

The feasibility of a piecewise-linear dynamic bowtie filter: Wedge and frame design

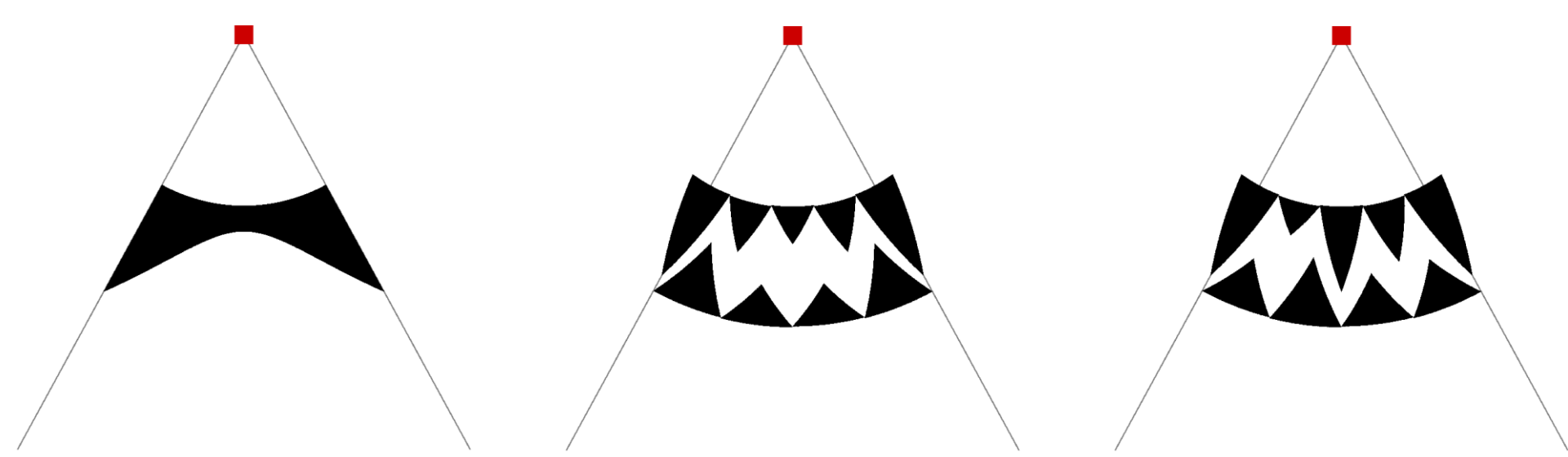
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Abstract

Since most CT scanners used for clinical purposes are not dedicated to the scanning of a specific organ, many utilize different "bowtie" filters to deliver varying amounts of radiations to patients. Traditional bowtie filters are designed for the average patient and are produce fixed attenuation profiles. The issue with this is that the filters cannot be personalized. This work proposes a solution: a design for a dynamically morphing bowtie filter that can attenuate radiation with a piecewise-linear profile. More specifically, this work focuses on the mechanical design of a prototype dynamic bowtie assembly.

