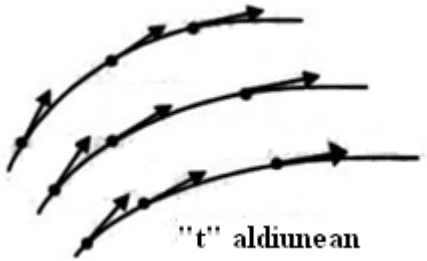
3. JARIAKINEN HIGIDURAREN OINARRIAK

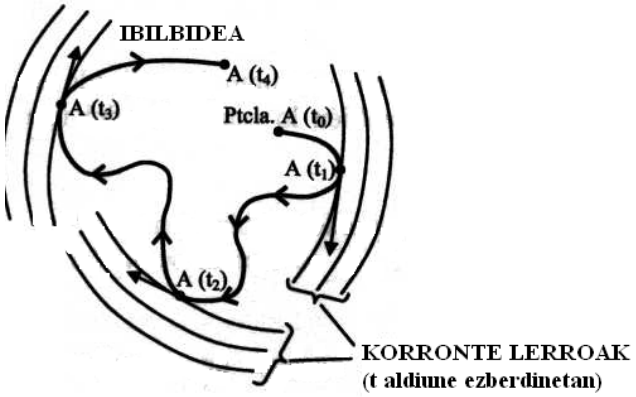
1. KORRONTE LERROAK, IBILBIDEAK, TRAZA-LERROAK ETA KORRONTE HODIA.
2. FLUXUA: OINARRIZKO KONTZEPTUAK.
3. FLUXU MOTAK (SAILKAPENA).
4. FLUXU LAMINARRA ETA ZURRUNBILOTSUA EDO TURBULENTOA.
5. MUGA-GERUZAREN TEORIA.
6. REYNOLDSen GARRAIO TMA.
7. JARRAITUTASUNAREN EKUAZIOA.

1. KORRONTE LERROAK, IBILBIDEAK, TRAZA-LERROAK ETA KORRONTE HODIA.

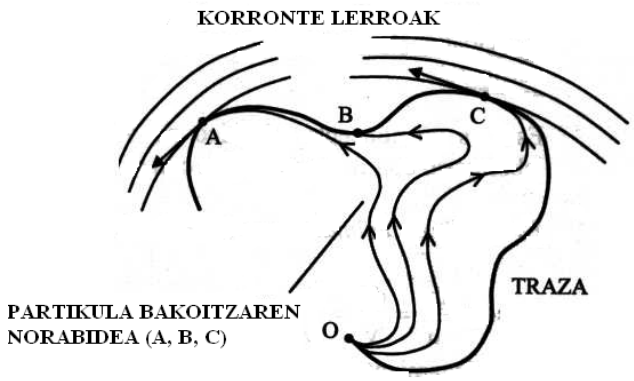
1. KORRONTE LERROAK:



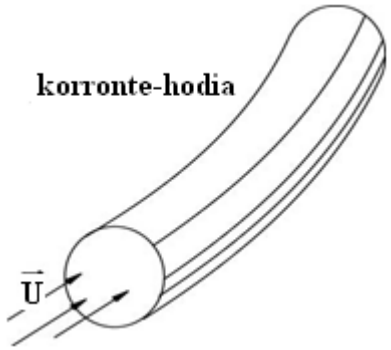
2. IBILBIDEA:



3. TRAZA-LERROAK:

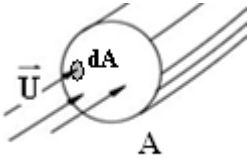


4. KORRONTE-HODIA:



2. FLUXUA: OINARRIZKO KONTZEPTUAK:

1. Q BOLUMETRIKOA



$$Q_V = \iint_A U\,\hat{n}\,dA = \{U\ uniformea\} = U \cdot A = U_m \cdot A$$

2. Q. MASIKOA

$$q_m = \iint_A \rho \vec{U} \hat{n}\,dA = \left\{ \begin{array}{l} \rho = kte \\ U\ uniformea \end{array} \right\} = \rho U A = \rho U_m A$$

