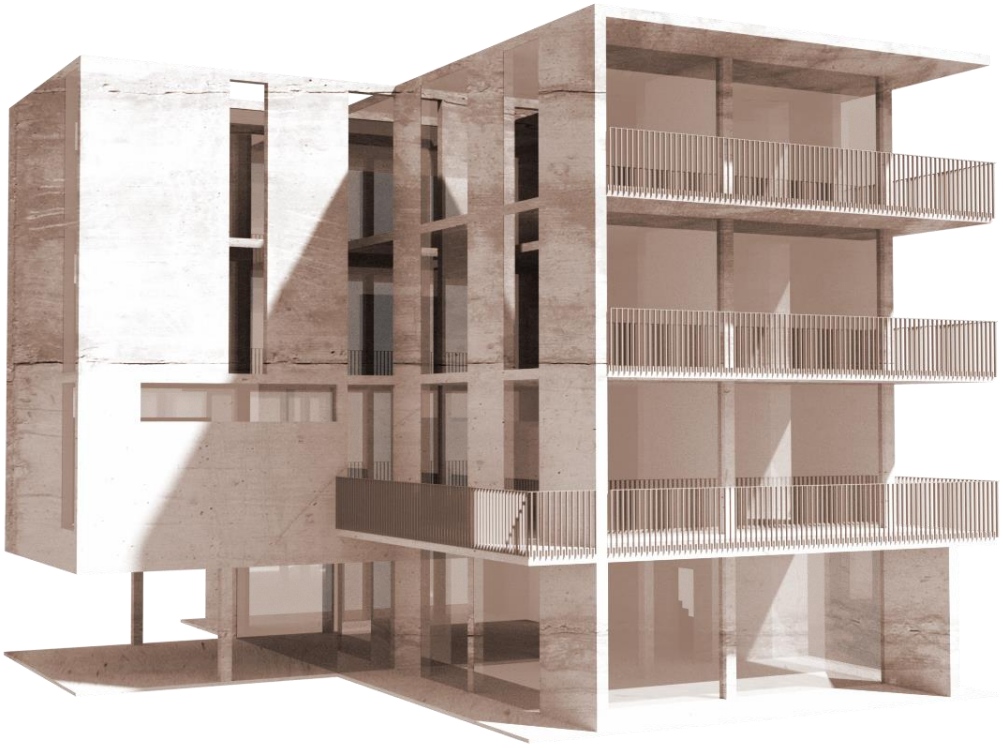
Bullet Constraints Builder Tutorial

3/3

Guide to Simulate a Multi-Family House with Fracture Modifier



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List of abbreviations:

Abbreviation	Description
BCB	Bullet Constraints Builder
FM	Fracture Modifier
RC	Reinforced Concrete

1. Introduction

The Bullet Constraints Builder (BCB) was developed from scratch during the three yearlong R&D project INACHUS [1]at LAUREA, University of Applied Sciences [2]. The focus during this time was on improving the software, its accuracy and speed, therefore tutorials were time and again postponed. Due to the growing interest and requests from universities and engineers around the world, tutorials became indispensable. This tutorial is the last of a series of three that have been written to gradually introduce the BCB basics.

BCB Tutorials:

1. Guide for BCB Installation & Simple Collapse Simulation
- installation instruction and introduction into a simple collapse simulation

2. Guide to Simulate a Multi-Family House with Standard Blender
- Introduction of the BCB fundamentals with standard Blender

3. Guide to Simulate a Multi-Family House with Fracture Modifier
- Introduction into a speed optimized variant with the FM

2. About this exercise

The tutorial 2/3 dealt with the simulation procedure with standard Blender. The simulations with standard Blender run relatively slow. In this present tutorial a speed optimized simulation approach is demonstrated that allows relatively big models to be simulated much more efficiently. For this a special Blender built- the Fracture Modifier (FM)- needs to be installed and used; the FM incorporates a better object handling method than standard Blender. For the FM download see section 3.
This exercise also introduces an automatic mode that allows the user to execute the Preprocessing Tools, the constraints build-up and the simulation in one go. The automatic mode permits the user´s absence during much of the simulation procedure. The collapse scenario will be an earthquake. This exercise is recommended for all those who want to achieve simulation results fast. Basic Blender knowledge is required.

Simulation with the Fracture Modifier
Step1 Load Blender model
Step2 Load configuration data
Step3 *Discretize*
Step4 *Add earthquake time history as collapse scenario*
Step5 *Turn on Automatic Mode*
Step6 *Build FM and simulate*

Table 1 Exercise diagram

[1] INACHUS. [Online] Institute of Communication and Computer Systems: https://www.inachus.eu/
[2] Laurea University of Applied Sciences, Wordpress. [Online]: https://inachuslaurea.wordpress.com/

3. Downloads and software installation

The software, files and documents that are necessary for the exercise are listed in Table 2. The software is available for Microsoft Windows, Linux and MacOS systems. For detailed installation instructions refer to tutorial 1/3, "Guide for software Installation & a simple collapse simulation".

