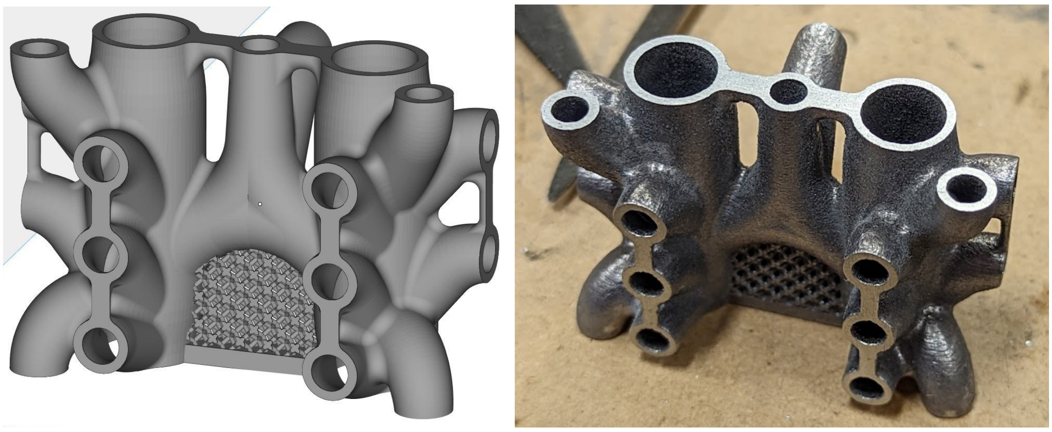
707 Assignment 2 Report



AM Manifold Prototype 1, model and part

Introduction

The completion of this project entailed producing a modified version of a given manifold, incorporating DfAM principles to add value to the final product when compared to traditional manufacturing processes. This involved modifying the part geometry in order to satisfy several criteria, such as optimising fluid flow, minimising solid part volume, ensuring printability, and adding extra features, such as labelling and tapped holes.

CAD for Flow Optimization

The core geometry of the manifold was designed to incur minimal pressure losses as the flow travelled from inlet to outlet, while maintaining all of the inlet and outlet locations from the original geometry. This was carried out in Siemens NX and mainly involved using a set of splines and lofts (with scaling laws) in order to achieve “organic” geometry shapes with as few hard corners and abrupt flow direction changes as possible.

Material Minimization

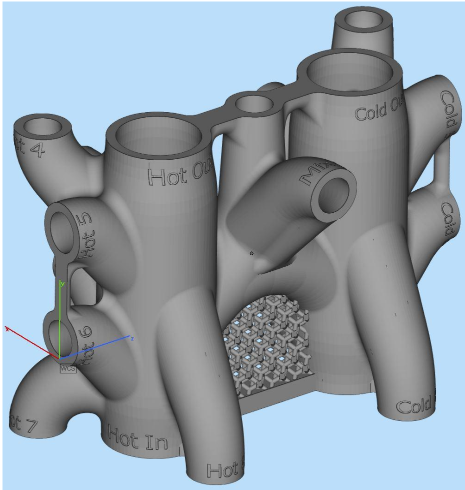
As cost scales directly with part material volume for additive technologies, effort was taken to remove as much material as reasonably possible. To achieve this, the core geometry was shelled to the required thickness of 1mm to ensure that only as much material was used as strictly needed. However, some small sections of material were added back in to increase part strength and stiffness, as well as making the part largely self supporting. The most obvious of these are the bridges connecting the different inlets and outlets.

Design for Printability

In order to make the part as self supporting as possible, horizontal outlets were angled at 45 degrees or steeper to avoid the need for support. Additionally, small supporting structures were added in necessary locations, the largest of which was done using a lattice structure (fluorite cell type). Additionally, a few structures were “bridged” together in order to prevent any “floating” components on the first few layers of the print, where different sections of the part would be entirely disconnected.

Detailing

Due in large part to client feedback following the initial prototype, labels were added to each of the inlets and outlets as a value adding feature of the final part. As this part is manufactured additively, debossing labels adds virtually no manufacturing cost. Additionally, the last few millimetres of each inlet and outlet were undersized slightly to allow for thread tapping; threads were not designed into the model itself, as additively manufactured threads tend to be much coarser and less accurate than manually tapped threads.



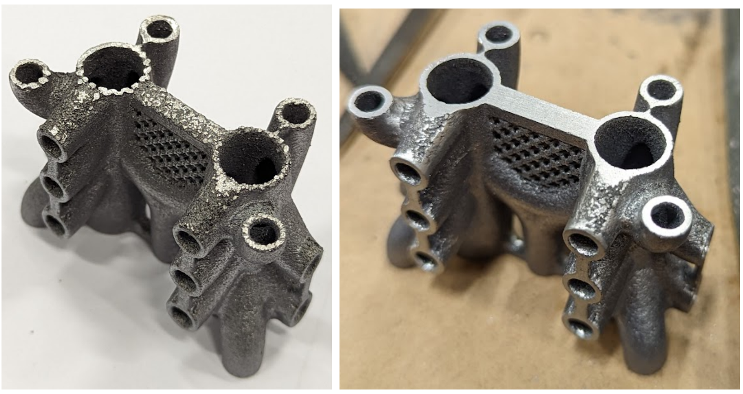
Model with inlet/outlet labels

Costing Analysis

According to the i-materialise quote generator, the additive manufacturing process for this part will cost approximately 220 NZD, however the Shapeways quote generator only gave an estimate of 165 NZD. Assuming 10-20 hours of design time and 1 hour of post processing at $50/hour, a reasonable cost estimate for 1 manifold is around 1000 NZD.

Post Processing

This part was designed to involve minimal post processing; the structure of the manifold was designed such that it is entirely self supporting and requires no removable support material. However, the part still requires removal from the bed and sanding and/or polishing to improve the surface finish, as well as tapping all inlets and outlets. In practice this took only about 45 minutes, though this prototype was not bead blasted or tapped. In a final version, this could also include surfacing off the critical faces with an end mill.



The prototype before and after post processing.