Process for aesthetic

Tuning your HP MJF technology to the design

Introduction

To maximize the look and feel of parts when 3D printing, it is important to consider the orientation and positioning of the parts in the build platform as well as the specific print profile and material used. It also is advisable to avoid situations wherein these elements are exposed to excessive or non-homogeneous heat during the printing process.

Optimizing look and feel

Printing profiles and materials

- If available for the intended material, consider using the Cosmetic print profile to maximize part look and feel.
- Consider also using HP 3D HR PA 11 (“HP PA 11”) in Fast or Balanced print profiles as it results in far fewer part quality defects. HP 3D HR PA 12 Glass Beads (“HP PA 12 GB”) also reduces the likelihood of imperfections, but the improvement with respect to HP 3D HR PA 12 (HP PA 12) is less pronounced than with HP PA 11.
- When the focus is on the appearance of the part, do not use Mechanical or non-tuned Balanced print profiles.

Figure 1. Look and feel of two identical parts printed with HP PA 12-Balanced (left) and HP PA 11-Mechanical (right)

Build platform placement and printing process

- Place small features such as pins, holes, and thin walls upside-down on the XY-plane to improve their look, feel, and strength. This also applies to raised texts, which should be printed on the XY-plane for maximum resolution.
- Embossed text, however, results in increased clarity when printed facing upwards.
- It is recommended to avoid upward-facing angles that are smaller than 20° between big, flat areas and the XY-plane.
- Downward-facing surfaces are typically exempt from stair-stepping if they are oriented using angles greater than 5° to 10°.

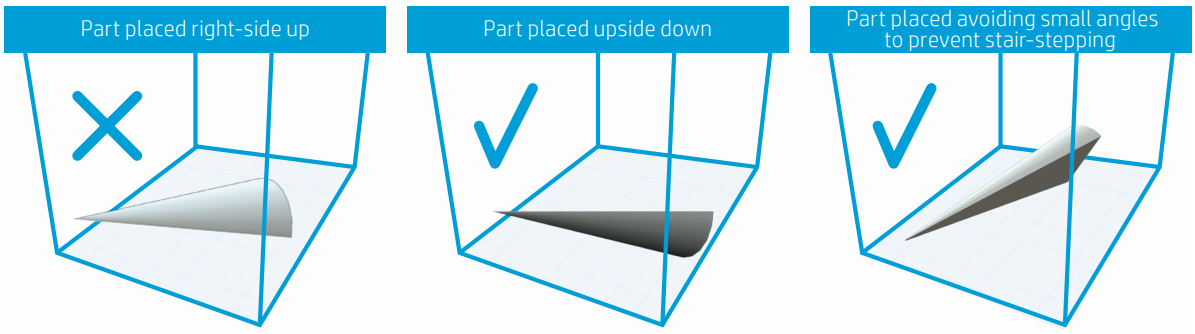


Figure 2. Orientation strategies for parts displaying curved areas to minimize the appearance of excessive layer discretization

- The recommended minimum distance between parts is 5 mm, and the ideal distance between parts and the build volume margins is between 10 mm and 20 mm.
- It is recommended to leave enough space between dense parts, or those with wall thicknesses greater than 15 mm. Normally, this distance separation should be greater than 10 mm.
- Avoid placing dense parts close to the walls of the build chamber as these artifacts mainly affect the last printed layer. Thus, it is recommended to rotate the part so that the top layers have a reduced cross-section, avoiding flat areas as much as possible.
- It is recommended to distribute the parts as homogeneously as possible on the XY-plane to facilitate similar energy absorption across the printing bed.
- Place parts in the bucket to prevent drastic changes in the printed areas per layer in the Z-direction.

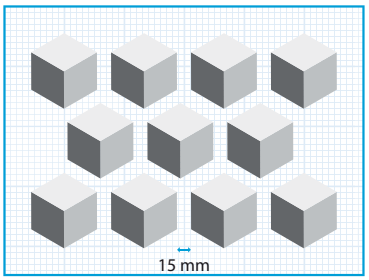


Figure 3. Recommended distance between dense parts

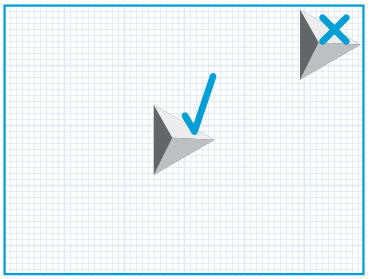


Figure 4. Recommended parts placement

Information regarding the printed area distribution is presented in certain professional software programs, such as Materialise Magics.

