

# ARG Report

root

December 7, 2020

This document was generated on 2020-12-07, 13:44:09 with the Automatic Report Generator (ARG) version "develop" on the Linux system `runner-ed2dce3a-project-18732201-concurrent-0`.

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# Introduction

The structure of this report was built by the Explorator component of ARG, which explored the following directory:

`/builds/AutomaticReportGenerator/arg/tests/build_tests/crush/data`

and discovered the following relevant data:

- ExodusII mesh in `crush_assembly.g`

# Chapter 1

## Geometry

This chapter describes the geometry as specified in the parameters file.

The term Electronic Product Definition (EPD) is also often used to denote the CAD geometry of the case.

### 1.1 Geometry Files

This section provides an overview of the geometry files found in:

`/builds/AutomaticReportGenerator/arg/tests/build_tests/crush/data/Interface`

We note that this is a particular case with a bijection between CAD and FEM items.



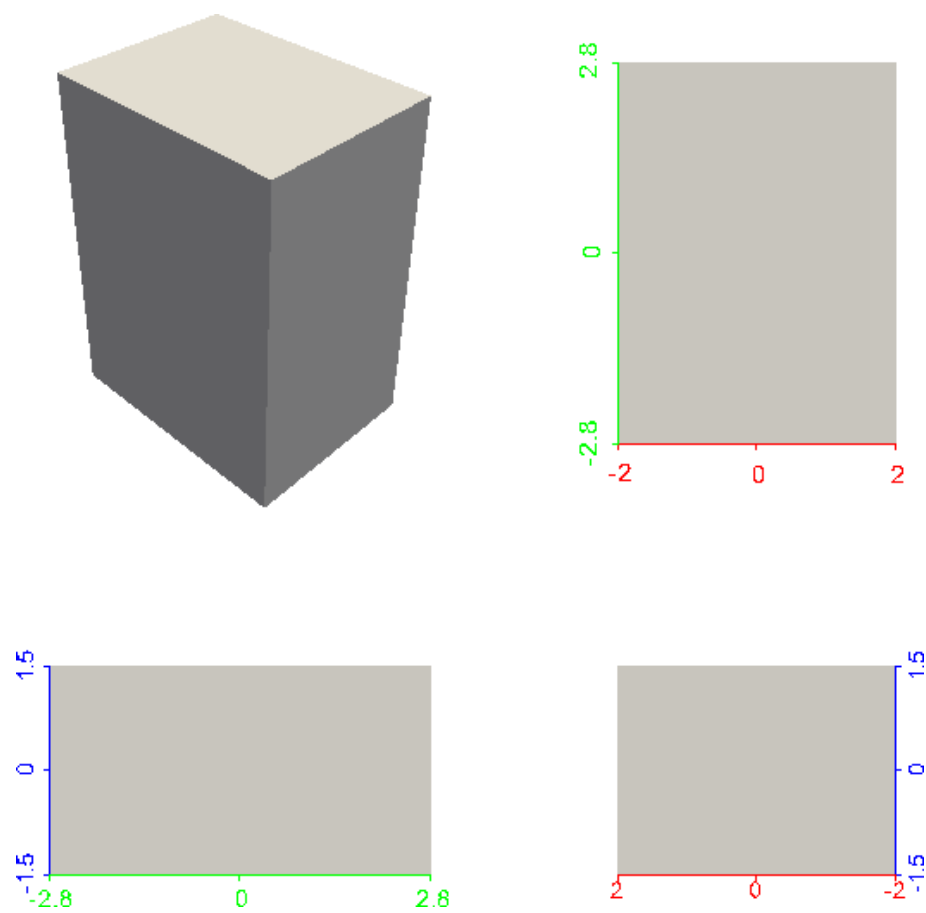


Figure 1.1: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `box_shell.stl`.

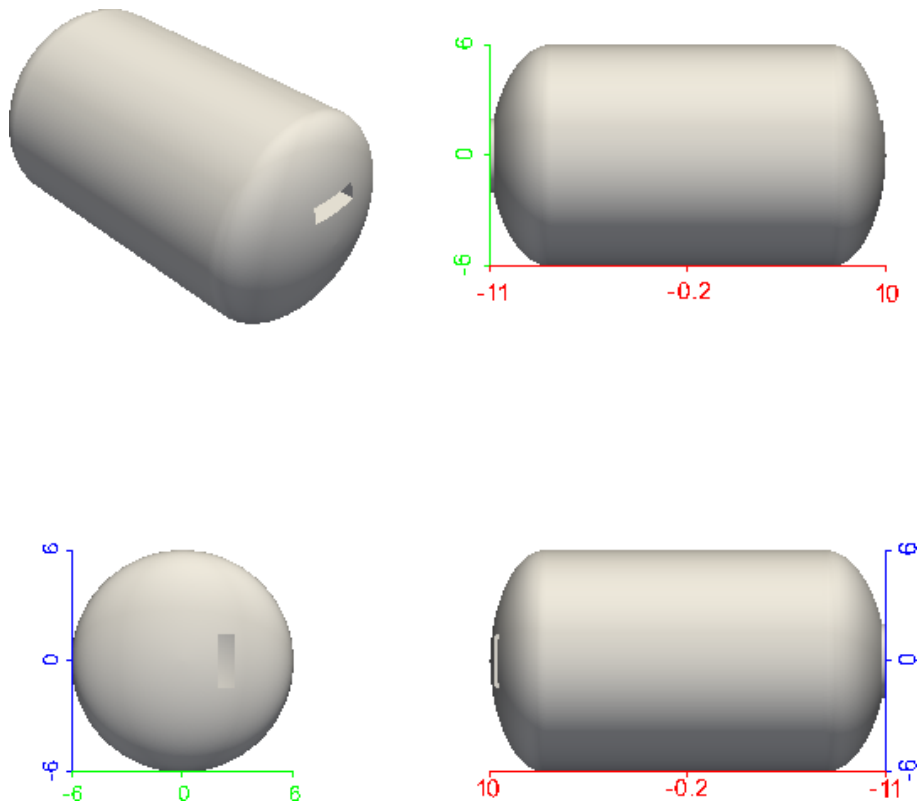


Figure 1.2: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `case.stl`.

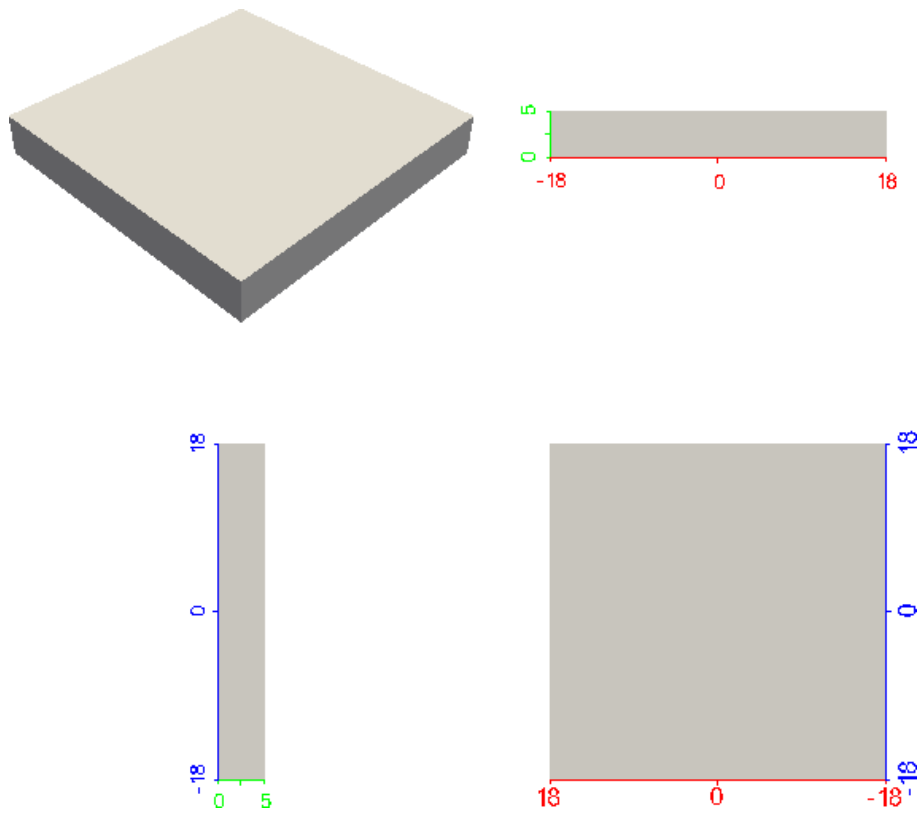


Figure 1.3: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `crusher.stl`.

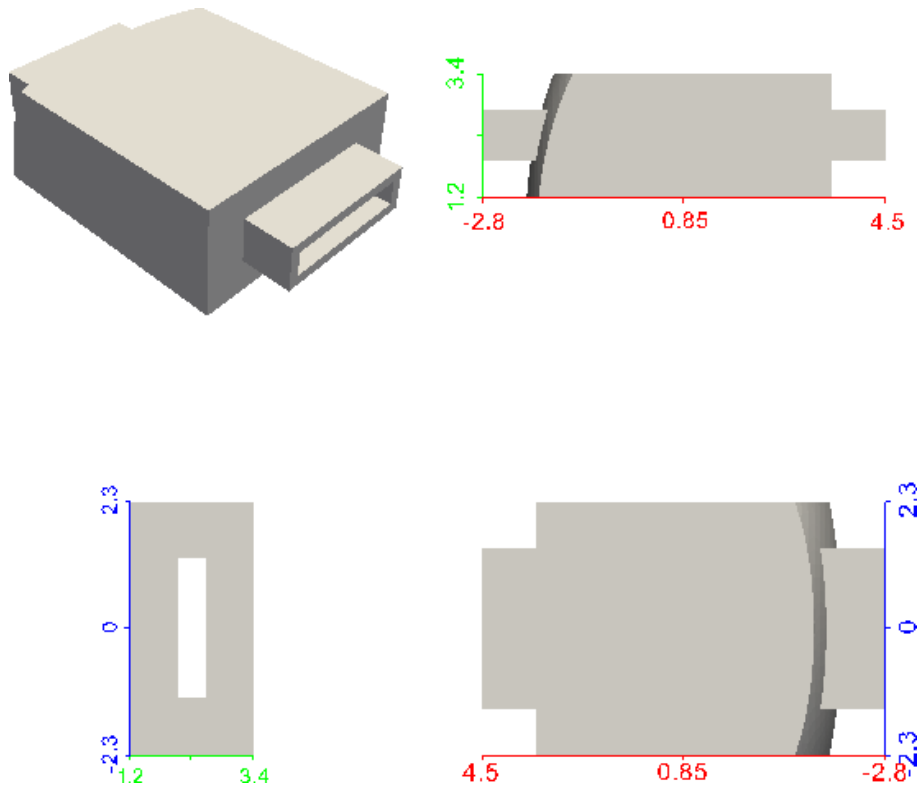


Figure 1.4: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of duct.stl.

