Fundamentals of Hydraulic Engineering Systems

Fifth Edition

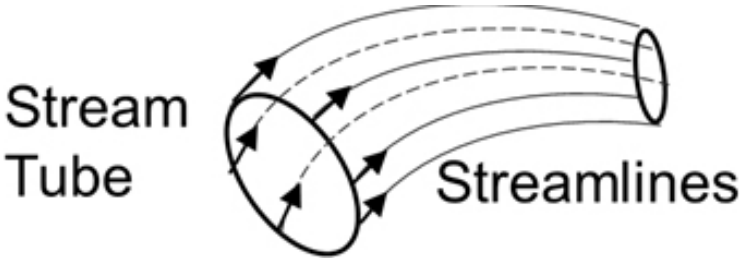
Chapter 3a

Water Flow in Pipes

Description of Pipe Flow Definitions and Visualization

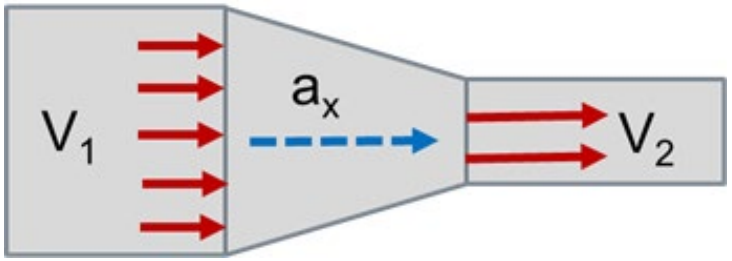
Definitions and Visualization

Questions: What is a streamline? What is a stream tube?
Streamline: imaginary lines drawn in the flow field which are everywhere tangent to velocity vectors
Stream tube: a grouping (bundle) of streamlines
Visualization:
Question: Define steady flow?
Question: Given steady flow, is fluid acceleration possible?



Local acceleration: (dV/dt) (equals zero in steady flow)
Convective acceleration:

$V(dV/ds) \rightarrow$ V change over distance



The Energy Equation (1 of 2)

Description and Visualization
From the pipe flow schematic:

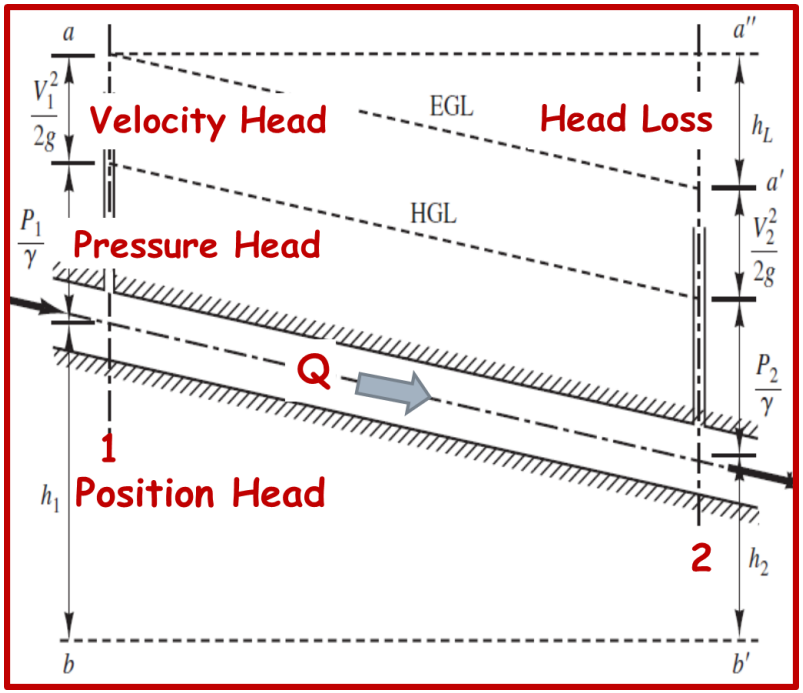


Figure 3.5 Total Energy and Head Loss in Pipe Flow

