



RocSlope

Block Computations

Verification Manual

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Introduction

This document presents an example which is used to verify the validity of blocks formed by the Block Engine in RocSlope. For a block to be correctly determined, the following must be established:

1. Joint surfaces intersect the material volumes to 'cut' the material volumes into volume pieces.
2. For each volume piece, determine:
 - a. The volume
 - b. The faces:
 - i. If the face is a joint face and which joint cut it.
 - ii. If the face is a material boundary (i.e., surface separating two different volume pieces belonging to the same block).
 - iii. If the face is a free face (i.e., daylighting face of the block).
3. For each block, determine the volume piece(s) which belong to the same block.
4. The determination of the non-terrain surface which encompasses the sides and the bottom of the external geology. Any blocks attached to the non-terrain surface is considered invalid.

1. Block Verification #1

[RocSlope Build 1.001]

1.1. Problem Description

For this verification, a 10 x 10 x 10 axis-aligned box is used as the External. Three sets of orthogonal joints which persist the entire external extents are added, and spaced consistently at 2 m apart.

Table 1.1: External Box Property

| Box Corners | X | Y | Z |
|---------------|----|----|----|
| First Corner | 0 | 0 | 0 |
| Second Corner | 10 | 10 | 10 |

Four material pieces exist which divide the cube into equal volumes, each with a different material property.

Table 1.2: Material Properties

| Region | Material Property |
|------------|-------------------|
| External_1 | Material 1 |
| External_2 | Material 2 |
| External_3 | Material 3 |
| External_4 | Material 4 |

Table 1.3: Joint Geometry of Synthetic Joint Sets

| | Joint Property | Dip (°) | Dip Direction (°) | Radius (m) | Spacing (m) | Traverse Start [X, Y, Z] (m) | Traverse End [X, Y, Z] (m) |
|-----------------------|------------------|---------|-------------------|------------|-------------|------------------------------|----------------------------|
| Synthetic Joint Set 1 | Joint Property 1 | 90 | 0 | 20 | 2 | 5, 0, 5 | 5, 10, 5 |
| Synthetic Joint Set 2 | Joint Property 2 | 90 | 90 | 20 | 2 | 0, 5, 5 | 10, 5, 5 |
| Synthetic Joint Set 3 | Joint Property 3 | 0 | 0 | 20 | 2 | 5, 5, 0 | 5, 5, 10 |

1.2. Blocks

125 blocks are expected from the division of a 10 m x 10 m x 10 m external box, by three orthogonal sets spaced at 2 m.

$$\begin{aligned} \text{total number of blocks} &= \left(\frac{10 \text{ m}}{2 \text{ m}}\right) \left(\frac{10 \text{ m}}{2 \text{ m}}\right) \left(\frac{10 \text{ m}}{2 \text{ m}}\right) \\ &= (5 \text{ blocks})(5 \text{ blocks})(5 \text{ blocks}) \\ &= 125 \text{ blocks} \end{aligned}$$

1.2.1. Number of Valid Blocks

Of those blocks, the ones which have a free surface on the sides or bottom of the external box will be considered invalid. Invalid blocks are those that touch the non-terrain, which in this case would be the four vertical sides and the bottom of the external box.

$$\begin{aligned} \text{total number of valid blocks} &= (5 - 2)(5 - 2)(5 - 1) \\ &= 36 \text{ blocks} \end{aligned}$$

In **RocSlope**, the **Block Information** lists 36 blocks when viewing **All Valid Blocks**. This validates that the correct number of expected sub volumes is created. Also, the correct non-terrain surface is computed and the blocks touching the non-terrain are being properly discarded as invalid blocks.