3. BATAZ BESTEKO ABIADURA

$$Q_V = \iint_A U\,\hat{n}\,dA = U_m A \Rightarrow U_m = \frac{Q_V}{A} = \frac{\iint_A U\,\hat{n}\,dA}{A}$$

$$U_m = \frac{Q_V}{A} = \frac{\sum U_i A_i}{A}$$

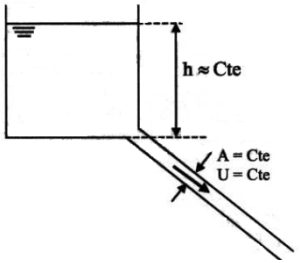
3. FLUXU MOTAK (SAILKAPENA).

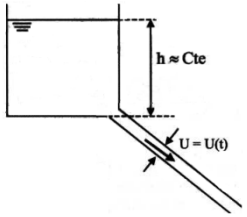
1. FLUXUAREN HEDADURA KONTUTAN HARTUTA:

2. KONPRIMAGARRITASUNARI BEGIRA:

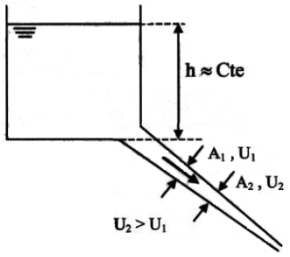
3. ABIADURAREN ALDAKUNTZA DENBORAREKIKO ETA KOKAPENAREKIKO:

1. F. IRAUNKORRA:



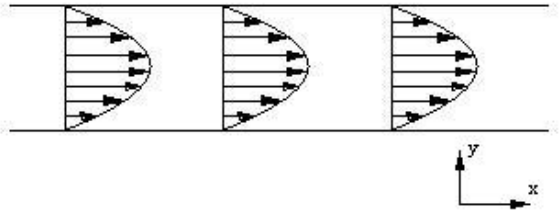


2. F. EZ IRAUNKORRA, ALDAKORRA EDO TRANSITORIOA:



4. FLUXUAREN ABIADURAREN OSAGAIAK KONTUAN HARTUTA:

1. DIMENTSIONALTASUNA:
2. DIREKZIONALTASUNA:



5. FLUXUAREN ITZULEZINTASUNA KONTUAN HARTUTA:
    1. FLUXU ITZULGARRIA.
    2. FLUXU ITZULEZINA.

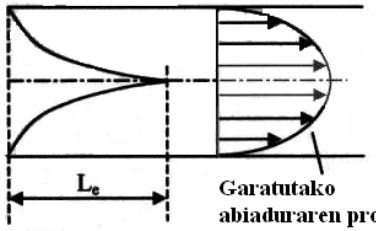
6. BISKOSITATE-INDARRAK KONTUAN HARTUTA:
    1. FLUXU ERROTAZIONALA:

    2. FLUXU IRROTAZIONALA.

7. BERE BISKOSITATEARI BEGIRA:
    1. F. BISKOSOA.
    2. F. EZ BISKOSOA= F. PERFEKTOA.

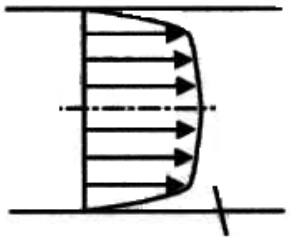
8. F. BISKOSOAK:

1. F. LAMINARRA:



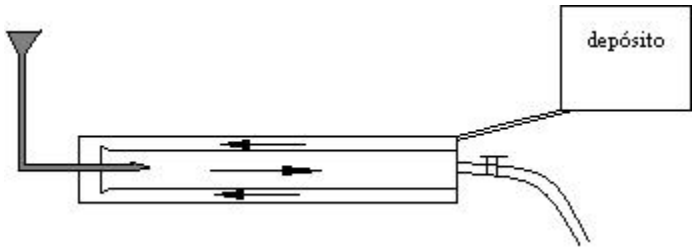
Garatutako abiaduraren profila e. laminarrerako: profil parabolikoa

