, type *group*, and press **Enter**.
- In the Parameter Pane, change the **Group Name** to *wrecking\_ball*.

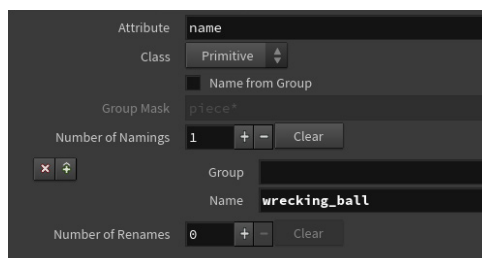


### 3. Add a *name* attribute to the sphere

- Left-click on the *Group* node's output dot.
- Press **Tab** in the Network View, type *name*, and press **Enter**.

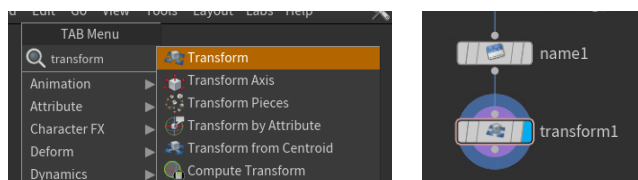


- In the Parameter Pane, change the **Name** parameter to *wrecking\_ball*.

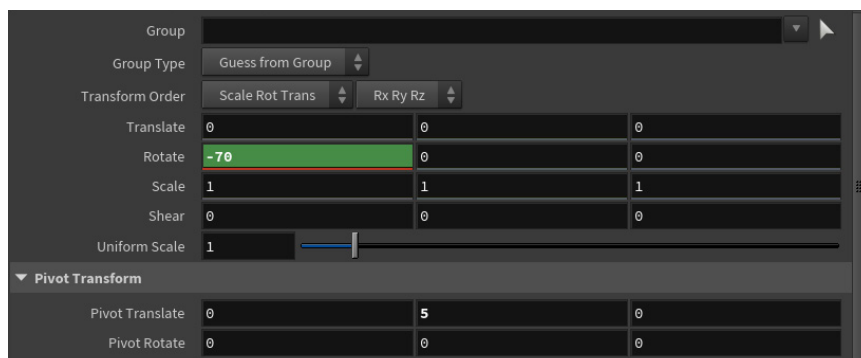


### 4. Animate the sphere

- Left-click on the *Name* node's output dot.
- Press **Tab** in the Network View, type *transform*, and press **Enter**.



- In the Parameter Pane, twirl open the **Pivot Transform** section and change **Pivot Translate** to 0, 5, and 0.
- Change the first value of **Rotate** to **-70**, and **Alt-click** the parameter field.
  - It should change to a green color to show that a keyframe has been added.

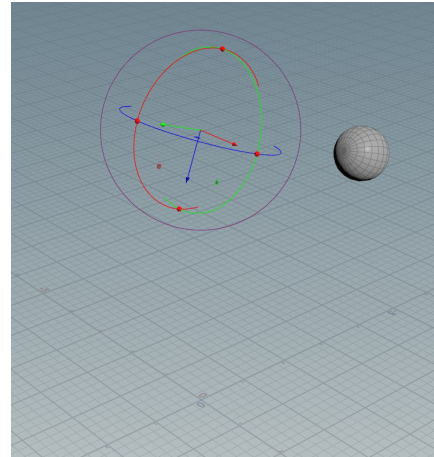
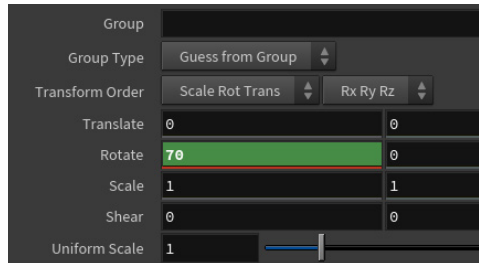




- Using the timeline, change the frame to **96**.



- Change the first value of **Rotate** to **70**, and **Alt-click** the parameter field to add another keyframe.



- If you grab the playhead in the timeline and drag it back and forth you should see the sphere animate.



