

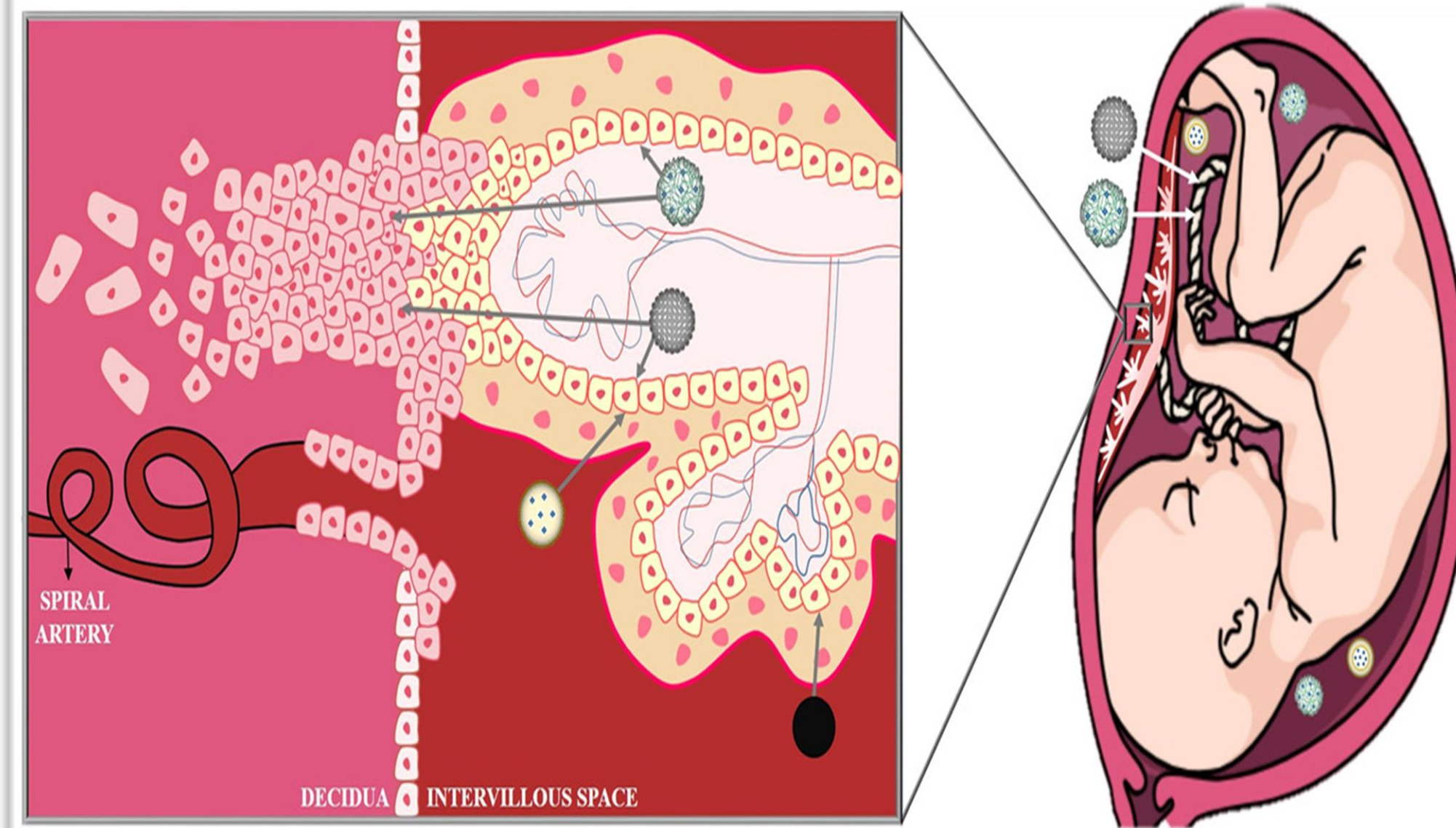
# Trophoblast-on-Chip Model

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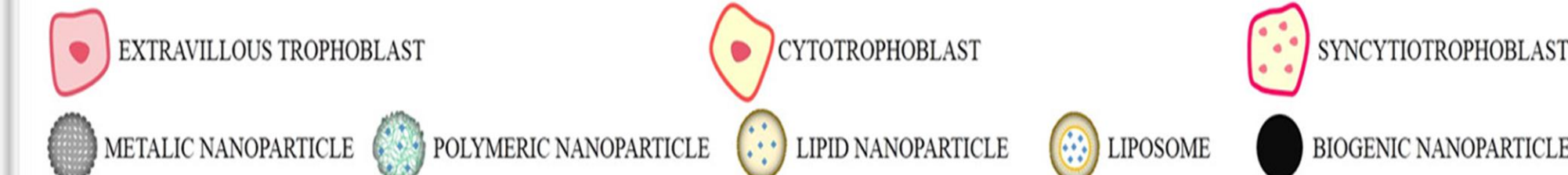
## Clinical Need & Research Question



The maternal-fetal interface is challenging to investigate in vivo models due to species-specific differences in placental development and ethics evaluating placental development in humans during gestation.