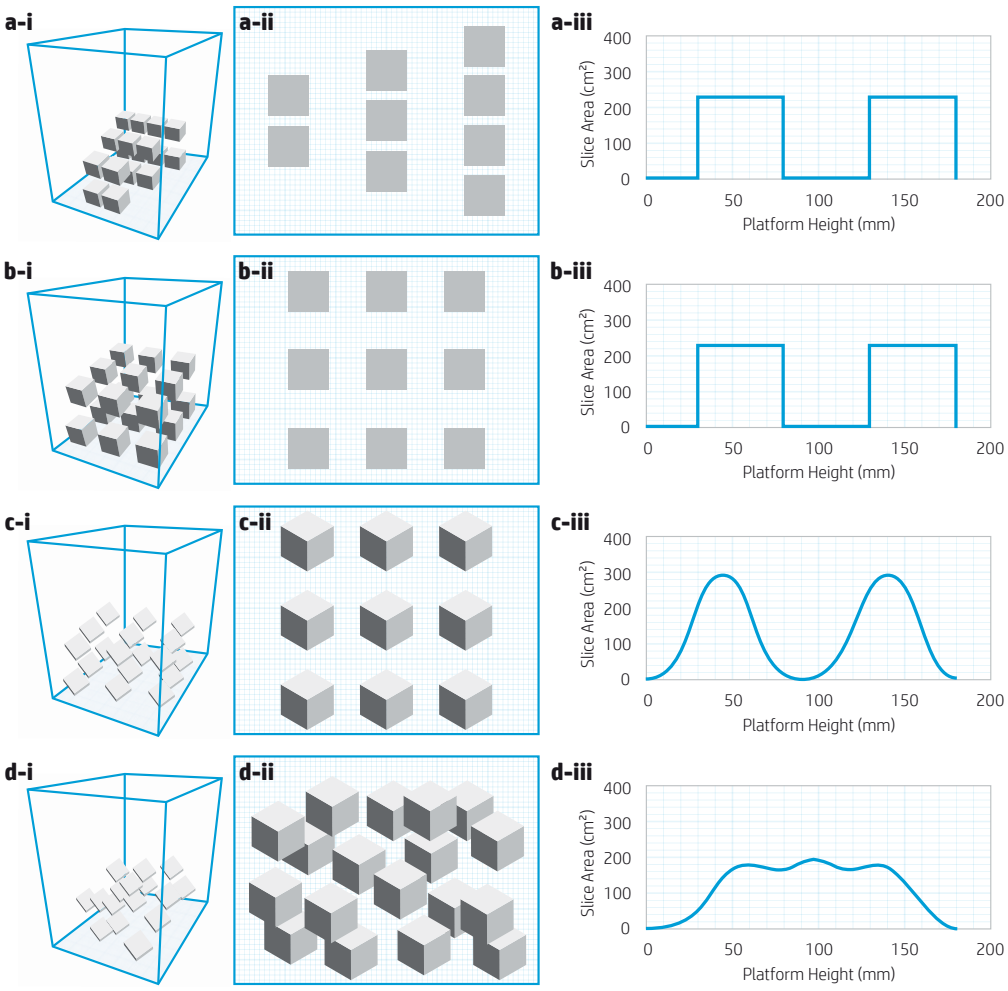


Figure 5. The printed area per layer distribution (right column) is used as an indicator of homogeneity in the Z-direction to prevent major differences in the energy absorption of parts. a) An example of a non-recommended job configuration displaying non-homogeneity in the three dimensions. b) A job that is homogeneous on the XY-plane but with a distinct and potentially problematic gap along the Z-axis. c) The gap along the Z-axis is smoother after rotating the cubes in order to prevent exposing large areas to the last layers to be printed. d) Using automatic packing, the printed area distribution is smoothened even further, minimizing adverse thermal effects. This is a recommended configuration

- Parts prone to displaying sinks or bubbles should be positioned farther away from other parts (approximately >10 mm), especially for objects directly above them (in the Z-direction). Positioning them in the top quarter of the bucket may help to reduce these effects.
- A good compromise between throughput and part quality is a packing density range between 8% and 12%. However, this value can be reassessed depending on application requirements.

