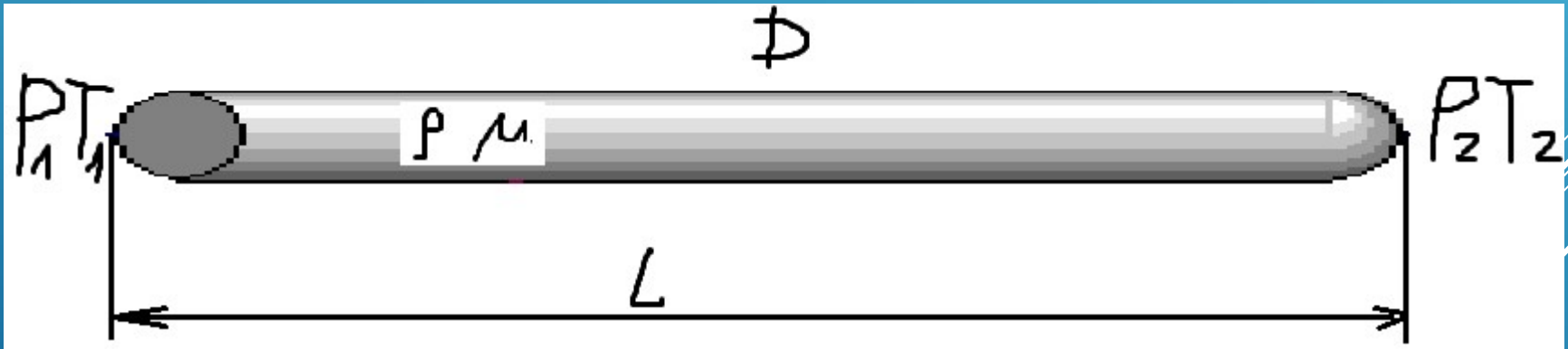
Design Calculation of Lines when Transporting Homogeneous Liquid

In general, pressure differential between the beginning and end line points is equal to:

$$P_1 - P_2 = \Delta P_f \pm \Delta Z \rho g + P_{l.s}$$



THE PRESSURE LOSS TO OVERCOME THE FRICTION FORCES ALONG THE LENGTH OF THE PIPELINE IS CALCULATED BY THE DARCY-WEISBACH EQUATION

$$P_f = \lambda \frac{L}{D} \frac{\upsilon^2}{2} \rho$$

$$\lambda = f(Re)$$

$$Re = \frac{\upsilon \cdot D}{\nu}$$

At laminar flow (Re<2320), the hydraulic resistance coefficient is equal to:

$$\lambda = \frac{64}{Re}$$

At turbulent flow, three zones are distinguished:

1) Zone of hydraulically smooth pipes.