Initial Specifications

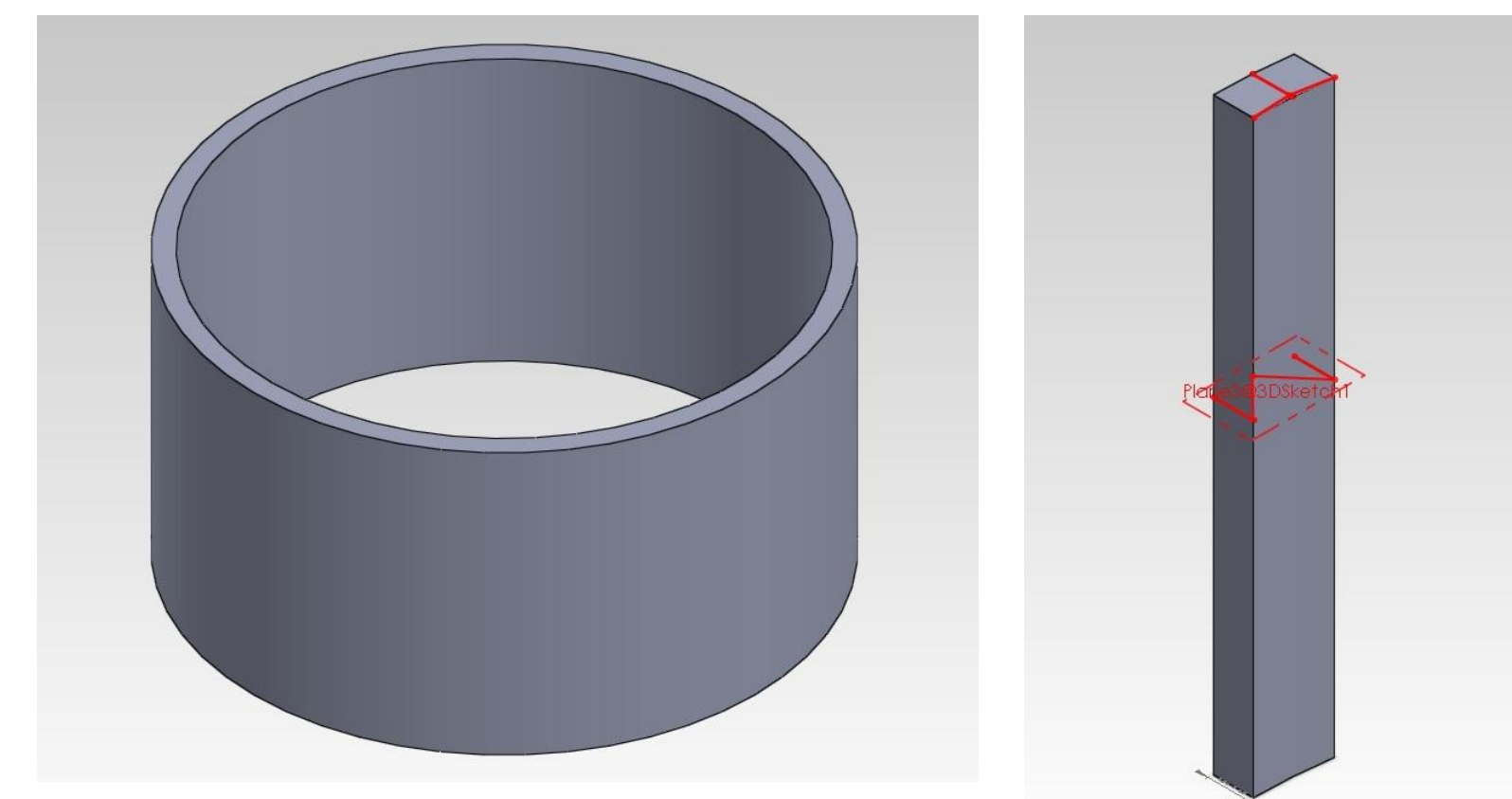


From the left: traditional bowtie filter, dynamic bowtie filter with configuration resembling traditional, dynamic bowtie with unique configuration [1]