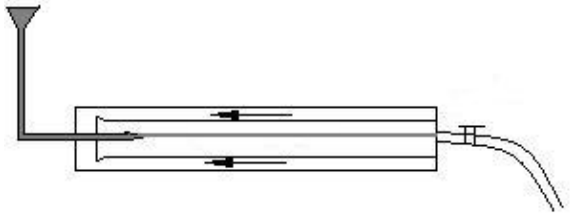
2. F. TURBULENTO:



Garatutako abiaduraren profila, e. turbulentorako: profil logaritmikoa

4. FLUXU LAMINARRA ETA TURBULENTUA (OSBORNE REYNOLDS-EN SAIAKUNTZA)



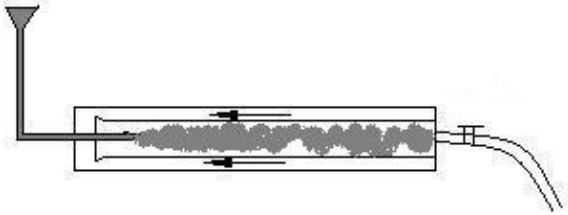


1. Q txikiak: R. LAMINARRA

$$\mathrm{Re} = \frac{UD\rho}{\mu} = \frac{UD}{\upsilon} \leq 2000$$

2. Q ertainak: R. TRANSIZIOZKOA

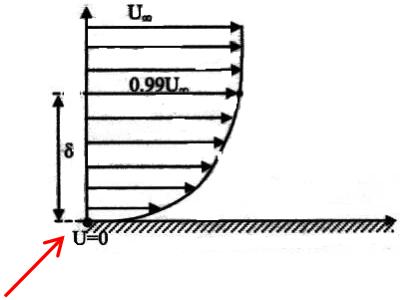
$$2000 < \mathrm{Re} = \frac{UD\rho}{\mu} = \frac{UD}{\upsilon} < 4000$$



