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Anchorage System for Penstocks- In Himalayan Region

Prof. A.N.Shankar[1], Prof. S.C. Gupta[2], Imran Hussain[3]
[1]Assistant Professor, [2]Former Associate Dean, [3]Student M. Tech (Structures), First – Third Civil Engineering Department, University of Petroleum and Energy Studies, Dehradun, India

Abstract: As the Himalayan region lies in the Eurasian plate and Indian plate, the fault is the youngest and active in the world. Hence this paper deals with the design of anchorage system for penstock line for the Himalayan region, India. Due to the earthquake the penstock lines may get distorted and at joints of the penstock may burst out. As the penstock line passes through the hills and mountain region, there will be change in the pressure and thrust in the penstock. Due to this the centrifugal force is generated by moving fluid which will produce the horizontal thrust on the penstock bends or at joints. As the pressure in the penstock is varying at every instant of time with respect to change in direction and elevation and due to earthquake there will be sloshing of liquid in the penstock. Hence to avoid the break-down and catastrophic failure of the penstock the anchorage system has to be provided.
Key words: Penstock, anchorage system, thrust, deviation angle, and momentum.

I. INTRODUCTION

The Himalayan region is the most earthquake prone area in India. As the penstocks are laid in this area to carry the fluids like water, petrol, diesel, oils etc., the penstock passes through many ups and downs in elevation due to the topographical requirement and due to change in direction the penstock is subjected to the change in pressure and the water hammer effect. The movement of penstock has to be avoided with the opposite reaction to the thrust generated by the moving fluid in the penstock [1-5].

II. HORIZONTAL THRUST

As the fluid flows in penstock during change in direction, the thrust is developed as shown in below figure 1. Due to this there will be movement in the penstock. This movement is due to the unbalance of internal pressure in penstock and centrifugal force generated due to the moving of fluid [1-5].

For buried penstocks, anchor blocks shall be provided at horizontal bends with large deflection angles which will produce forces not exceeding the frictional and compressive resistance of soil, at vertical bends at summits and at bends adjacent to power house or pumping plant [1].

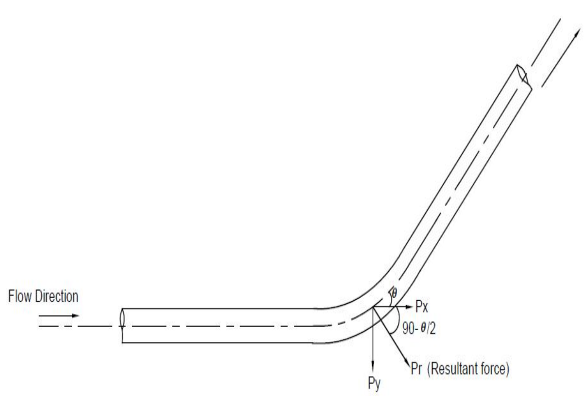

Figure 1

III. THRUST REACTION

Thrust reaction is calculated as per the Newton 2nd law of motion. Whenever the velocity of flow varies, there is change in momentum.

$$F=ma$$

That is the force exerted is proportional to the rate of change of momentum [6].

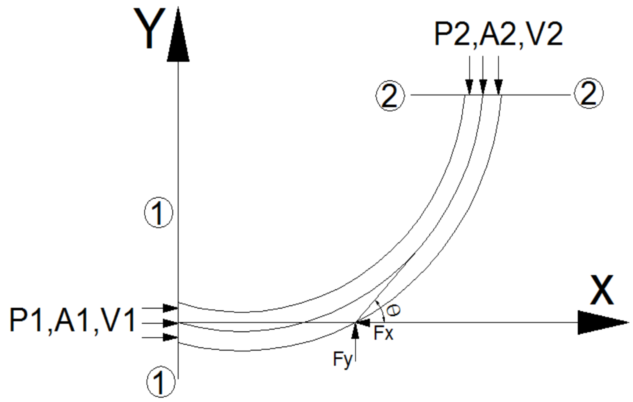

Figure-2

After resolving the forces due the pressure in the penstocks bends the thrust is calculated [6]. And for this calculated thrust the anchorage is provided.

And due to the presence of fluid in the penstock, the seismic force also has to be calculated [1].

