ARG Report  
root  
2021-08-25

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# 4. 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

# 5. 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.

## 5.1. Geometry Files

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

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

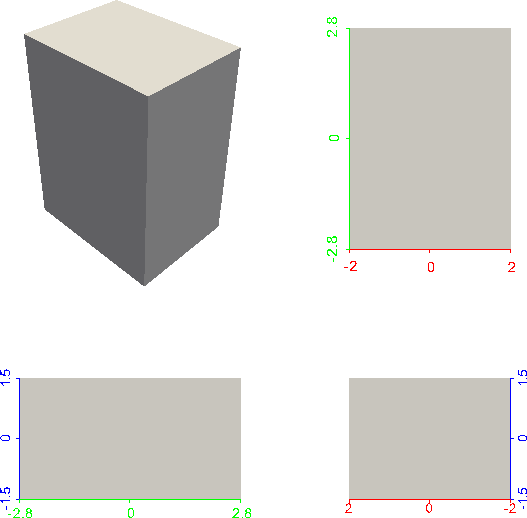


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of box\_shell.stl.

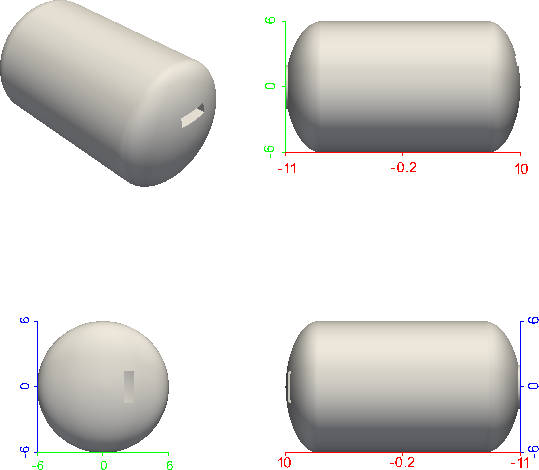


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of case.stl.

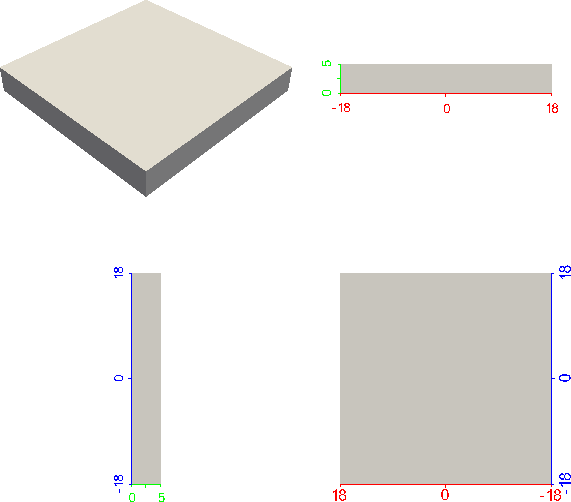


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of crusher.stl.

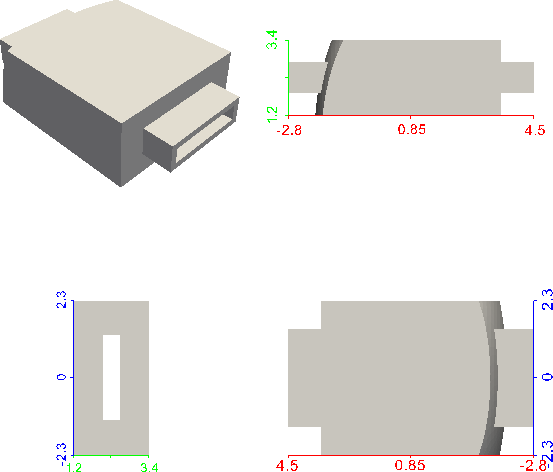


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of duct.stl.

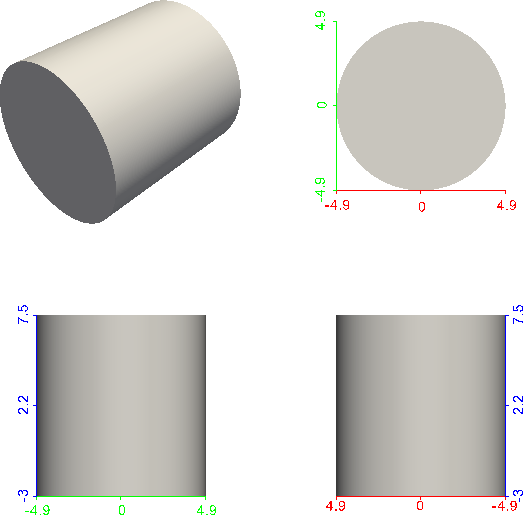


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of foam.stl.

