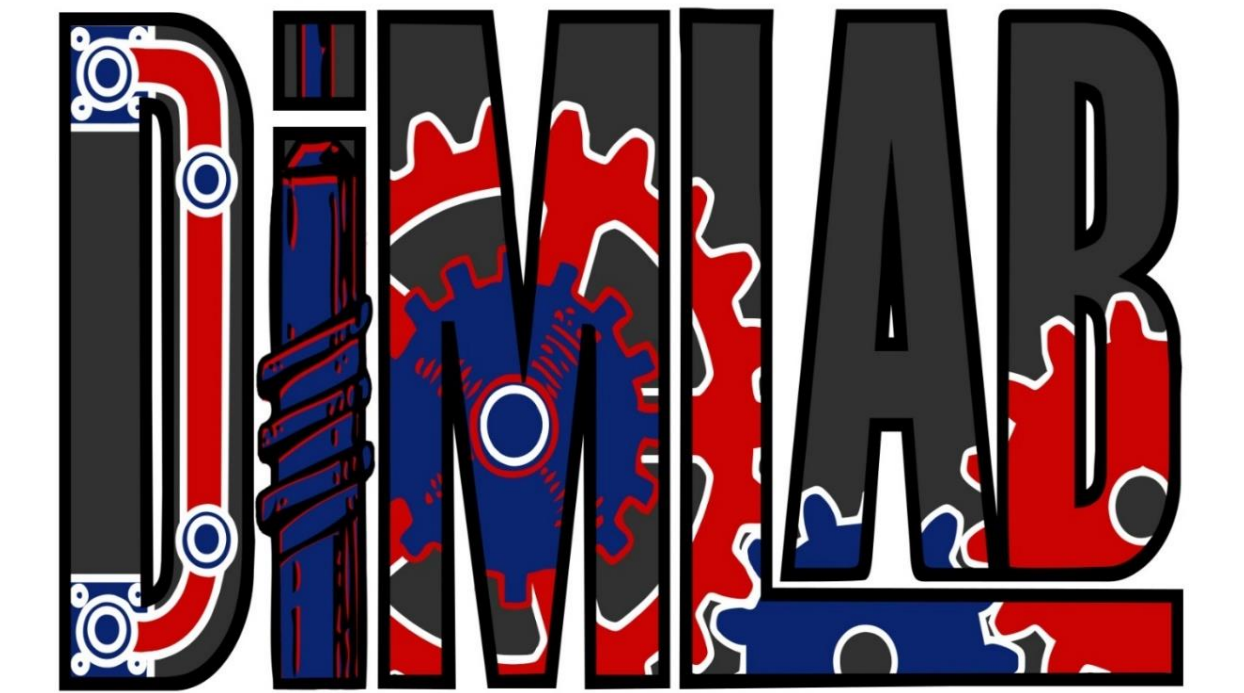


# Joint Design and Analysis of Leakage in Variable Geometry Dies for Polymer Extrusion

Suresh Kumar Kanathala