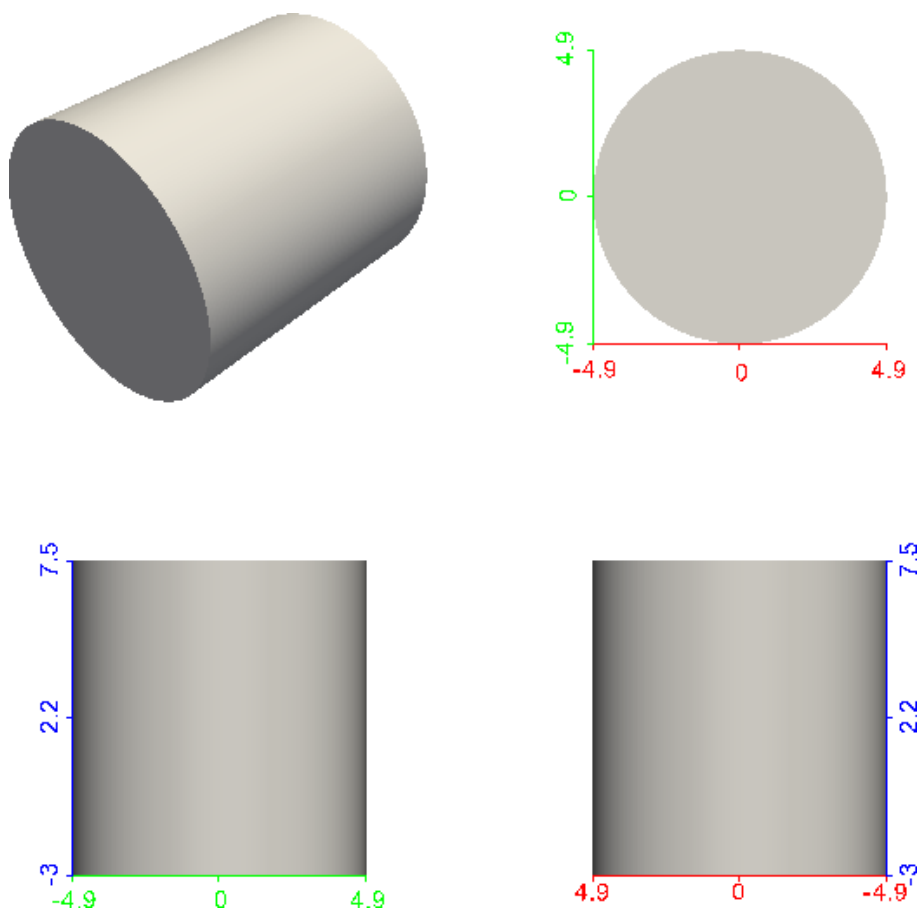


Figure 1.5: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `foam.stl`.

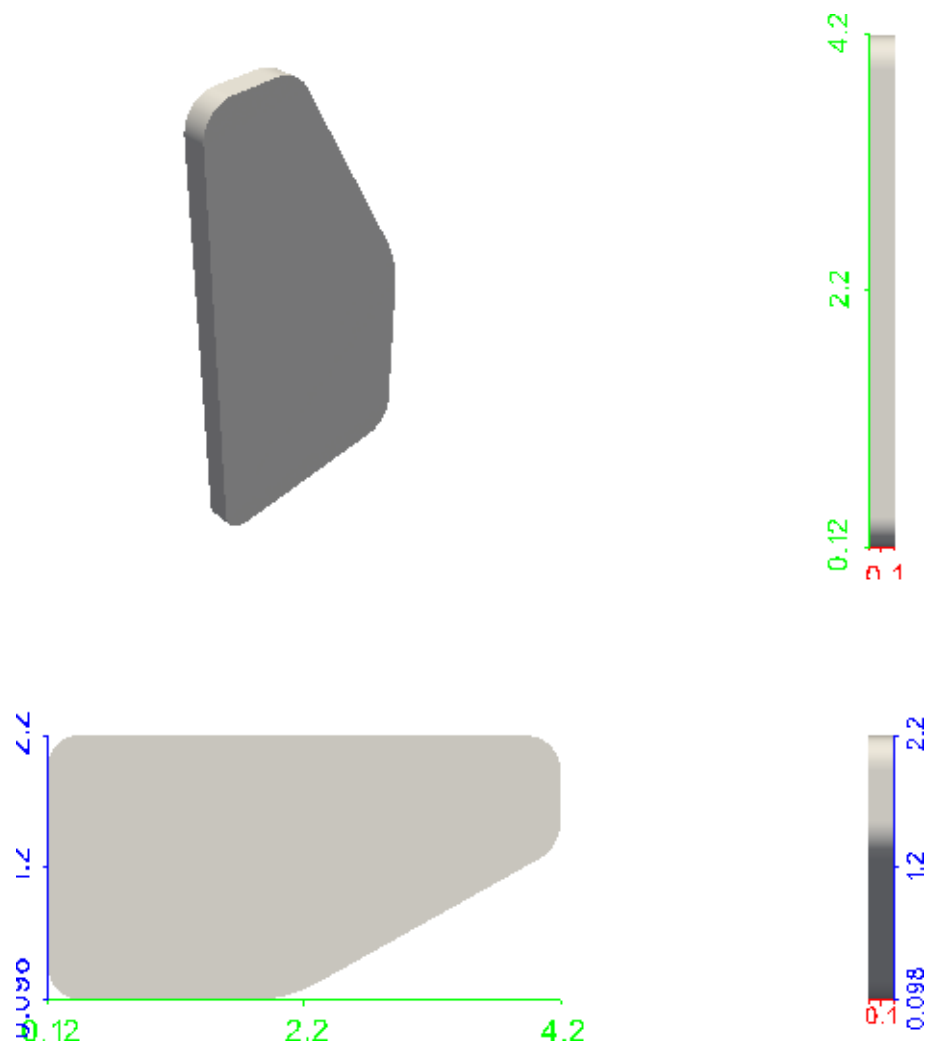


Figure 1.6: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `lid.stl`.

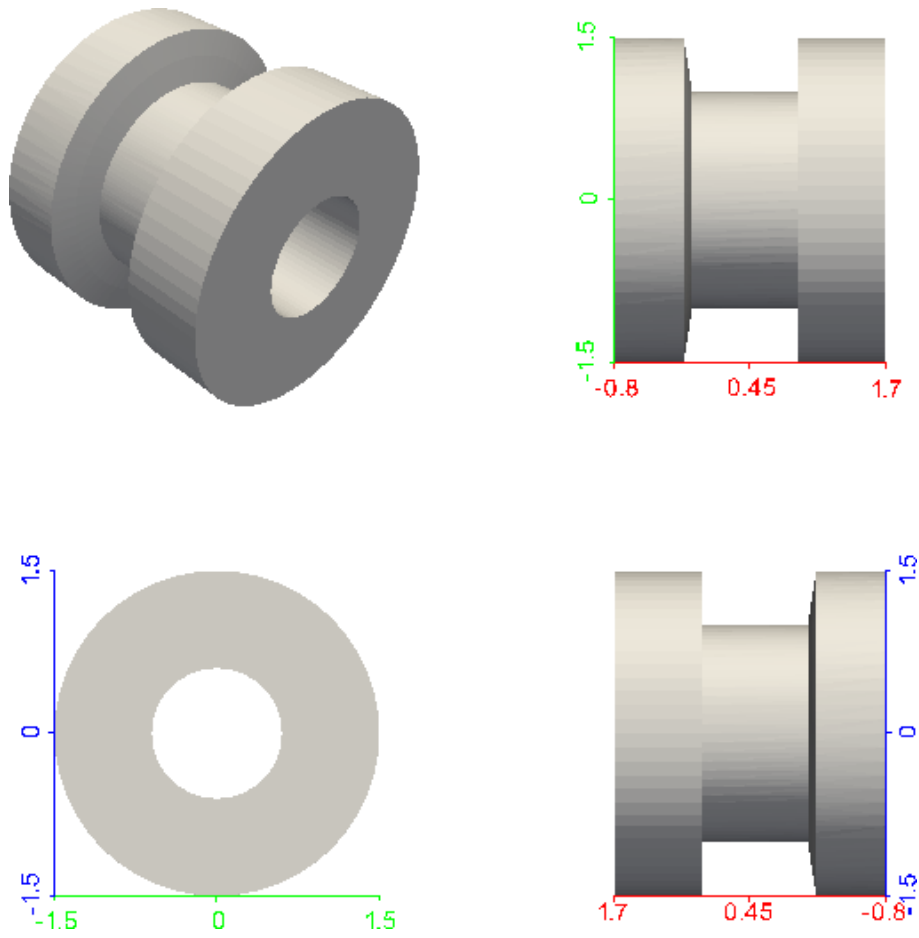


Figure 1.7: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `plug.stl`.

