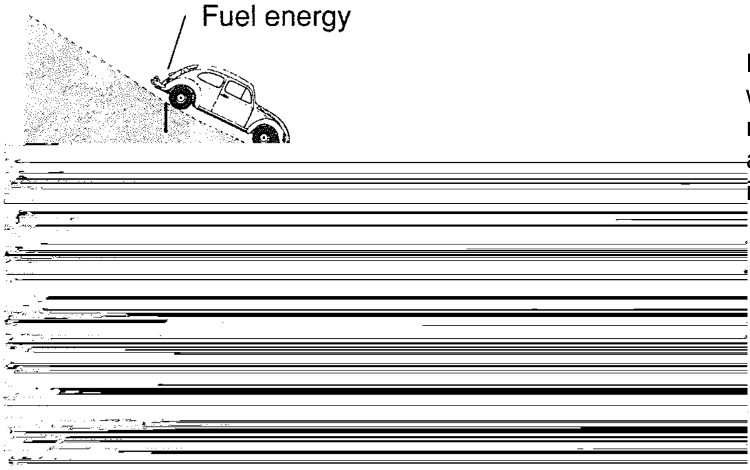
29. Designing simple pipelines

Introduction

This paper tries to introduce the reader to the principles of pipeline design. It is a very difficult process for people who have not previously been taught the principles of hydraulics to understand and so it has been necessary to simplify the calculations by excluding factors that usually have only a small effect on the design.

Terminology

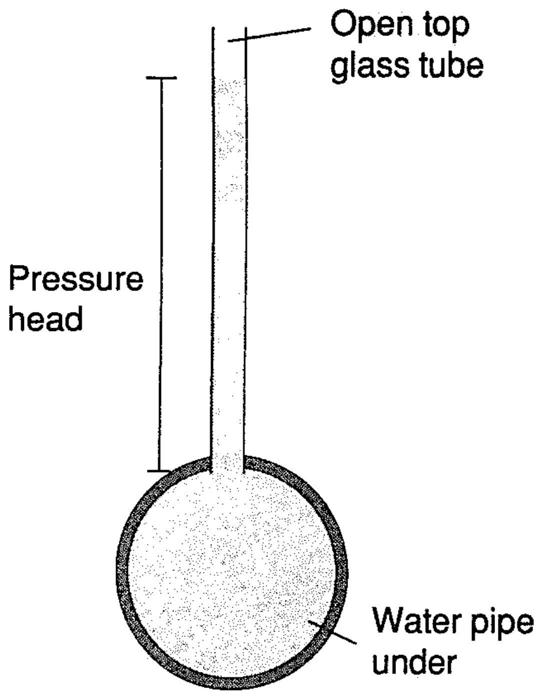
Water flowing along a pipe is a bit like a car travelling along a road. For the car to move it must use energy. That energy can be supplied by the fuel in the fuel tank being burned and by the height of the car above the point it is trying to reach. As the car travels along some of the energy will be used up overcoming the friction in the car’s moving parts. On a flat road the energy would all come from the fuel but on a steep slope it could all come from the change in height of the car. (Figure 1.)



F 1

In the same way, to overcome the friction of the moving water against the pipe surface, water flowing along a pipe requires energy. Initially, it is all supplied by the change in altitude *(, a)* but it can be converted into an internal energy store known as .

If we connect a glass tube with an open top to the top of a pipe full of water under pressure, provided the pipe is tall enough, the water will rise up the tube until the pressure at the bottom of the tube produced by the weight of the water column is the same as the pressure in the pipe. This column of water is called the a . (Figure 2).