3. Q handiak: R. TURBULENTOA

$$\mathrm{Re} = \frac{UD\rho}{\mu} = \frac{UD}{\upsilon} > 4000$$

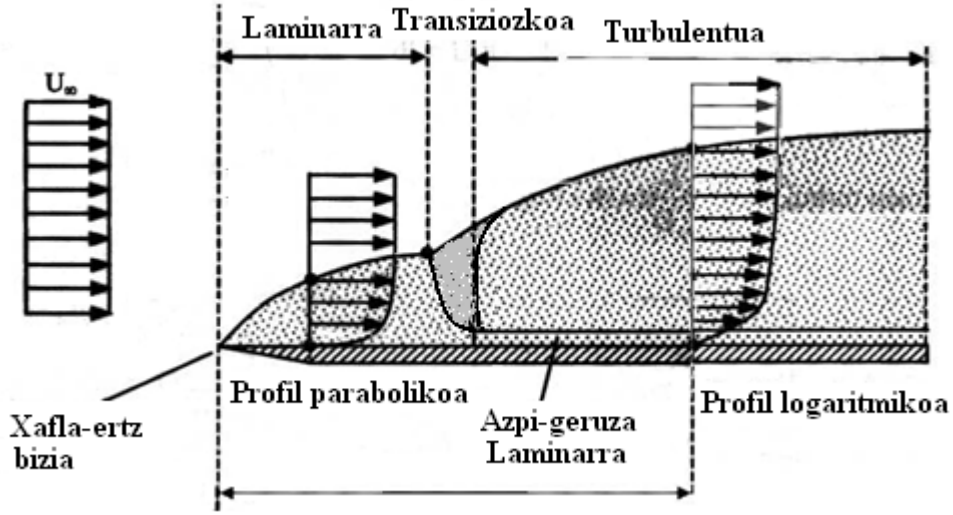
5. MUGA GERUZAREN TEORIA



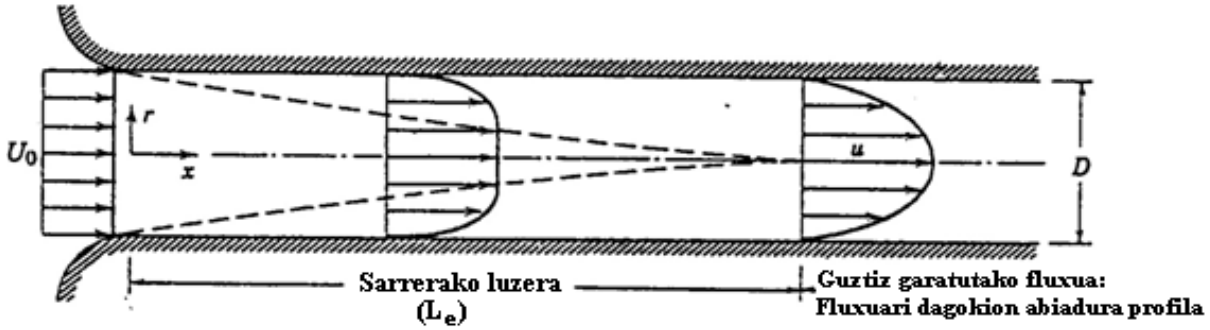
$$\delta = Muga\ geruzaren\ lodiera \Rightarrow \frac{u}{U} = 0{,}99$$