IV. ANCHORAGE SYSTEM

The anchorage system should be so provided that the resultant force which is created by elbow along the line of active pressure has to be carried by the anchorage system and from the anchorage system the load which is transmitted to the surrounding soil or the supporting soil should be less than the safe bearing capacity of the soil [1,4].

V. CONCLUSION

The anchorage system provision in the Himalayan region by the use of any homogeneous and heterogeneous material should be such that it sufficiently transfers the thrust generated by the moving fluid and during the time of earthquake in the pipe bends and pipe joints.

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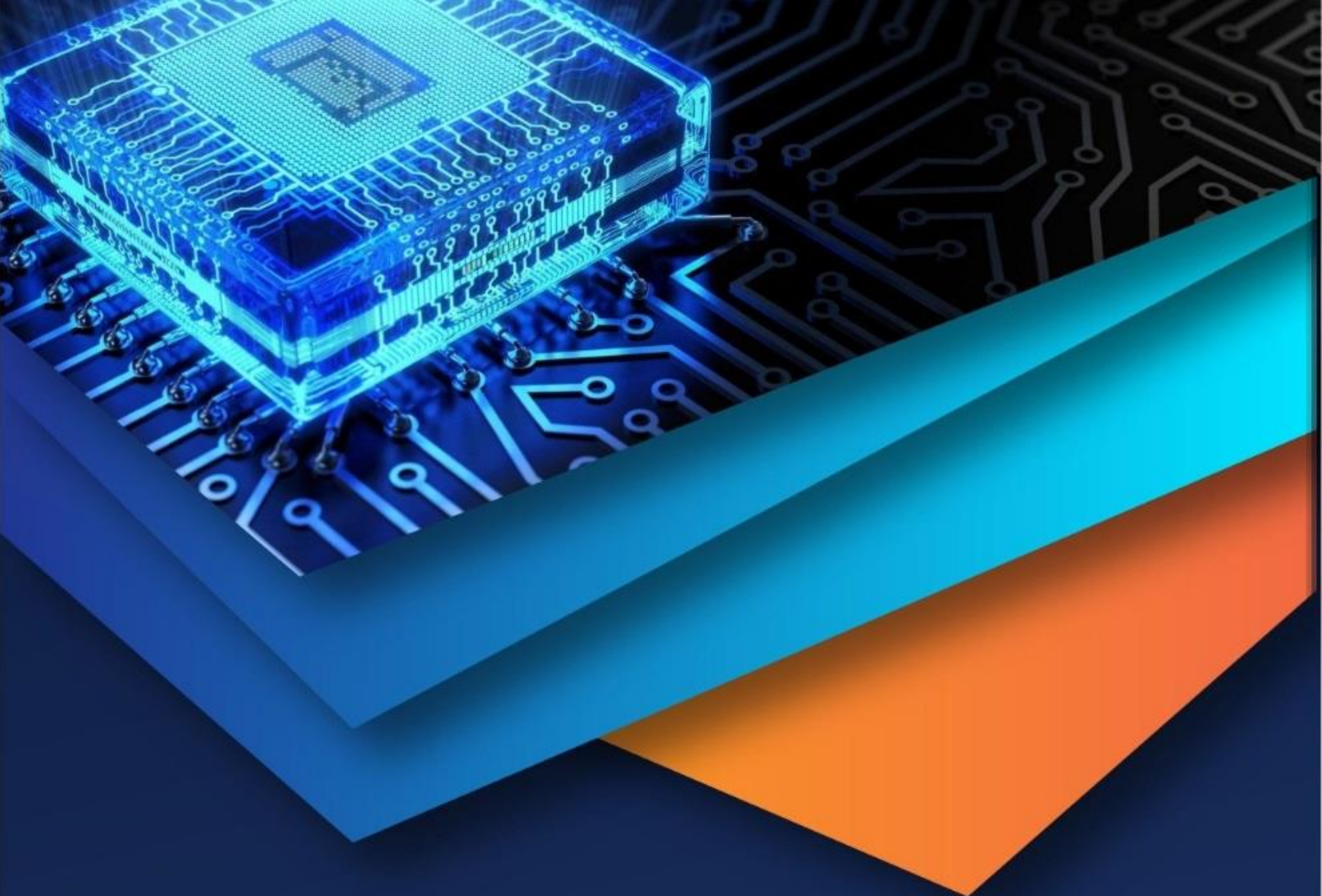

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