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Magnetohydrodynamic Viscous Fluid Flow Between Parallel Plates with Base Injection and Top Suction With an Angular Velocity

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***Abstract:** In this article manages the issue of stable electrically lead laminar progression of a gooey incompressible liquid stream associating two parallel permeable plates of a divert in the event of a transverse attractive field through base infusion and top suction. Dependable vertical stream is made and controlled by a weight slope. Vertical speed is enduring everywhere in the field stream. It implies $v=v_w$=constant. Answer for little and huge Reynolds number is talk about and the diagram of speed profile for stream including parallel permeable plate with base infusion and top suction through a rakish speed Ω has been considered.*

***Keywords :** About four key words or phrases in alphabetical order, separated by commas.*
***Keywords :** Magnetohydrodynamic flow, fluid flow, parallel plates, angular velocity.*

I. INTRODUCTION

The Fluid flow in between same kind of plates arranged in a manner which the hydrodynamic flow established by the Magneto hydrodynamic flow. The main usage of the concept in many fields in real time and also industrial like Magneto hydrodynamic flow, and they are MHD control generator, Aeronautics, Chemical synthesis, Dispersion of Metals, Electronics, Hydromagnetic dynamo action, MHD couples and bearings, MHD flow meters for liquid metals, MHD pumps.

Berman [1] examined the issue of adjusted laminar progression of an incompressible thick liquid from start to finish a permeable path with uniform rectangular cross portion, while the R-Reynolds number is wretched be considered in addition to an irritation arrangement expect ordinary divider speeds to be the equivalent was gotten. Sellars [2] broad the issue contemplated while the R-Reynolds number is raised. Later Yuan [3] suggested the few concepts of the infusion Reynolds numbers in two dimensional constraints with unflattering steam path along with their permeable dividers.

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Soundalgekar V. M [4] detailed the transfer of the MHD heat as a flow in their given non constant body temperature using the injection and suction as their major focused idea. Attia.H.A [5] [6] main concepts of the unsteady stream in the fixed plates as a parallel plates
which has gooey liquid in the form of incompressible and exchange of warmth in the fixed plates. The normal and formed suction and the properties of blend are their major factor influenced. The consistency of their temperature in each subordinate are monitored whose fluids flows through their penetrable and parallel plates. The fluids flow in the shaky steam and dusty coordinating fluids. Ganesh [7] assured the measurement of the MHD fluid stream of viscous liquid. Ganesh [8] studies the MHD behaviour in the thick walls as plates in the parallel position which has fluid flow in porous plates with the concept of top suction and the entrenched. Krishnambal [9] highlighted the work of the stream in the fixed plates in parallel conditions and susceptible. Hafeez H. Y [10] gives the flow of the stream in the porous plates fixed in the bases, the flow studies by their MHD as bottom injection and suction at the top. Another highlight of MHD mentioned in Ganesh [11] which close concept of the parallel and porous plates. R. Delhi Babu [13] investigated the effects of steady magneto hydrodynamic flow in angular velocity which in poured in the plates fixed as a parallel plate. J. Charles Prem Anand [14] studied Magnetohydrodynamic effects on steady blood flow in a stenosis under angular velocity.

The new concept of the stream flow as incompressible liquid which in thick state liquid connecting two penetrable parallel plates inside seeing a transverse alluring field and angular velocity with base imbuement and best suction through precise speed.

II. PROCEDURE FOR PAPER SUBMISSION

Considering the proportionate permeable plates, the new methodology introduced in plates while the fluid flow as incompressible liquid in thick state, the laminar development improvised and the top suction at their dividers with the velocity of the sight of a crosswise attractive field of solidarity is mentioned as H_0. The dividers in the vertical position with the rakish speed Ω. The starting point is focused initially for the channel flow. The axis are mentioned as x and y for the tomahawks comparable and vertical position of their channel dividers. The determination of the long way channel is mentioned as L. The distance measured in the fixed plates is 2h.

Continuity equation $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}=0$ (1)

Equations of momentum are

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=-\frac{1}{\rho}\frac{\partial p}{\partial x}+\frac{\mu}{\rho}\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right)+2\Omega u-\frac{\sigma_e B_0{}^2 u}{\rho} \quad (2)$$

$$u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}=-\frac{1}{\rho}\frac{\partial p}{\partial y}+\frac{\mu}{\rho}\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}\right)-2\Omega v \quad (3)$$

Angular velocity is denoted as Ω and the electrical conductivity is mentioned as σ, B_0 represents induction of Electromagnetic and B_0 defined as $\mu_e H_0$, where μ_e is the magnetic permeability.