### Research Question

How do we mimic the human placental microenvironment by designing a device that makes it possible to reproduce key placental microenvironment elements such as trophoblast cells and pancreatic extracellular matrix (ECM) components?

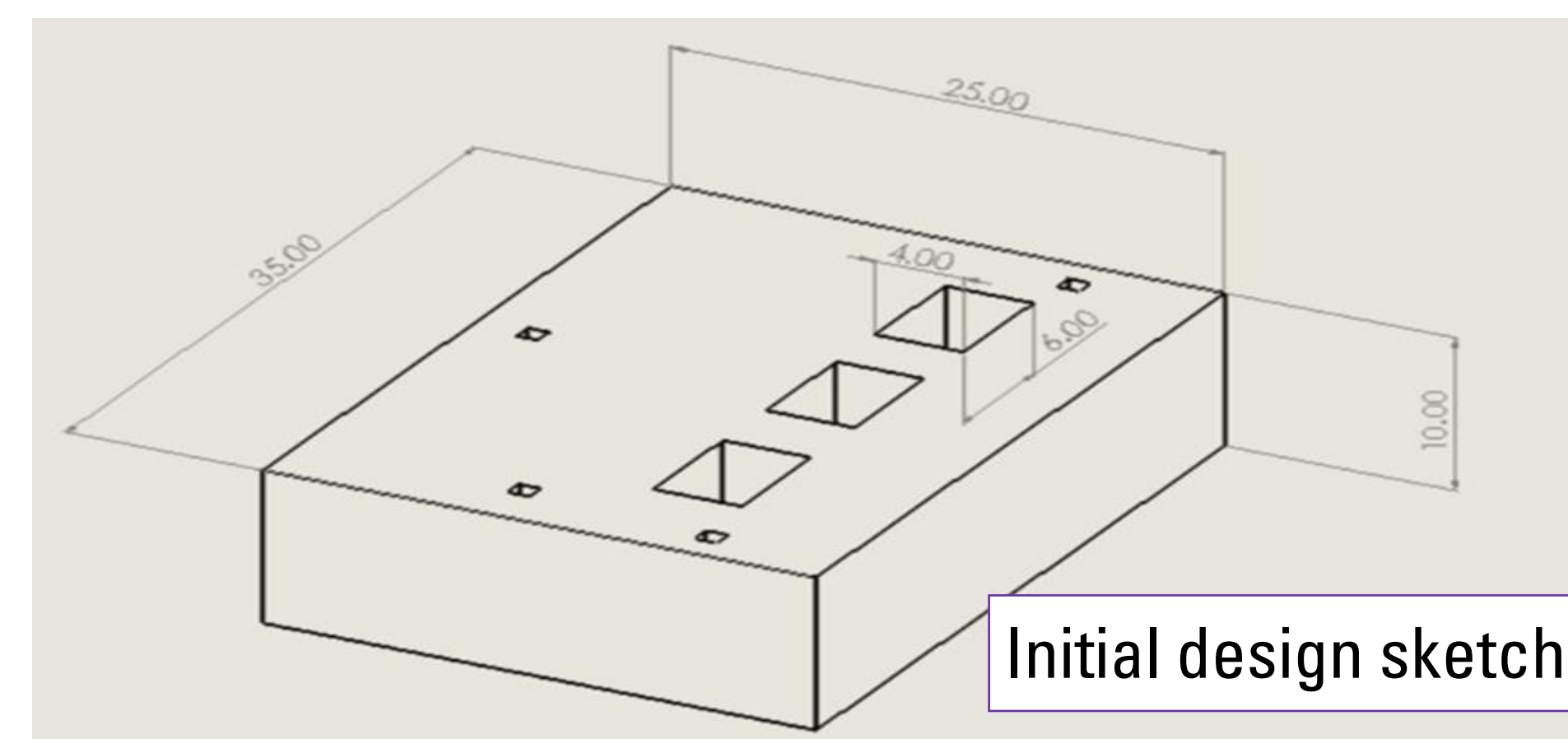


## Research Aim

- Design a 3D printed chip that incorporates dynamic medium flow, with the goal of enabling real-time monitoring of trophoblast cell invasion and cell-to-cell interactions.
- Evaluate the suitability of our chip design as a platform to support ECM-mimicking hydrogels and trophoblast cell viability.