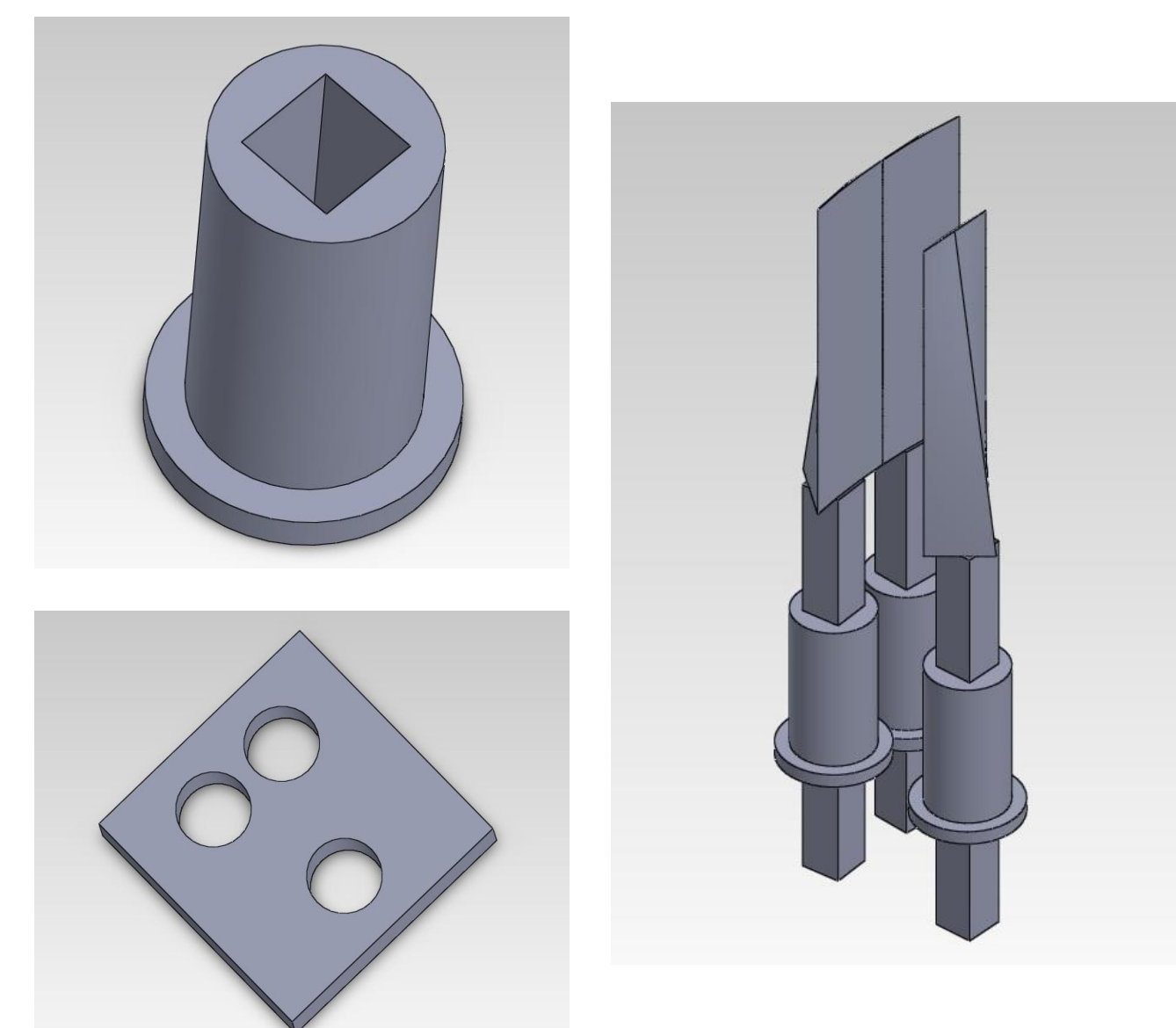
Source-bowtie distance	80 mm
Number of triangular wedges	15
Width of each triangle	11.4 mm
Material	Iron
Maximum attenuation	99.7%
Maximum depth of wedge	6.1mm
Axial height extent of wedge	40mm
Actuator speed	25 cm/sec