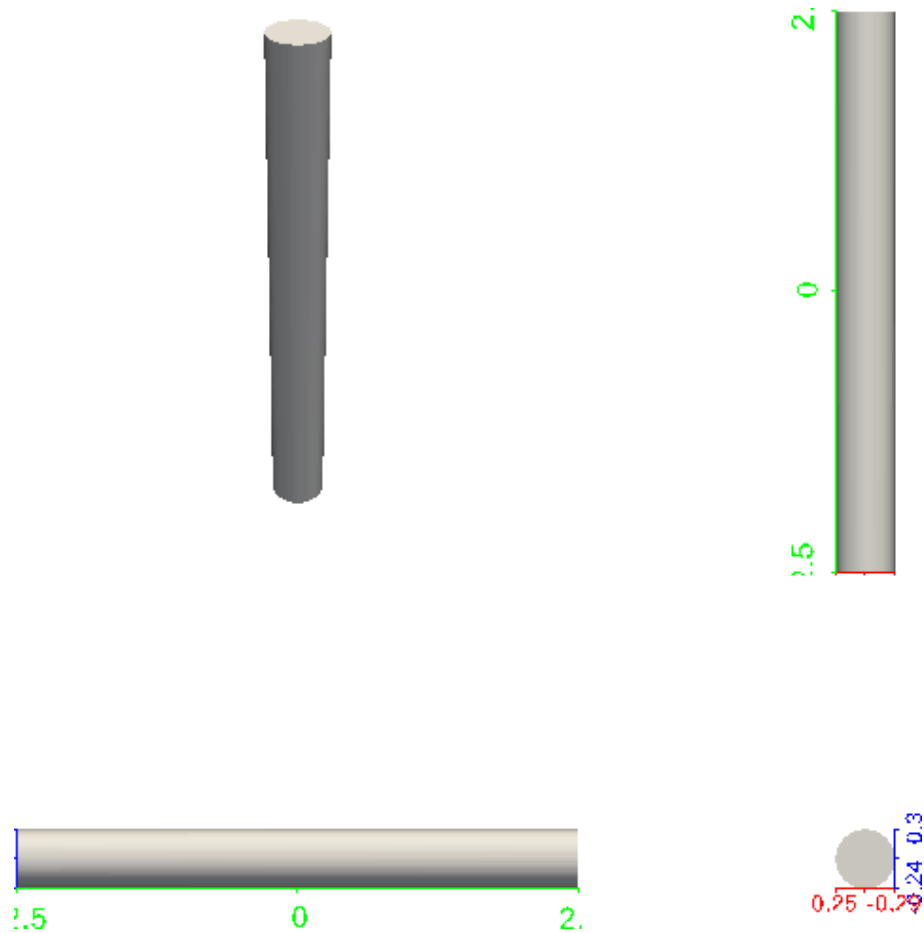


Figure 1.8: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `post.stl`.



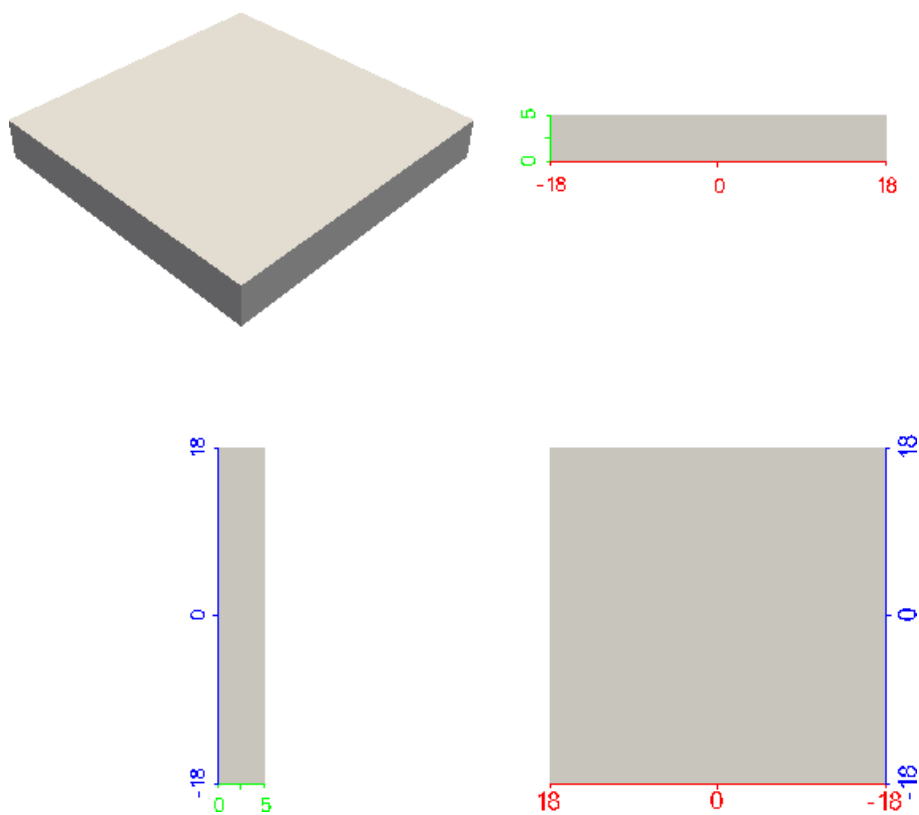


Figure 1.9: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `target.stl`.

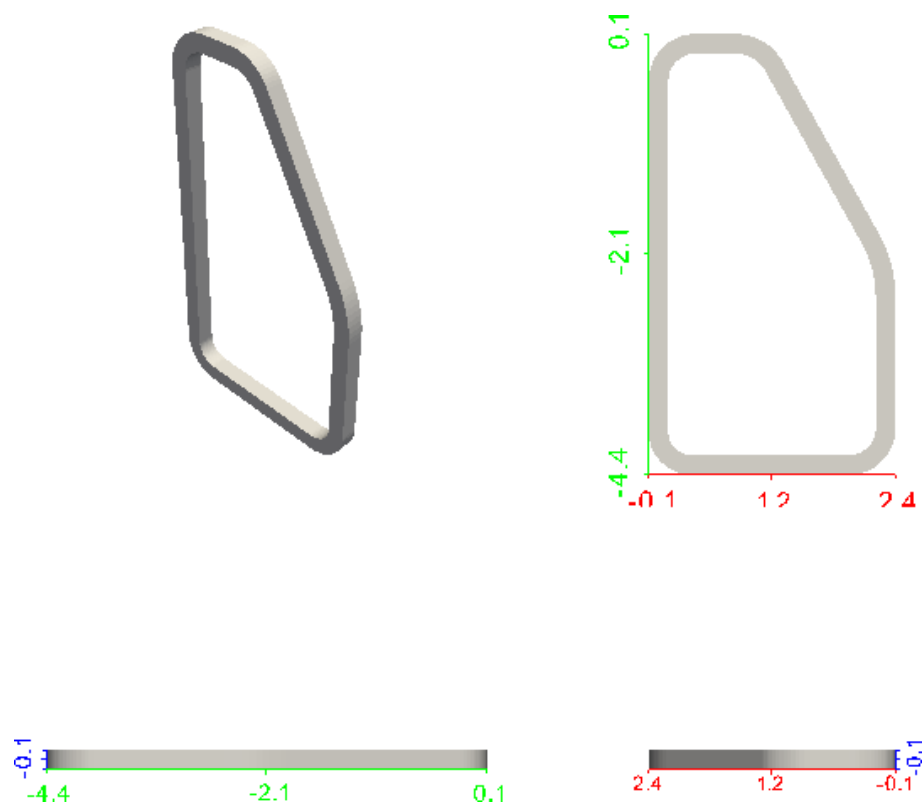


Figure 1.10: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `weld.stl`.

## 1.2 CAD metadata

This section describes the CAD metadata found in:

/builds/AutomaticReportGenerator/arg/tests/build\_tests/crush/data/Interface

CAD parameter	parameter value
DWG_TITLE1	NOT FOUND
UNITS	NOT FOUND
MATERIAL	NOT FOUND

Table 1.1: CAD metadata for part lid.

CAD parameter	parameter value
DWG_TITLE1	UNDEFINED
UNITS	INCH
MATERIAL	material_1

Table 1.2: CAD metadata for part box\_shell.

CAD parameter	parameter value
DWG_TITLE1	UNDEFINED
UNITS	INCH
MATERIAL	material_5

Table 1.3: CAD metadata for part foam.

CAD parameter	parameter value
DWG_TITLE1	NOT FOUND
UNITS	NOT FOUND
MATERIAL	NOT FOUND

Table 1.4: CAD metadata for part duct.

CAD parameter	parameter value
DWG_TITLE1	NOT FOUND
UNITS	NOT FOUND
MATERIAL	NOT FOUND

Table 1.5: CAD metadata for part weld.

CAD parameter	parameter value
DWG_TITLE1	UNDEFINED
UNITS	INCH
MATERIAL	material_2

Table 1.6: CAD metadata for part target.

CAD parameter	parameter value
DWG_TITLE1	UNDEFINED
UNITS	INCH
MATERIAL	material_3

Table 1.7: CAD metadata for part case.

CAD parameter	parameter value
DWG_TITLE1	UNDEFINED
UNITS	INCH
MATERIAL	material_4

Table 1.8: CAD metadata for part crusher.

CAD parameter	parameter value
DWG_TITLE1	NOT FOUND
UNITS	NOT FOUND
MATERIAL	NOT FOUND

Table 1.9: CAD metadata for part post.

CAD parameter	parameter value
DWG_TITLE1	NOT FOUND
UNITS	NOT FOUND
MATERIAL	NOT FOUND

Table 1.10: CAD metadata for part plug.

