



The RockBuilder

*Generating Rock Geometry for Rigid-Body Rockfall
Simulation in RAMMS::Rockfall*

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Why Rock Shape Matters in Rockfall Dynamics



Rockfall motion is governed by **rigid-body dynamics with intermittent impacts**. The **location of the contact point** determines how translation and rotation evolve.

Impact force at the contact point generates torque:

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$$

- \mathbf{F} = contact force
- \mathbf{r} = vector from rock center of mass to contact point

Rock shape determines \mathbf{r} .

Consequences of Rock Shape (three bullets)

- 1. Rotation generation:** Irregular rocks produce large torques during impact.
- 2. Energy dissipation:** Different contact geometries produce different rebound behaviour.
- 3. Trajectory variability:** Small shape differences produce large differences in runout.

Therefore **realistic rock geometry is essential** for reliable rockfall trajectory simulations.

Reference: *Leine et al., 2014*



The RockBuilder: Creating Rock Geometry



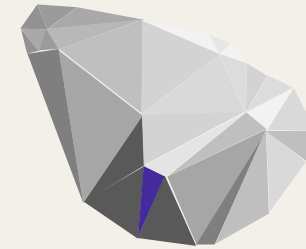
In RAMMS, rocks are represented as **convex hull geometries defined by point-cloud vertices**, which are used to compute impacts and rotations during rockfall motion.



Real rocks



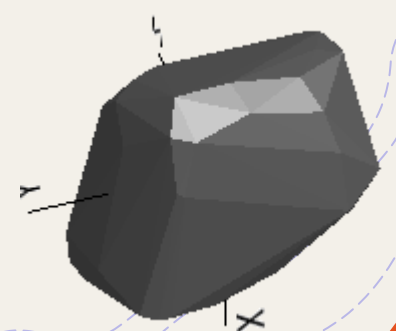
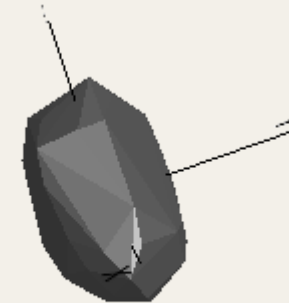
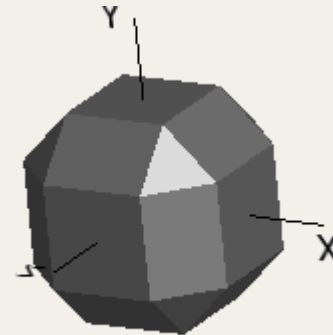
Point-cloud



Convex hull

The RockBuilder creates realistic rock geometries.

- Generates point-cloud (.pts) files
- Defines rock shape and volume
- Creates reusable rock libraries



Rocks in the field can be scanned with mobile phones and converted to point-clouds with appropriate software tools.

Starting the RockBuilder



The **Rockbuilder** can be started from the **Rock Input Tab**, or from the **main window** by activating the **rockbulider icon**.

RAMMS | Run Simulation

General Terrain Forest Dam/Net Rock Release Stop

ROCK PARAMETERS Rock Builder

ROCK Types

Sphere Cuboid Rock

Select ROCK File (*.pts) EOTA_111_1.0m3.pts

Rock Characteristics

Density (kg/m3) 2700

Volume (m3) 1.00

Mass (kg) 2701.3

Max Rock Dimensions
X / Y / Z (m): 1.12 / 1.12 / 1.12

ROCK File Folder (.pts)

click to select Empty

Save FULL Output Cancel RUN `300` SIMULATIONS

Rockfall GUI

95%

ROCKFALL

PARAMETER:

RAMMS | Rock Builder

Rock Shape Classification

1: Equant 2: Flat 3: Long

Choose Rock Shape (From Rock Library)

(1) - EOTA_111

(From Other Source)

Add To Library

Rock Shape Viewer

Rock Characteristics

Nr of points

Density (kg/m3) 2700.0

Mass (kg) 0.0

Volume (m3) 0.000

Dims (m): 0.00 0.00 0.00

Enter New PTS Filename

Close

The RockBuilder input window

The RockBuilder Input Mask



Rock shape classification scheme used in RAMMS

Access to existing rocks in library or from user (field data)