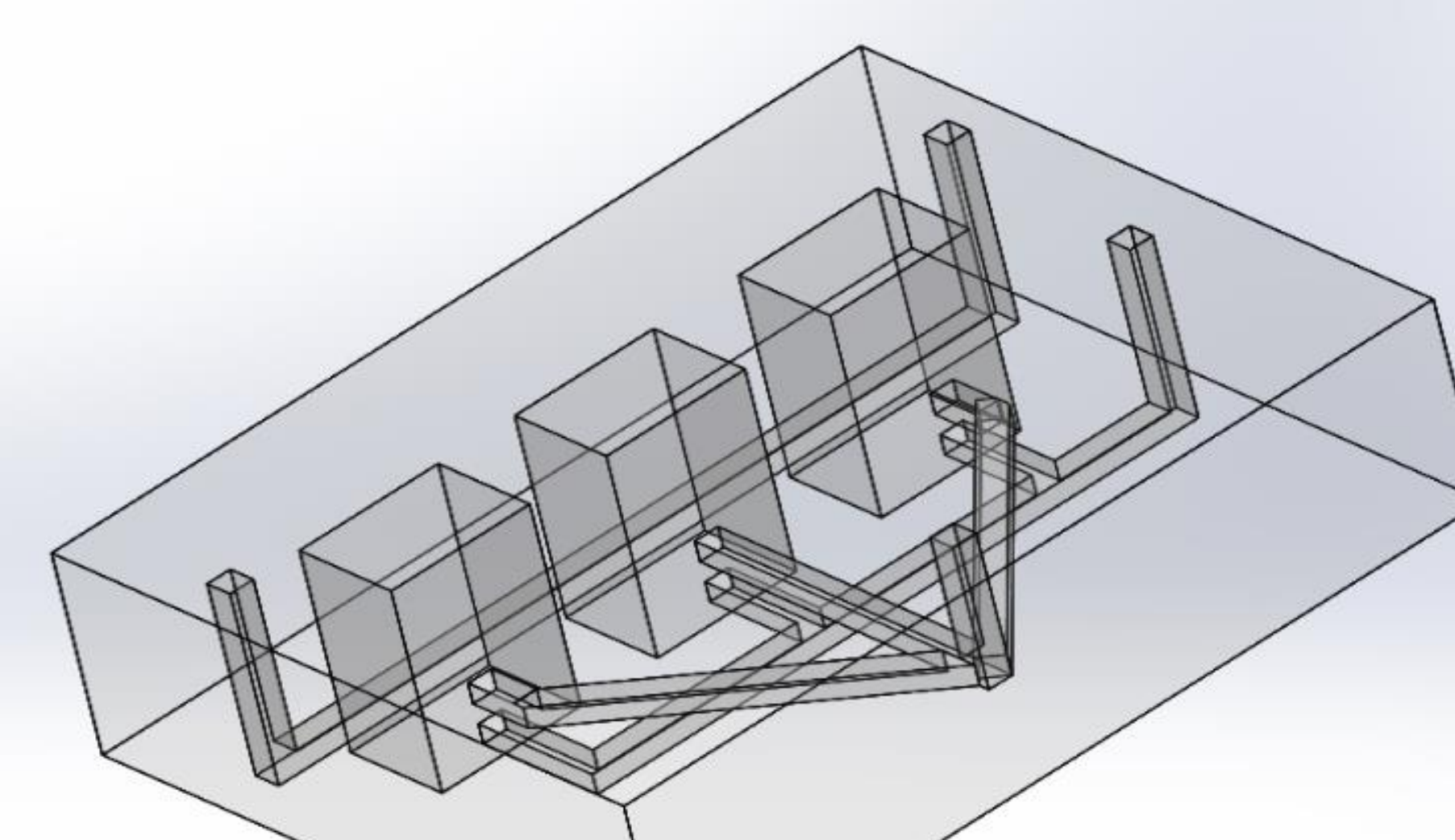
## Assumptions & Device Specification

- The velocity profile entering the flow domain was assumed to be uniform (i.e Flow is steady and lamina)
- No slip at the inner walls of the maternal and fetal channels (i.e  $u=0$ )
- Density is constant (incompressible fluid) i.e water
- Friction losses are negligible
- Device Height of device=7mm
- Length of device= 32mm
- Width of device =21mm
- Length of fetal channel=29mm
- Flow rate= 30uL/min
- Diameter of channels=1.5mm
- Volume of collecting channel at maternal side is approximately  $2.36\text{mm}^3$