## Chapter 2

# ExodusII Mesh

This chapter describes the ExodusII mesh in:

`/builds/AutomaticReportGenerator/arg/tests/build_tests/crush/data/crush_assembly.g`

### 2.1 Overview

This section provides an overview of the meta-data and global properties of this ExodusII mesh.

item	number
Exodus II files	1
element blocks	10
elements	994848
node sets	2
nodes	1141300
side sets	8

Table 2.1: Topological properties of `crush_assembly.g`

block ID	block name
1	case
2	duct
3	plug
4	box_shell
5	lid
6	weld
7	post
8	target
9	crusher
10	foam

Table 2.2: Element blocks of `crush_assembly.g`

node set ID	node set name
1	z_symmetry_nodeset
2	target_bottom_nodeset

Table 2.3: Node sets of `crush_assembly.g`

side set ID	side set name
1	crusher_sideset
2	case_outer_sideset
3	case_inner_sideset
4	foam_outer_sideset
5	foam_inner_sideset
6	box_shell_outer_sideset
7	interface_case_sideset
8	interface_plug_sideset

Table 2.4: Side sets of `crush_assembly.g`

## 2.2 Mesh Blocks

This section provides a description of all blocks contained in the mesh.

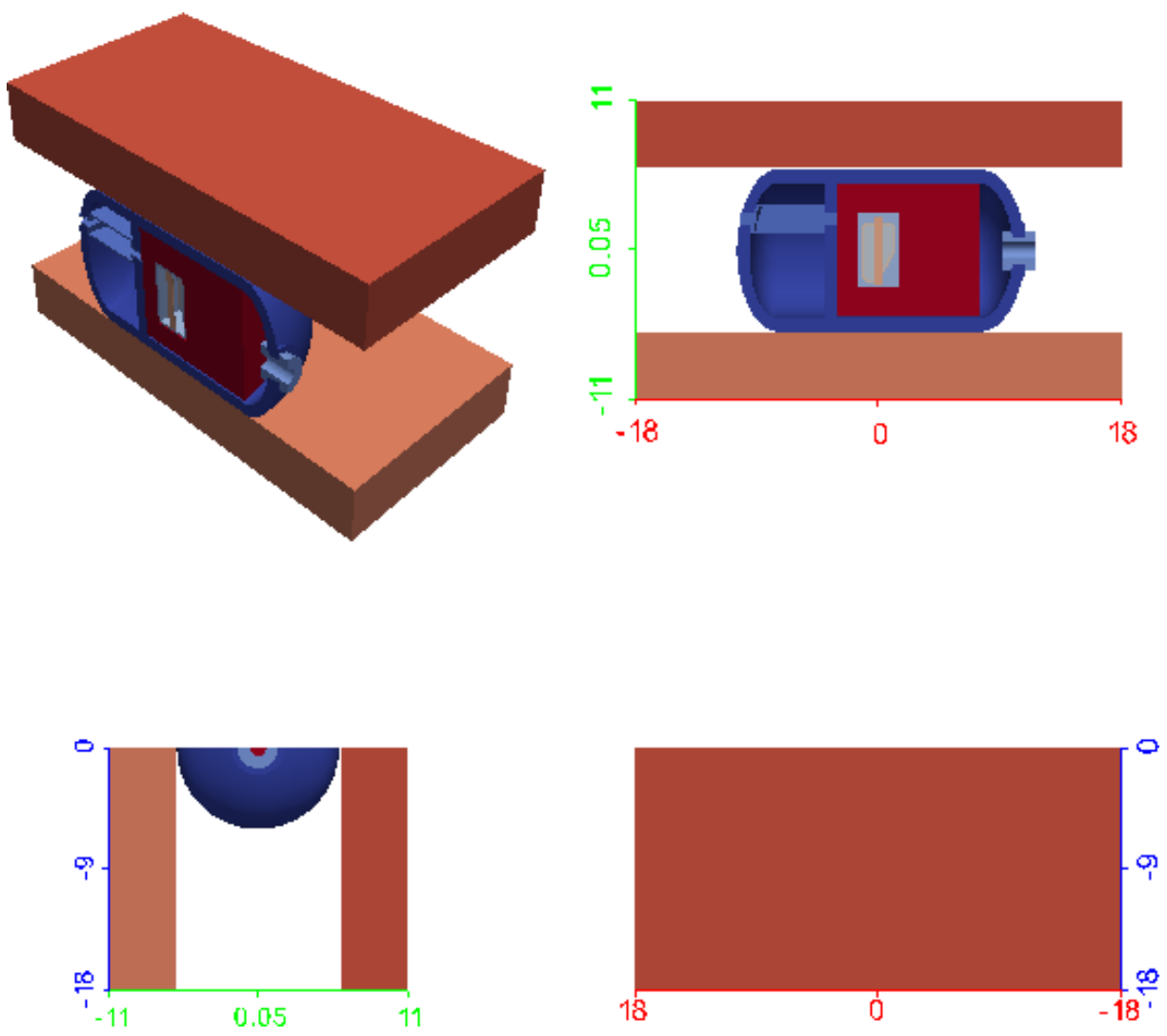


Figure 2.1: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of `crush_assembly.g`.



# Block 1 (case) summary

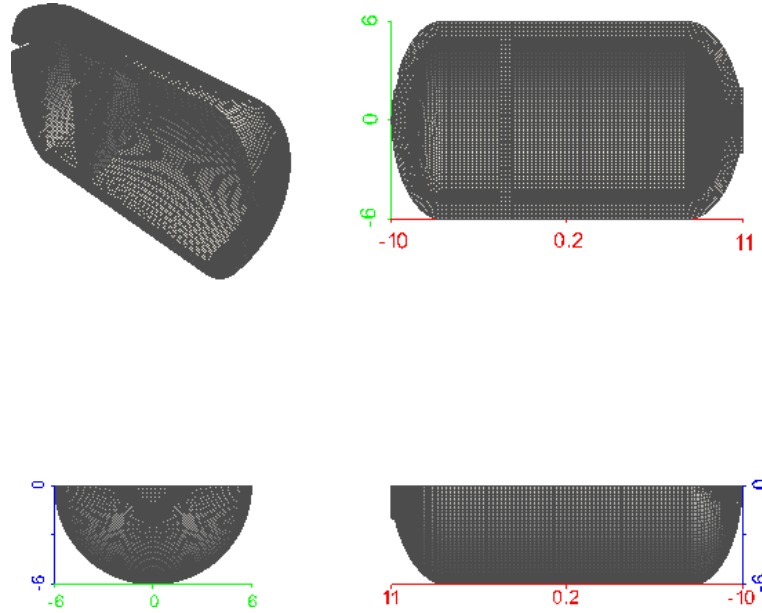


Figure 2.2: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 1.

property	value
number of nodes	163818
number of elements	143240
type of first element in block	HEX8

Table 2.5: Properties of block case.

Block 1 (**case**) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.4061	0.9816	1	0.04298	0.04379
shape	0.5047	0.8758	0.9999	0.05902	0.06739

Table 2.6: Element quality statistics of block **case**.

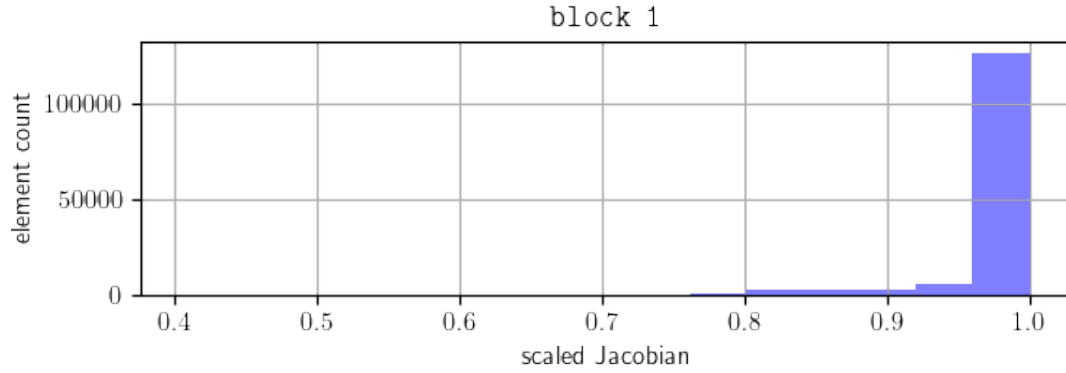


Figure 2.3: Histogram of scaled Jacobian element quality in block **case**.

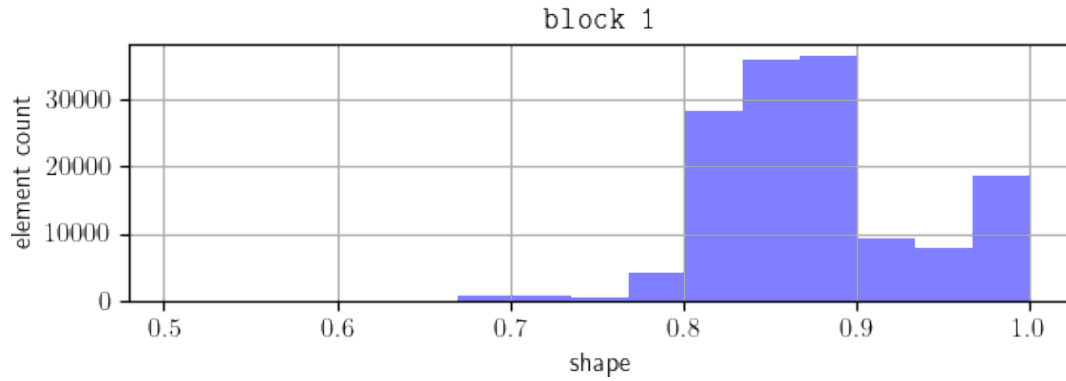


Figure 2.4: Histogram of shape element quality in block **case**.