Numerical input for density, mass, volume and dimension

Newly created rocks must be saved in the rocks directory

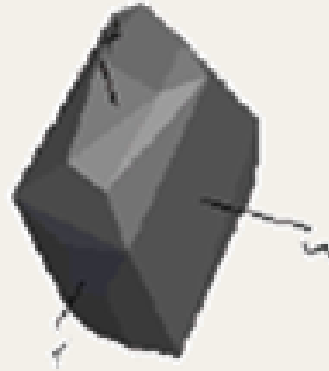
Visualization window: what you see is what you get

Rock Shape Classification



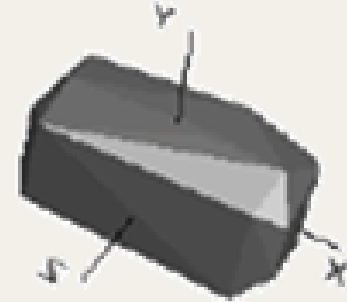
1: Equant (Blocky)

All axes similar — roughly cubic.
Most common shape.



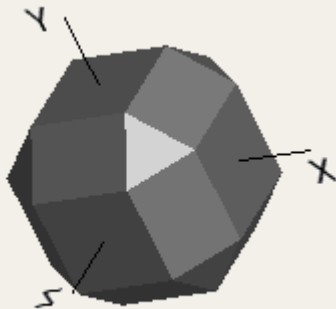
2: Flat (Tabular)

One axis much shorter — disc or slab-like.

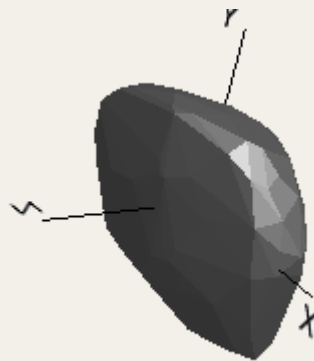


3: Long (Elongated)

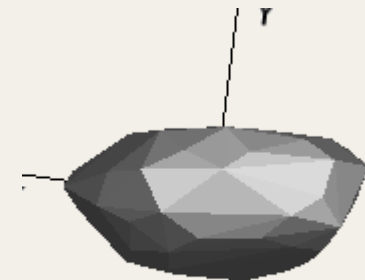
One axis much longer — rod or log-like.



EOTA_111_1.0m3



Real_Flat_2.35_0.5m3



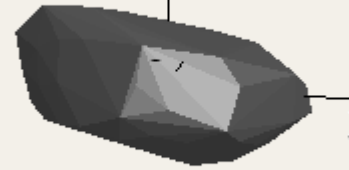
Real_Long_2.0_1.2m3

Rock Library

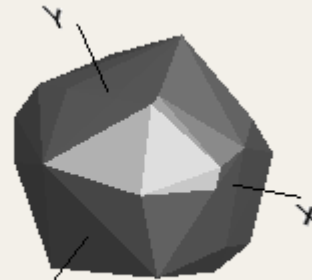
Rock shape and runout:

- **Equant:** Long, straight runout
- **Flat:** Long runout with greater lateral spread

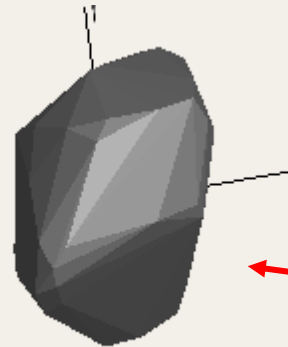
Rock Library:
Choose from predefined shapes.



