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# Build Plate Clamping Mechanism for Additive Manufacturing Apparatus

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**Title: Build plate clamping mechanism for additive manufacturing apparatus**

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Abstract: A new clamp is described for clamping of build plates onto a build plate carrier of an additive manufacturing apparatus. The build plate clamp comprises a clamp body and a flexible member.

There are multiple principles currently used for clamping of build plates of 3D printers. Solutions vary from magnets, vacuum, thumbscrews to spring clamps or clips. Despite the fact the below explained solution can be used on both non-heated as well as heated build plates, its main focus are heated build plates. These can be heated in case of Ultimaker S5 up to 150°C. This poses a challenge of materials that could withstand these conditions without thermal creep. The current solution is to use spring steel build plate clips. These do not offer a good user experience since they can have sharp corners and their thickness can't be increased with the current design. This means user doesn't have a confident grip when operating said build plate clips. In case of polymers that would be able to withstand these temperatures without thermal creep or degradation, we are talking about PEI (Ultem), PEKK, PEEK and similar expensive plastics (For example widely used PTFE has a glass transition temperature of only around 115 °C).

We propose a novel solution that solves this problem and on top of that allows for clamping of build plates with slightly different thickness. For Ultimaker printers this is designed to accommodate range of build plate thickness between 4 and 6 mm. As can be seen in Fig. 1, the build plate clamp consists of two main components. Clamp body (1) can be made of any suitable material including polymers, while flexible member (2) can be made of e.g. spring steel, phosphor bronze, high-temp polymer or composite. Note that due to high design freedom, clamp body (1) may have any additional feature(s) to optimize the usability (e.g. lip to hold the clamp securely while operating).

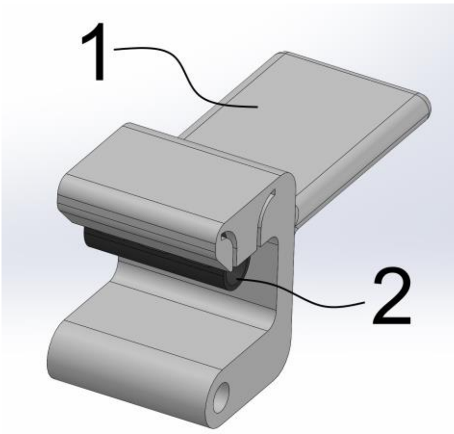


Fig. 1 – Build plate clamp. Clamp body (1), Flexible member (2)

The proposed shape of the flexible member can be seen in Fig. 2, where we also show an example of a version with additional features (e.g. cutouts) to limit thermal conductivity of said member.

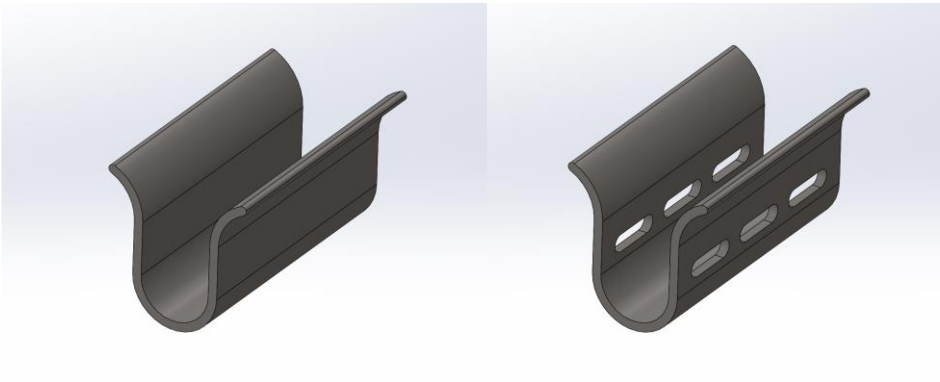

Fig. 2 – Flexible member without (left) and with (right) additional cutouts

The shape of the member (2) is designed as such, that the radii on the top are roughly equal to the radii of the cutout tracks in clamp body (1). The clamping force and vertical translational travel of the member (2) can be tuned by design. See Fig. 3 for explanation of how the flexible member travels inside the clamp's tracks. The behavior can be tuned by the flexible members dimensions (e.g. thickness or radii) and tracks' dimensions.

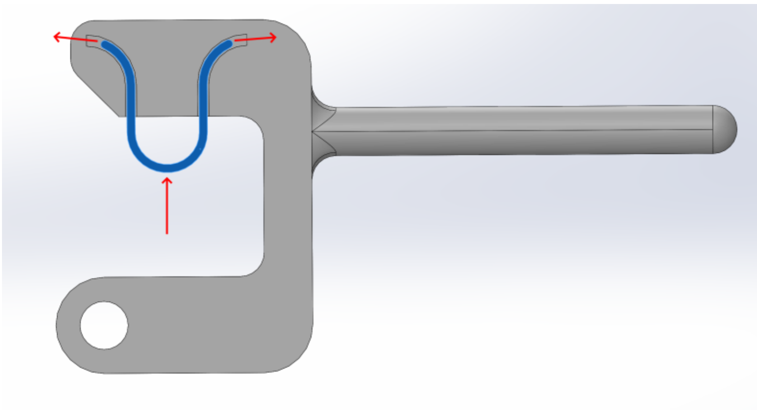

Fig. 3 – Travel of the flexible member inside the clamp body.

