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***Steady laminar incompressible flow between adjacent discs****:*

* *Z direction momentum:*

***Assumptions****:*

* *Flow is taken to be two-dimensional: , and are taken to be constant across the channel between rotor plates, and hence, are mean flow velocities at each r and θ.*
* *The flow field with and velocity components is treated as begin inviscid, with a body-force representation of the wall shear effects. The viscous drag exerted on the flow by the side walls of the channel between the rotos is modelled as a body force acting on the flow at each (r, θ) location.*
* *The flow field is radially symmetric. The inlet flow at the rotor outer edge is assumed uniform, resulting in a flow field that is the same at any angle θ. All θ derivatives of the flow quantities are therefore zero.*
* *Radial velocity derivatives and divisions in radial and theta directions are negligible as compared to Axial case.*
* *Constant friction factor characteristics within the flow passage.*
* *Axial direction effects must not be ignored.*

***Simplified version****:*

* *Continuity:*
* *Radial direction momentum:*
* *Theta direction momentum:*
* *Z direction momentum:*

***Velocity definition****:*

*Where:*

***Integral simplifications for phi:***

*Equation 5 yields that , and integrating it over the channel:*

*mass conservation requires that , where is the mass flow rate per channel:*

*Note:*

*Hence:*

*Theta direction wall friction force for fluid element in channel between rotors with volume is given by:*

*where is the hydraulic diameter of the channel ().For parallel plates, . For Newtonian fluid, it follows that:*

*For the purpose of this analysis, tangential shear interaction o the flow within the disk surface is postulated*

*Where:*

*For laminar flow, . For flow with roughened surface of turbulence action, an enhancement number is defined as such:*

***Relationship between n, Fpo and Po***

*Combining with the remaining two equations (absolute terms):*

***Wall Shear Stress***

***Wall Friction Term***

***Dimensionless Variables:***

***Note***

*From the above definitions:*

***Tangential ODE***

*Integrating both side across the channel :*

*Divide both side by :*

***Radial ODE***

*Integrating both side across the channel :*

***Power Generated Equation***

*From the definition of torque per rotor disc surface:*

*Total Torque:*

*Total Power:*

***Mechanical Efficiency***

*Rearranging:*

***Ideal Efficiency***

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