Wedge and system specifications [1]

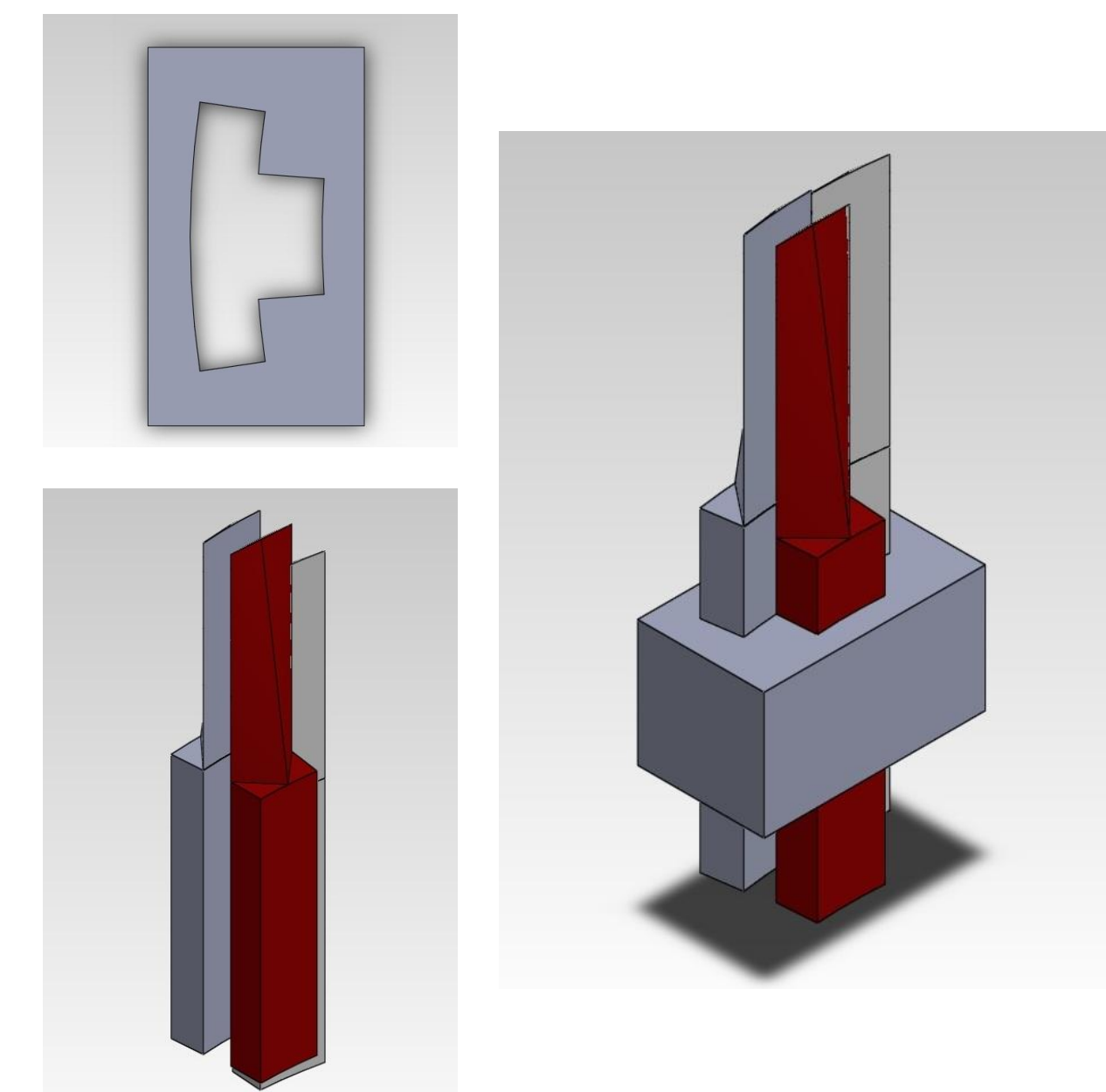