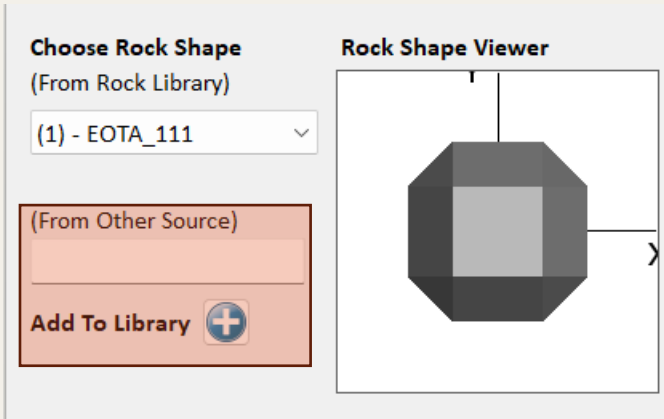
Real_Long_2.0_1.2m3



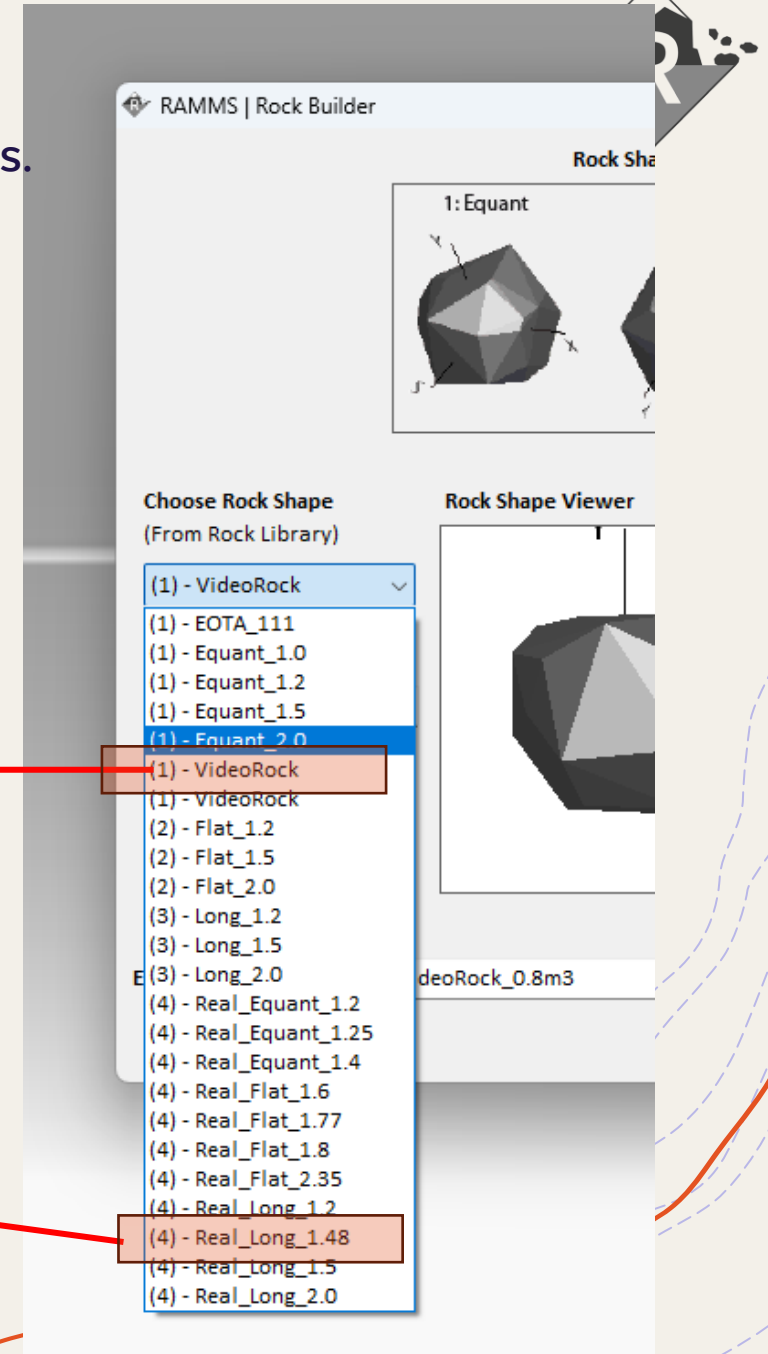
VideoRock_0.8m3



Real_Long_1.48_0.7m3



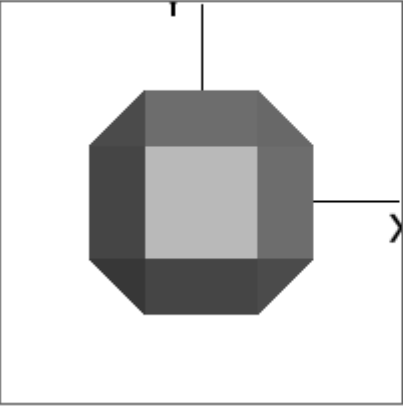
From Other Source:
Load any external .pts file
and add to custom library.