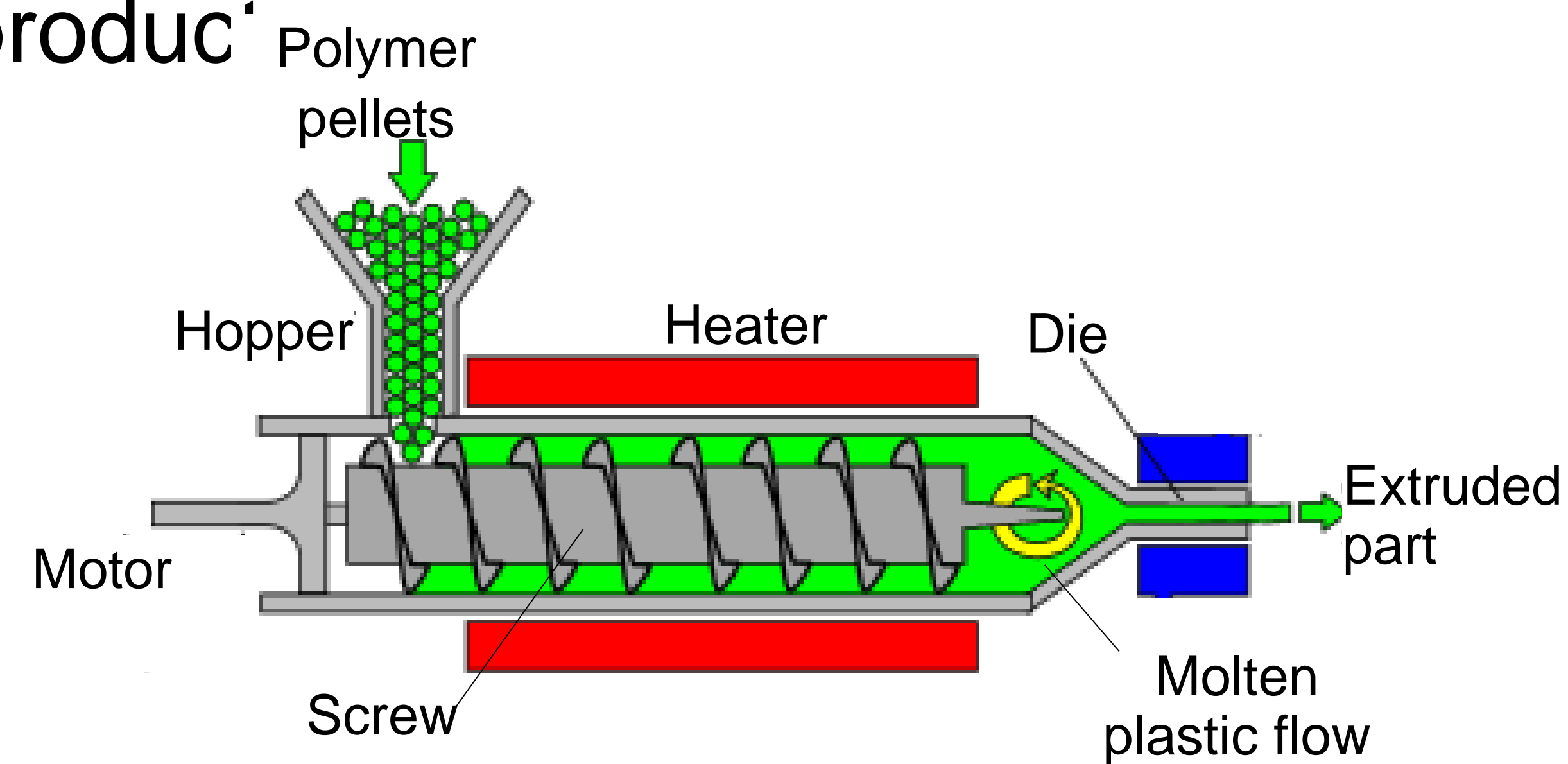
Advisors: Dr. David Myszka & Dr. Andrew Murray  
Department of Mechanical & Aerospace Engineering