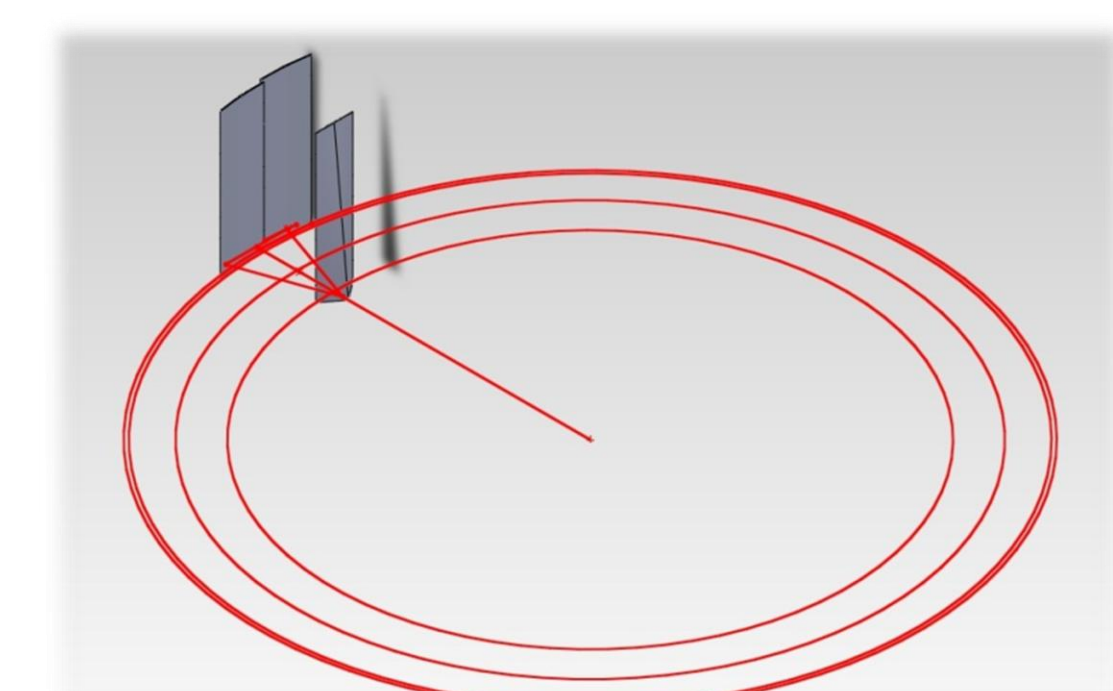
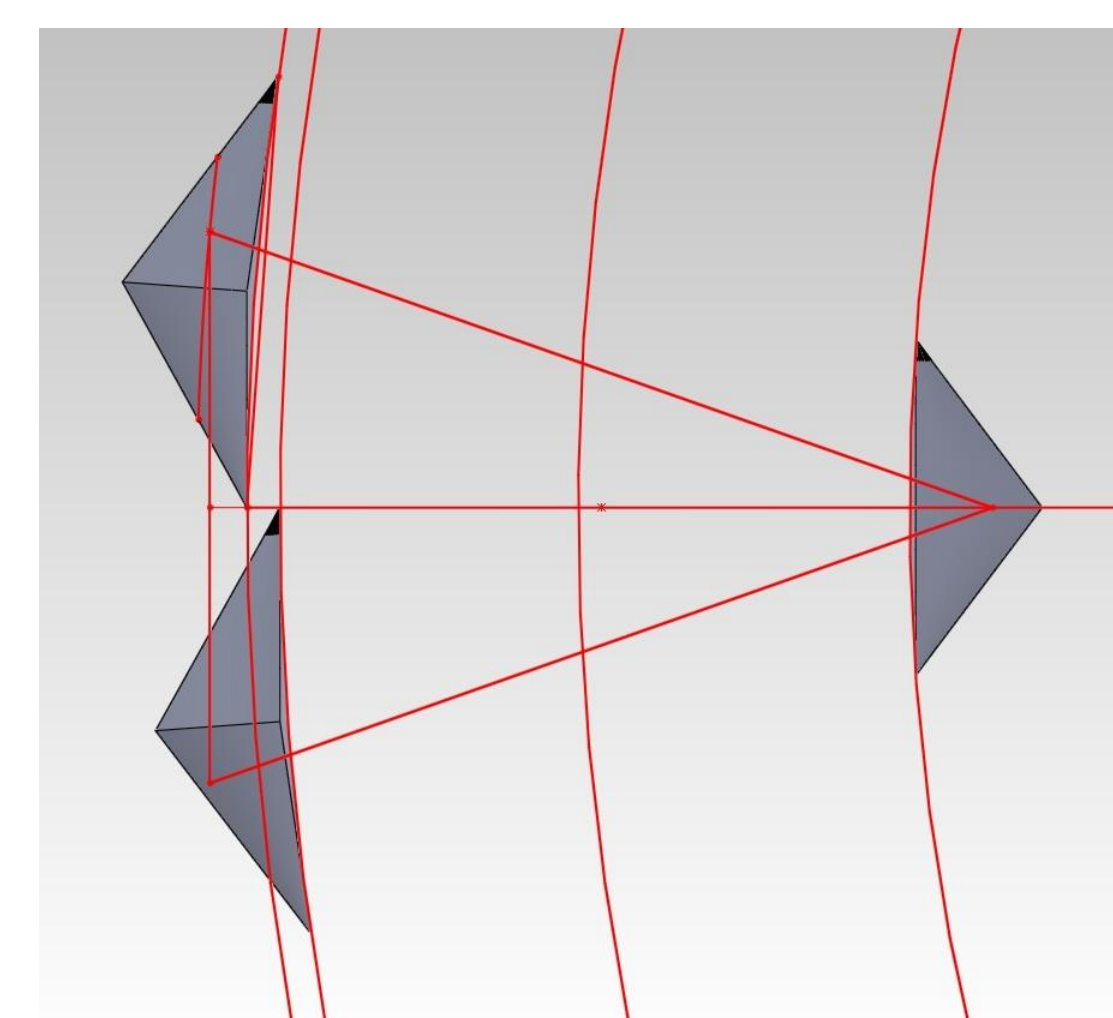
Design Process