Simplified conditions based on boundary defined as

$$u[x,h]=u[x,-h]=0$$

$$V=u[x,h]=-u[x,-h]$$

The suction of the channel divider is mentioned as V

Let $v=\frac{\mu}{\rho}$ denotes kinematic viscosity, coefficient of viscosity denoted as μ and ρ represents the fluid density.

Considering the same kind of the porous plates which has fluid flow at $y=h$ & $y=-h$.

$\frac{\partial p}{\partial x}$ as pressure gradient which identified using the stream flow. The perpendicular flow is monitored and the consistent if checked. Hence perpendicular velocity component is stable in all places in the stream field. It means, $v=v_w$ = constant. Therefore, continuity equation shows that u is a function of 'y' only.

After the simplification of (2) equation converted

$$v_w\frac{du}{dy}=-\frac{1}{\rho}\frac{dp}{dx}+v\frac{d^2u}{dy^2}+2\Omega u-\sigma_e B_0{}^2 u \quad (4)$$

$$\Rightarrow \frac{d^2u}{dy^2}-\frac{v_w}{v}\frac{du}{dy}-\frac{\sigma_e B_0^2 u}{v}+\frac{2\Omega u}{v}=\frac{1}{\rho v}\frac{dp}{dx}=\frac{1}{\mu}\frac{dp}{dx} \quad (5)$$

Homogeneous part of the equation (5) yields

$$\frac{d^2u}{dy^2}-\frac{v_w}{v}\frac{du}{dy}+\frac{2\Omega u-\sigma_e B_0^2 u}{v}=0 \quad (6)$$

$$\Rightarrow\left(D^2-\frac{v_w}{v}D+\frac{2\Omega-\sigma_e B_o^2}{v}\right)u=0$$

$$\Rightarrow u(y)=Ae^{k_1 y}+Be^{k_2 y}+\frac{v}{\mu\left(2\Omega-\sigma_e B_o^2\right)}\frac{dp}{dx} \quad (7)$$

Where $k_1=\frac{1}{2}\left(\frac{R}{h}+\sqrt{\left(\frac{R^2}{h^2}-4\left(\frac{2\Omega-\sigma_e B_0{}^2}{v}\right)\right)}\right)$ and

$$k_2=\frac{1}{2}\left(\frac{R}{h}-\sqrt{\left(\frac{R^2}{h^2}-4\left(\frac{2\Omega-\sigma_e B_0{}^2}{v}\right)\right)}\right)$$

Since the Wall Reynolds number $R=\frac{v_w}{v}h$

Since u(y) = 0 when y = h and y = -h (8)

$$\Rightarrow u(h)=Ae^{k_1 h}+Be^{k_2 h}+\frac{v}{\mu\left(2\Omega-\sigma_e B_o^2\right)}\frac{dp}{dx}=0 \quad (9)$$

$$u(-h)=Ae^{-k_1 h}+Be^{-k_2 h}+\frac{v}{\mu\left(2\Omega-\sigma_e B_o^2\right)}\frac{dp}{dx}=0 \quad (10)$$

Subtracting from equation (9) to equation (10) we get,

$$0=A(e^{k_1 h}-e^{-k_1 h})+B(e^{k_2 h}-e^{-k_2 h})$$

$$\Rightarrow A=-B\frac{Sinh(k_2 h)}{Sinh(k_1 h)} \quad (11)$$

Adding equation (9) and equation (10) we get,

$$\Rightarrow B=\frac{v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\cdot\frac{1}{[Sinh(k_2 h)Coth(k_1 h)-Cosh(k_2 h)]} \quad (12)$$

$$A=\frac{-v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\cdot\frac{Sinh(k_2 h)/Sinh(k_1 h)}{[Sinh(k_2 h)Coth(k_1 h)-Cosh(k_2 h)]}$$