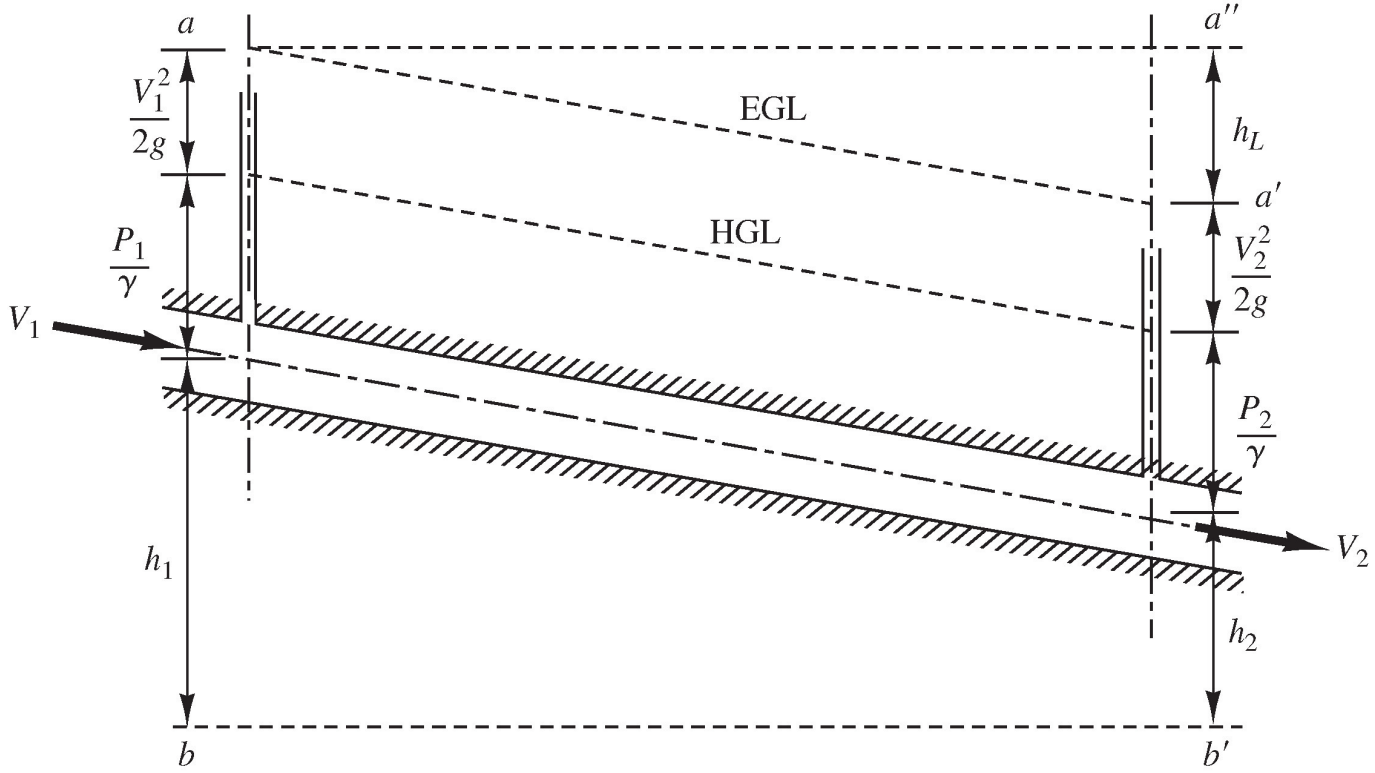
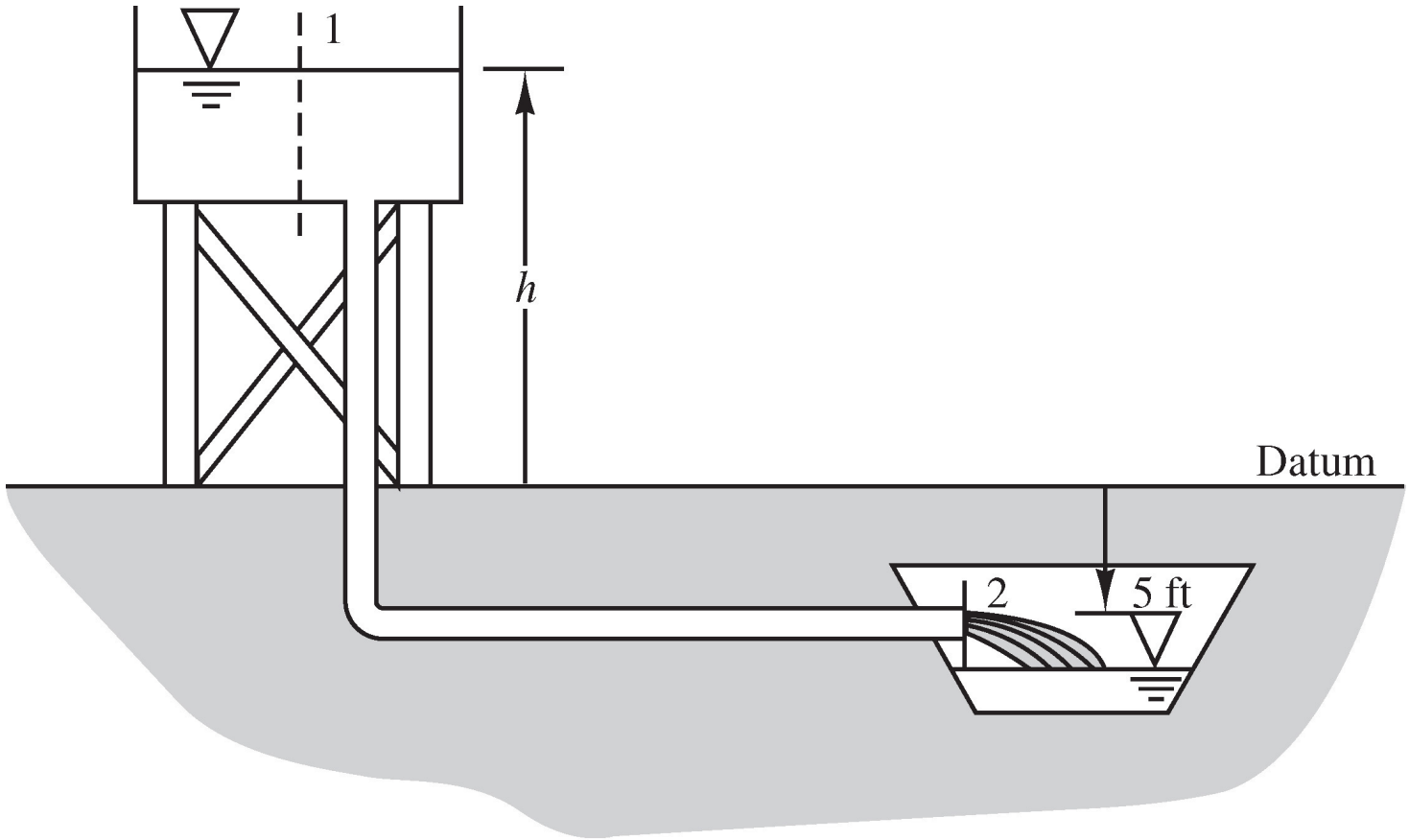
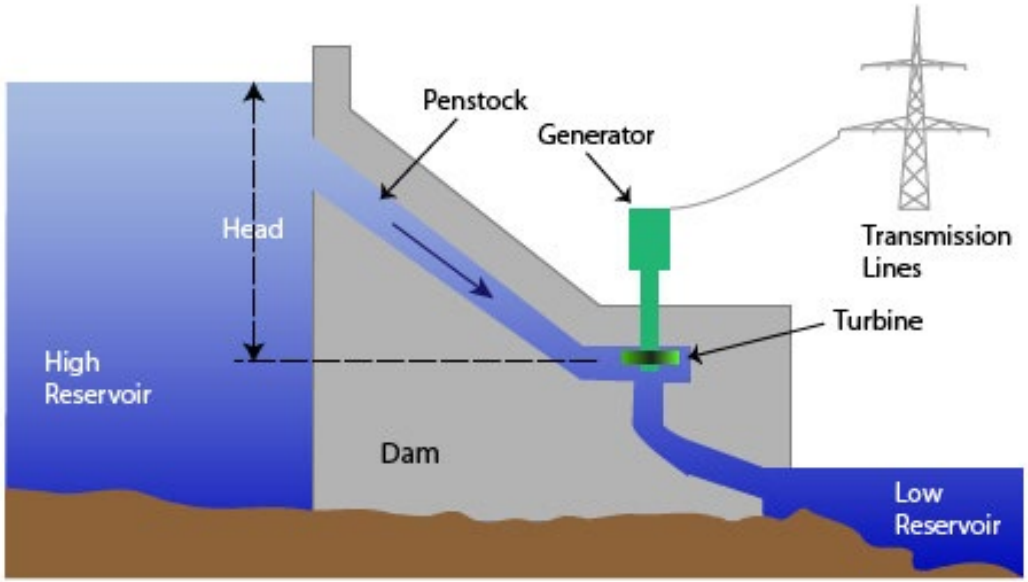