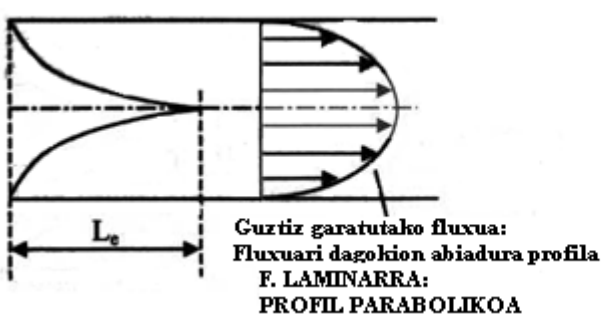
Ez-irristatze baldintza

1. MUGA GERUZAREN ERAKETA KANPOKO FLUXU BATENTZAT (XAFLA LEUN OSO FINA)



3. BARNE FLUXU BATEN MUGA GERUZA

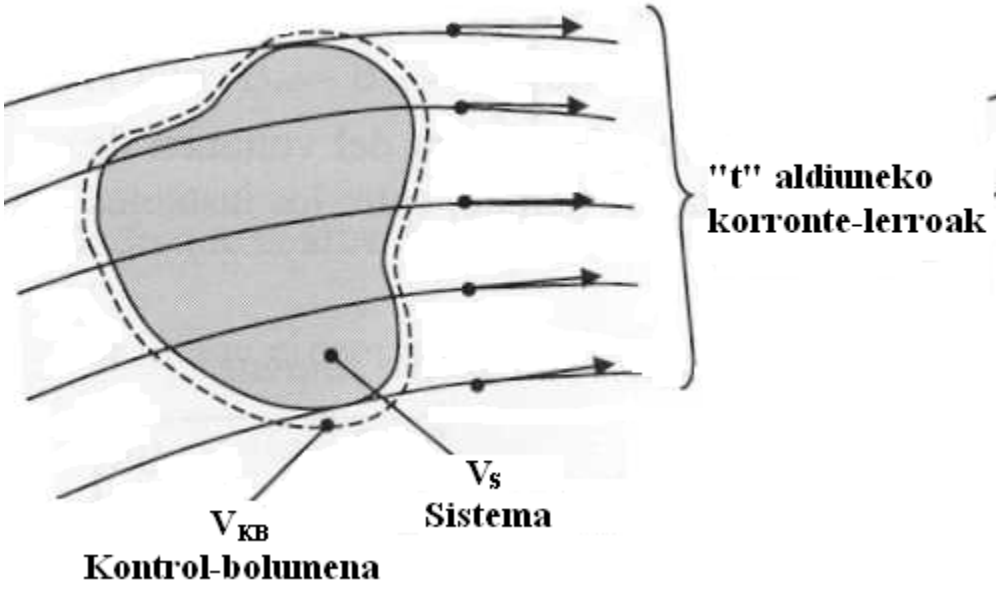


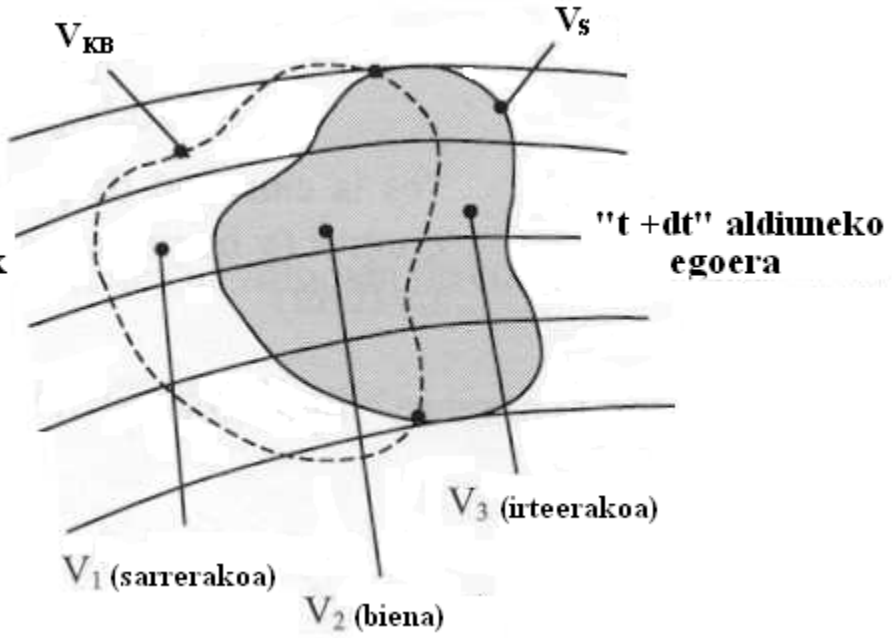


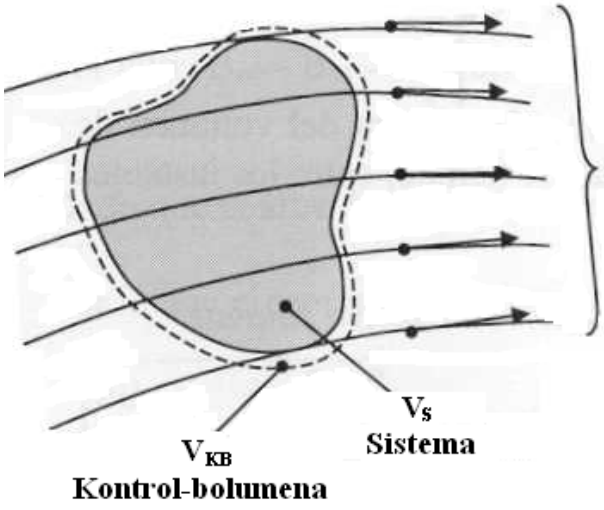
$$\frac{Le}{D} = f(\mathrm{Re}) \Rightarrow \begin{cases} R.\ LAMINAR \Rightarrow \dfrac{Le}{D} = 0.06\,\mathrm{Re}_D \\ R.\ TURBULENTO \Rightarrow \dfrac{Le}{D} = 4.4\,\mathrm{Re}_D^{1/6} \end{cases}$$