Same Rock Geometry, Different Shape and Size

A single rock geometry can be used to create different rock shapes and sizes by changing dimensions and volumes.

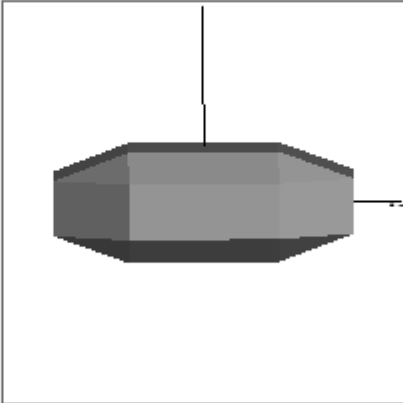
Rock Shape Viewer



Rock Characteristics

Nr of points	24
Density (kg/m ³)	2700.0
Mass (kg)	2701.3
Volume (m ³)	1.000
Dims (m):	1.12 1.12 1.12

Rock Shape Viewer



Rock Characteristics

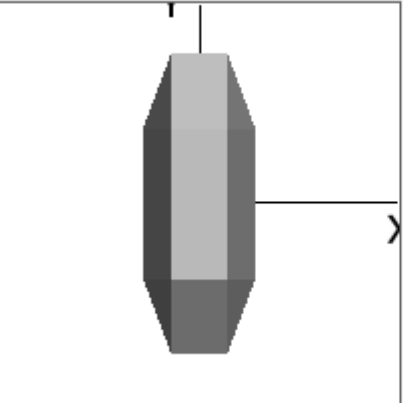
Nr of points	24
Density (kg/m ³)	2700.0
Mass (kg)	7210.0
Volume (m ³)	2.670
Dims (m):	1.12 1.12 3.00

Nr of point cloud points.

Density (kg/m³)

Mass/Volume

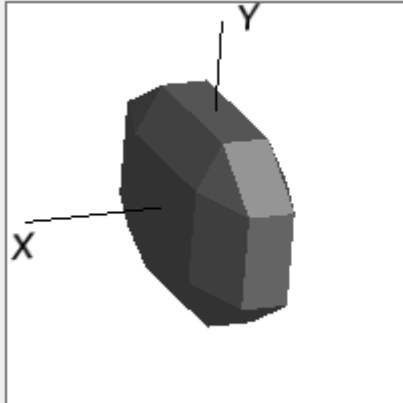
Rock Shape Viewer



Rock Characteristics

Nr of points	24
Density (kg/m ³)	2700.0
Mass (kg)	7222.8
Volume (m ³)	2.675
Dims (m):	1.12 3.00 1.12

Rock Shape Viewer



Rock Characteristics

Nr of points	24
Density (kg/m ³)	2700.0
Mass (kg)	91800.0
Volume (m ³)	34.000
Dims (m):	2.00 4.00 6.00

Dims (m): Axis-length (X/Y/Z). Click "Unlock aspect" to change axis dimensions.

Saving the Rock File



For a **rock of a specific shape and size** to be used it must be **SAVED**.

Saving

- Enter filename or accept the suggested name.
- **Save** button writes the .pts file to disk.
- RAMMS auto-creates a rocks-folder in your project.
- Encodes shape type, axis length (1.25m) and volume (1.0m³).
- However, mass and density are helpers only. Set density in *Run Simulation dialog* for the actual simulation.
⚠ **NOT stored in .pts file!**

Choose Rock Shape
(From Rock Library)
(4) - Real_Equant_1.25
(From Other Source)
Add To Library

Rock Shape Viewer

Rock Characteristics

Nr of points	90
Density (kg/m ³)	2500
Mass (kg)	1808.0
Volume (m ³)	0.723
Dims (m):	1.17 1.25 1.00