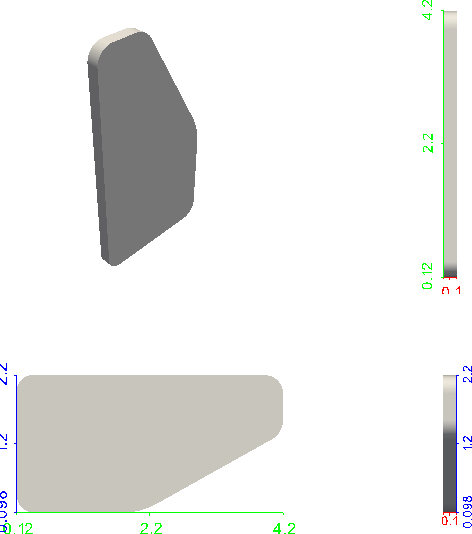


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of lid.stl.

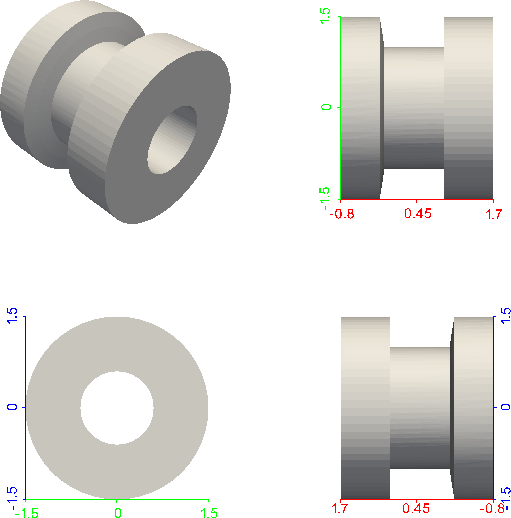


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of plug.stl.

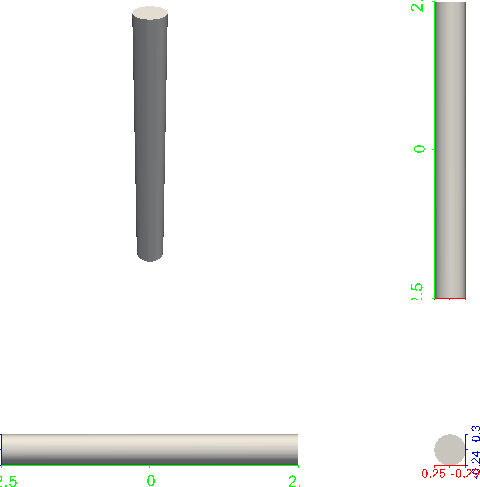


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of post.stl.

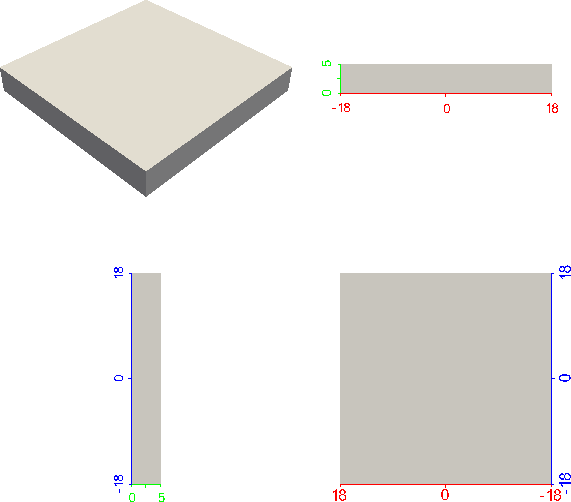


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of target.stl.