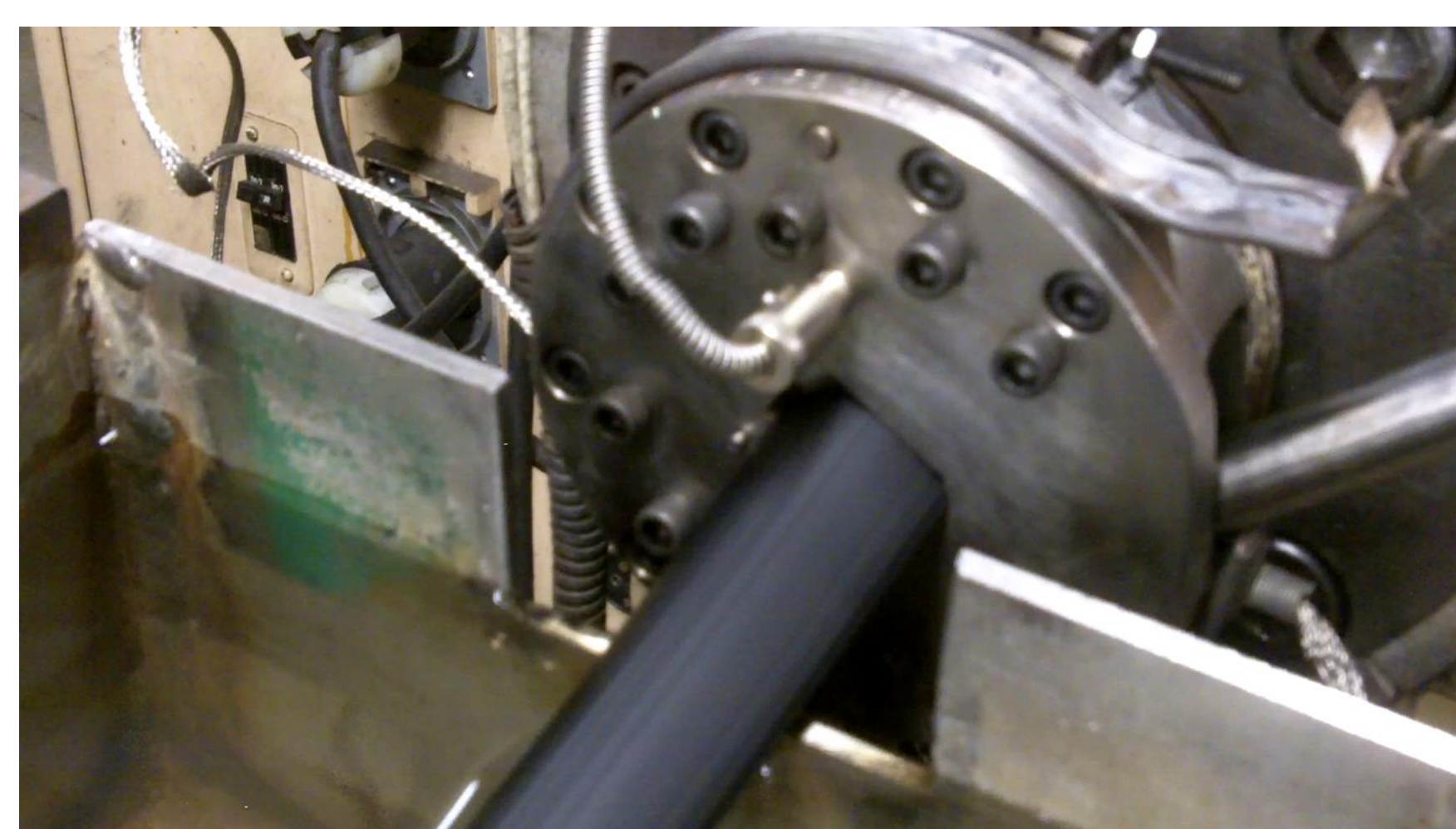
**Research objectives:** Computational fluid dynamics models have been constructed and used to assess the effect of the clearance size on the leakage through the joints, The goal of this analysis is to optimize the geometry of the joints.

## Polymer extrusion

Extrusion is the process of utilizing pressure to force melted plastic through die orifice. The channel shape of the die is what primarily defines the cross section profile of the extruded product'