F 2

One big difference between energy in cars and pipes is that the energy in pipes can change the way it is stored. If we assume for a moment that the water can travel along the pipe without using any energy then some or all of the energy can be converted between pressure and potential energy. The total energy, however, remains the same. (Figure 3)

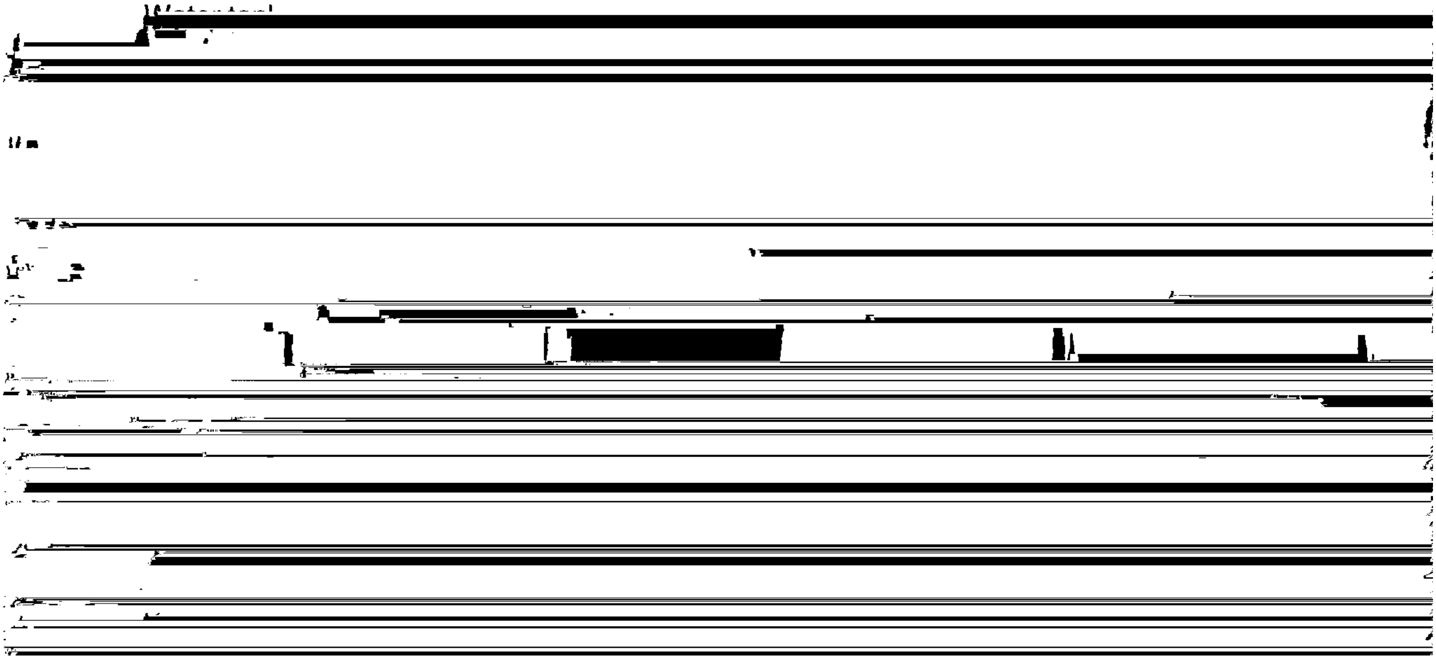


Figure 3

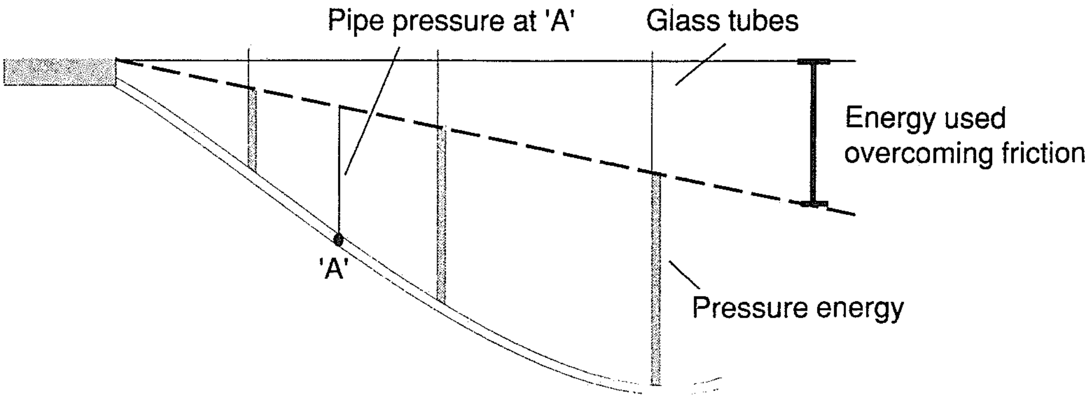


Figure 4

Note: *P*, *a* *a* *b* *a* *a* . *a* *c*

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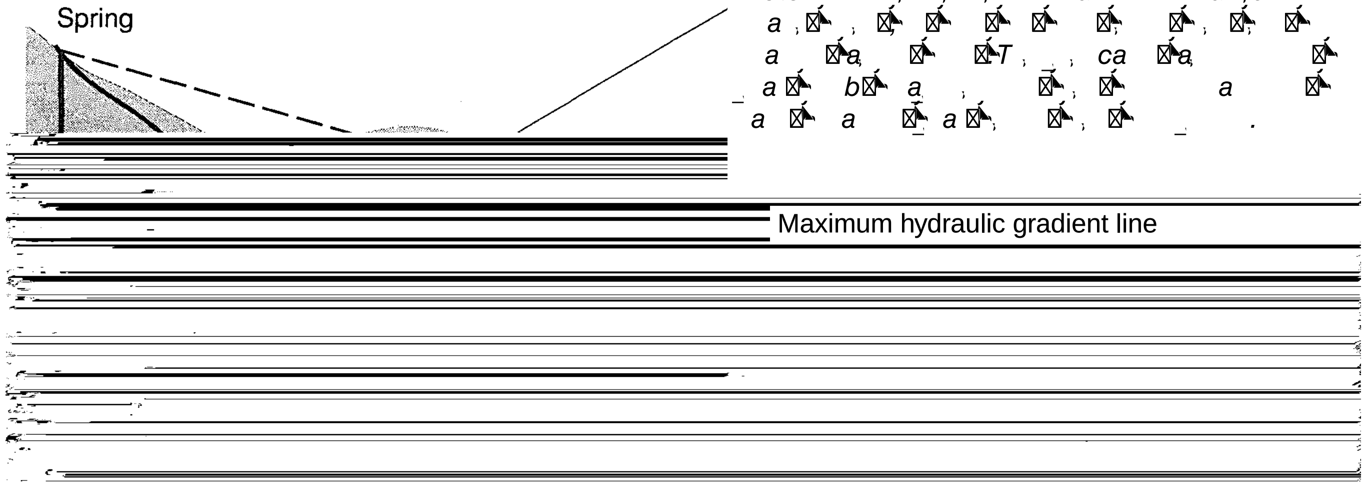
Example

It is hoped to use a spring 2 000m from a village as a source of water. What size of pipe must be laid if a flow of 3000 litres per hour is required and the spring is 50 metres higher than the village? (Figure 5 shows a section along the proposed pipeline.)



F[illegible] 5

Energy available at the spring box	50m (potential energy)
Energy needed in the pipe in the village for distributing the water around the pipes in the village and out of the standposts	7m (pressure energy)
Maximum energy that can be lost by friction	50 - 7 = 43m
Energy loss per metre length of Pipe (It is acceptable to use the pipe length if the horizontal length cannot be measured)	$\frac{43}{2000} = 0.02$ m/m

From the table, for flows of 3 000 litres per hour we would need 38mm diameter for all pipe materials. This is the maximum flow for a 38mm GI pipe having an energy loss of 0.02m/m but HDPE and uPVC pipes of this diameter would provide 3500 l/h. The selection would depend on the cost, types of pipe available and type of ground in which the pipe was to be laid.

Note: [illegible]

Further reading:

Jordan Jnr, Thomas D., *[illegible]*. Intermediate Technology Publications, 1984.

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