## Block 2 (duct) summary

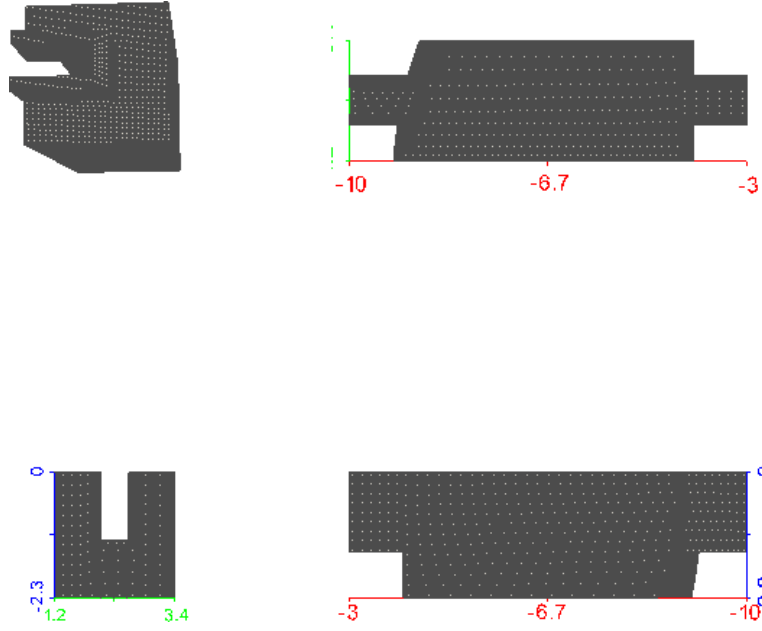


Figure 2.5: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 2.

property	value
number of nodes	378701
number of elements	327424
type of first element in block	HEX8

Table 2.7: Properties of block duct.

Block 2 (**duct**) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.8379	0.9732	1	0.0309	0.03175
shape	0.8821	0.9745	0.9998	0.02051	0.02105

Table 2.8: Element quality statistics of block **duct**.

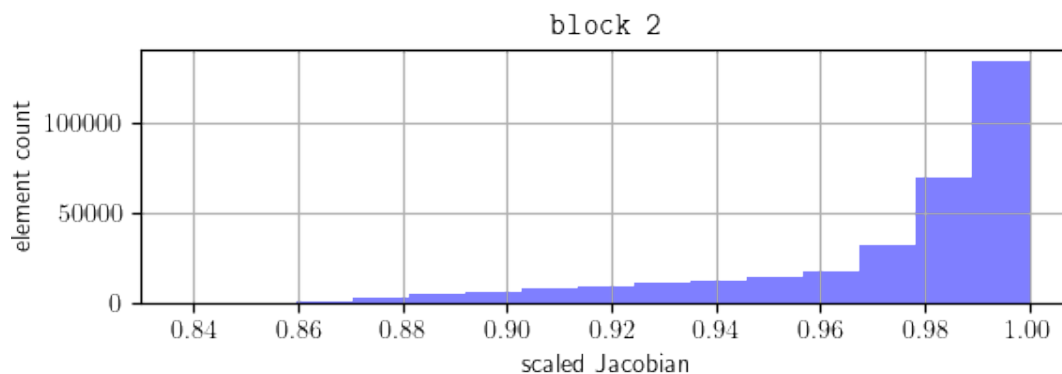


Figure 2.6: Histogram of scaled Jacobian element quality in block **duct**.

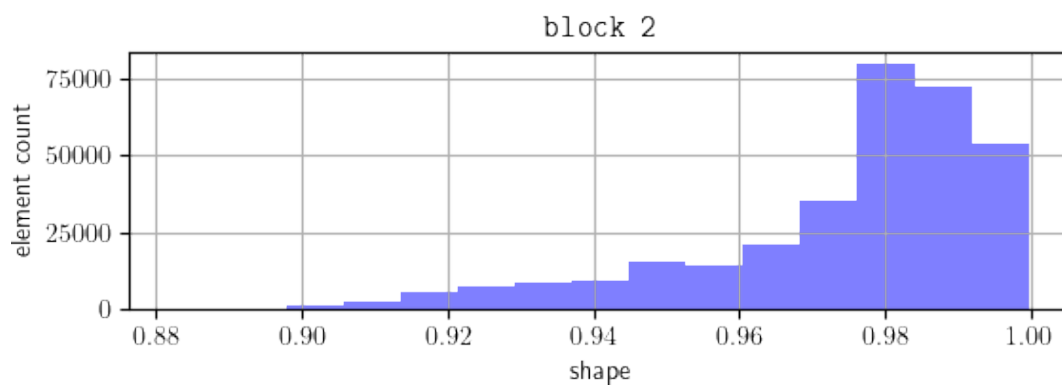


Figure 2.7: Histogram of shape element quality in block **duct**.

### Block 3 (plug) summary

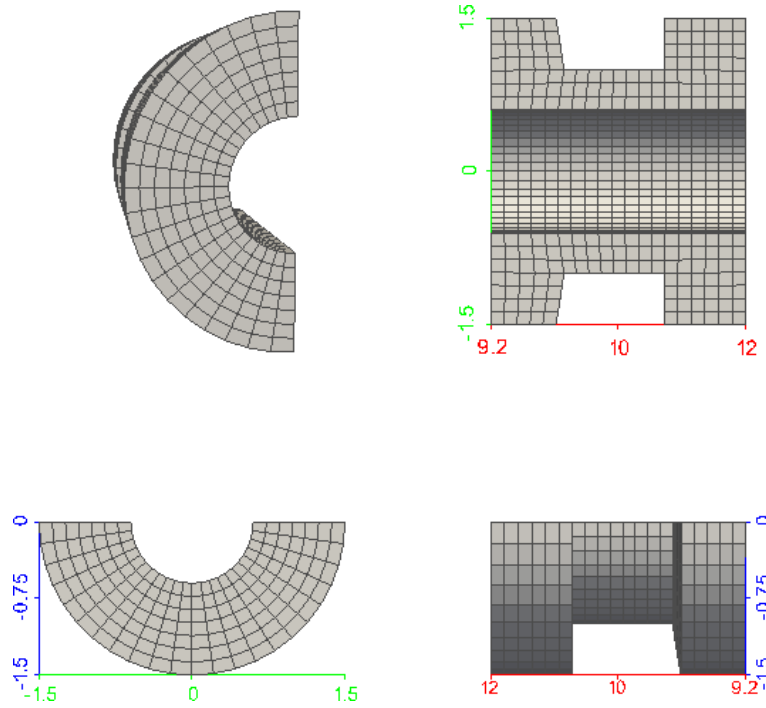


Figure 2.8: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 3.

property	value
number of nodes	3036
number of elements	2222
type of first element in block	HEX8

Table 2.9: Properties of block `plug`.

### Block 3 (plug) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.9818	0.9947	0.9974	0.003746	0.003766
shape	0.8666	0.9496	0.9957	0.03586	0.03776

Table 2.10: Element quality statistics of block `plug`.

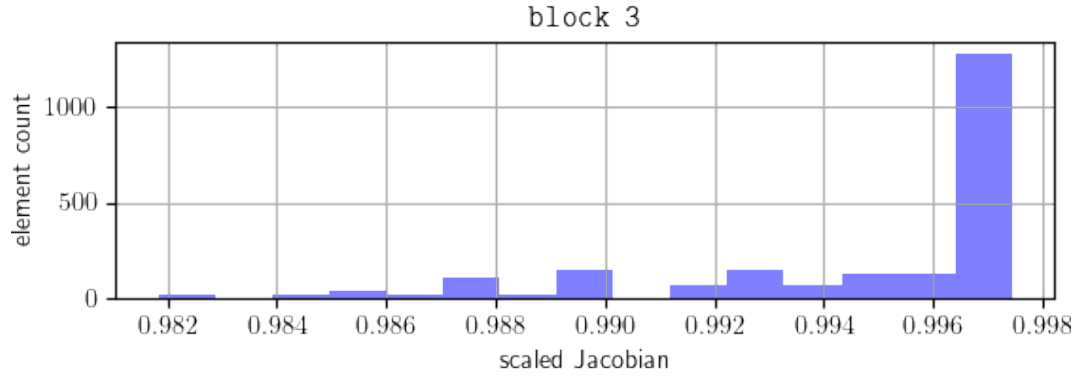


Figure 2.9: Histogram of scaled Jacobian element quality in block `plug`.

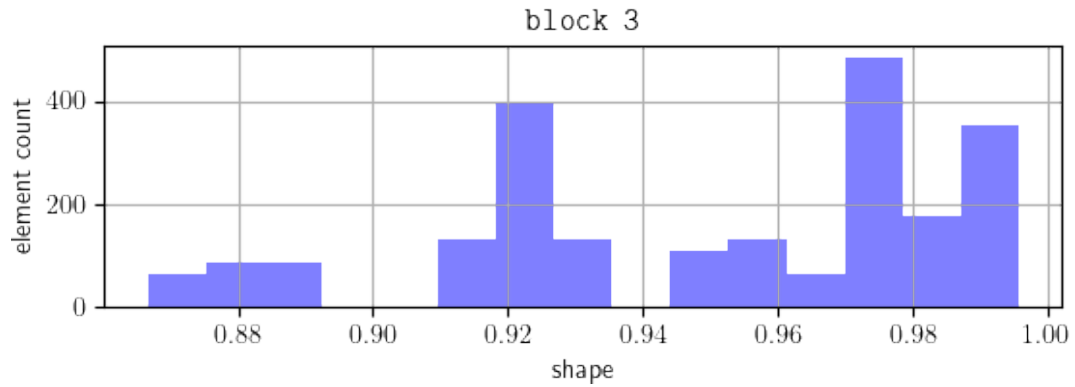


Figure 2.10: Histogram of shape element quality in block `plug`.