This zone occurs at $2320<Re<10^5$

$$\lambda = \frac{0,3164}{Re^{0,25}}$$

2) Zone of combined friction law

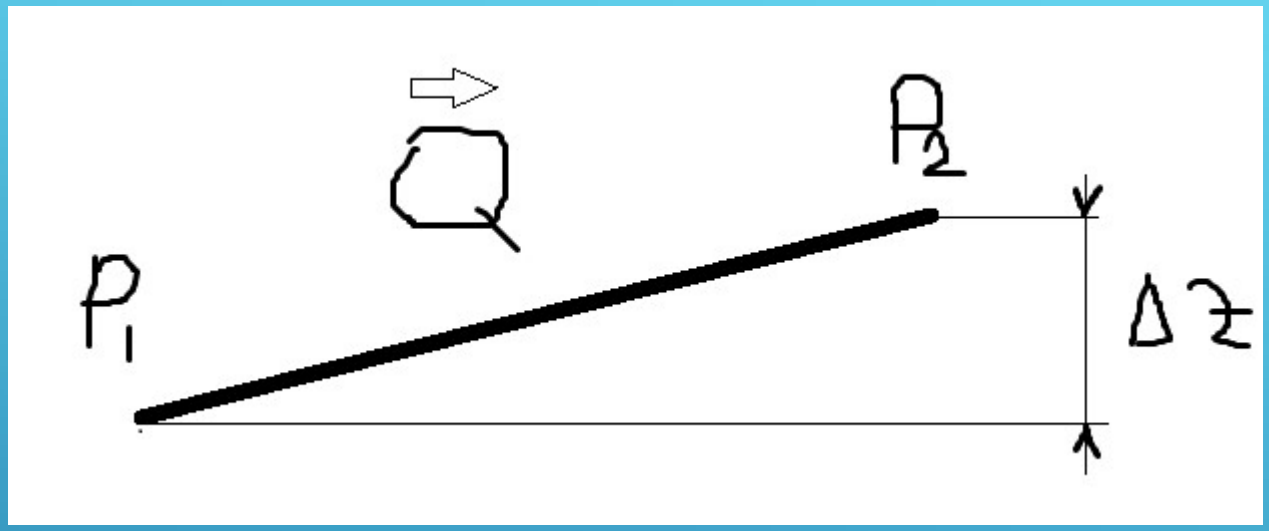
$$10^5 < Re < \frac{2\Delta}{D}$$

$$\lambda = 0{,}11\left(\frac{68}{Re} + \frac{\Delta}{D}\right)^{0{,}25}$$

3) Zone of hydraulically rigid pipes or quadratic zone

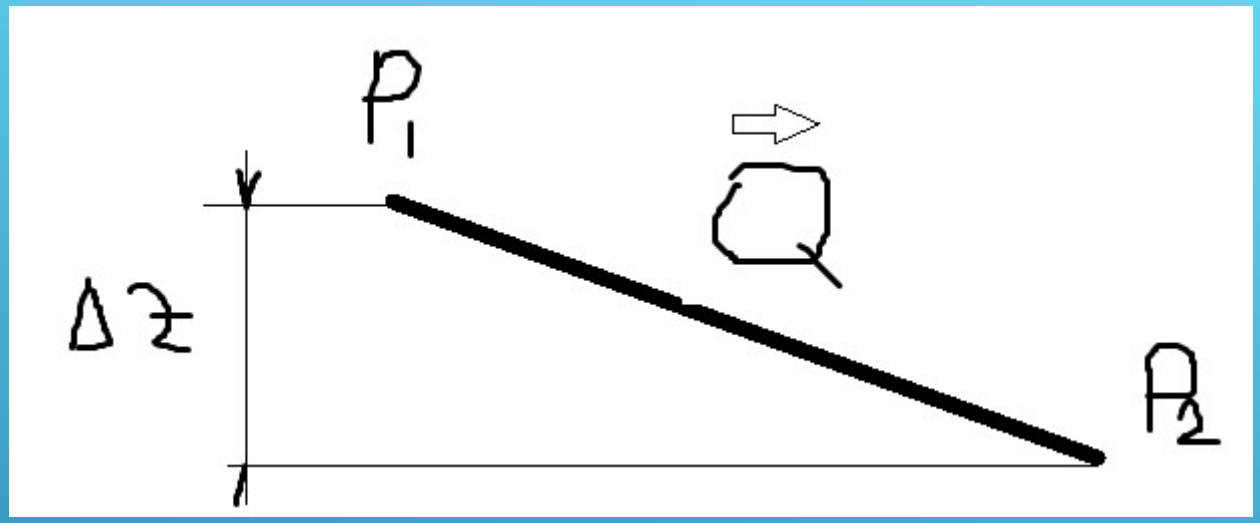
$$\frac{2\Delta}{D} << Re$$

$$\lambda = 0{,}11\left[\frac{\Delta}{D}\right]^{0{,}25}$$



$$P_1 - P_2 = \Delta P_f \pm \Delta Z \rho g + P_{l.s}$$

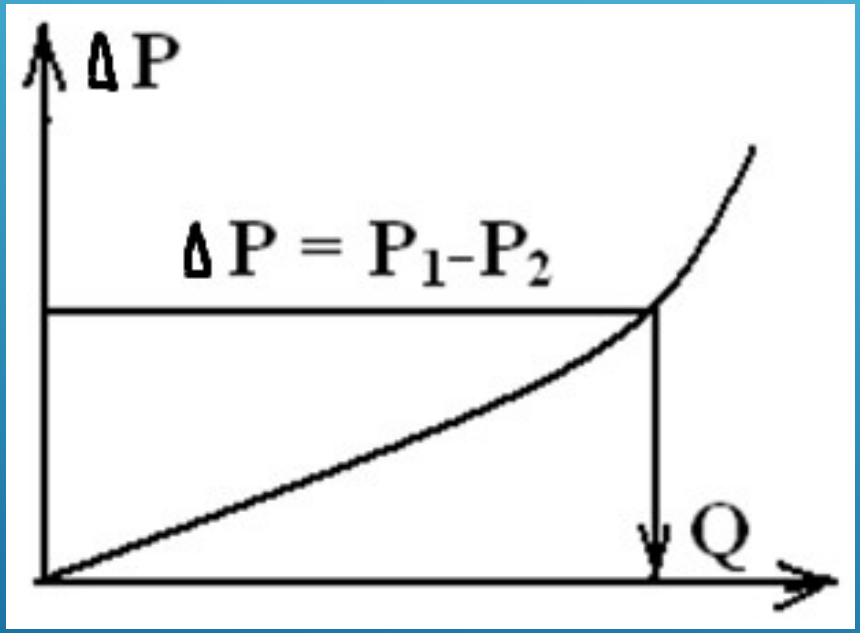
+ or −?