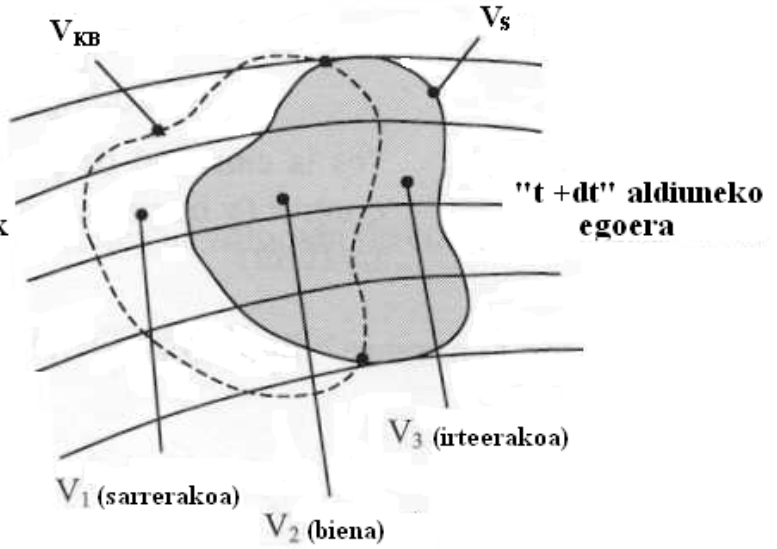
6. REYNOLDSen GARRAIO TMA

1. OINARRIZKO KONTZEPTUAK
    1. SISTEMA
    2. KONTROL BOLUMENA (KB)
2. TMAren EBAZPENA.









$$\frac{dB^S}{dt} = \frac{B^S_{t+\delta t} - B^S_t}{dt} = \left[\lim_{\delta t \to 0} \frac{(\int_{KB} b\rho dV)_{t+dt} + (\int_{v_3} b \quad \rho \quad dV)_{t+dt} - (\int_{V_1} b \quad \rho \quad dV)_{t+dt} \quad (\int_{KB} b\rho dV)_t}{dt} - \frac{}{dt} \right]$$

$$\frac{dB^S}{dt} = \frac{B^S_{t+dt} - B^S_t}{dt} = \lim_{dt \to 0} \frac{(\int_{KB} b\rho dV)_{t+\delta t} - (\int_{KB} b\rho dV)_t}{dt} + \lim_{dt \to 0} \frac{(\int_{v_3} b \quad \rho \quad dV)_{t+dt} - (\int_{V_1} b \quad \rho \quad dV)_{t+dt}}{dt}$$

$$\lim_{dt \to 0} \frac{(\int_{KB} b\rho dV)_{t+\delta t} - (\int_{KB} b\rho dV)_t}{dt} = \frac{\partial}{\partial t} \int_{KB} b\rho dV = \frac{dB^{KB}}{dt}$$

$$\lim_{dt \to 0} \frac{(\int_{V_3} b\rho dV)_{t+\delta t}}{dt} = \int_{A_{irteera}} b\rho \vec{U} d\vec{A} = \dot{B}_{irteera} \qquad \lim_{dt \to 0} \frac{(\int_{V1} b\rho dV)_{t+\delta t}}{dt} = \int_{A_{sarrera}} b\rho \vec{U} d\vec{A} = \dot{B}_{sarrera}$$

REYNOLDSen GARRAIO TMA :

$$\left.\begin{aligned} \frac{dB^S}{dt} &= \frac{dB^{KB}}{dt} + \dot{B}_{IRTEERAKOA} - \dot{B}_{SARRERAKOA} \\ \dot{B}_{IRTEERAKOA} - \dot{B}_{SARRERAKOA} &= \iint_{KG} \rho b \vec{U} d\vec{A} \end{aligned}\right\} \frac{dB^S}{dt} = \frac{dB^{KB}}{dt} + \iint_{KG} \rho b \vec{U} d\vec{A}$$

6. JARRAITUTASUNAREN EKUAZIOA: MASAREN KONTSERBAZIOA PPIOA