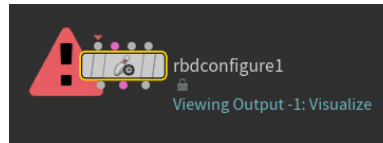
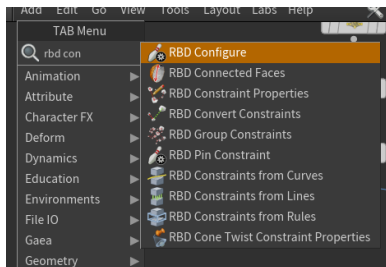
## PART THREE

# Prepare Bricks for Simulation

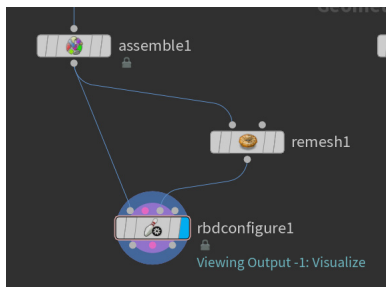
In this next part of this exercise, you will guide your students through the steps to prepare geometry to be simulated with RBD. In order to do this, you'll use several of the RBD nodes in Houdini to create glue-like geometry between the bricks. Also, you will pin some of the bricks in place to keep the wall upright.

### 1. Configure the bricks for the RBD simulation

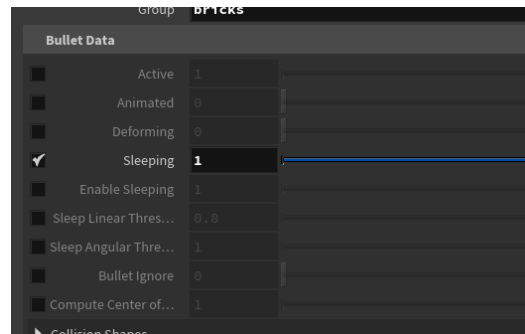
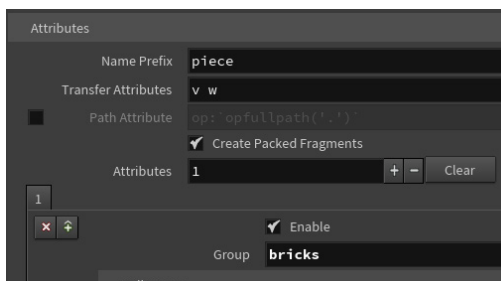
- Press **Tab** in the Network View, type *rbd con*, and press **Enter**.
- **Left-click** to place the node.



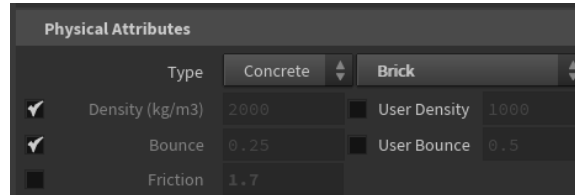
- Connect the wires as shown in the following image.



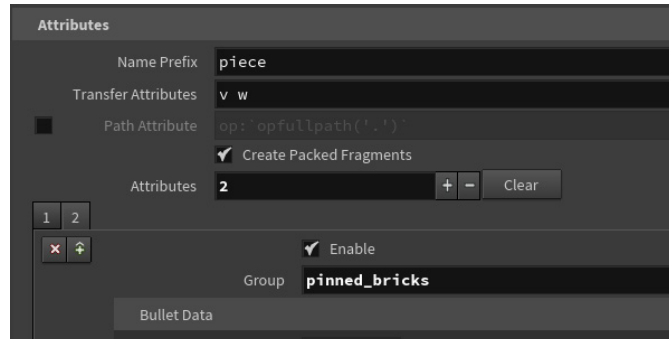
- In the Parameter Pane, scroll down to the **Attributes** section and change the **Group** to *bricks*.
- Scroll down to the **Bullet Data** section, and **check** the box next to **Sleeping**.
- Change the **Sleeping** value to **1**.



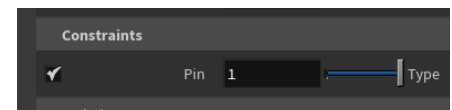
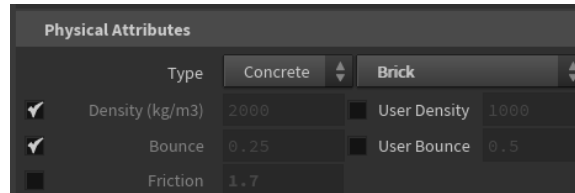
- Scroll down to the **Physical Attributes** section and change the second **Type** drop-down to **Brick**.



- Scroll up to the top of the **Attributes** section and change the number of **Attributes** to **2**.
- There is now a second tab in this section, and in this new tab, change the **Group** to *pinned\_bricks*.