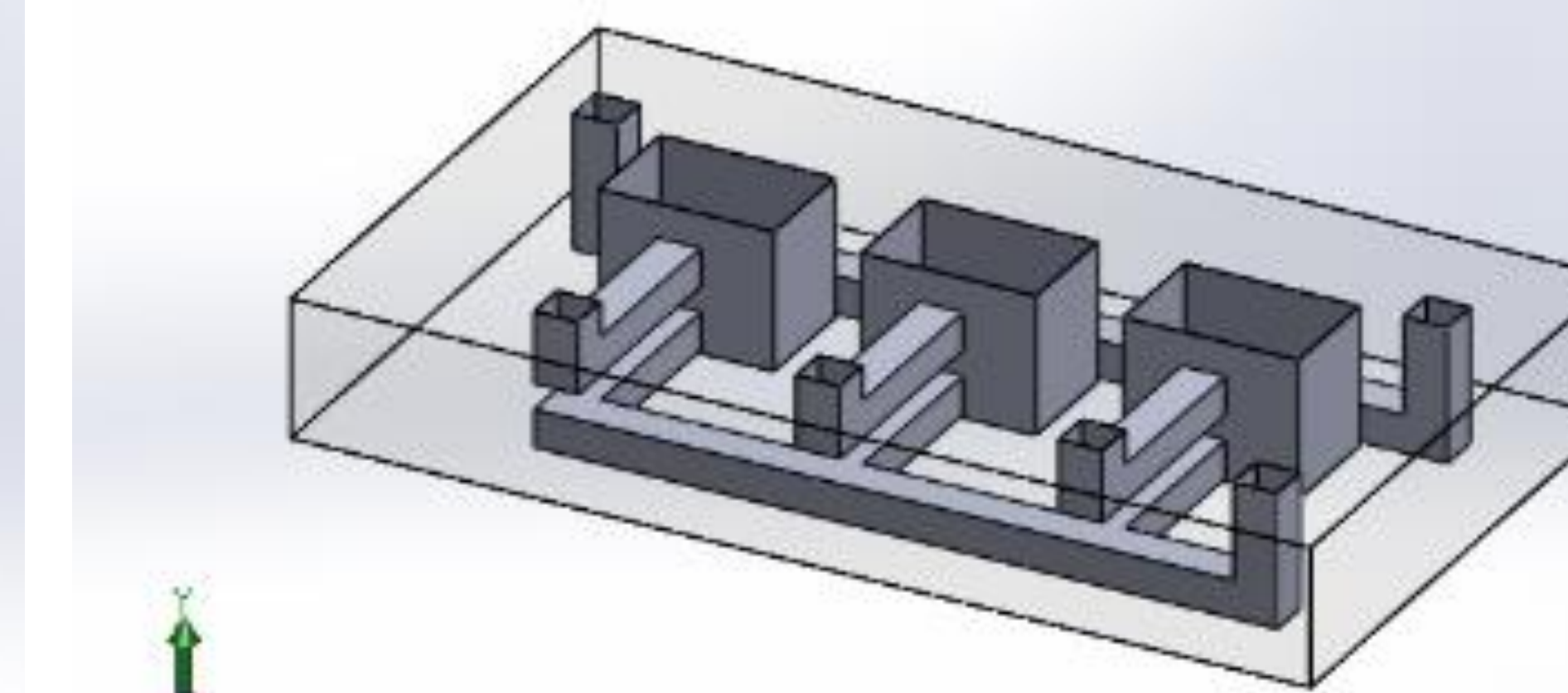
Initial design sketch

## Prototype Design Iterations

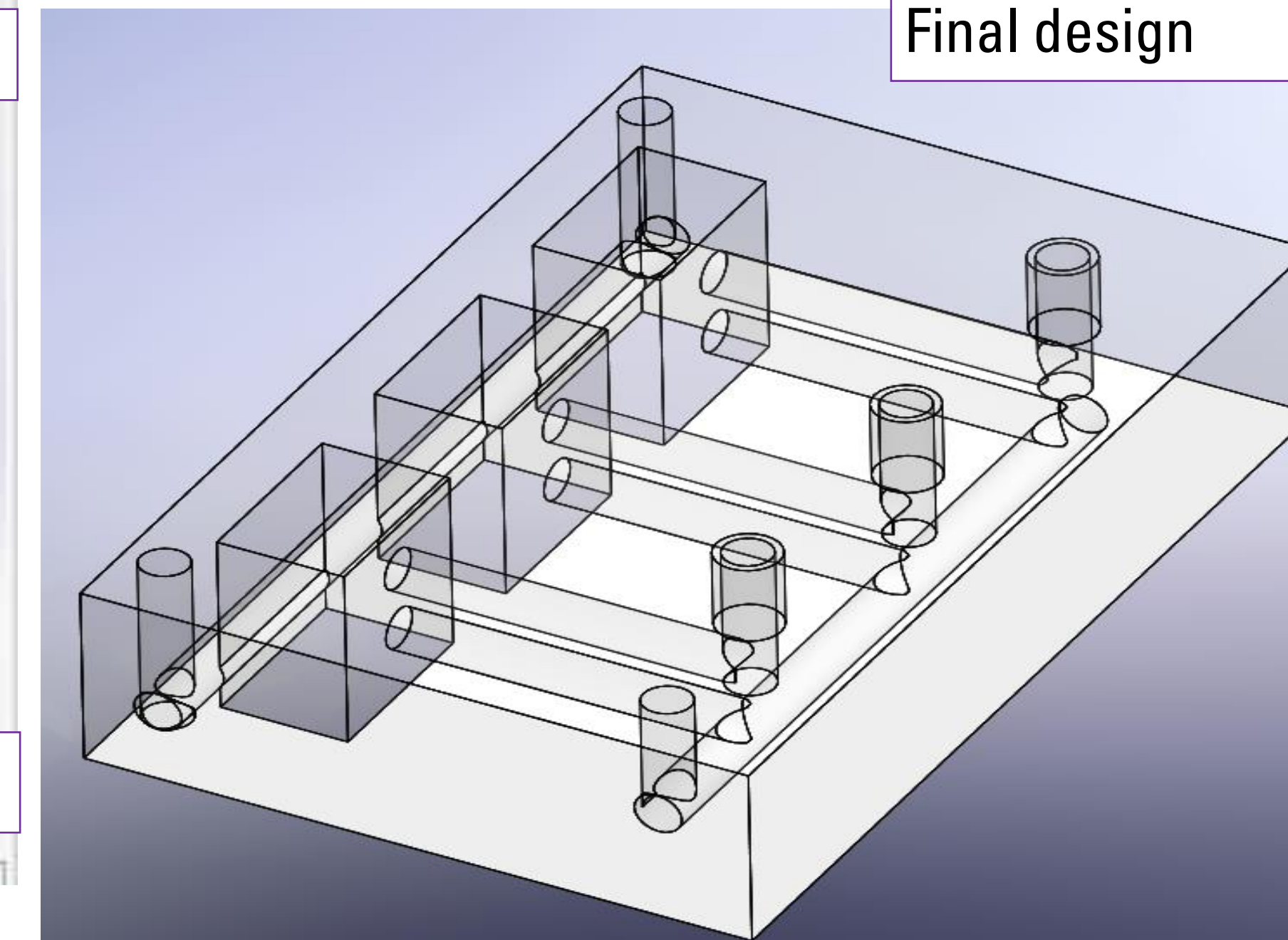


Initial design with wells with higher height

2<sup>nd</sup> Iteration with increased diameter of channels



