

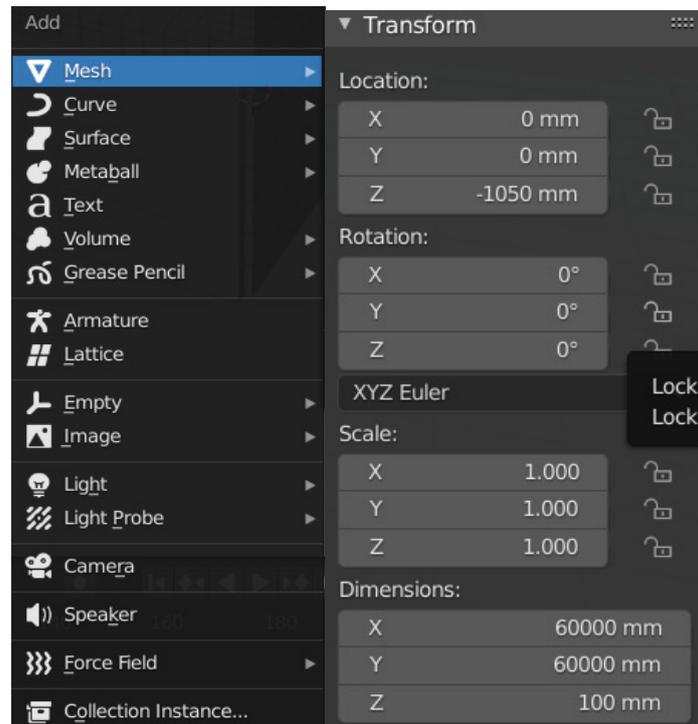
Appendix S1. Blender Fundamentals in Modeling the Great Walls

A.1 Main modeling steps

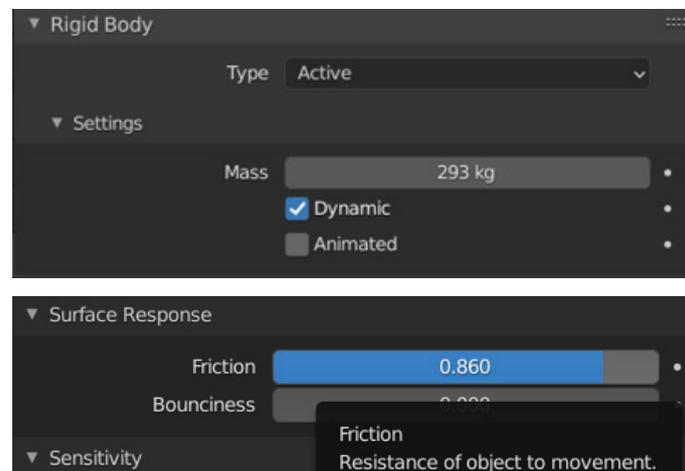
1. Set up a ground.
2. Model brick, stone, and gravel in block elements with the actual dimensions measured onsite.
3. Infill a block inside the base of the Great Walls.
4. Divide the block infill with “fracture” in Blender multiple times until each infill element is the same size as the actual infill rubbles and gravels onsite.
5. Integrate the cluster of the new fractured blocks and then group the blocks based on their attributes (i.e., brick, rubble, gravel, soil, etc.).
6. Define each group of blocks’ mass, type, and contact properties, which includes friction of coefficient, and adhesive/glue strength.
7. Modify the initial condition of each model based on the type of hazard. For instance, an initial rotation angle needs to be defined for the parapet wall in the case of parapet walls inward tilting. In addition, the initial tilt angle needs to be measured onsite.

A.2 Main modeling inputs

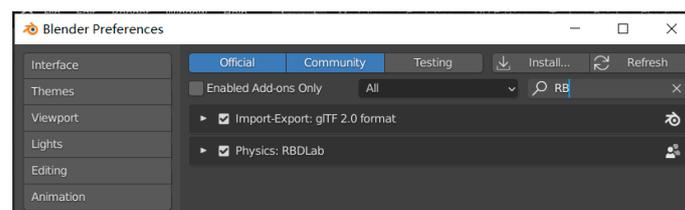
1. Select basic modeling mesh type and define its position and dimension.



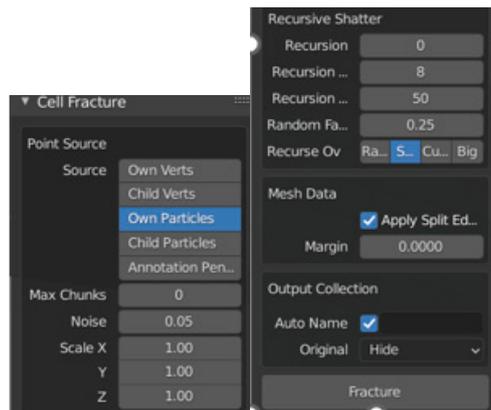
2. Define the blocks' status of motion, mass, friction coefficient, etc.



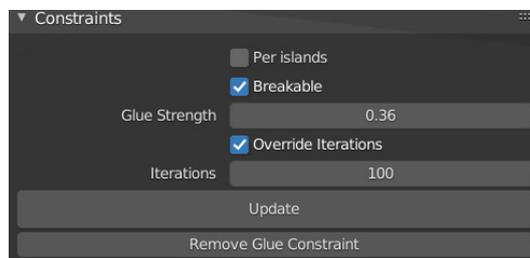
3. Add "RBDLab plug-in" in the preference setting.



4. Set up “random factor” in the cell fracture modular, and then start “fracture” process.



5. Define adhesive/glue strength in the constrains modular.



6. Define the Cahe setup in the physics modular.