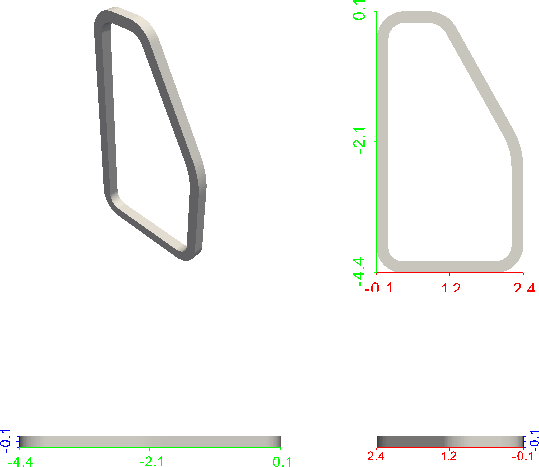


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of weld.stl.

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

## 5.2. 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 | UNDEFINED |
| UNITS | INCH |
| MATERIAL | material\_1 |

Table : CAD metadata for part box\_shell.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | UNDEFINED |
| UNITS | INCH |
| MATERIAL | material\_3 |

Table : CAD metadata for part case.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | NOT FOUND |
| UNITS | NOT FOUND |
| MATERIAL | NOT FOUND |

Table : CAD metadata for part post.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | UNDEFINED |
| UNITS | INCH |
| MATERIAL | material\_5 |

Table : CAD metadata for part foam.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | UNDEFINED |
| UNITS | INCH |
| MATERIAL | material\_2 |

Table : CAD metadata for part target.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | NOT FOUND |
| UNITS | NOT FOUND |
| MATERIAL | NOT FOUND |

Table : CAD metadata for part duct.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | NOT FOUND |
| UNITS | NOT FOUND |
| MATERIAL | NOT FOUND |

Table : CAD metadata for part plug.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | NOT FOUND |
| UNITS | NOT FOUND |
| MATERIAL | NOT FOUND |

Table : CAD metadata for part lid.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | NOT FOUND |
| UNITS | NOT FOUND |
| MATERIAL | NOT FOUND |

Table : CAD metadata for part weld.

|  |  |
| --- | --- |
| CAD parameter | parameter value |
| DWG\_TITLE1 | UNDEFINED |
| UNITS | INCH |
| MATERIAL | material\_4 |

Table : CAD metadata for part crusher.

# 6. ExodusII Mesh

This chapter describes the ExodusII mesh in:

/builds/AutomaticReportGenerator/arg/tests/build\_tests/crush/data/crush\_assembly.g

## 6.1. 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 : 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 : Element blocks of crush\_assembly.g

|  |  |
| --- | --- |
| node set ID | node set name |
| 1 | z\_symmetry\_nodeset |
| 2 | target\_bottom\_nodeset |

Table : 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 : Side sets of crush\_assembly.g

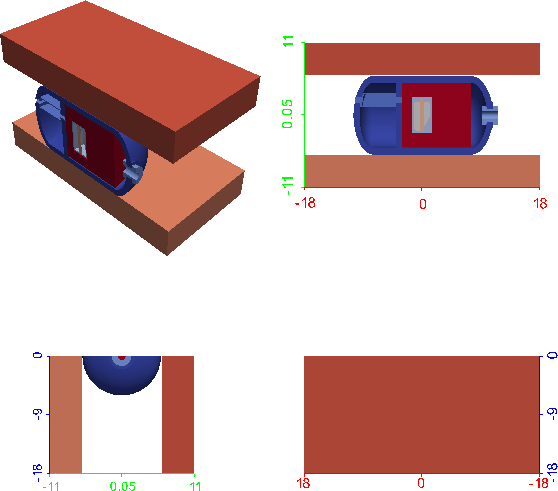


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of crush\_assembly.g.

## 6.2. Mesh Blocks

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

# 7. Block 1 (case) summary

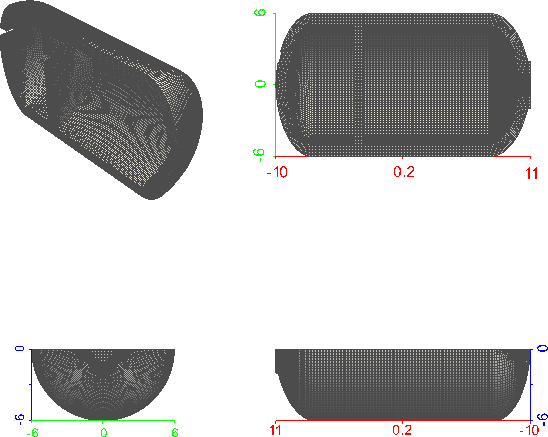


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 1.

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

Table : Properties of block case.