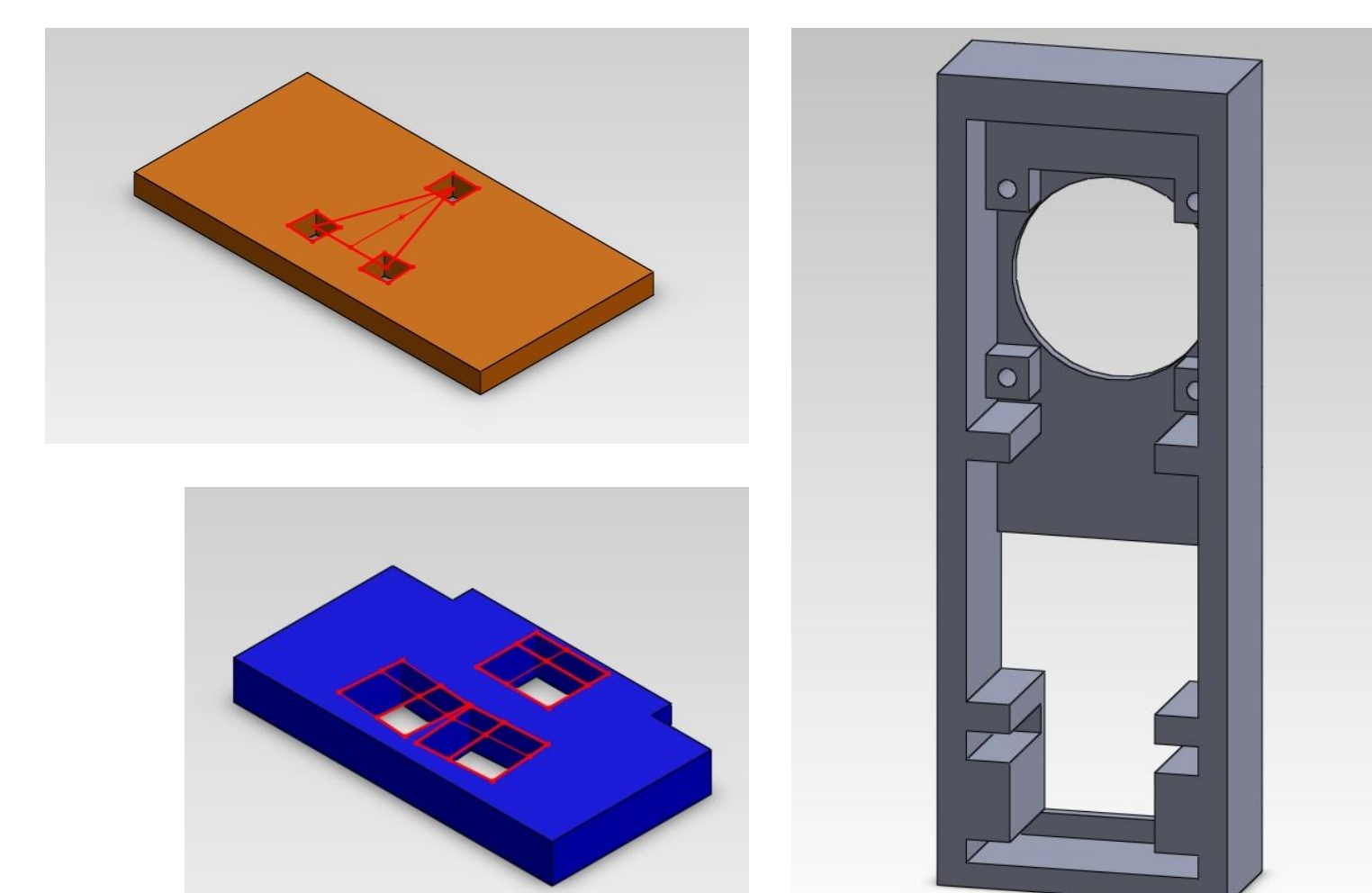
Iteration 1: Different wedge approaches



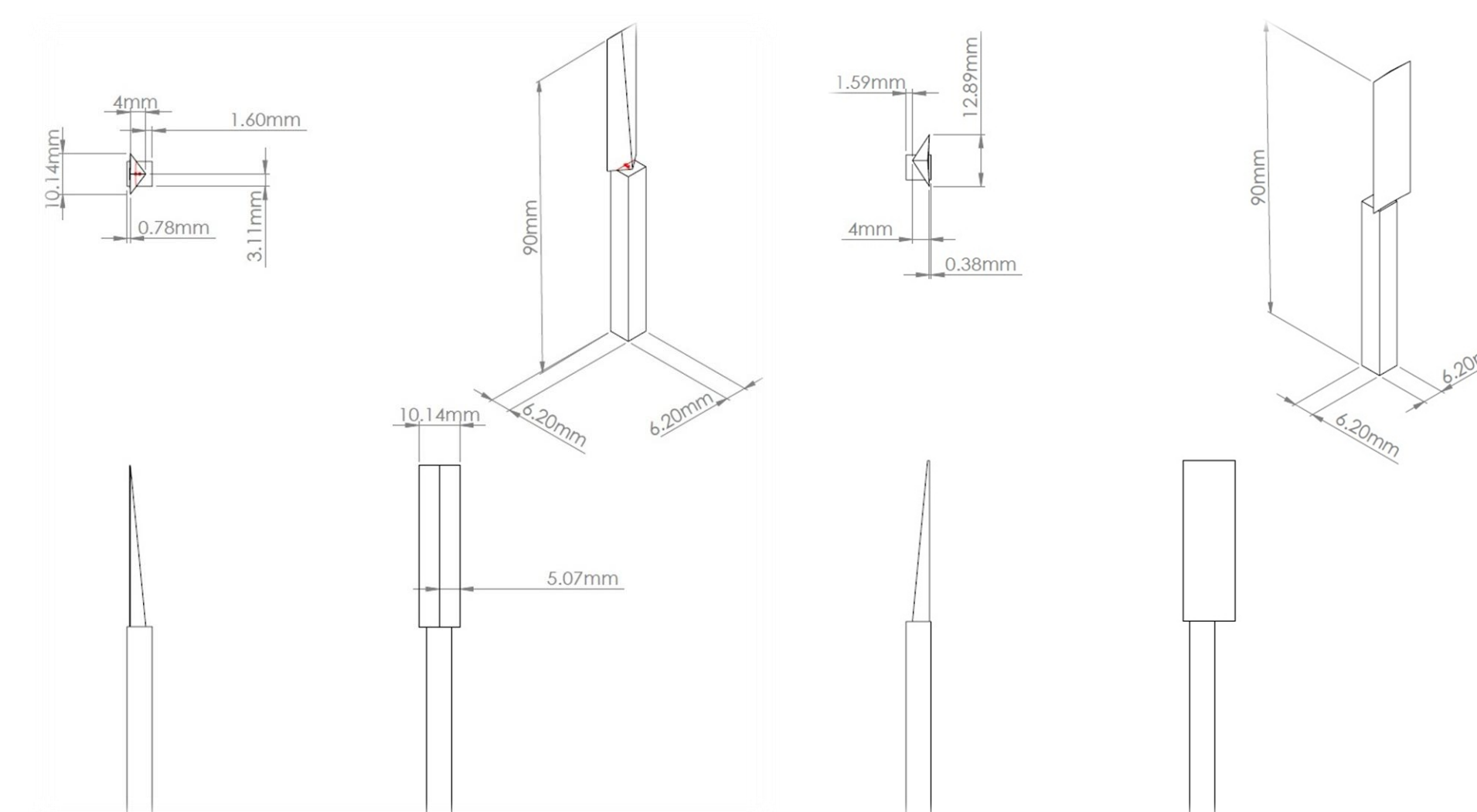
Iteration 3: Bushing approach



Iteration 2: Wedge holder and assembly