Software installation for the exercise - Download and install the Fracture Modifier, click "download FM" - Download and install the BCB add-on, click "download BCB"		
Trouble shooting:	Problem: *Not all BCB features are working as expected*	*Possible solution:* *- make sure that the BCB is compatible with the installed FM version* *- Blender should be started as administrator: right click on the program icon and Run as administrator*
Documents - Download the Blender model with stored configuration settings click here - Download the earthquake pattern click here		

Table 2

System requirement:

Minimum Hard Disk: 100 GB Memory 4 GB RAM Processor: Intel Pentium III Graphics Cards: Accelerated Open GL	Recommended Hard Disk: 1 TB Memory: 8 GB RAM Processor: Intel Core i7-5820K or higher Graphics Card: GeForce GTX 980 Ti or similiar

Table 3

4. Exercise with the Fracture Modifier

step 1

Open the Blender model

- open the Blender model with stored configuration settings, see download section 3. In this model the element properties are already defined, Figure 1.

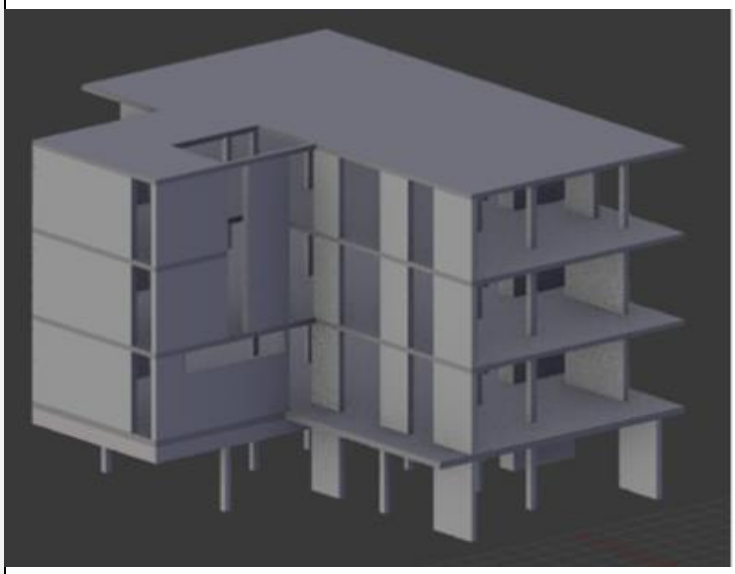


Figure 1

step 2

Load configuration data

- load the configuration data, Figure 2. The element groups with strength properties will be loaded, the Element Group List should look as shown in Figure 3.

Figure 2

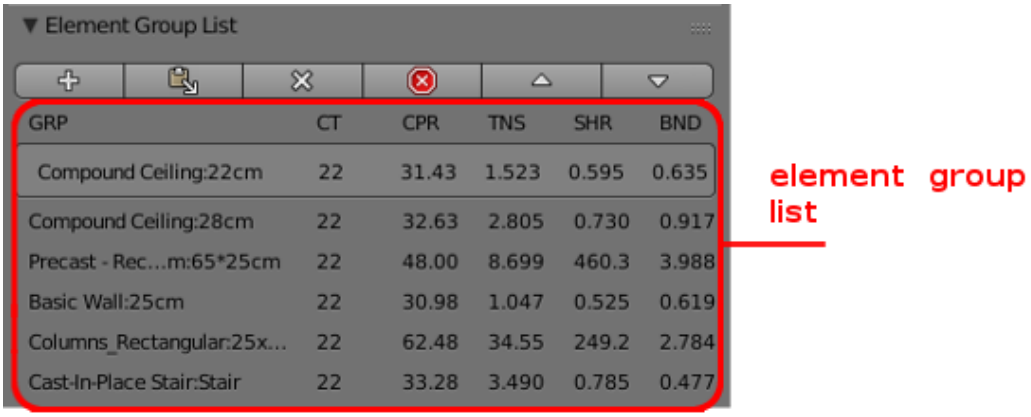


Figure 3

step 3

Discretize

- click on “Preprocessing Tools” in the main BCB UI. This will open the Preprocessing tool panel and reveal the Preprocessing sub-steps.

- pay attention to the field “Discretize”, Figure 4. Change the default Minimum Size Limit value to 1.50. The resulting discretization will be relatively high.