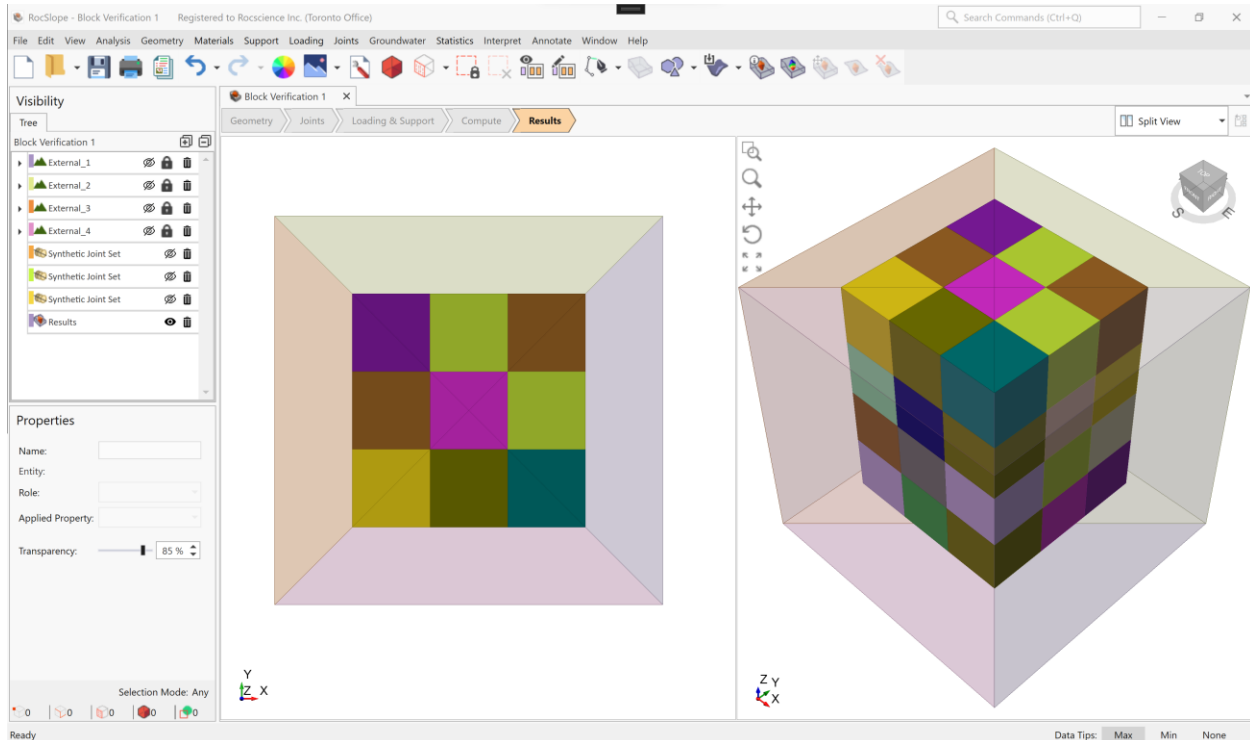


Figure 1.1: RocSlope 3D CAD View showing Results after Compute Blocks

1.2.2. Volume

Each block should have the same volume formed by 2 m x 2 m x 2 m joint spacing.

$$\text{block volume} = (2\text{ m})(2\text{ m})(2\text{ m}) = 8\text{ m}^3$$

In **RocSlope**, all Valid Blocks in the **Block Information** have a **Volume** of 8 m³. This validates that the correct volume is computed for each material piece. For blocks which have more than one material piece, this also validates that the correct material boundaries are mapped in order to determine the adjacent volume piece(s) which belong to the same block.

1.2.3. Slope Face Area

For blocks which daylight (i.e., have a face on the top of the external box), the daylighting area should be a square with 2 m x 2 m dimensions.

The slope face area for a daylighting block is computed as:

$$\text{block slope face area} = (2\text{ m})(2\text{ m}) = 4\text{ m}^2$$

Else (for non-daylighting blocks):

$$\text{block slope face area} = 0\text{ m}^2$$

The total number of blocks which daylight should only include the top blocks:

$$\begin{aligned}\text{total number of daylighting blocks} &= (5 - 2)(5 - 2) \\ &= 9\text{ blocks}\end{aligned}$$

In **RocSlope**, 9 of the Valid Blocks in the **Block Information** have a **Slope Face Area** of 4 m² (these are the daylighting blocks) and the remaining 27 blocks have a **Slope Face Area** of 0 m². This validates that the free surfaces of blocks are determined correctly.