# 8. Block 1 (case) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 0.4061 | 0.9816 | 1 | 0.04298 | 0.04379 |
| shape | 0.5047 | 0.8758 | 0.9999 | 0.05902 | 0.06739 |

Table : Element quality statistics of block case.

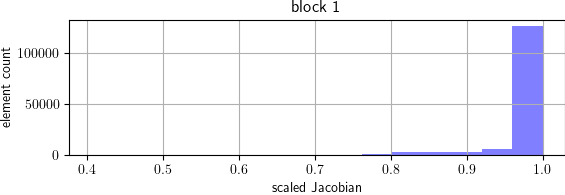


Figure : Histogram of scaled Jacobian element quality in block case.

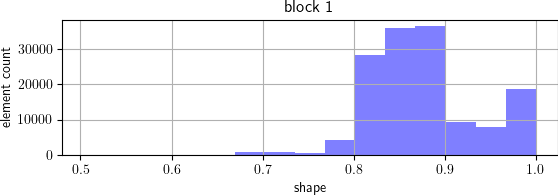


Figure : Histogram of shape element quality in block case.

# 9. Block 2 (duct) summary

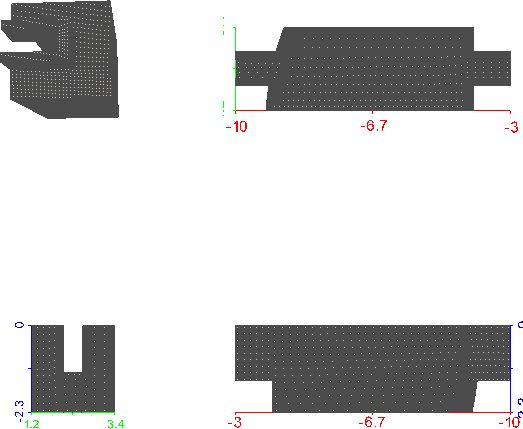


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 2.

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

Table : Properties of block duct.

# 10. Block 2 (duct) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 0.8379 | 0.9732 | 1 | 0.0309 | 0.03175 |
| shape | 0.8821 | 0.9745 | 0.9998 | 0.02051 | 0.02105 |

Table : Element quality statistics of block duct.

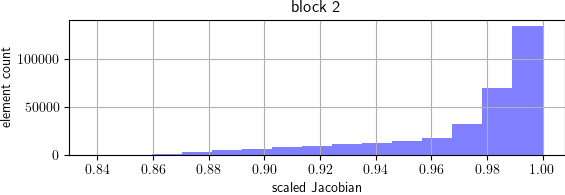


Figure : Histogram of scaled Jacobian element quality in block duct.

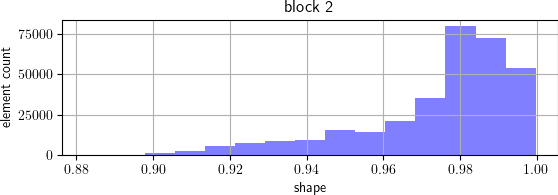


Figure : Histogram of shape element quality in block duct.

# 11. Block 3 (plug) summary

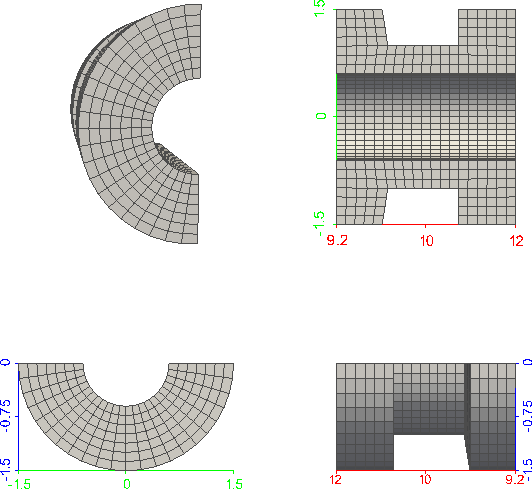


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 3.

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

Table : Properties of block plug.

# 12. Block 3 (plug) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(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 : Element quality statistics of block plug.

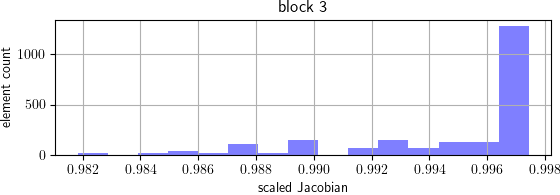


Figure : Histogram of scaled Jacobian element quality in block plug.