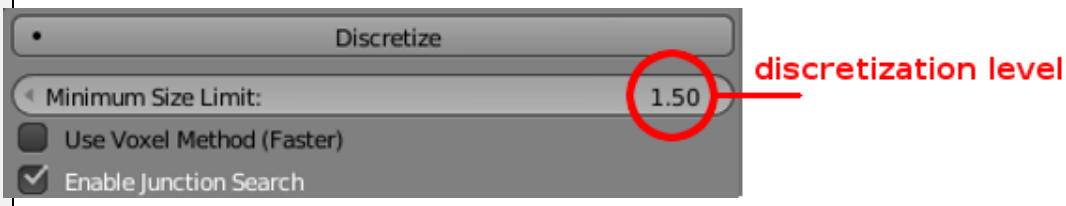


Figure 4

step 4

Add earthquake time story as collapse scenario

- navigate to the sub-step Ground Motion and the field CSV File at the bottom of the Preprocessing Tools, Figure 5. Browse for the file “Earthquake mag 7 accel.csv”, see download section 3.

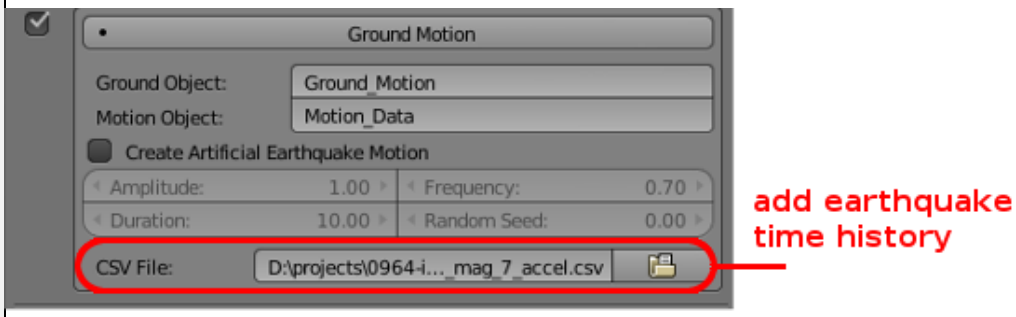


Figure 5

step 5

Turn on Automatic Mode

- This step introduces a fully automated workflow that executes the Preprocessing Tools, the constraints build-up and the simulation in one go. The Automatic Mode comes in handy in large simulations when Blender becomes non responsive during the execution of the simulation steps. This means the user´s presence is not required during a large part of the simulation process.

- To include the Preprocessing Tools in the automatic mode make sure that the field “Run On Automatic Mode” in the header of the Preprocessing Tools is checked, Figure 6.

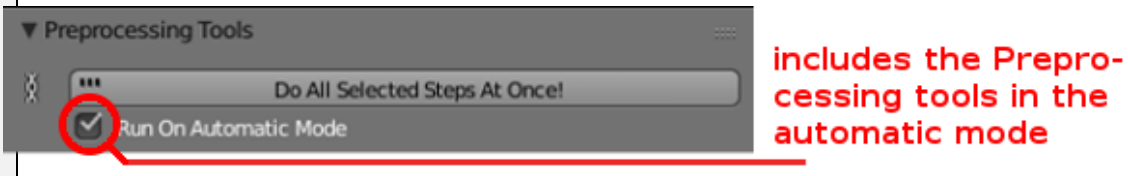


Figure 6

- close the Preprocessing Tools by clicking on the Preprocessing Tools header.

- open the BCB Global Settings tab and check the field Automatic Mode, Figure 7.

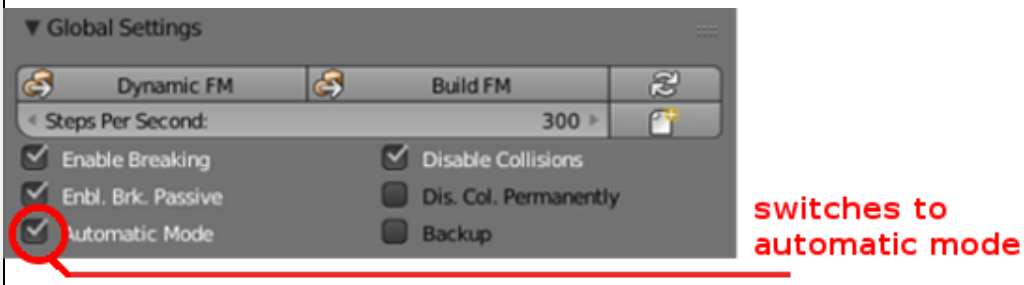


Figure 7

- to close this step it is advised to save the element configuration, Figure 8. The settings can now be reloaded each time the Blend file is opened.