Block 4 (box\_shell) summary

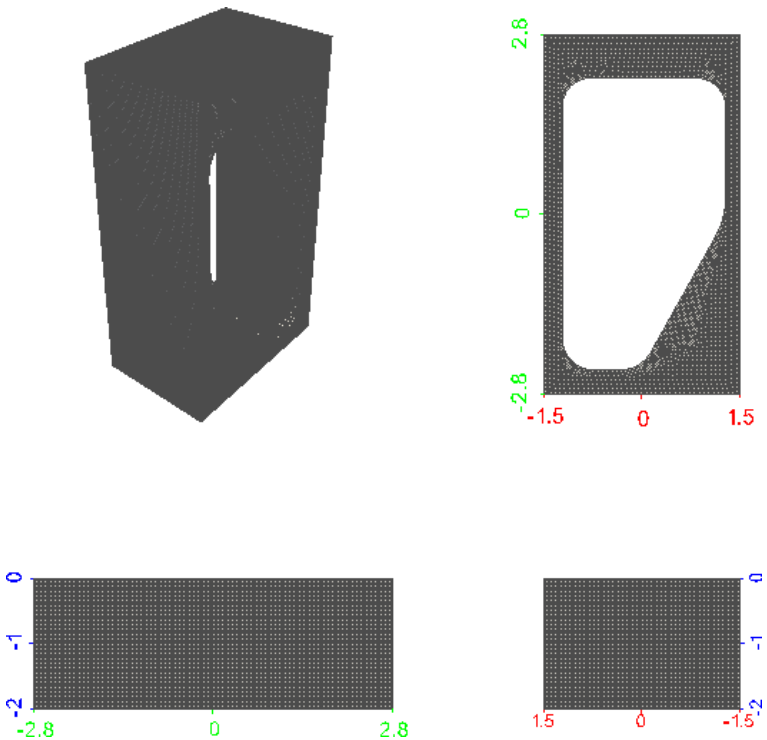


Figure 2.11: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 4.

property	value
number of nodes	278453
number of elements	238000
type of first element in block	HEX8

Table 2.11: Properties of block box\_shell.

Block 4 (`box_shell`) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.6088	0.9951	1	0.01345	0.01352
shape	0.6524	0.9931	0.9998	0.0164	0.01652

Table 2.12: Element quality statistics of block `box_shell`.

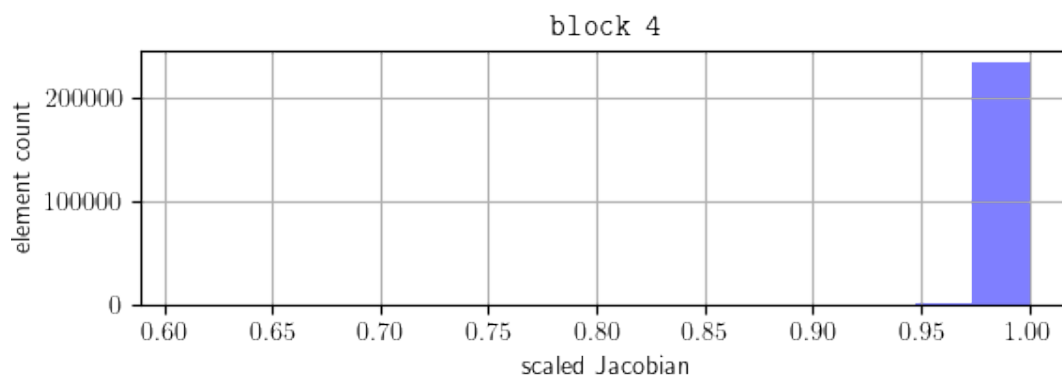


Figure 2.12: Histogram of scaled Jacobian element quality in block `box_shell`.

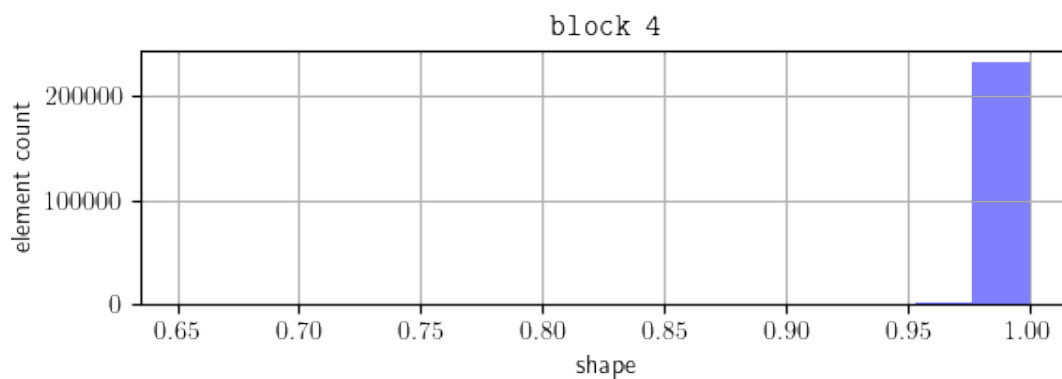


Figure 2.13: Histogram of shape element quality in block `box_shell`.



# Block 5 (lid) summary

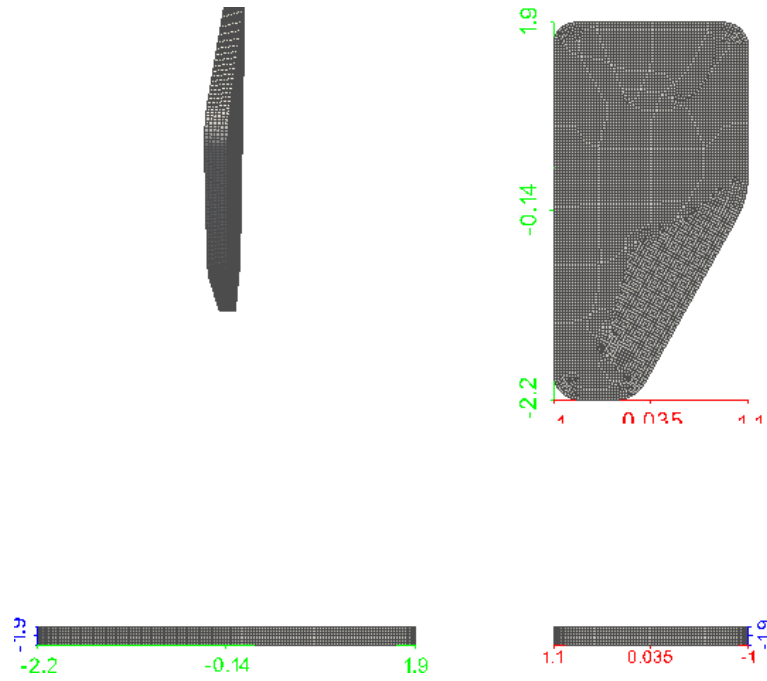


Figure 2.14: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 5.

property	value
number of nodes	52563
number of elements	43986
type of first element in block	HEX8

Table 2.13: Properties of block 1id.

Block 5 (1id) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.7408	0.996	1	0.02035	0.02043
shape	0.7275	0.9933	0.9999	0.02438	0.02455

Table 2.14: Element quality statistics of block 1id.

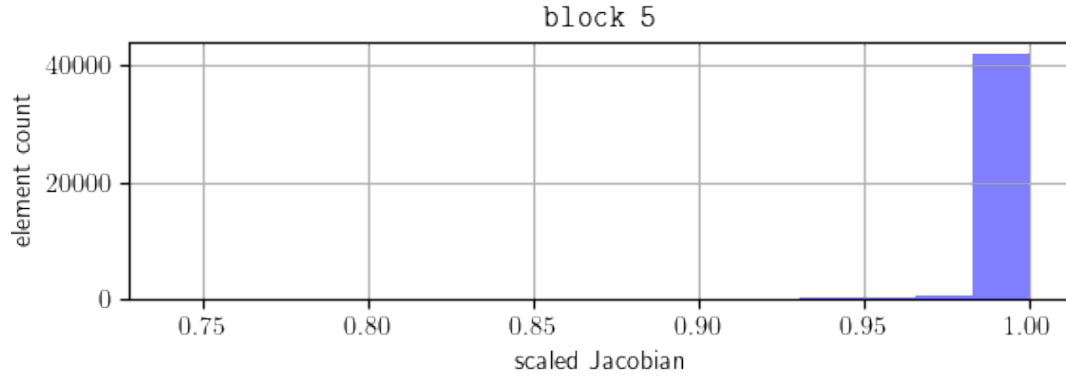


Figure 2.15: Histogram of scaled Jacobian element quality in block 1id.

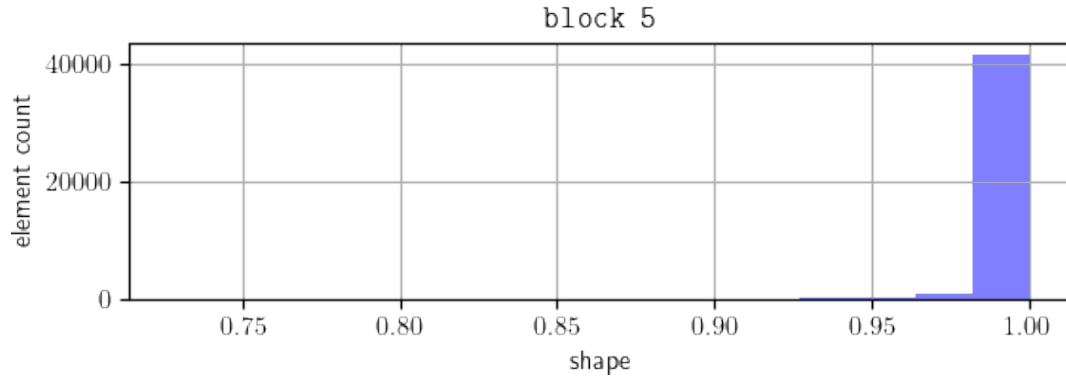


Figure 2.16: Histogram of shape element quality in block 1id.