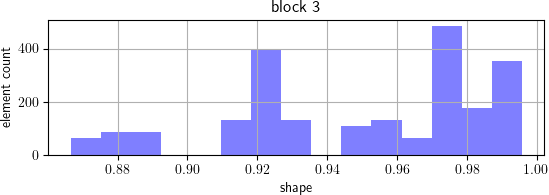


Figure : Histogram of shape element quality in block plug.

# 13. Block 4 (box\_shell) summary

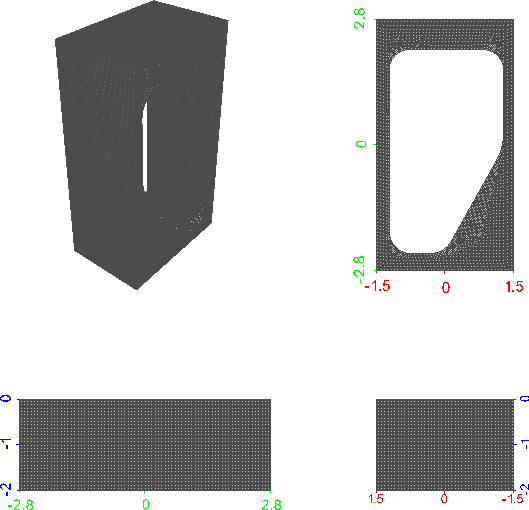


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 4.

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

Table : Properties of block box\_shell.

# 14. Block 4 (box\_shell) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 0.6088 | 0.9951 | 1 | 0.01345 | 0.01352 |
| shape | 0.6524 | 0.9931 | 0.9998 | 0.0164 | 0.01652 |

Table : Element quality statistics of block box\_shell.

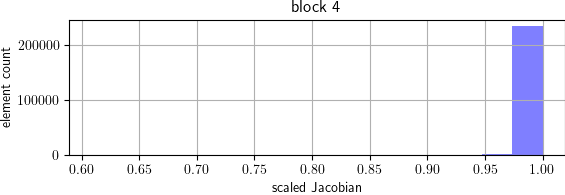


Figure : Histogram of scaled Jacobian element quality in block box\_shell.

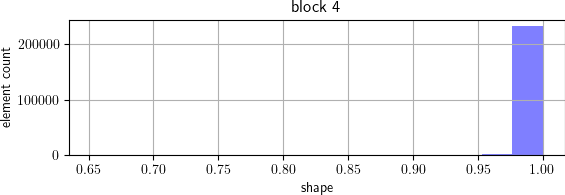


Figure : Histogram of shape element quality in block box\_shell.

# 15. Block 5 (lid) summary

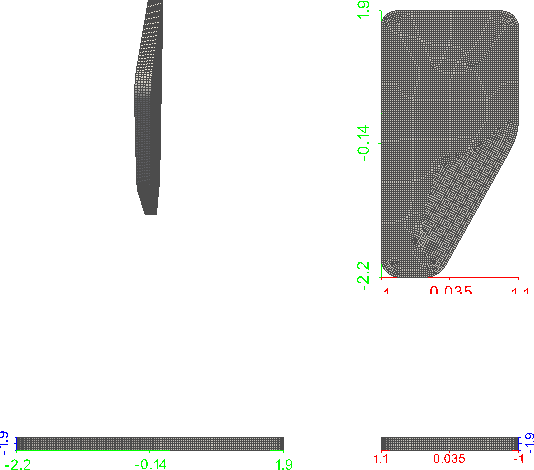


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 5.

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

Table : Properties of block lid.

# 16. Block 5 (lid) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 0.7408 | 0.996 | 1 | 0.02035 | 0.02043 |
| shape | 0.7275 | 0.9933 | 0.9999 | 0.02438 | 0.02455 |

Table : Element quality statistics of block lid.

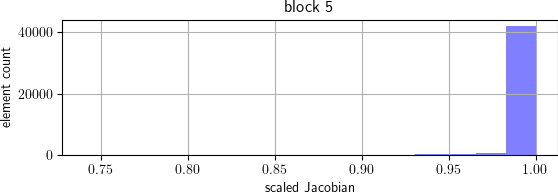


Figure : Histogram of scaled Jacobian element quality in block lid.