1.2.4. Joints

For blocks which daylight (i.e., have a face on the top of the external box), they should have 5 joint faces (2 joint faces from Synthetic Joint Set 1, 2 joint faces from Synthetic Joint Set 2, and 1 joint face from Synthetic Joint Set 3).

For non-daylighting blocks, they should have 6 joint faces (2 joint faces from Synthetic Joint Set 1, 2 joint faces from Synthetic Joint Set 2, and 2 joint faces from Synthetic Joint Set 3).

In **RocSlope**, 9 of the Valid Blocks in the **Block Information** have a value of 5 for **# of Joints** (these are the daylighting blocks) and the remaining 27 blocks have a value of 6 for **# of Joints**.

In **RocSlope**, the **Detailed Block Information** for any given block will indicate that there exists:

- 2 parallel vertical joints with:
 - Dip = 90, Dip Direction = 0 or 180
 - Joint Property = Joint Property 1
 - Area = 4 m²
- 2 parallel vertical joints with:
 - Dip = 90, Dip Direction = 90 or 270

- Joint Property = Joint Property 2
- Area = 4 m²
- 2 parallel horizontal (or a single horizontal joint if non-daylighting) joints with:
 - Dip = 0, Dip Direction = 0 or 180
 - Joint Property = Joint Property 3
 - Area = 4 m²

This validates that the joint surfaces of blocks are determined correctly and that their assigned joint properties are also getting mapped correctly.

1.3. RocSlope Results

The **RocSlope** results are summarized below.

Table 1.4: Block Information for All Valid Blocks

| ID | Volume (m ³) | Slope Face Area (m ²) | # of Joints |
|----|--------------------------|-----------------------------------|-------------|
| 1 | 8 | 0 | 6 |
| 2 | 8 | 4 | 5 |
| 3 | 8 | 4 | 5 |
| 4 | 8 | 0 | 6 |
| 5 | 8 | 0 | 6 |
| 6 | 8 | 0 | 6 |
| 7 | 8 | 0 | 6 |
| 8 | 8 | 0 | 6 |
| 9 | 8 | 0 | 6 |
| 10 | 8 | 0 | 6 |
| 11 | 8 | 4 | 5 |
| 12 | 8 | 0 | 6 |
| 13 | 8 | 0 | 6 |
| 14 | 8 | 0 | 6 |

| | | | |
|----|---|---|---|
| 15 | 8 | 4 | 5 |
| 16 | 8 | 0 | 6 |
| 17 | 8 | 0 | 6 |
| 18 | 8 | 4 | 5 |
| 19 | 8 | 0 | 6 |
| 20 | 8 | 0 | 6 |
| 21 | 8 | 4 | 5 |
| 22 | 8 | 0 | 6 |
| 23 | 8 | 0 | 6 |
| 24 | 8 | 0 | 6 |
| 25 | 8 | 0 | 6 |
| 26 | 8 | 4 | 5 |
| 27 | 8 | 0 | 6 |
| 28 | 8 | 0 | 6 |
| 29 | 8 | 0 | 6 |
| 30 | 8 | 0 | 6 |
| 31 | 8 | 0 | 6 |
| 32 | 8 | 0 | 6 |
| 33 | 8 | 0 | 6 |
| 34 | 8 | 0 | 6 |
| 35 | 8 | 4 | 5 |
| 36 | 8 | 4 | 5 |

Table 1.5: Detailed Block Information for Joints (Block 11)

| ID | Area (m²) | Joint Property | Dip (°) | Dip Direction (°) |
|-----------|-----------------------------|-----------------------|----------------|--------------------------|
| 1 | 4 | Joint Property 1 | 90 | 180 |
| 2 | 4 | Joint Property 3 | 0 | 180 |
| 3 | 4 | Joint Property 2 | 90 | 270 |
| 4 | 4 | Joint Property 2 | 90 | 270 |
| 5 | 4 | Joint Property 1 | 90 | 180 |