Device size reduced

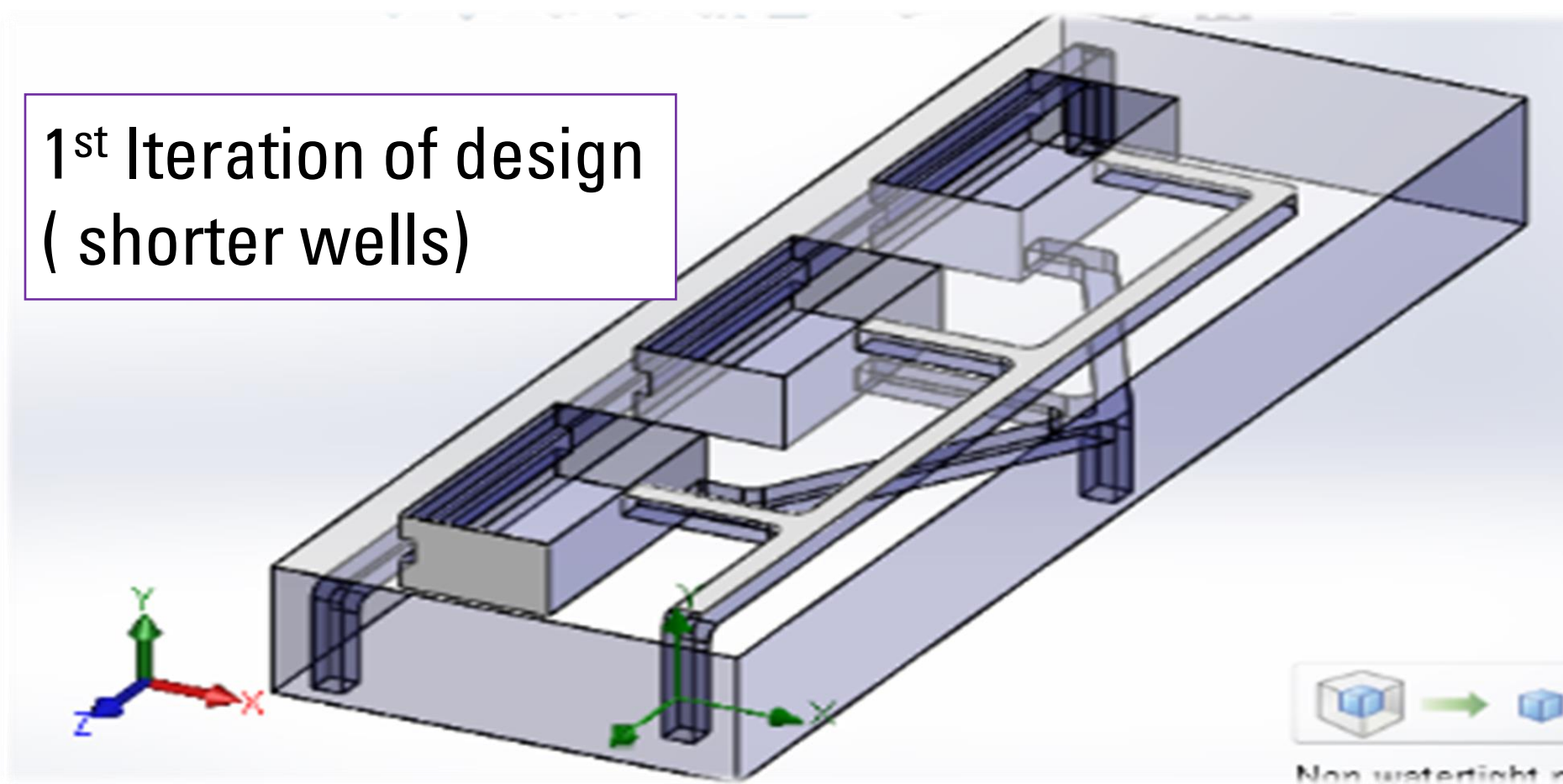


Final design

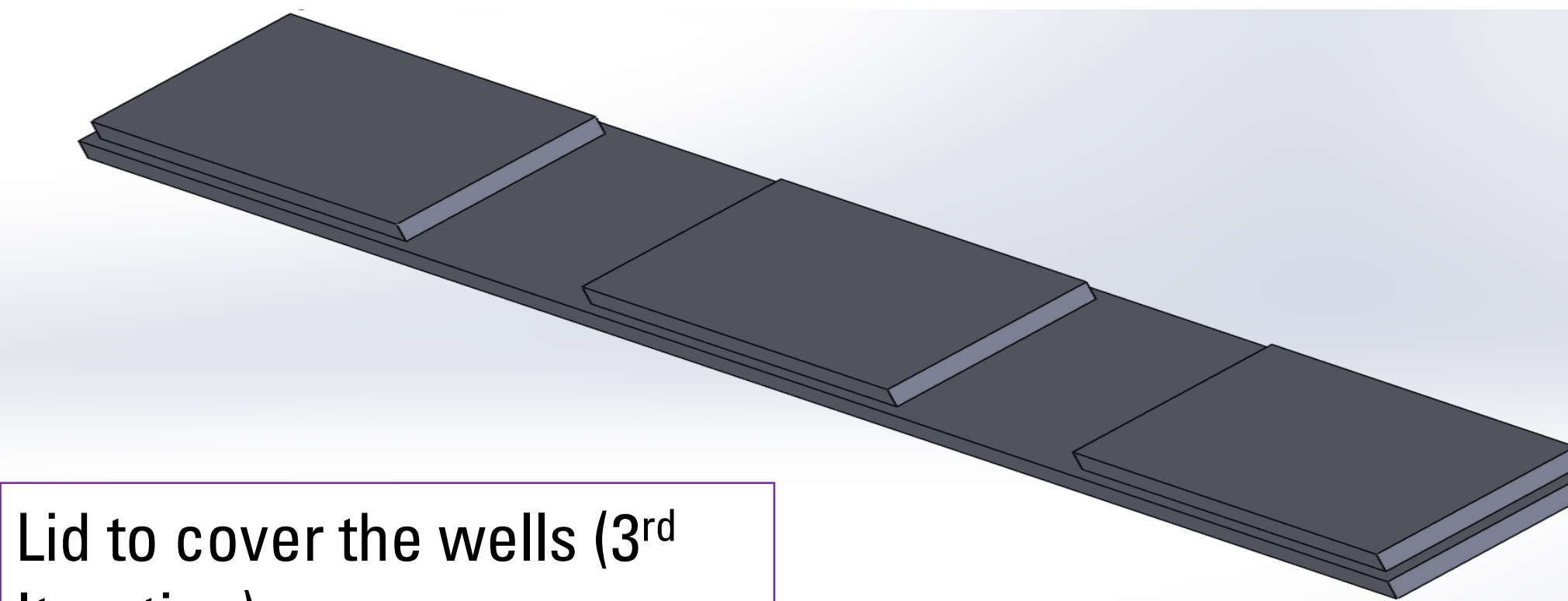
Alterations made for final design includes;

- Rectangular channels changed to circular channels