Enter New PTS Filename Real_Equant_1.25_0.7m3

Close

Example filename: Real_Equant_1.25_1.0m³

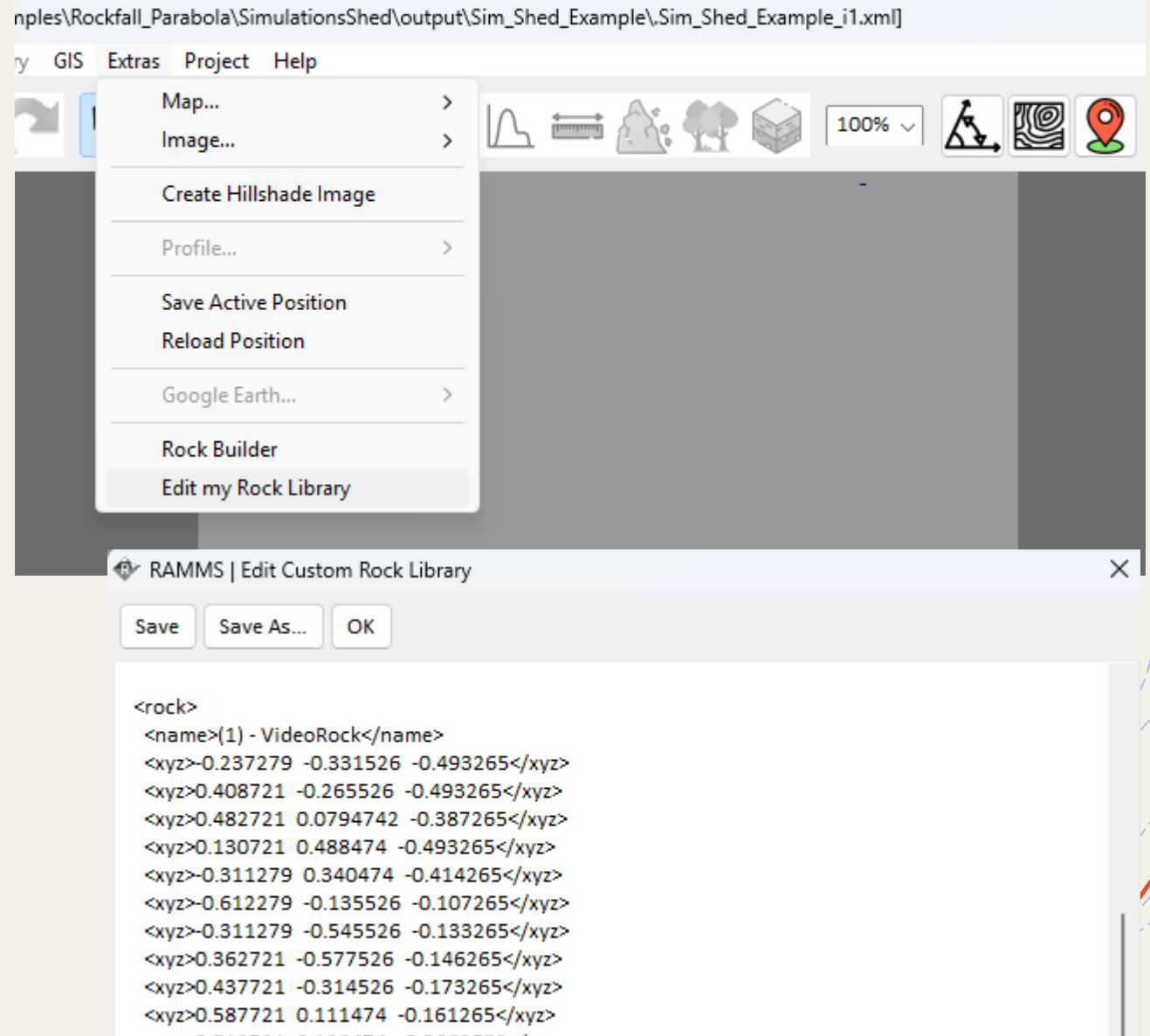
Customizing the Rock Library



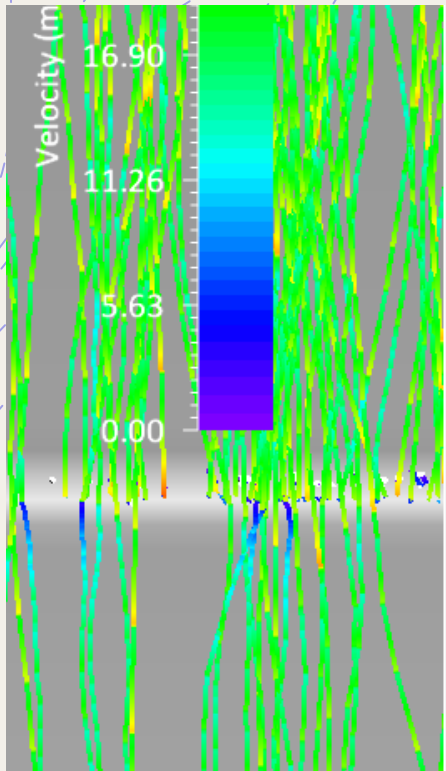
Rocks added to the rock library can be edited manually

Editing manually

- *Extras* → *Edit my Rock Library* opens the XML editor.
- Delete entire `<rock>...</rock>` blocks to remove entries.
- Save → OK → Restart RAMMS.
- Do NOT delete `</ramms>` — will corrupt the file.



Visualization of Rocks in Output Mode



Files General Display Rock Scenario

Rock Information

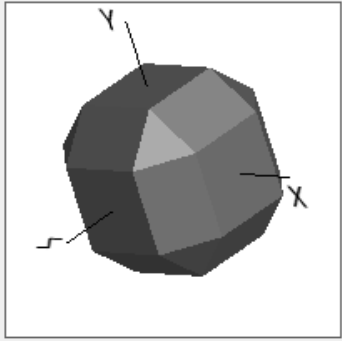
Name: EOTA_111_1.0m3.pts

Dimensions X/Y/Z (m):

Rock Density (kg/m3):

Rock Volume (m3):

Rock Mass (kg):



After simulation completes:

- Switch to Trajectory-mode and select a trajectory.
- Open ROCKFALL panel → Various → Rock tab.

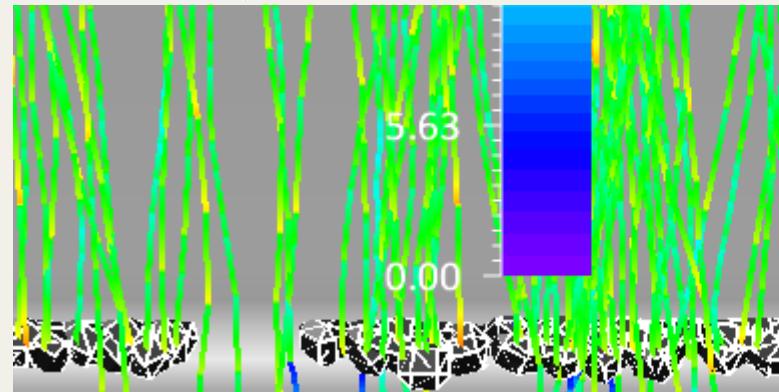
Displayed per trajectory:

Nam, Dimensions X/Y/Z, Density, Volume, Mass.

Example: EOTA_111_1.0m3.pts

1.12 / 1.12 / 1.12 m | 2700 kg/m³ | 1.000 m³ | 2701.3 kg

Rocks can be magnified with **Rock Magnification** in **General Tab**



End Time (s)

Dump Step (s)

Grid Resolution (m)

Rock Magnification (x)

Project Region Information

Summary



1. Rock shape controls rockfall dynamics.

Realistic rock geometry determines contact forces, rotation and energy dissipation during impacts.

2. Rocks in RAMMS are represented as convex hull point clouds.

The RockBuilder generates *.pts* files that define the vertices of the rock geometry used in simulations.

3. RockBuilder allows users to create realistic rock libraries.

Different rock shapes, sizes and volumes can be defined and reused in rockfall simulations.

4. User-friendly workflow for defining rock properties.

Rock geometry, dimensions, density and volume can be quickly specified in the RockBuilder interface and saved for use in simulations.