Block 6 (weld) summary

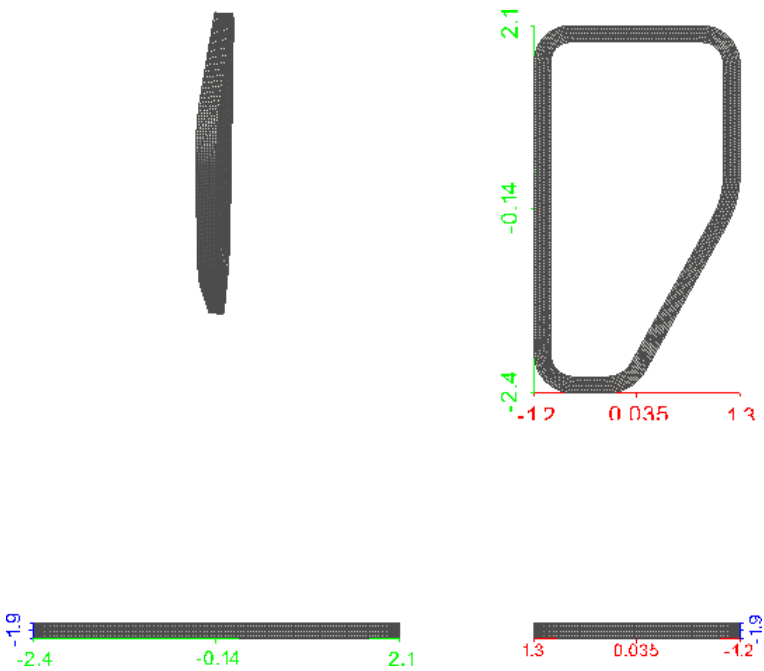


Figure 2.17: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 6.

property	value
number of nodes	30699
number of elements	24256
type of first element in block	HEX8

Table 2.15: Properties of block `weld`.

Block 6 (`weld`) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.3748	0.9057	0.9999	0.1082	0.1194
shape	0.4939	0.9138	0.9917	0.08219	0.08994

Table 2.16: Element quality statistics of block `weld`.

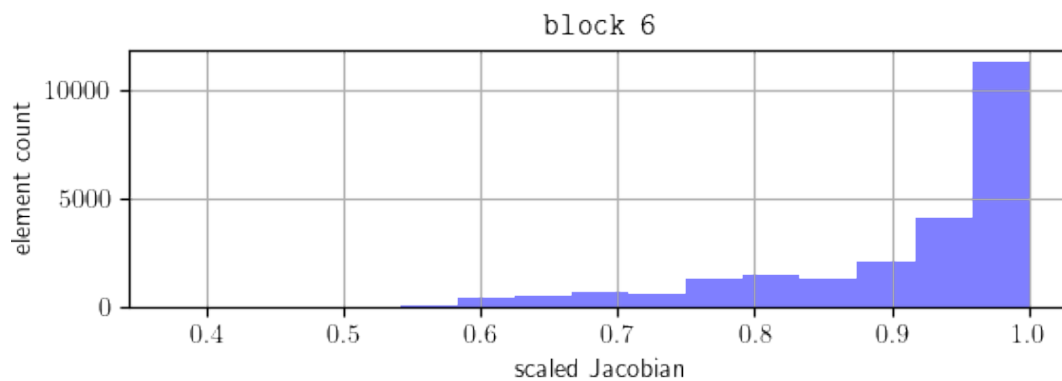


Figure 2.18: Histogram of scaled Jacobian element quality in block `weld`.

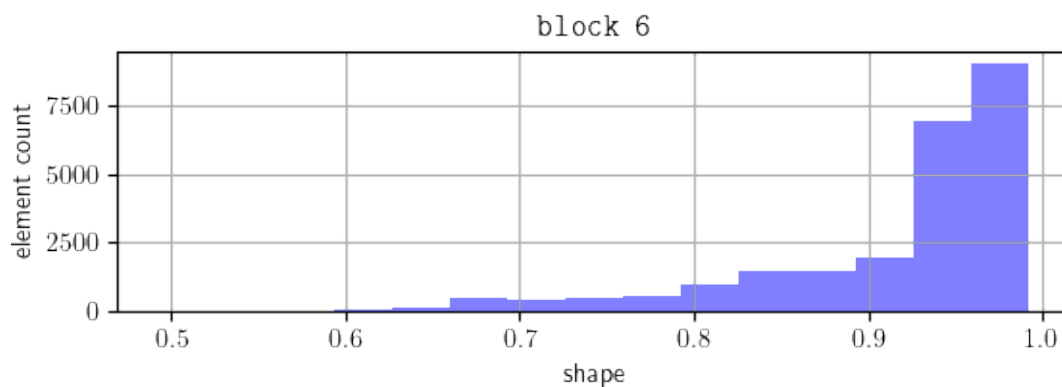


Figure 2.19: Histogram of shape element quality in block `weld`.

Block 7 (`post`) summary

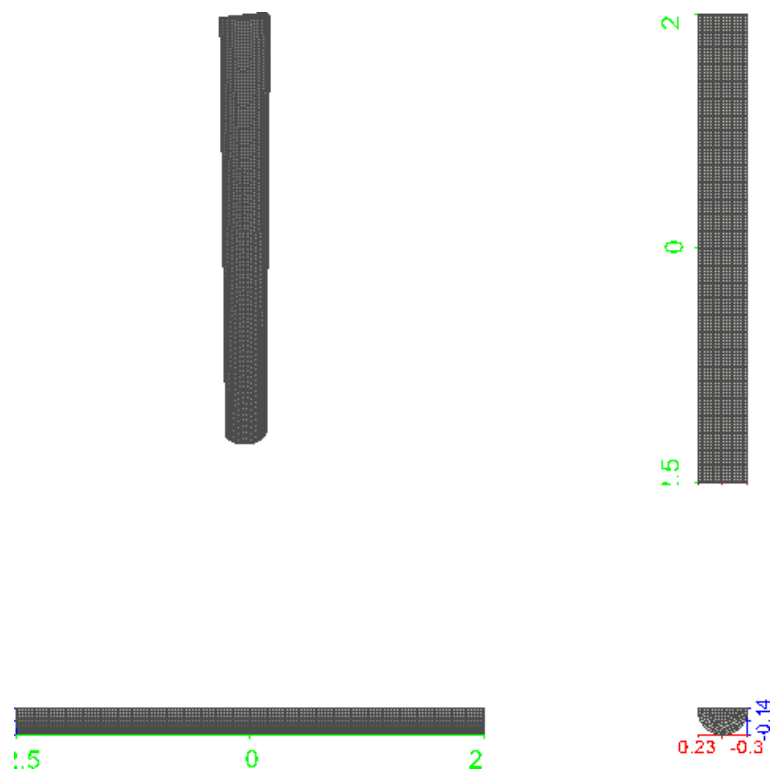


Figure 2.20: Perspective (top left) and parallel (top right: `XY`; bottom left: `YZ`; bottom right: `XZ`) rendering of block 7.

property	value
number of nodes	24928
number of elements	20864
type of first element in block	HEX8

Table 2.17: Properties of block `post`.

Block 7 (**post**) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.7522	0.9528	0.9995	0.05798	0.06086
shape	0.7608	0.951	0.9988	0.05655	0.05947

Table 2.18: Element quality statistics of block **post**.

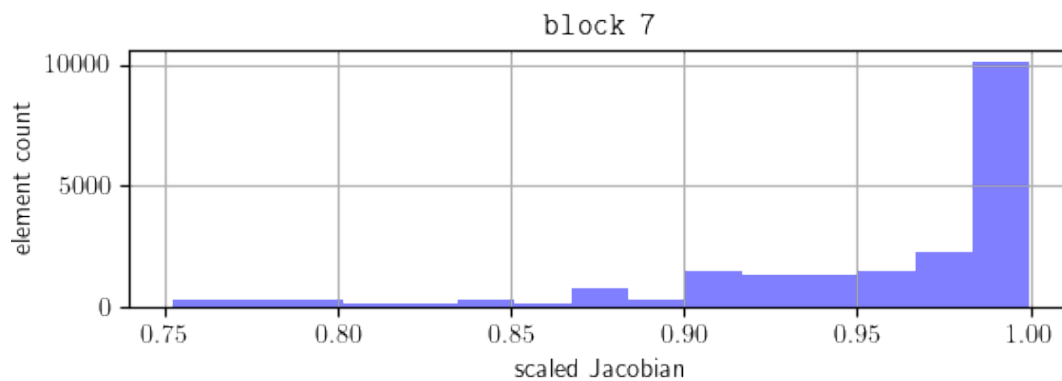


Figure 2.21: Histogram of scaled Jacobian element quality in block **post**.

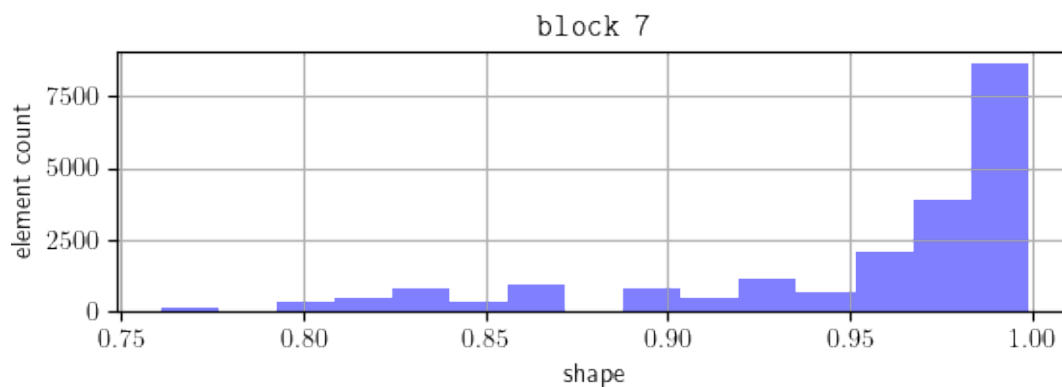


Figure 2.22: Histogram of shape element quality in block **post**.