$$P_1 - P_2 = \Delta P_f \pm \Delta Z \rho g + P_{l.s}$$

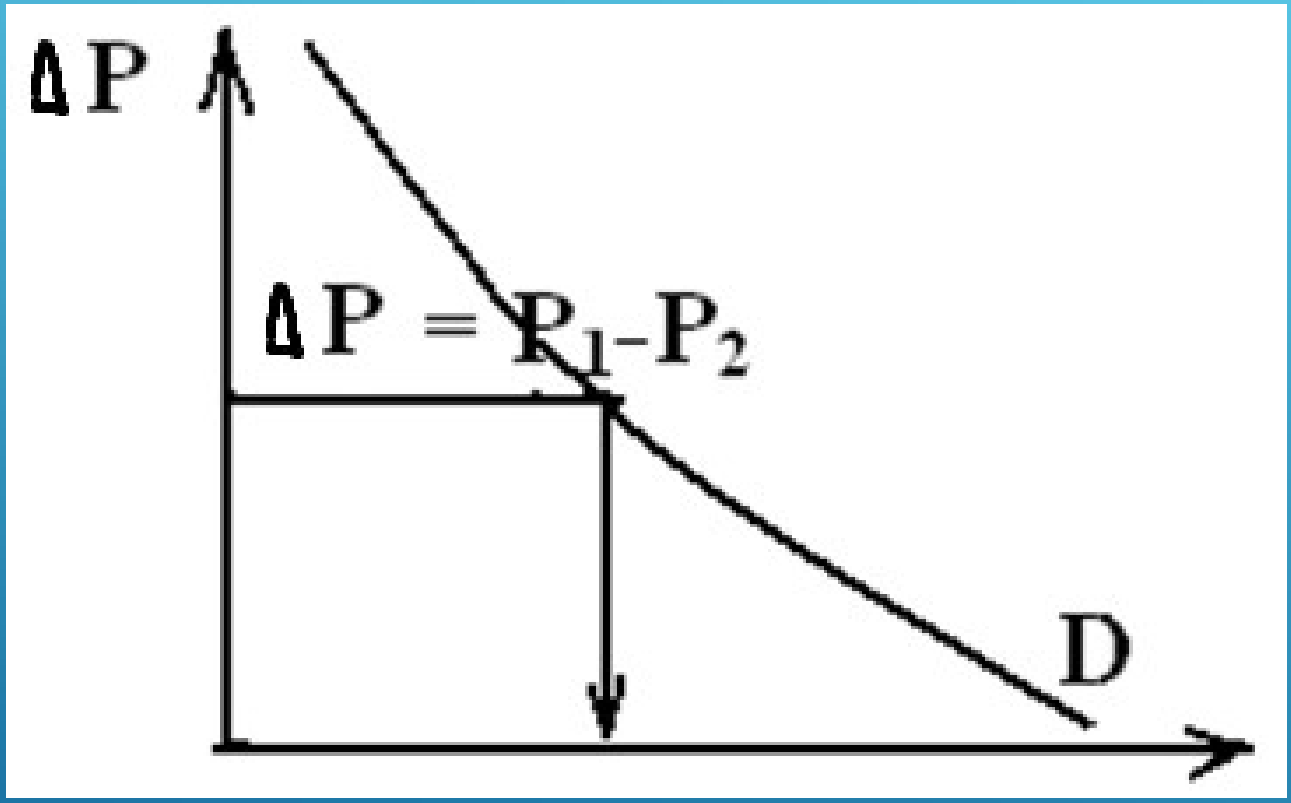
+ or −?

If we have a problem to determine the capacity of the pipeline Q, then this problem can be solved by graphoanalytical method. Here it is necessary to take several arbitrary values of fluid flow Q and determine the pressure loss.



Grapho-Analytical Method for Determination of Line Flow Capacity

Similarly, the problem of determining the required diameter of the pipeline is solved



Grapho-Analytical Method for Determination of Line Diameter

Required oil pipeline diameter for degassed oil supply from the separation unit to the oil treatment unit (OTU).

P_1=2,1 MPa

P_2=0,8 MPa

L=5000 m

ρ=820 kg|m^3

μ=3 mPa·s

Q=750 m^3|d

	1	2	3	4	5
1	d, m	v, m/s	Re	л	dP, Pa
2	0,05	4,42	60406,6	0,026	20825802
3	0,1	1,12	30613,3	0,026	668595,2
4	0,15	0,49	20090	0,0277	90893,85
5	0,2	0,28	15306,6	0,0327	26277,72
6	0,25	0,176	12026,6	0,0302	250000