The advice provided in this section is summarized in the flowchart (Figure 6), which can be used as a guide to maximize the look and feel of printed parts.

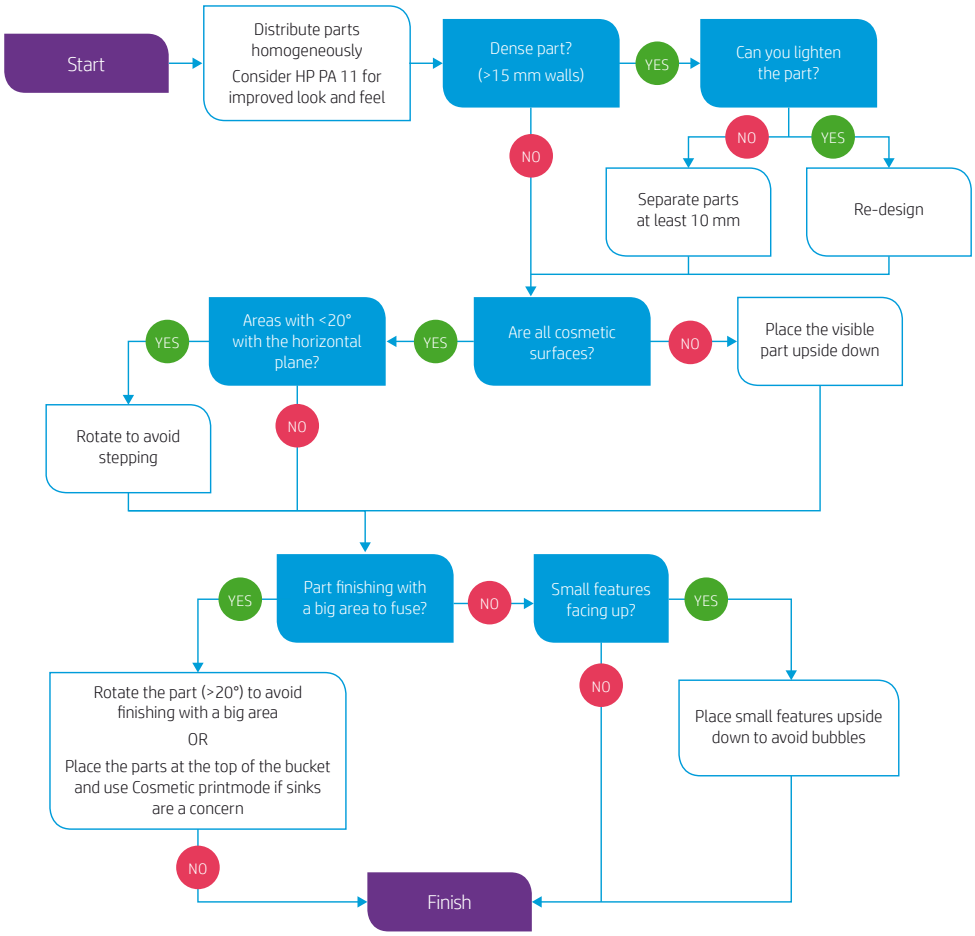
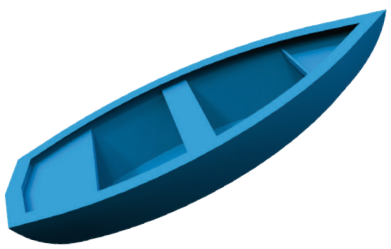


Figure 6. Flowchart for an appropriate process-parameter selection based on the geometry and functionality of a part in order to maximize its look and feel