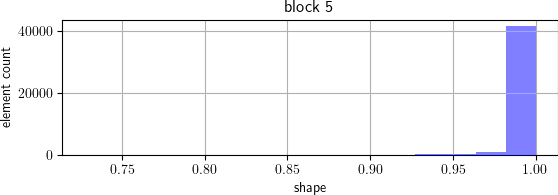


Figure : Histogram of shape element quality in block lid.

# 17. Block 6 (weld) summary

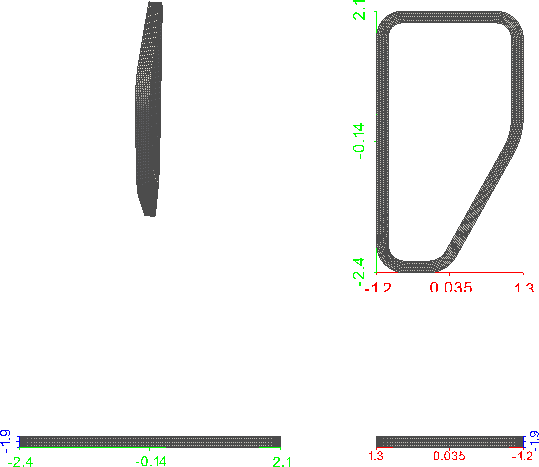


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 6.

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

Table : Properties of block weld.

# 18. Block 6 (weld) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(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 : Element quality statistics of block weld.

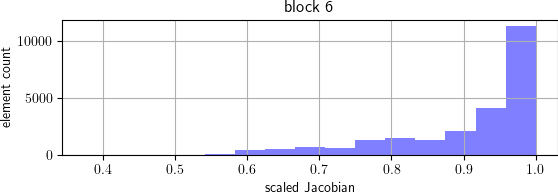


Figure : Histogram of scaled Jacobian element quality in block weld.

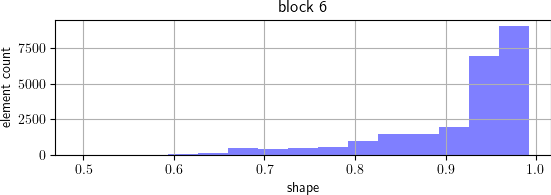


Figure : Histogram of shape element quality in block weld.

# 19. Block 7 (post) summary

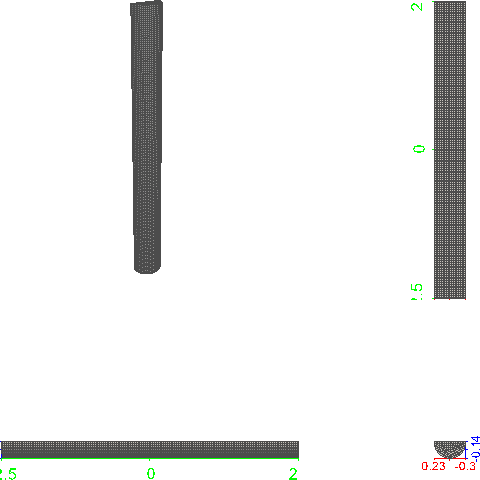


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 7.

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

Table : Properties of block post.

# 20. Block 7 (post) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(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 : Element quality statistics of block post.

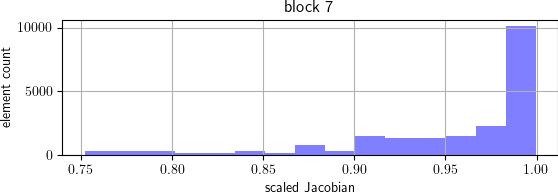


Figure : Histogram of scaled Jacobian element quality in block post.

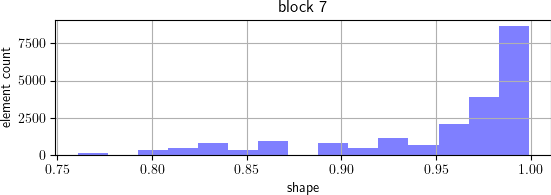


Figure : Histogram of shape element quality in block post.