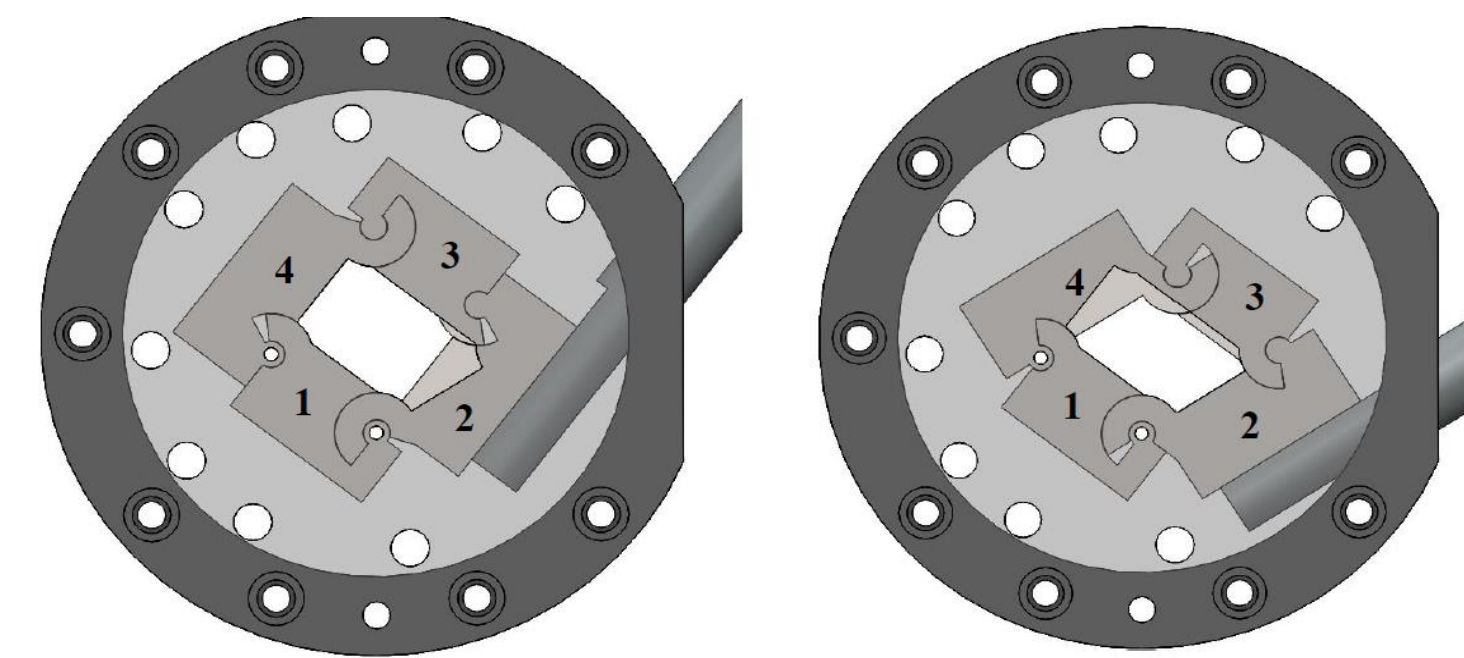


A variable geometry die allows the cross section of the extruded part to change over its length, thereby introducing the capacity to manufacture plastic components faster and with lower tooling costs than injection molding.



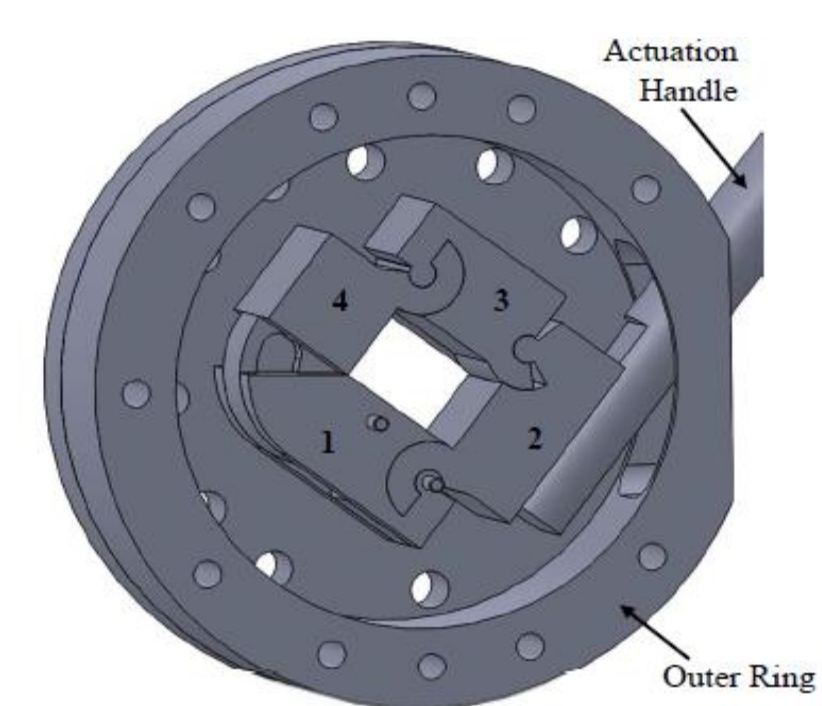
## Joints used in Variable Geometry Dies

- Crescent joint  
Deemed as best option when sharp corner is not required in extrudate.



a & b Shown in Limit positions

- Corner Joint  
Considered as best option when a sharp corner is required.
- Prismatic Joint  
Necessary when a cross-sectional feature changes length.