Figure 3.6 Flow from an Elevated Water Tank



Hydroelectric Power Plants



These power plants transform hydraulic energy (position head of the water upstream) to electric (renewable) energy.

Hoover Dam is over 200m high.

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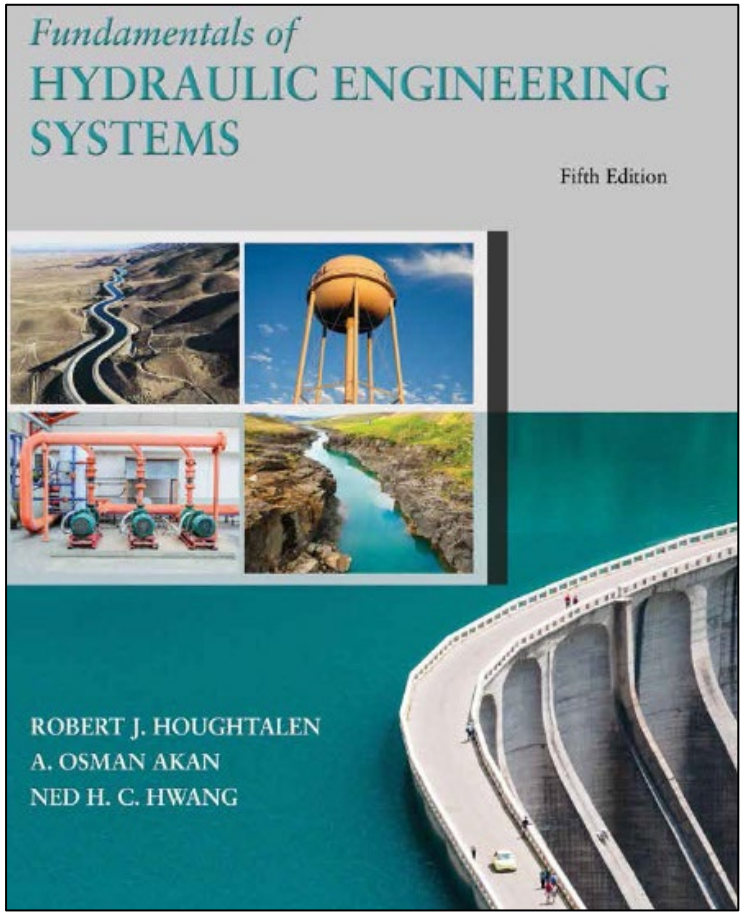

Chapter 3b

Water Flow in Pipes