**7. INTRODUCTION TO INTERNAL FLOW**

**INTERNAL FLOW:** A flow through a conduit (without free surface), which is driven by pressure gradient.

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| **INTERNAL FLOW** | **OPEN CHANNEL FLOW** |
| No free surface. | Free surface present. |
| Pressure need not be atmospheric. | Pressure throughout the free surface is atmospheric. |
| Pressure varies throughout the flow. | Pressure throughout the flow remains constant. |
| Flow is driven by pressure forces/ Pressure Gradient. | Flow is driven by Gravitational Force. |
| E.g. Every Flow through pipe, etc… | E.g. flow in canal river, etc… |

**REYNOLD’S NUMBER ():** It’s dimensionless number represent the ratio of inertia force to viscous force.

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| Where, Characteristic dimension, |  |  |
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| For flow through Pipe/ Duct, | | |
| Laminar Flow | Transition Flow | Turbulent Flow |

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| **DEVELOPMENT/ ESTABLISHMENT OF FLOW:**  Establishment entrance length, | Objectives_template |

**FUNDAMENTALS OF INTERNAL FLOW THROUGH PIPES:**

**CONDITIONS FOR VALIDITY OF THEORY:**

1. Flow must be steady. ()
2. Flow must be fully developed.

**EQUATION GOVERNING INTERNAL FLOW THROUGH PIPES:**

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| |  |  | | --- | --- | |  |  | |  |  | | Radial Axis,  Axis along the flow, | | Permeability | Fundamentals of Fluid Flow in Porous Media |
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**PRESSURE DROP:**

Pressure decreases linearly along the length of flow,

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**SHEAR STRESS**

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|  | This equation is valid for steady and fully developed for any type of flow. E.g. Laminar, Turbulent, etc… |
| **Conclusion:**   1. increases with respect to radius. 2. At the wall of the pipe shear stress is maximum known as boundary shear or wall shear stress. | *C:\Users\Shiv\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.MSO\C7924F38.tmp* |

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| **FRICTION COEFFICIENT & FRICTION FACTOR:**  “The ratio of wall shear stress dynamic pressure is known as friction coefficient.”  **FOR INTERNAL FLOW:**  “Friction coefficient if known as fanning’s friction coefficient ”  **DARCY FRICTION FACTOR :** | |  |
|  |
| **MAJOR HEAD LOSS :**For inclined pipe, by using continuity equation and Bernoulli’s Equation, (Piezometric head difference)   |  |  |  | | --- | --- | --- | |  |  |  |  * Above Equation is known as **Darcy-Weisbach Equation**. | Chapter 3_Lect Notes_Turbulent Flow and Moody Diagram | |

**SUMMARY:**

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| 1 | Flow Governing Equation, |  |
| 2 | Pressure Drop is positive in the direction of flow. |  |
| 3 | Shear Stress or Wall shear Stress, |  |
| 4 | Friction factor or friction coefficient, |  |
| 5 | Darcy-Weisbach Equation, |  |

**NOTE:** If the flow is non horizontal then, Replace every static pressure term by corresponding piezometric pressure.