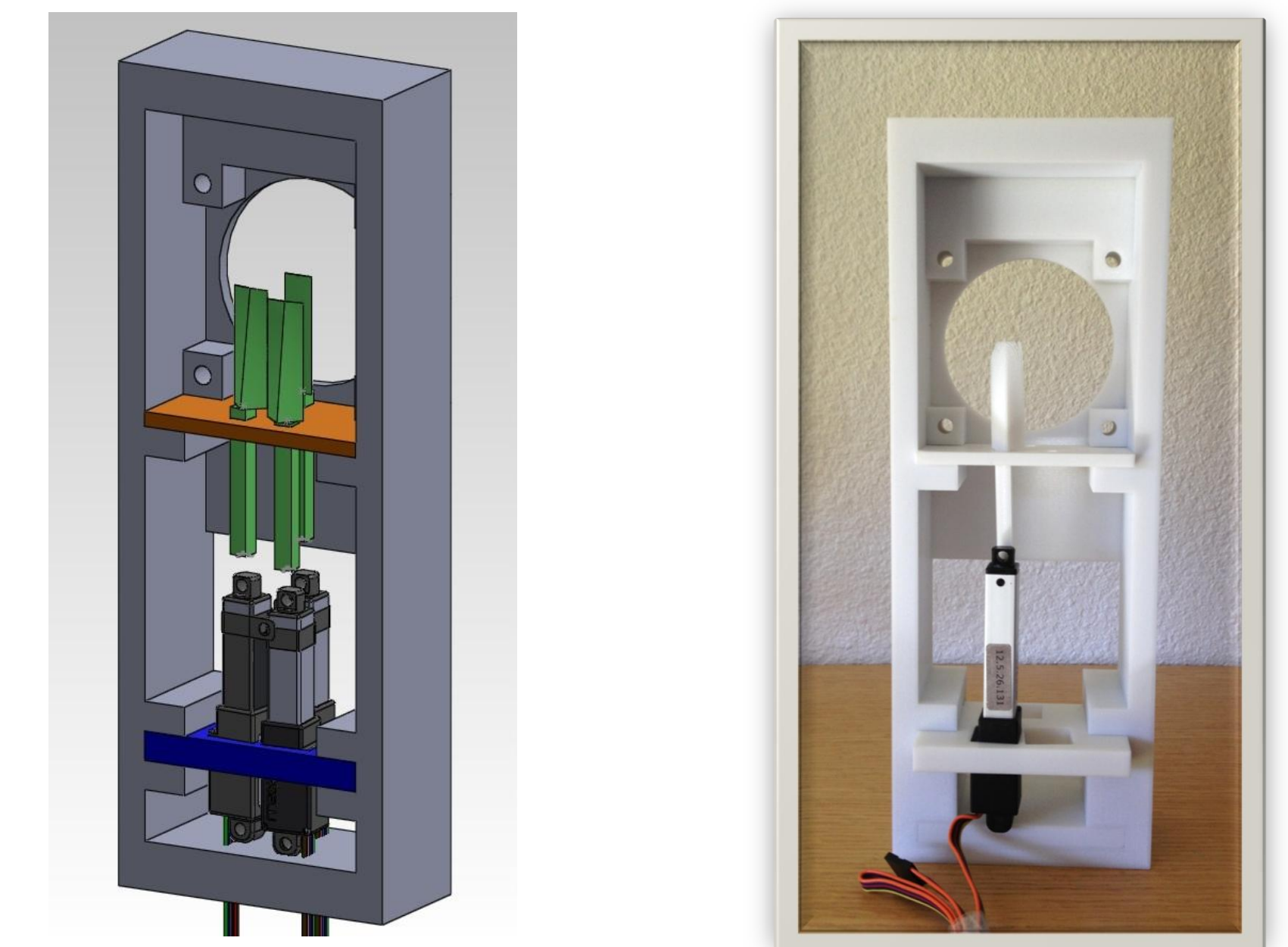


Iteration 4: Frame with removable holders

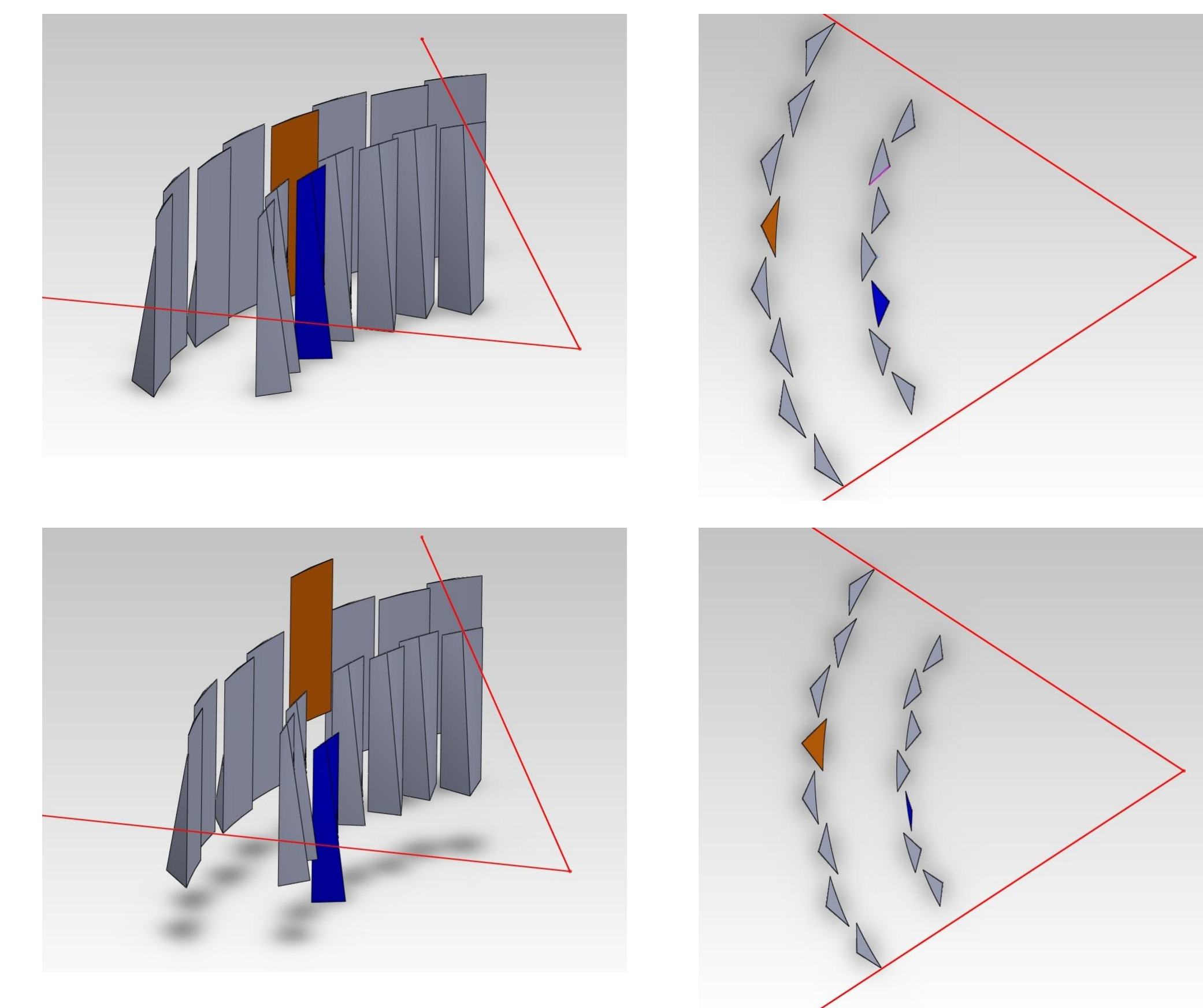


Iteration 5: Offset and unique wedges

Final Product



Future Directions



Fifteen wedge assembly: shifted and un-shifted

References

Hsieh SS, Pelc NJ. "The feasibility of a piecewise-linear dynamic bowtie filter". (Under internal review)