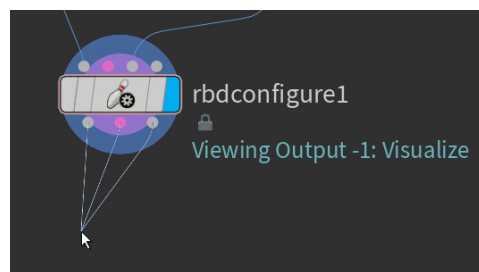


- Scroll down to the **Physical Attributes** section and change the second **Type** drop-down to **Brick**.
- In the **Constraints** section, check the box next to **Pin**.

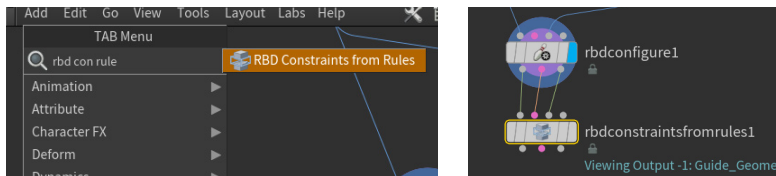


## 2. Glue the bricks to each other

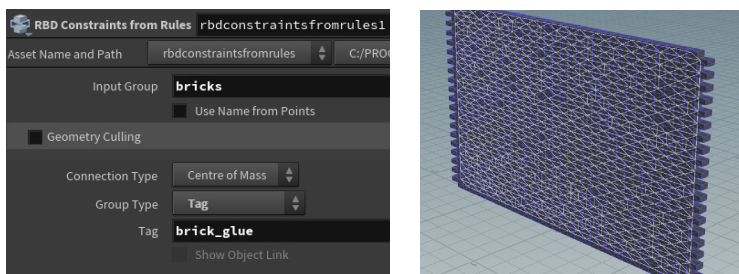
- **Shift + Left-click** the three output dots on *rbdconfigure1* from left to right.
  - You should now have three wires connected to your pointer.



- Press **Tab** in the Network View, type *rbd con rule*, and press **Enter**.
  - Three wires will now be connected between the nodes.

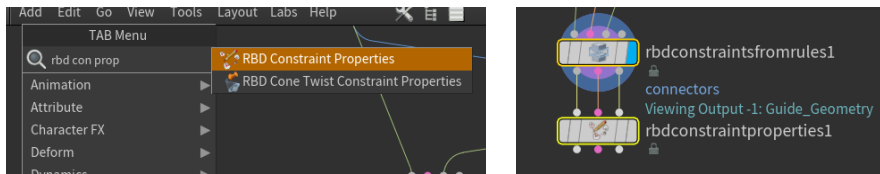


- In the Parameter Pane, change the **Input Group** to *bricks*.
- Change the **Group Type** drop-down to **Tag**, and change the **Tag** to *brick\_glue*.
- In the Scene View, you should now see a visualization of the lines that will glue the adjacent bricks together.

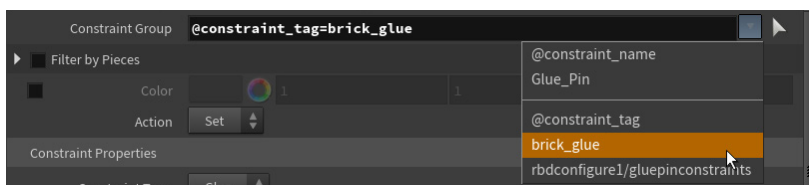


### 3. Adjust the strength of the glue

- Shift + Left-click** the three output dots on *rbdconstraintsfromrules1* from left to right.
- Press **Tab** in the Network View, type *rbd con prop*, and press **Enter**.



- In the Parameter Pane, use the drop-down next to **Constraint Group** to select the *brick\_glue* constraint tag.



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- Scroll down to the **Glue** section, and change the **Strength** to **100**.
  - Also, **check** the box next to **Strength Variance**.