- Length of device reduced from 35mm to 32mm
- Width of device reduced from 25mm to 21mm.
- Height of entire device reduced from 10mm to 7mm.

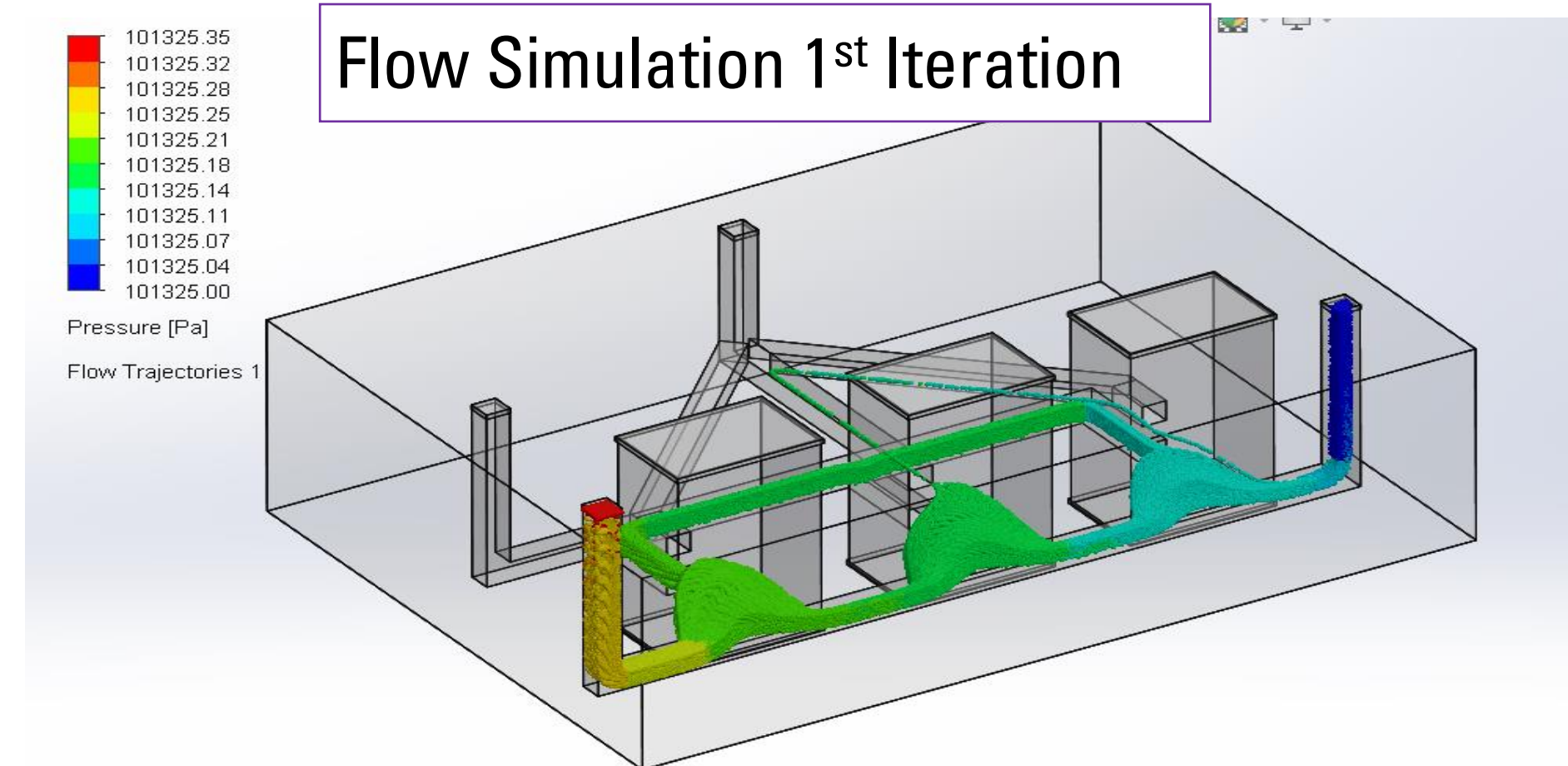
1<sup>st</sup> Iteration of design (shorter wells)



