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Hot Pockets

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Title: Hot pockets

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Abstract: This publication relates a method of additive manufacturing 3D objects using thermoplastic materials. When depositing a layer of an 3D object, some traces within that layer are printed using an increased temperature to improve the strength of the object. The printing temperature may only be increased for those parts that are enclosed by those parts that are printed using regular (i.e. lower) temperatures.

When printing with an FFF (Fused Filament Fabrication) device, “tic-tac” shaped traces are produced. When these traces are packed together, small voids are formed, see Figure 1. These voids form weak spots in the 3D printed object and limit the strength of the object as a whole.

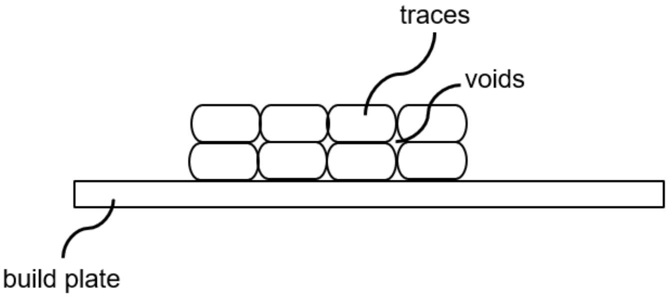

Fig. 1 cross section of printed layers showing voids

It is well known that layer adhesion is greatly affected by the printing temperature. As a rule of thumb, the higher the printing temperature, the better the layers adhere together, in all directions. However, higher printing temperatures also result in poor accuracy; warm material has a lower viscosity, making it go to places where you don’t want it to go. As such it’s a balancing act to use the right temperature. This is especially important when printing the walls of the objects. At present, all wall lines are printed at the exact same temperature.

In this publication, we propose to use different print temperatures within the same layer, wherein certain wall lines in a 3D object are purposefully overheated (printed at a much higher temperature) to increase adhesion and reduce the voids mentioned above.

We came up with the following strategies:

Strategy 1. Print the outer walls at the normal temperature and overheat all the inner walls. This will make the inner walls droop more, but since this is on the inside of the print, it’s expected to not matter as much, as the outer wall is most defining for the accuracy. Figure 2 shows a top view of a layer of a rectangular shaped object with inner walls (see red lines) printed with an increased temperature.

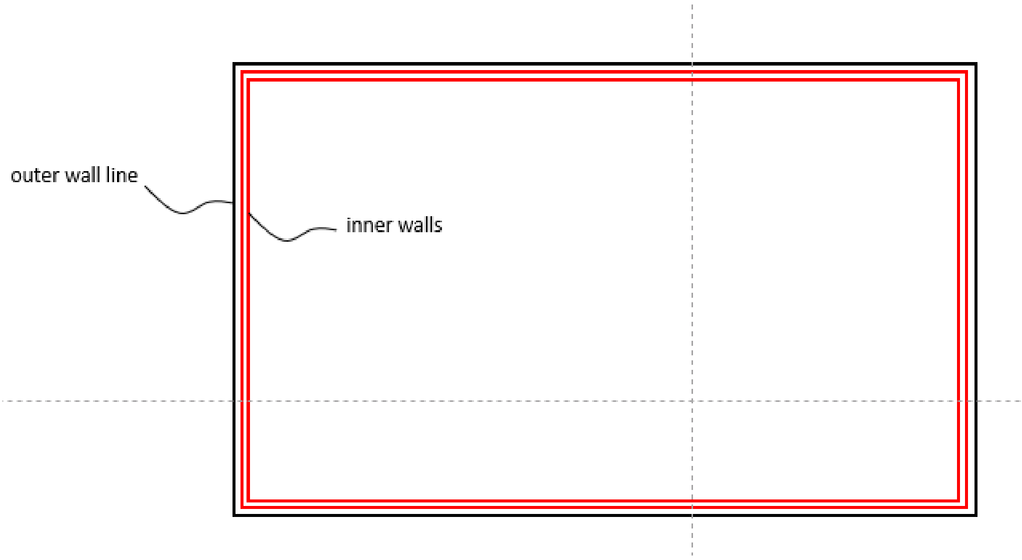

Fig. 2 Top view of a layer of a rectangular shaped object acc. to strategy 1

Strategy 2. Print the outer wall at the normal temperature and print the innermost inner wall at normal temperature. Make sure that these are printed first. The walls that fill the area between these two walls can be overheated, see red lines in Figure 3. Since the material is “caught” on all sides by walls, the lower viscosity should not have a negative impact (e.g.; It’s a bit akin to casting in a mould)