Block 8 (**target**) summary

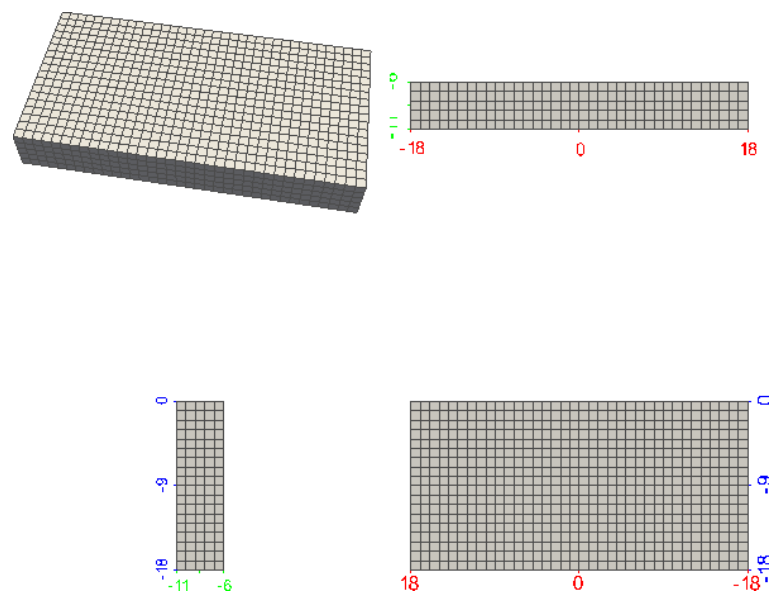


Figure 2.23: Perspective (top left) and parallel (top right: **XY**; bottom left: **YZ**; bottom right: **XZ**) rendering of block 8.

property	value
number of nodes	4218
number of elements	3240
type of first element in block	HEX8

Table 2.19: Properties of block **target**.

Block 8 (**target**) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	1	1	1	0	0
shape	1	1	1	0	0

Table 2.20: Element quality statistics of block **target**.

Histogram of scaled Jacobian element quality in block **target** is too narrow to be inserted (coefficient of variation:  $0.0 < 0.001$ ).

Histogram of shape element quality in block **target** is too narrow to be inserted (coefficient of variation:  $0.0 < 0.001$ ).



Block 9 (crusher) summary

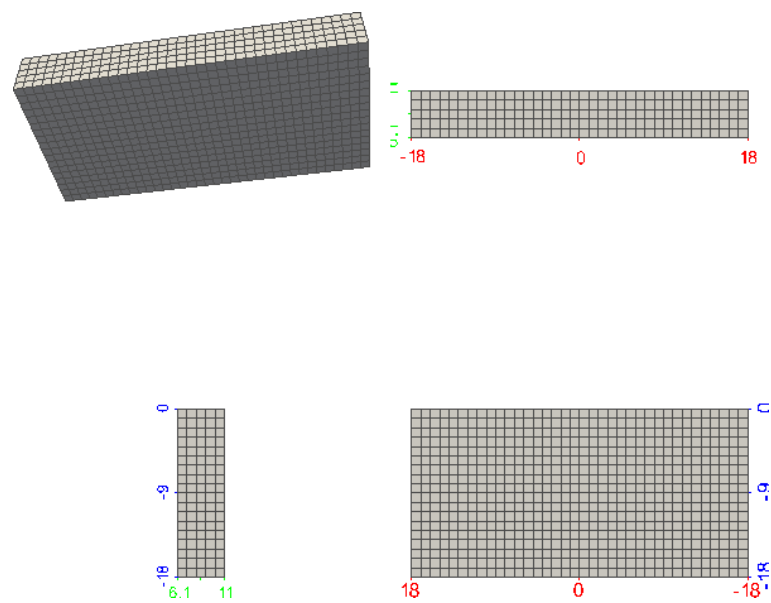


Figure 2.24: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 9.

property	value
number of nodes	4218
number of elements	3240
type of first element in block	HEX8

Table 2.21: Properties of block crusher.

Block 9 (**crusher**) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	1	1	1	0	0
shape	1	1	1	0	0

Table 2.22: Element quality statistics of block **crusher**.

Histogram of scaled Jacobian element quality in block **crusher** is too narrow to be inserted (coefficient of variation:  $0.0 < 0.001$ ).

Histogram of shape element quality in block **crusher** is too narrow to be inserted (coefficient of variation:  $0.0 < 0.001$ ).

Block 10 (foam) summary

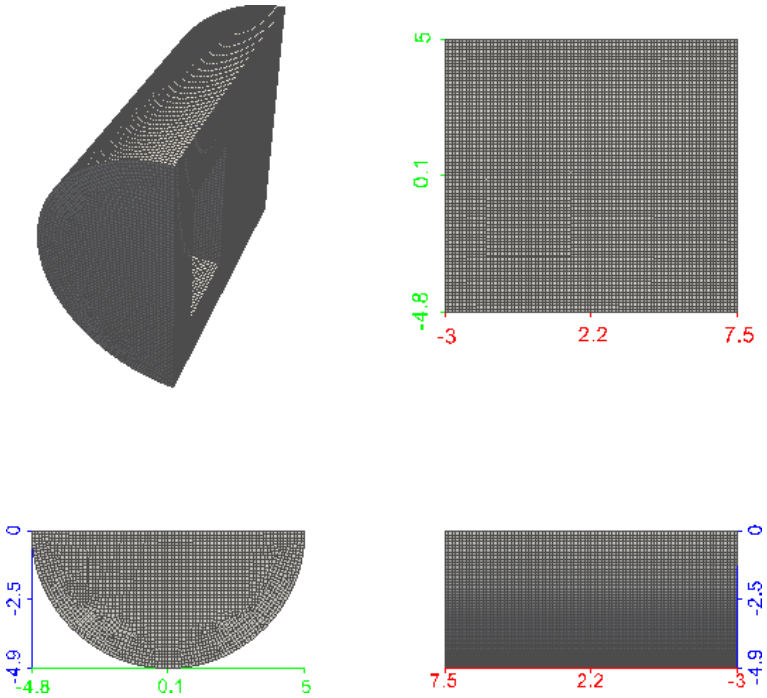


Figure 2.25: Perspective (top left) and parallel (top right:  $XY$ ; bottom left:  $YZ$ ; bottom right:  $XZ$ ) rendering of block 10.

property	value
number of nodes	200666
number of elements	188376
type of first element in block	HEX8

Table 2.23: Properties of block foam.

# Block 10 (foam) element quality

$\mathcal{Q}$	$\min(\mathcal{Q})$	$\mu(\mathcal{Q})$	$\max(\mathcal{Q})$	$\sigma(\mathcal{Q})$	$\sigma/\mu(\mathcal{Q})$
scaled Jacobian	0.6998	0.9903	1	0.03133	0.03164
shape	0.7526	0.9884	1	0.03306	0.03344

Table 2.24: Element quality statistics of block **foam**.

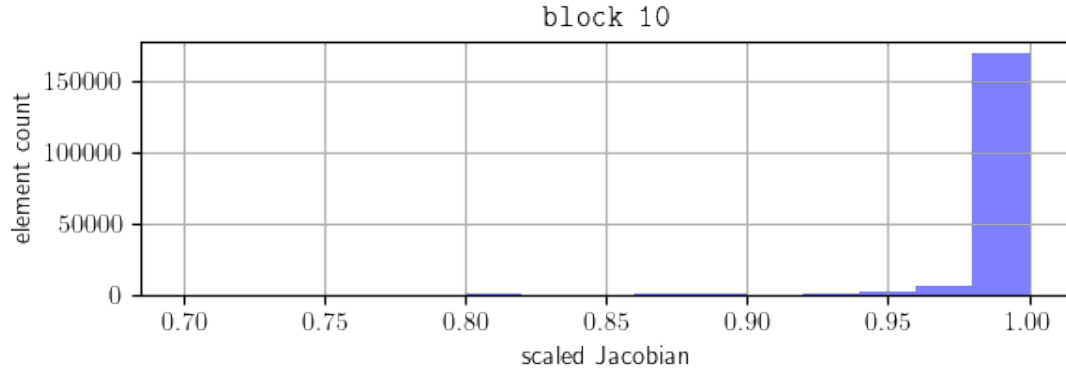


Figure 2.26: Histogram of scaled Jacobian element quality in block **foam**.

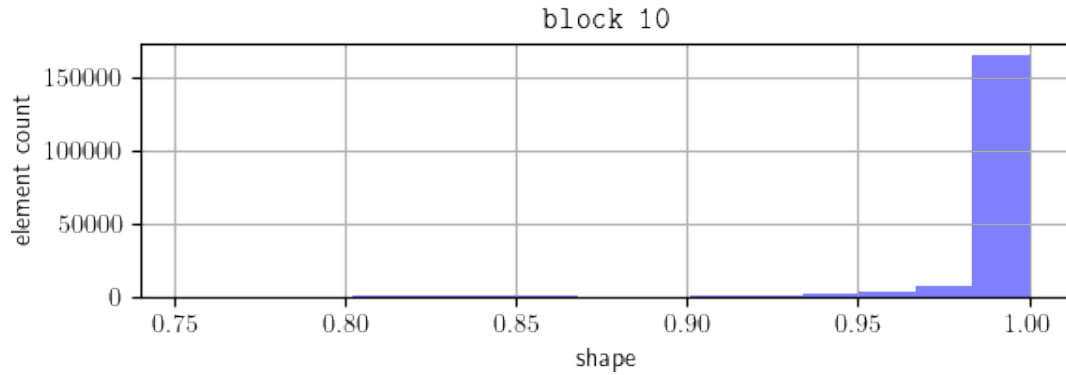


Figure 2.27: Histogram of shape element quality in block **foam**.