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INNOVATIVE BUILD ENVELOPE DESIGN TO IMPROVE UNPACKING PROSESS

HP INC

Innovative build envelope design to improve unpacking process

Abstract

Some 3D printing technology works by printing 2D layers of a given thickness one on top of another. For every layer, a uniform layer of powder is placed in the whole printer's build bed, and agents are placed at the specific points which are willing to be melted to form the part. Once the job is finished, it requires several hours to cool down (depending on the job's height), so an external natural cooling unit may be used to allow external cooling, releasing the build unit during the cooling hours. The workflow when using the natural cooling unit consists in transferring the job from the build unit to the natural cooling unit just after the printing, letting the job cool down in the unit during the required hours and doing the unpack directly from the natural cooling unit.

To be able to perform this workflow without having an impact on the part quality metrics of the printed parts, it is necessary to print a build envelope around the parts during the printing process. This envelope is designed with the purpose of reducing to the minimum the movement of the powder and the job parts when doing the extract operation, while also controlling the thermal stability of the printed job. However, during the unpack operation the user needs to break the envelope, so he can properly extract the powder and the parts. To avoid this, we propose a workflow which prints the build envelope's top cover slightly separated from the rest of the envelope, allowing an easier unpack and preserving the part quality.

Problems Solved

When using the external cooling feature the printer needs to print an envelope to control the job temperature and reduce the potential powder movement during the build extraction to the natural cooling unit. However, this adds some complexity to the unpack operation because the user needs to break the build envelope somehow to extract the powder and the parts during the unpack in the processing station. Our solution removes the necessity of breaking the envelope, allowing a more comfortable unpack.

Prior Solutions

There are prior solutions for this problem, but with some drawbacks that our solution overcomes. A first solution consists in printing a closed envelope, but this has the aforementioned problem that the user needs to break the envelope. Other more sophisticate solutions consist in designing the build envelope with a mechanism to open the top cover, while it is still attached to the rest of the envelope. Although this later envelope is easy to open, having the top cover still attached to the rest of the envelope is a trouble while doing the unpack because it may interfere with the aspiration hoses.

Another solution would be to print an envelope without a top cover, but in this situation the job may have some cool down issues that would affect the part quality, which is not acceptable by the users.

Description of the solution

The innovation of this disclosure consists in the design modification of the build envelope printed during the printing process of the job. Up until now, this envelope was formed by 6 edge-connected grid walls (see **Figure 1**, on the left side). However, the user had to break the connections between the top cover grid and the lateral ones to be able to remove the top cover and start the unpack process. To overcome this limitation, we propose to leave a minimum space between the top cover and the lateral walls, in a way that the envelope is divided in 2 different parts during the printing. This modification allows the user to remove the top cover just at the beginning of the unpack easily, without requiring breaking anything, while preserving all the part quality thanks to the thermal stability that the printer provides when printing a top cover.

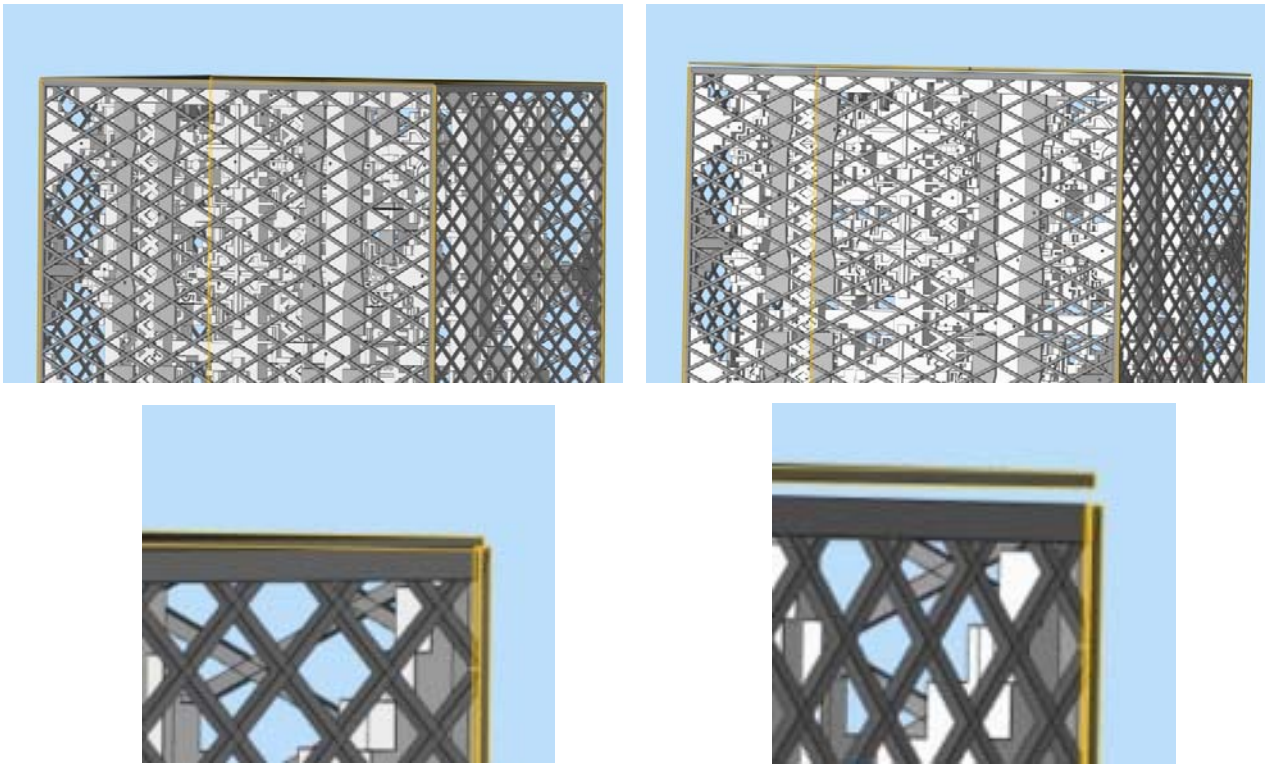

Figure 1: On the left, the old build envelope for the external cooling. On the right, the new build envelope design with the separation of the top cover.

The separation between the top cover and the side walls can be adjusted and varies depending on the configured material, because each material may require a different powder layer thickness and a different minimum separation between parts to deliver the best part quality.

With the new separation of the top cover, one could think about removing the top cover of the design. However, it is important to keep it to have a better thermal control for the printer parts. The top cover with the grid pattern allows a gradual, stabilized and uniform heat evacuation. And this controlled cool down of the material is also required to avoid dimensional distortions in the printed parts due to material shrinkage.

This new procedure will improve the satisfaction of the customers and reduces the time and effort needed for doing the unpack. We have tested and evaluated this new solution, which was unanimously evaluated as an improvement with respect to the previous build envelope design, from the user experience and the part quality points of the view.

Advantages

The proposed solution has some advantages:

- The separate build envelope top cover eases the access to the powder and the parts when doing the extract from the natural cooling unit.
- The proposed design changes keep the thermal control of the printed parts during the cool down of the material.
- The proposed solution is easily detectable since it is manifested in a certain physically printed build envelope.

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