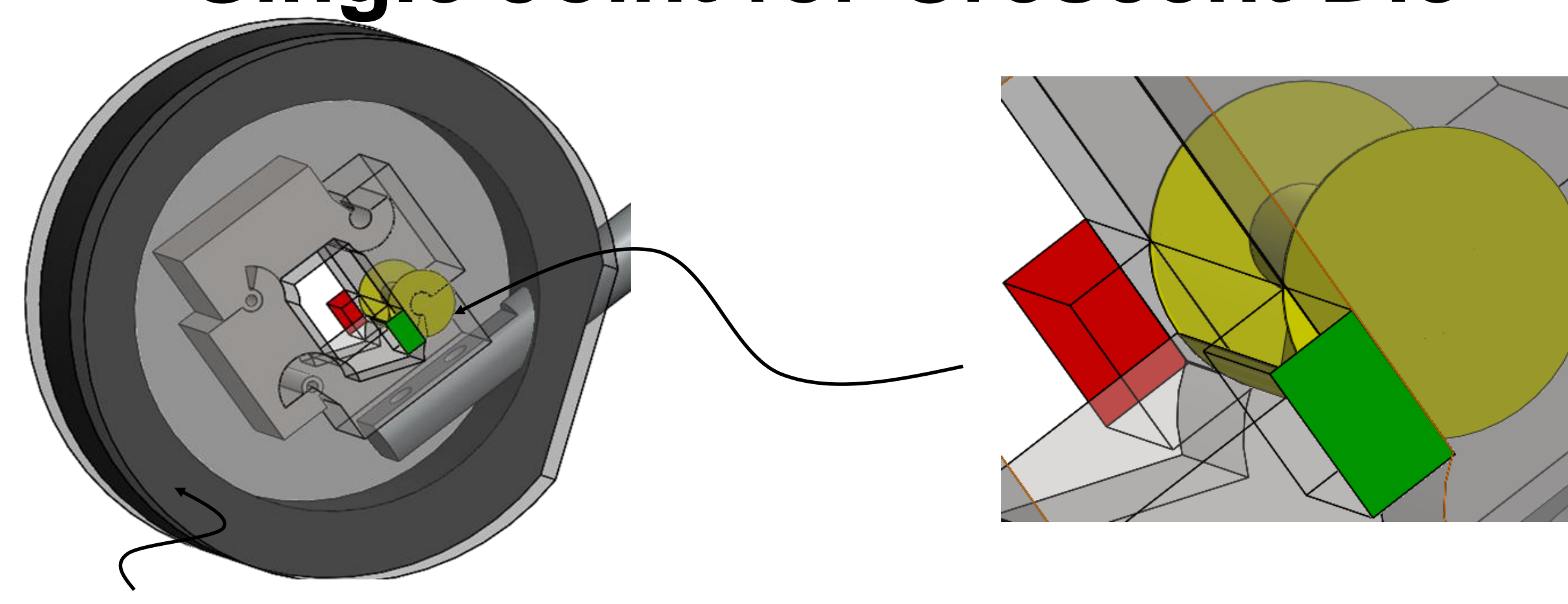


One Crescent and 3 Corner Joint



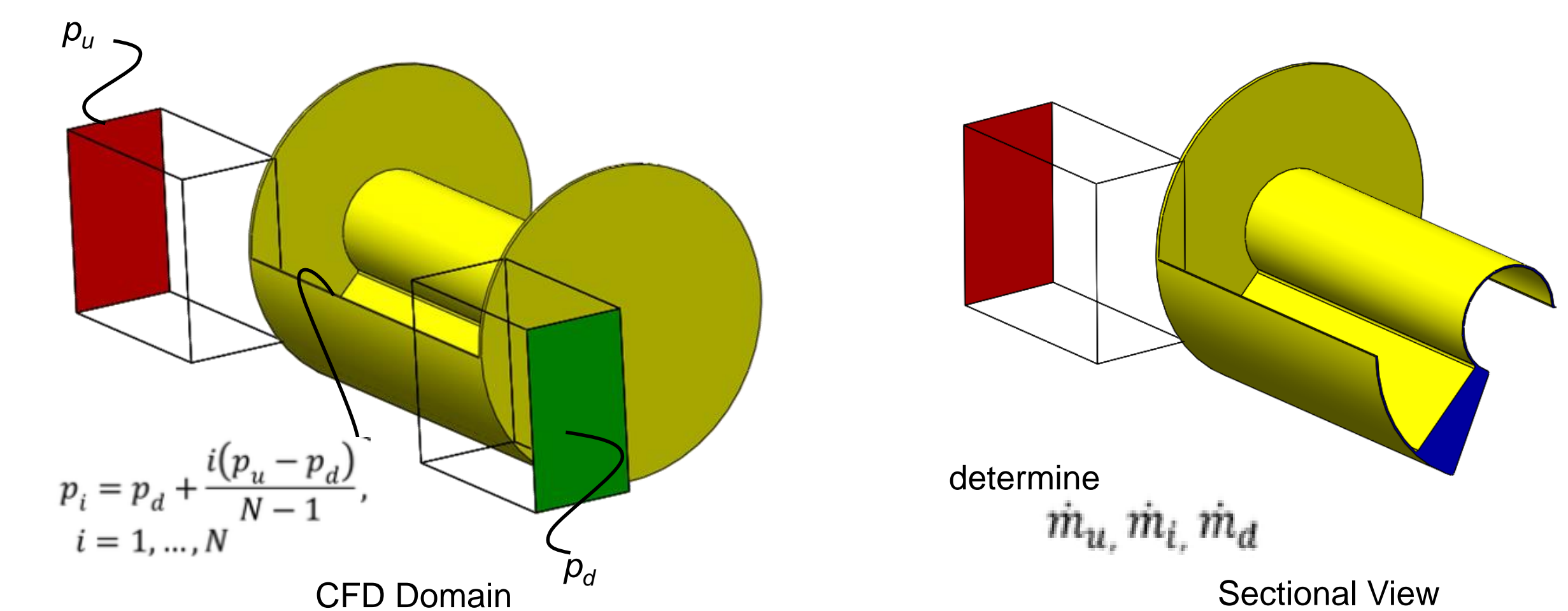
Crescent, Corner and Prismatic Joint

## CFD Model to Assess Leakage at a Single Joint for Crescent Die



Cover is shown transparent

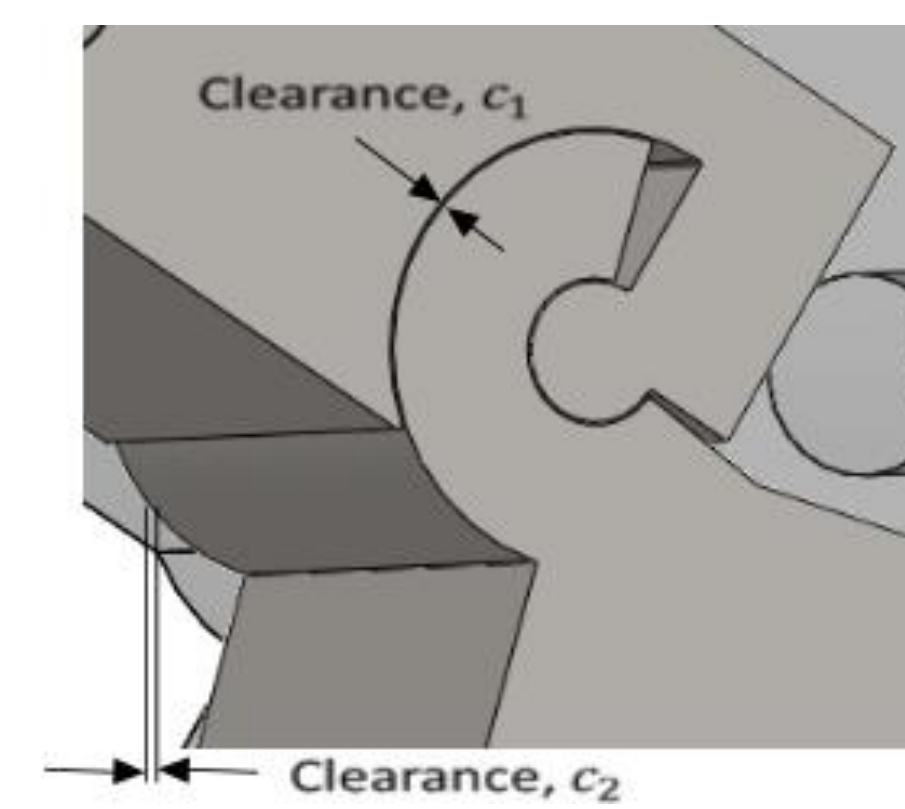
## Initial CFD Domain



$$p_i = p_d + \frac{i(p_u - p_d)}{N - 1}, \quad i = 1, \dots, N$$

determine  $\dot{m}_u, \dot{m}_i, \dot{m}_d$

## Assessment of Leakage



From 1-D incompressible flow, we have

$$\dot{m}_u = CA\sqrt{2\rho(p_u - p_d)}$$

Calculate Resistance to Flow CA, For various clearance's  $c_1$  and  $c_2$

Project Objectives:

1. Since clearance =  $f$  (cost  $^{-1}$ ), select clearance that balances cost and flow resistance.
2. Determine the flow resistance of different joint designs.

## Future Perspective

CFD model will be altered to incorporate flow through the die and to measure leakage flow through the joint.