Aesthetic example

To further illustrate the recommendations provided for cosmetic parts, below is an example involving a toy sailboat:

a



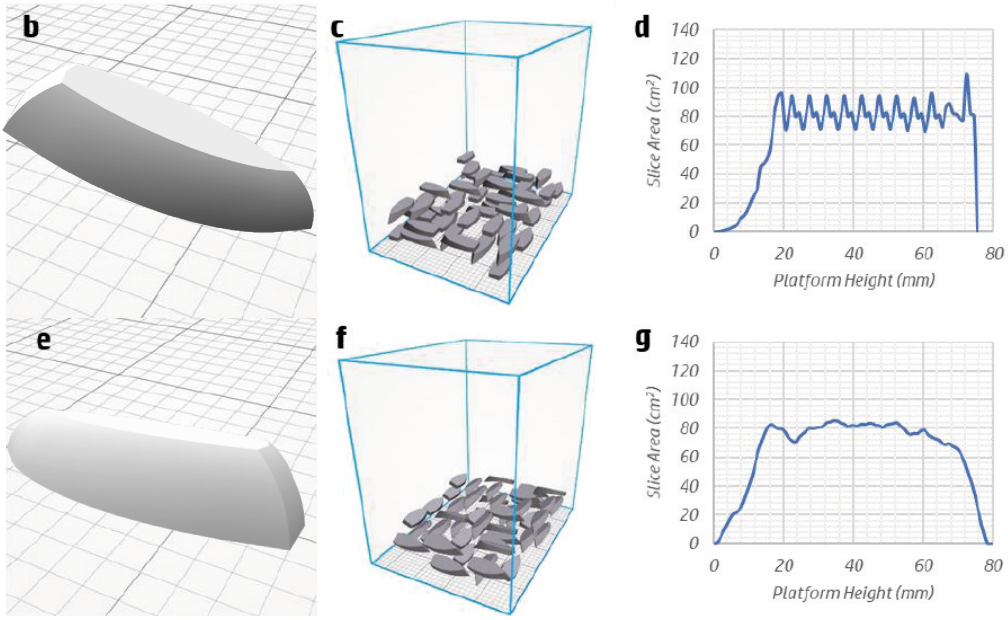


Figure 7. An example of part orientation focusing on maximizing the look and feel of a toy sailboat (a). b-d) Initial orientation stage wherein the part has a large area parallel to the XY-plane, increasing the effect of the artifacts. Fifty parts were placed, allowing rotation around the Z-axis. The area-per-layer distribution fluctuates and ends abruptly. e-g) A boat rotated 25° around its own axis in order to prevent artifacts and excessive layer-stepping. The collective area distribution with 50 boats is smoother than in the previous scenario

Since the most visible area of the object is the inside of the boat, it is clear that the part needs to be placed facing downward to provide a better finish in that section.

A first approach would be to leave it flat, but the printed area distribution of this orientation (especially in the collective case with 50 parts) ends sharply after a maximum peak, which should be avoided in order to minimize surface artifacts such as capillarity, abraded tops, and sinks.

Consequently, the boat should always be angled more than 20° in order to minimize the visibility of the individual layers. This rotation can be performed around a different axis or a combination of them. The rotation axis along the boat's length is chosen to minimize the required Z-dimension printing and smooth the printed area distributed across the many layers.

In terms of the position of the parts in the build chamber, it is best to look for the center of the platform, but there is no significant difference in the result between orienting the parts along the printing axis (X) or re-coating axis (Y). Thus, in the collective scenarios where 50 boats are printed in the same job, rotations around the Z-axis are allowed, which can increase packing density (depending on the geometry of the parts) and, more importantly, helps the required droplets to be shared across the build platform. This homogeneous distribution of the printing load is critical to prevent the over-stress of a small set of dies while leaving others idle for long periods of time.

The orientation advice for this part can be used for HP PA 12, HP PA 12 GB, and HP PA 11. However, since HP PA 11 and HP PA 12 GB typically result in reduced capillarity, a flat orientation could be applied in situations where the accuracy of some features on the XY-plane (like the hole for the sail) are critical or the height of the job is restricted.

Natural Cooling is recommended for all materials, since a faster cooling rate can lead to deviations on the flat areas with respect to their nominal shapes.

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