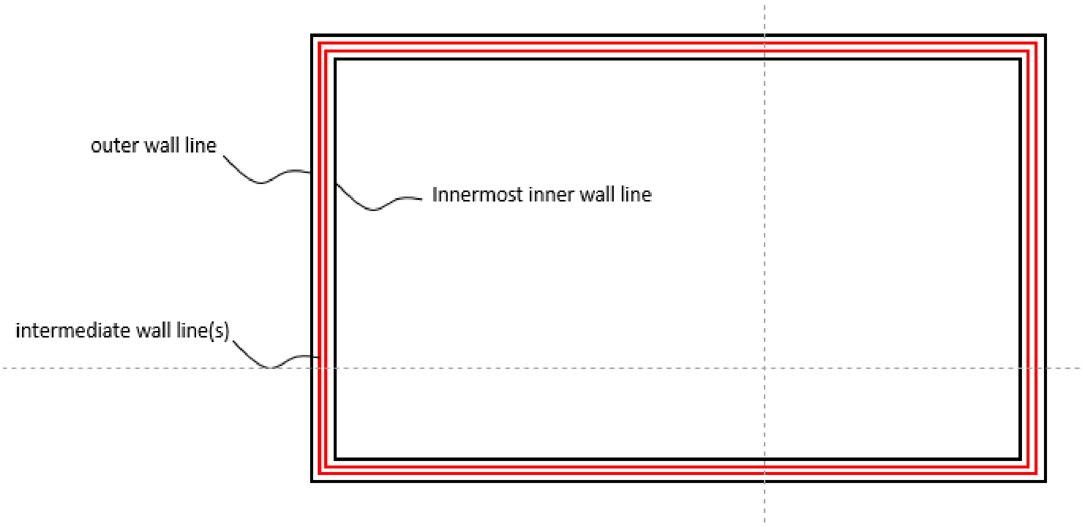

Fig. 3 Top view of a layer of a rectangular shaped object acc. to strategy 2

Strategy 3. Overheating the infill; Since the infill is always caught on all sides by material, the accuracy isn’t much of a factor. Figure 4 and 5 shown two examples of a layer of a printed object wherein the infill (see red lines) is printed using an increased temperature to decrease the viscosity of the print material.

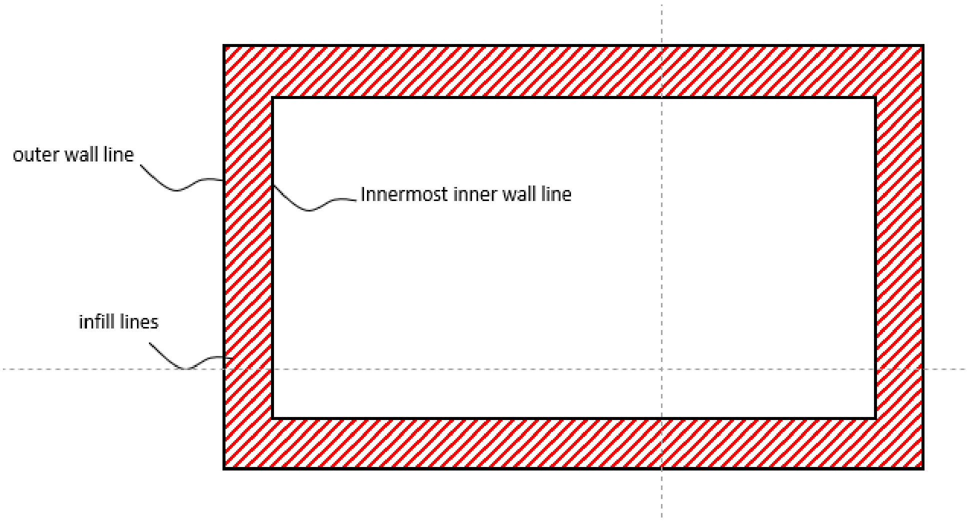

Fig. 4 Top view of a layer of an object acc. to strategy 3

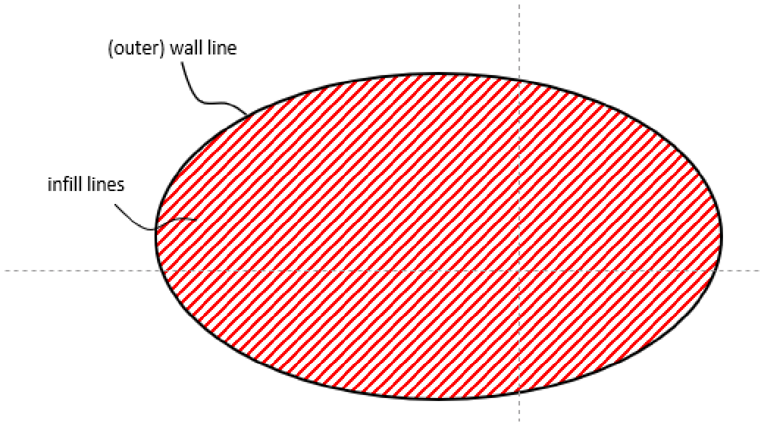

Fig. 5 Top view of a layer of another object acc. to strategy 3