# 21. Block 8 (target) summary

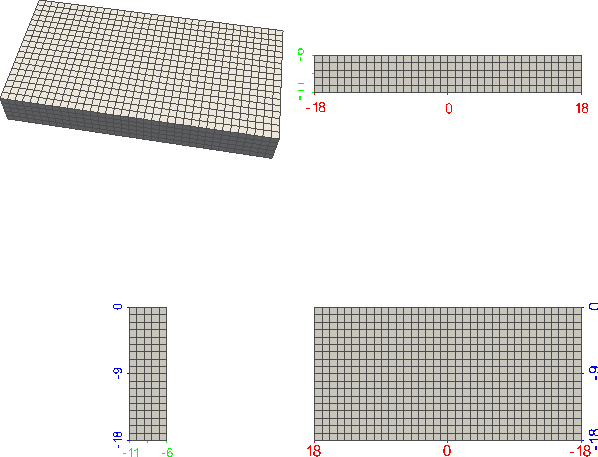


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 8.

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

Table : Properties of block target.

# 22. Block 8 (target) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 1 | 1 | 1 | 0 | 0 |
| shape | 1 | 1 | 1 | 0 | 0 |

Table : 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).

# 23. Block 9 (crusher) summary

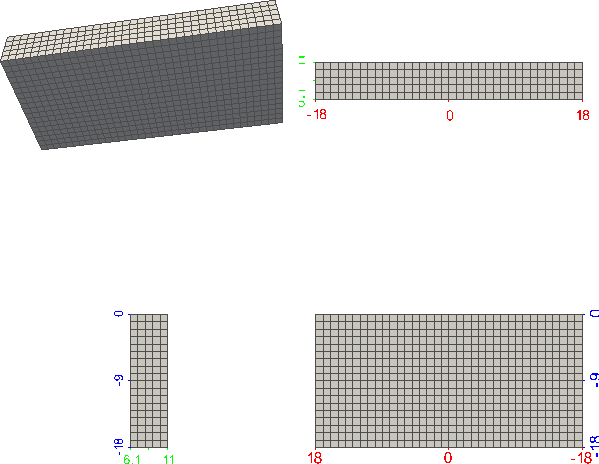


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 9.

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

Table : Properties of block crusher.

# 24. Block 9 (crusher) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 1 | 1 | 1 | 0 | 0 |
| shape | 1 | 1 | 1 | 0 | 0 |

Table : 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).

# 25. Block 10 (foam) summary

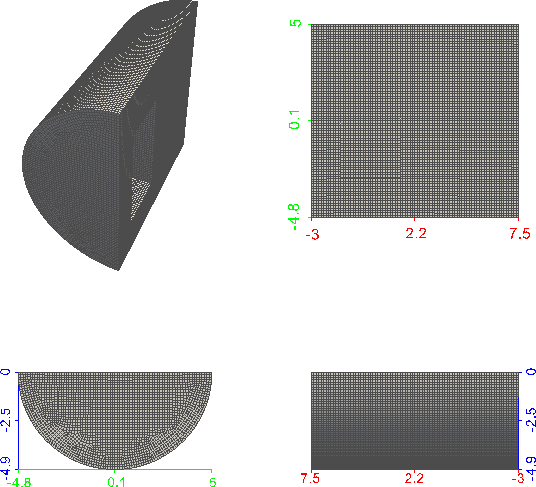


Figure : Perspective (top left) and parallel (top right: XY; bottom left: YZ; bottom right: XZ) rendering of block 10.

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

Table : Properties of block foam.

# 26. Block 10 (foam) element quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Q | min(Q) | μ(Q) | max(Q) | σ(Q) | σ/μ(Q) |
| scaled Jacobian | 0.6998 | 0.9903 | 1 | 0.03133 | 0.03164 |
| shape | 0.7526 | 0.9884 | 1 | 0.03306 | 0.03344 |

Table : Element quality statistics of block foam.

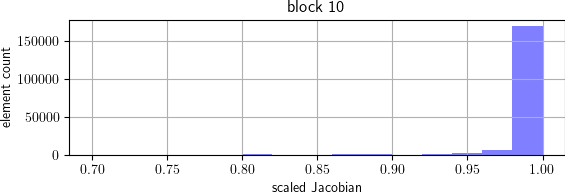


Figure : Histogram of scaled Jacobian element quality in block foam.

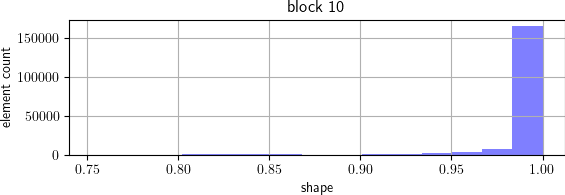


Figure : Histogram of shape element quality in block foam.