Manual for Support Structure Benchmark

This document is an attachment to the following publication:

Bartsch et al. (2020) Benchmark parts for the evaluation of optimized support structures in laser powder bed fusion of metals. 11th CIRP Conference on Photonic Technologies [LANE 2020], September 6-10.

Here, the steps necessary to complete a benchmark of support structures according to the procedure described by the publication above are listed. Additional information and advice is given via bullet points as well as figures.

The files of the benchmark parts are provided at (DOI). Here, you can find the Excel sheet template as well. All data gathered throughout the benchmark can be filled into the Excel sheet to provide a comprehensive overview of the results.

If any problems arise with the benchmark or the files, please contact:

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The authors are not liable for any damage caused by the benchmark procedure.

1 Preprocessing

1.1 Setting the support structures and placing the components on the building platform

- If possible, manufacture all parts within one build job
- Otherwise, avoid the manufacturing of parts not related to the benchmark to eliminate unwanted influences
- Make sure to spread the parts as evenly as possible to avoid them influencing each other
- Position the parts with equal geometry in a way that manufacturing conditions are as similar as possible
- No additional offset for wire eroding is implemented in the STL/step files

1.2 Slicing

2 Manufacturing

- To be able to track differences and possible manufacturing errors, keep the log files
- No heat treatment after manufacturing necessary since performance during manufacturing process is to be evaluated

3 Postprocessing

3.1 Removal from build platform

- Measure the weight of the parts with support structures on

3.2 Remove support structures

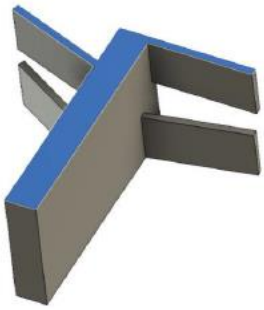
- (manually) detach the support structures, preferably by the same person
- Time the effort for each part separately
- Rate the effort needed for detachment according to scale
- Rate the residuals after removing
- Measure the weight of the parts without support structures

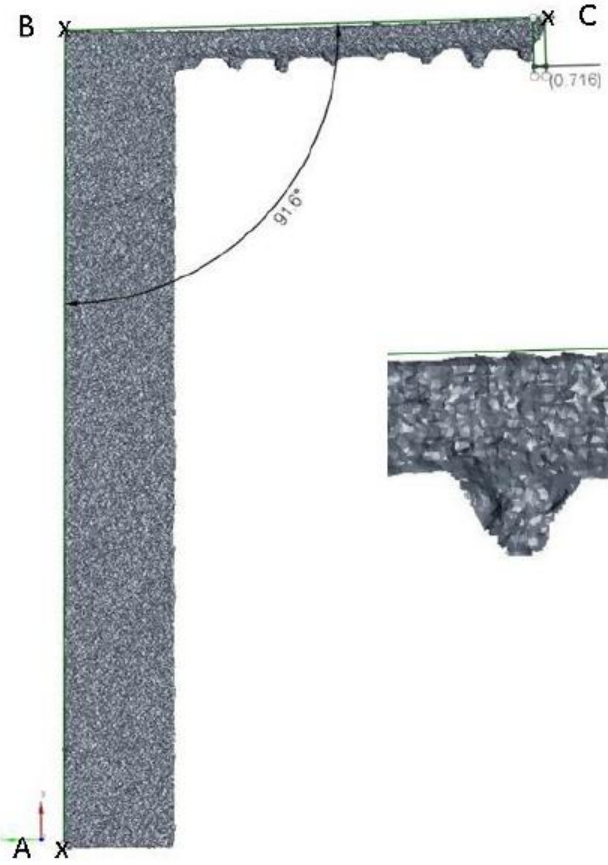
3.3 Visual inspection

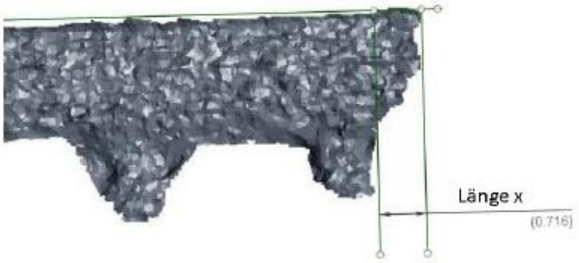
- Check each part for all criteria
- Sample images are given in the Excel sheet

3.4 Determination of distortion

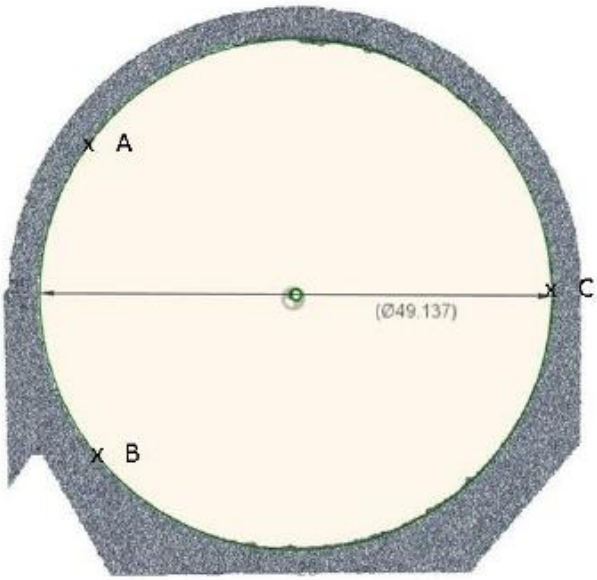
- Coordinate measurement machine or microscope necessary
- Part 1:
    - Measure the upper surface/plane
    - Mark points A, B, and C
    - Connect them with lines
    - Curling is determined by the angle of lines AB and BC
    - Edge accuracy is given by x (take care that this line is parallel to BC)







- Part 3:
    - Only the hole with 50 mm diameter is measured
    - Measure the upper surface/plane
    - Set 3 points on the inner edge to create a circle (whose diameter is measured)
    - Be careful that no sections with residuals are chosen for reference points



- Part 4 & 5:
    - Measure the upper surface/plane
    - Mark points A and B
    - Connect the points with a line
    - Create a parallel line to include the hole side wall
    - Repeat the procedure for the second side wall