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DEPARTMENT: Mechanical Engineering

COURSE CODE: MEE322

COURSE TITLE: FLUID MECHANICS 2

MATRIC NUMBER: 17/ENG06/106

ASSIGNMENT II

1. (A) **Conditions for coutte flow:**

**(i)**

* The velocity is defined by equation

u =Uy/b – [(1/2η) (dp/dx) (by-y^2))]

&

Uy/b – [(1/2η) (d (p+ egz)/dx) (by-y^2))]

* The flowrate is defined by equation

(Ub/2) – [(1/2η) \* (dp/dx) \* [(b^3)/6]]

&

(Ub/2) – [((b^3)/12η) \* (dp/dx)]

* Shear stress is defined by

**T**= (ηb/b) – [(0.5) \* (dp/dx)\*(b-2y)]

1. THE TWO PLATES GUARDING THE FLOW MUST BE PARRALEL TO EACH OTHER
2. ONE OF THE PLATE BOUNDING THE FLOW MUST BE STATIONARY WHILE THE VELOCITY OF THE OTHER TENDING TOWARDS INFINITY

**(ii) (i)** the characteristics of the **fluid**, (viscosity, density, compressibility)

**(ii)**the speed of flow,**(iii)**the shape of the solid surface **(iv)** Raynold number

**(iii**

|  |  |
| --- | --- |
| **AEROFOIL** | **HYDROFOIL** |
| If the fluid is a [gas](https://en.wikipedia.org/wiki/Gas), the foil is called an [airfoil](https://en.wikipedia.org/wiki/Airfoil) or aerofoil, | and if the fluid is [water](https://en.wikipedia.org/wiki/Water) the foil is called a [hydrofoil](https://en.wikipedia.org/wiki/Hydrofoil) |
| while **airfoil** is a structure shaped to produce lift when moving **in** air. | **hydrofoil** is (nautical) a wing attached to the hull **of** a ship that raises it out **of** the water when travelling at speed and thus reduces drag |
| A lifting surface that opperats in water | A wing on an aircraft |
|  |  |

(B)

H= 0.9, b=10 mm (= 0.01), u=1 m/s, dx=­6mm dp=60Kn/m(^2)

y =?

1. VELOCITY DISTRIBUTION (U)

U = Uy/b – [(1/2η)(dp/dx)(by-y^2))]

U = {**(1 \* y) / 0.01**} – [ **{1 / (2\*(0.9\*10^(-3) )** \* **(-(60 \* 10^(3))** \* (0.01y – y^2) ]

= 100y – [ (0.556\*10^3) \* (-10^3) \* (0.01y – y^2)]

= 5660y – [ -5560y + (5.56\*10^5) \* y^2]

= 5660y + [(5.56y^2) \* 10^5)]

1. Flow rate (q) q= (Ub/2) – [((b^3)/12η) \* (dp/dx)]

= (1 \* 0.01/2) – [((0.01)^3)/12(0.9\*10^-3)) \* (60 \* 10^3)/60)]

= (0.005) – [(9.259 \* 10^-5) \* (10)]

= (0.005) + [(0.09259)]

= 0.0976(m^3)/s

1. Shear stress distribution

= (ηb/b) – [(0.5) \* (dp/dx)\*(b-2y)]

= (0.9(10^-3)) / 0.01) – [(0.5) \* (-10^3)\*(0.01-2y)]

= (0.09) – [(0.5) \* (-10^3)\*(0.01-2y)]

= (0.09) – [-5 + 10y]

= 5.09 – 1000y

NUMBER (2)

**SOLUTION**

P`1 = P1 + egh

= 250 \* 10^3) + (1260\*9.81\*1)

= 262.6\* 10^3)N/m^2

P`2 = P2 + egh

= 80\*10^3) + (1260\*9.81\*0)

= 80 \* 10^3 Flow in downslope while upper plate

moves upslope

dp/dx=((182.6\*10^3)/1.414)

dp/dx = - 128.95 \* 10^3N/m^3

dp = 262.6 \* 10^3) – 80\*10^3

= 182.6 \* 10^3 N/m^-2

1. Velocity distribution

U = (Uy/b) – [(0.5 η) \* (dp/dx)\*(by-y^2)]

= -(1.5/0.01)y – [ (1/2(0.9))\*(-128.95\*10^3) (0.01y-y^2)]

= -(150)y – [ -(716.96)-(7.17\*10^4)y^2]

= 566.96 + (7.17\*10^4)y^2

(ii)

**η=0.9Ns/m^2 , U=1.5m/s, b= 0.01m, p1=250kn/m^2, p2=80kn/m^2**

Where U= 566y + (7.17 \* 10^4) y^2

du/dy = 566 + 1.43 \* 10^6)y

τ = η(du/dy)

= 0.9 (566 + 1.43 \* 10^6)y)

= 509.4 + 1.287 \* 10^ 6)y

(iii) Maximum Velocity

Umax occurs @ du/dy= 0

Substitute back into the previous equation

0 = 566 + 1.43\* 10^6) (y)

y = -566/1.43\*10^6)

y = -3.958 10^-4)

Therefore

Umax = 566.96y + (7.17\*(10^4))

Where we substitute the value of y

Umax = 566.96(3.958 \* 10^-4)) + (7.17 \* 10^4))(1.57 \* 10^-7))

= 0.2244 + 0.01112

1. **T** = 509.4 +1.287 (10^6)) (-3.956 \* 10^-4)

**= 509.4 -509.4**

**= 0**