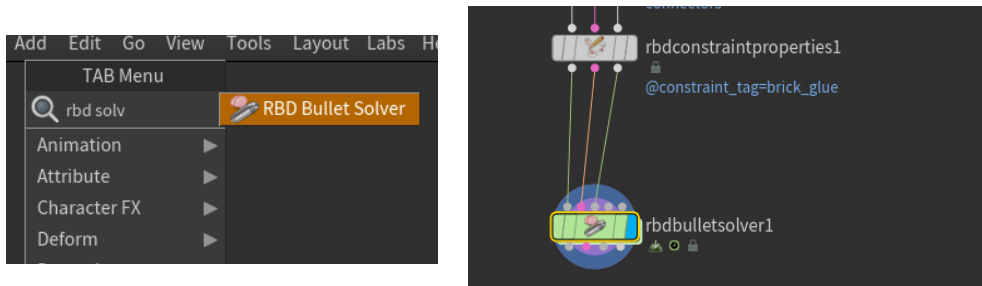
## PART FOUR

# Create the Simulation

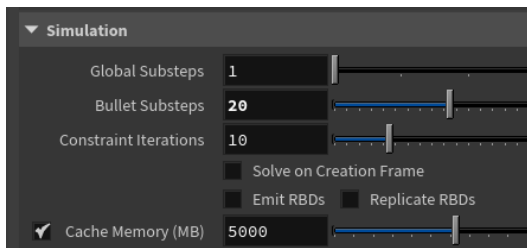
In this final part of this exercise, you will guide your students through how to add an RBD simulation to the scene. While adding the node is simple, there are many properties on the solver which will affect the simulation. You'll also make sure to connect the wrecking ball to the simulation to break the bricks apart.

### 1. Add an RBD Solver to the scene

- **Shift + Left-click** the three output dots on *rbdconstraintproperties1* from left to right.
- Press **Tab** in the Network View, type *rbd solv*, and press **Enter**.



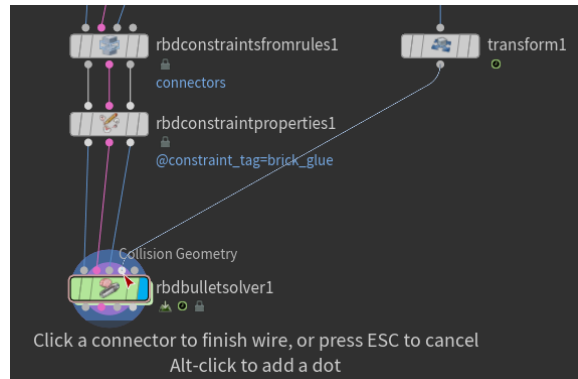
- In the Parameter Pane, change the number of **Bullet Substeps** to 20.



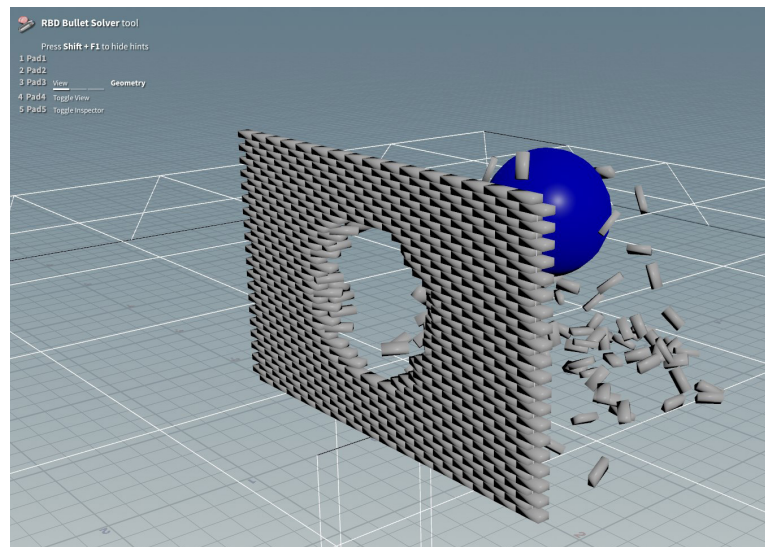
- Switch to the **Collision** tab, and change the **Collision Type** to **Deforming**.
- Scroll down to the **Ground Collision** section, and change the **Ground Type** drop-down to **Ground Plane**.



- Connect the output of *transform1* to the fourth input of the *rdbulletsolver1*.



- Make sure that the blue Display Flag is on the *rdbulletsolver1*, and press play on the timeline.
  - You should now be able to see the sphere break through the wall, and the bricks go flying.
  - Feel free to play with the **Strength** parameter on *rbdconstraintproperties1* to see what happens when you make the Glue constraints stronger or weaker.



## CONGRATULATIONS

You have now completed your wall breaking exercise. This has taken you through a project that began with a brick wall imported from disk. From there, you prepared the geometry for simulation with names and attributes, animated a sphere to break through the wall, and then created an RBD solver node to run the simulation.