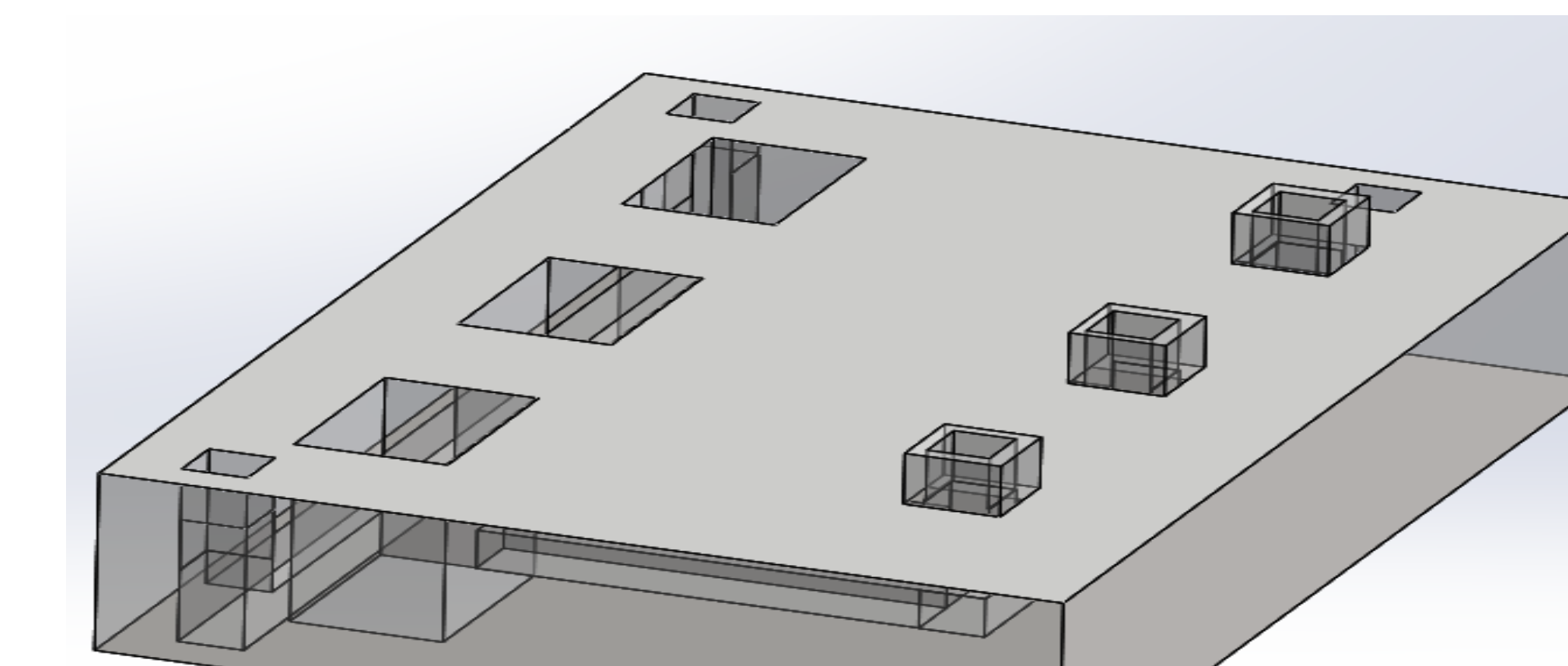
Lid to cover the wells (3<sup>rd</sup> Iteration)