Fig. 4 shows the overview of the application of the clamping mechanism. Build plate (3) is placed on top of a build plate carrier (4) and clamped down by the clamping components (1,2).

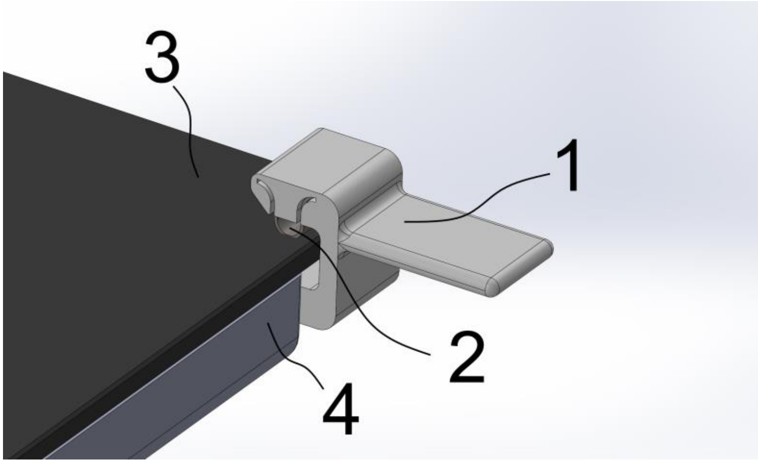


Fig. 4 – Overview of the clamping mechanism. Clamp body(1), Flexible member (2), Build plate (3), Build plate carrier (4)

Fig. 5 – Mechanism engaged (top) and disengaged (bottom)

It is noted that the radii on the flexible member can also be bend inwards as can be seen in Fig. 6. The underlying working of the mechanism is the same.

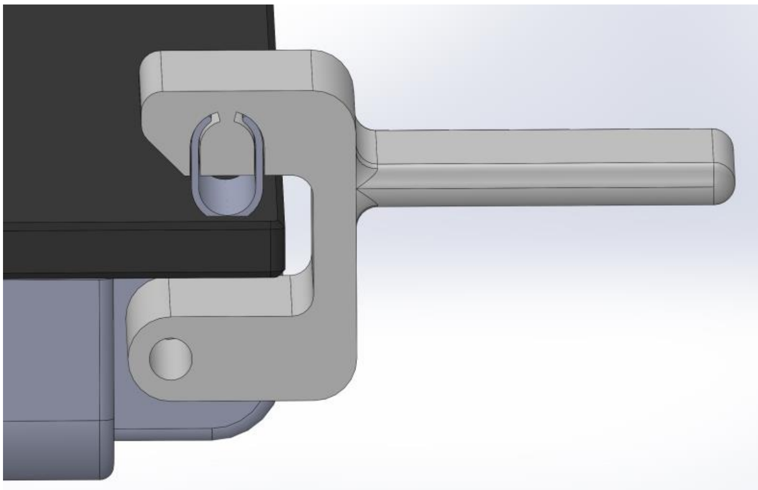

Fig. 6 – Inward-bent radii option

Fig. 7 – Inward-bent radii flexible member

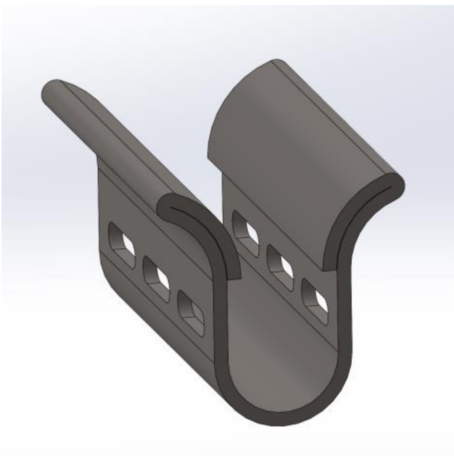

Fig. 8 – Hem on a flexible member

**Additional remarks:**

1. The clamp body (1) may consist of multiple individual components to allow for easier manufacturing, assembly or providing different means of locking of flexible member (2) than pictured in this document.
2. Kinematics of the clamp motion may be designed such that the clamp works as a bistable mechanism (Stay put when closed)
3. If the flexible member (2) is made of ductile material and the edge condition after manufacturing would be causing too much friction or even scraping of the internal tracks in clamp body (1) a hem as can be seen in Fig. 8 may be used.
4. Potentially a hybrid solution consisting of one radius bent outwards and one radius inwards may be proposed as the principle of working is the same.