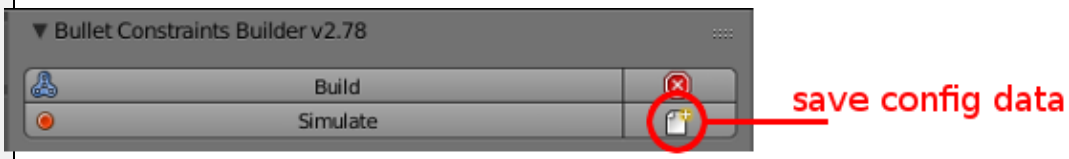


Figure 8

- Save the Blender model. Use this model for any subsequent simulation.

TIP:

-To monitor the progress of the simulation it is advised to have the system console window open. Blender will be not responsive for some time and will appear to have crashed. The system monitor can also provide vital information for trouble shooting, Figure 9.

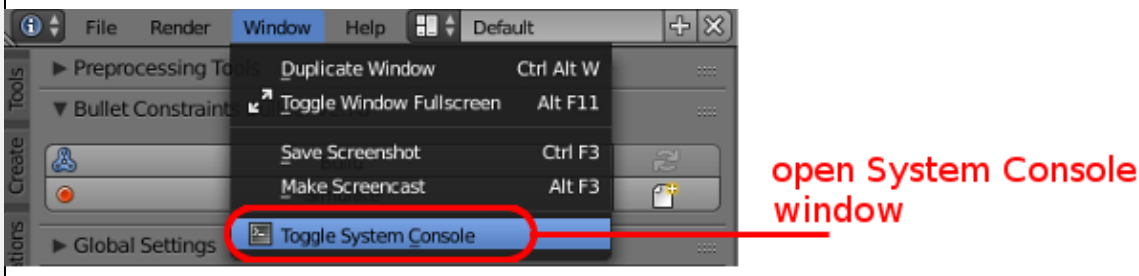
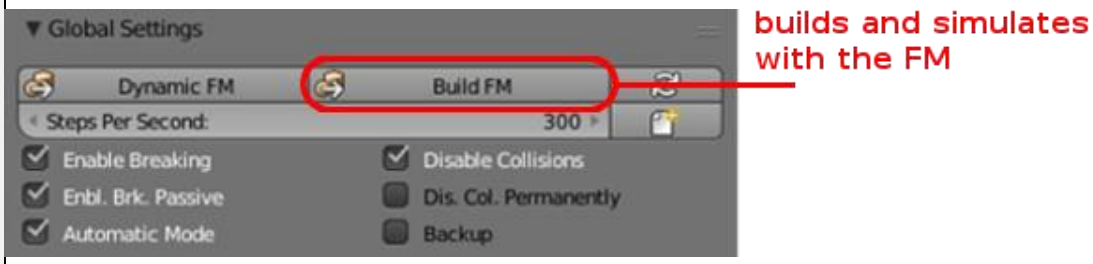
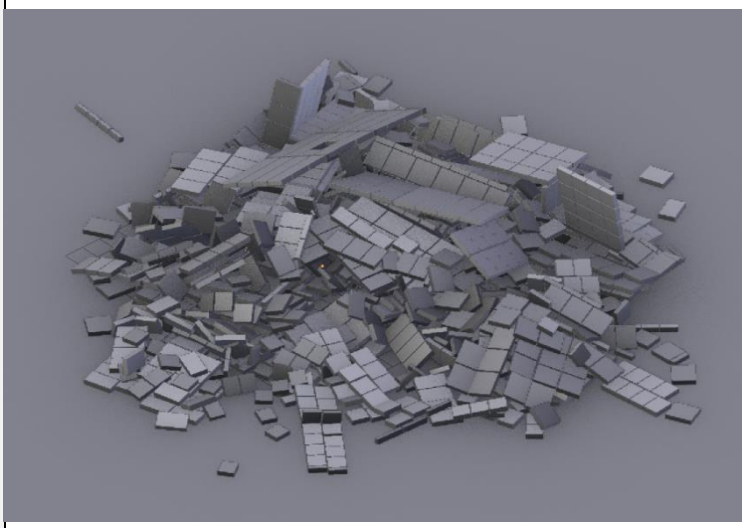


Figure 9

step 6 ***Build FM and simulate***	- select the entire model by pressing the "A"- key on your keyboard. - then press BuildFM, Figure 10, this will automatically execute first the Preprocessing tools and then the simulation.  *Figure 10* - the collapsed model is shown in Figure 11  *Figure 11*	
Trouble shooting:	Problem: When pressing "Build FM" nothing happens.	*Possible solution:* *-Are there element groups in the Element Group List?* *-Are all elements selected when pressing "Build FM"?* *-Are all the Preprocessing tool sub-steps activated?* *-Is the Automatic Mode active?*