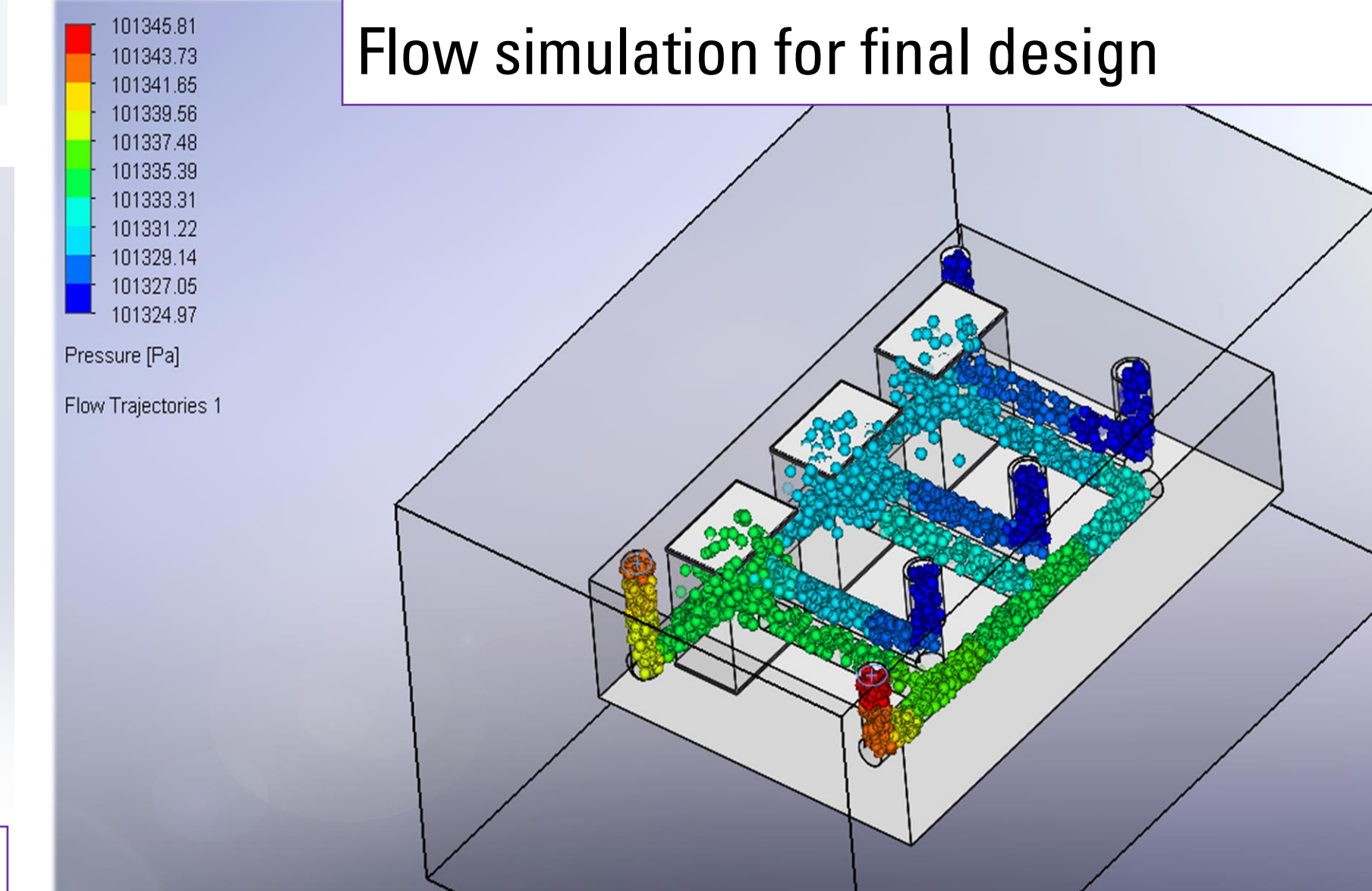
Flow Simulation 1<sup>st</sup> Iteration



4<sup>th</sup> iteration with collecting channels



Flow simulation for final design



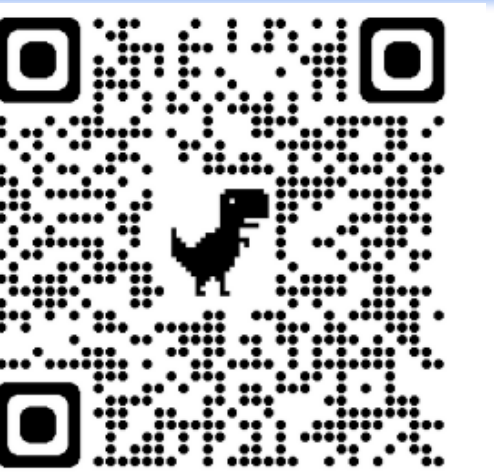
## Acknowledgements

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### Simulations



### References



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