(13)

$$u(y)=\frac{-v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\frac{(e^{k_1 y}\,Sinh(k_2 h)/Sinh(k_1 h)-e^{k_2 y})}{[Sinh(k_2 h)Coth(k_1 h)-Cosh(k_2 h)]}+\frac{v}{\mu(2\Omega-\sigma_e B_0^2)}\frac{dp}{dx}$$

$$=\frac{-v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\left(\left[\frac{e^{k_1 y}\frac{Sinh(k_2 h)}{Sinh(k_1 h)}-e^{k_2 y}}{Sinh(k_2 h)Coth(k_1 h)-Cosh(k_2 h)}\right]-1\right)$$

$$=\frac{-v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\left[\frac{e^{k_1 y}.Sinh(k_2 h)-e^{k_2 y}.Sinh(k_1 h)-Cosh(k_1 h).Sinh(k_2 h)+Cosh(k_2 h).Sinh(k_1 h)}{Sinh(k_1 h)(Sinh(k_2 h)Coth(k_1 h)-Cosh(k_2 h))}\right]$$

$$\Theta\ Sinh(k_1 h)\approx k_1 h\ \&\ Sinh(k_2 h)\approx k_2 h$$

$$u(y)=\frac{-v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\left[\frac{e^{k_1 y}.k_2 h-e^{k_2 y}.k_1 h-k_2 h.Cosh(k_1 h)+k_1 h.Cosh(k_2 h)}{k_1 h.\left[\frac{Cosh(k_1 h).k_2 h}{k_1 h}-Cosh(k_2 h)\right]}\right]$$

(4)

$$=\frac{v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\left[\frac{\frac{-k_1 k_2 h^2(k_1-k_2)}{2}+\frac{k_1 k_2 y^2(k_1-k_2)}{2}.....}{(k_1-k_2)-\frac{k_1 k_2 h^2(k_1-k_2)}{2}}\right]$$

(14)

$$=\frac{v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\left(\frac{\frac{k_1 k_2(y^2-h^2)}{2}}{\left(1-\frac{k_1 k_2 h^2}{2}\right)}\right)$$

$$u(y)=\frac{v\,dp/dx}{\mu(2\Omega-\sigma_e B_0^2)}\frac{\frac{k_1 k_2 h^2}{2}(\frac{y^2}{h^2}-1)}{(1-\frac{k_1 k_2 h^2}{2})} \quad (15)$$

$$\Rightarrow\frac{u}{u_{\max}}=\frac{v}{\mu(2\Omega-\sigma_e B_0^2)}\cdot\frac{k_1 k_2}{\left(1-\frac{k_1 k_2 h^2}{2}\right)}\cdot\left(1-\frac{y^2}{h}\right)$$

where $u_{\max}\cong\frac{h^2}{2\mu}\left(-dp/dx\right)$

It demonstrates that Poiseuille arrangement is recouped.

III. DISCUSSION

Figure mentioned below are speed profiles which streamed

for the Wall Reynolds number estimations. The diagrams mentioned with R<0 in - 1<y<1 gives the deviation in shapes with their Wall R-Reynolds number. The increase of the Reynolds numbers and the decrease in the velocity are highlighted, the usual velocity is gradually decreasing when the Reynolds numbers expands.

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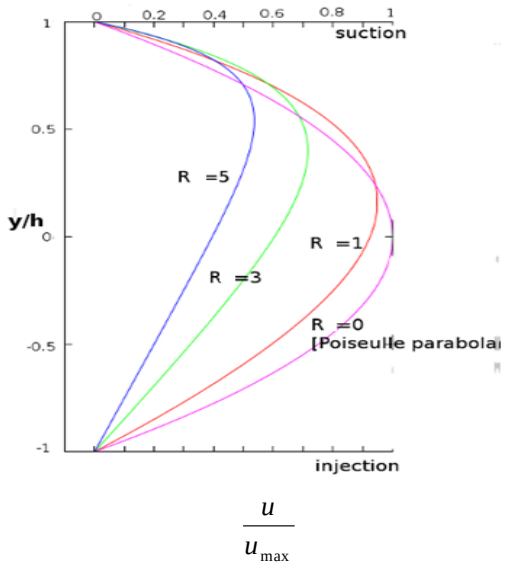

Fig: Velocity profiles for various estimations of R

IV. CONCLUSION

In the above investigation a class of arrangement of flow of viscous fluid between two parallel porous plates with base injection and best suction is introduced under angular velocity when a cross flow velocity along the boundary is uniform, the convective acceleration is linear and the flow is driven from pressure gradient.

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