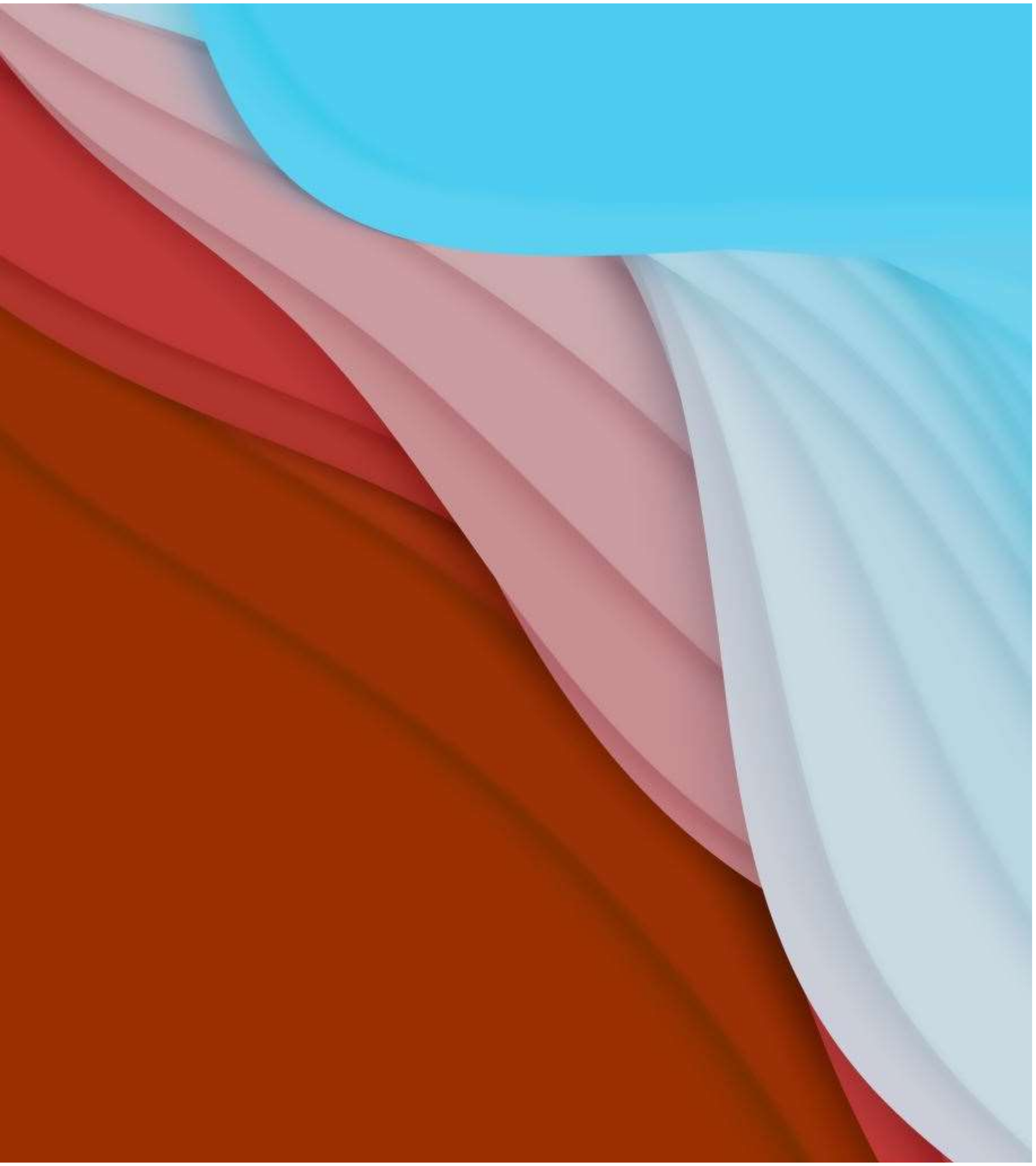
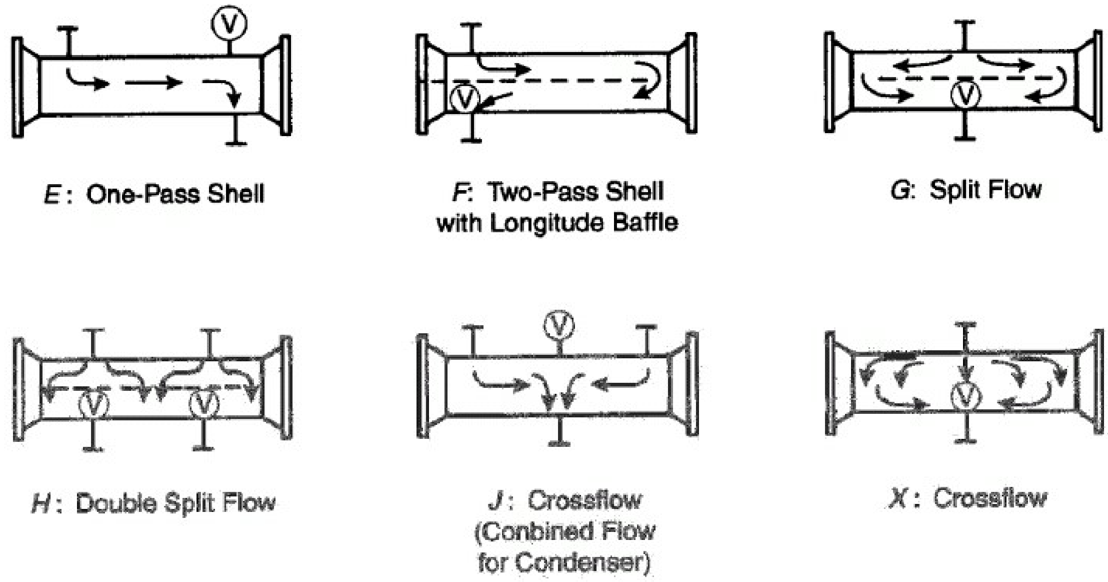


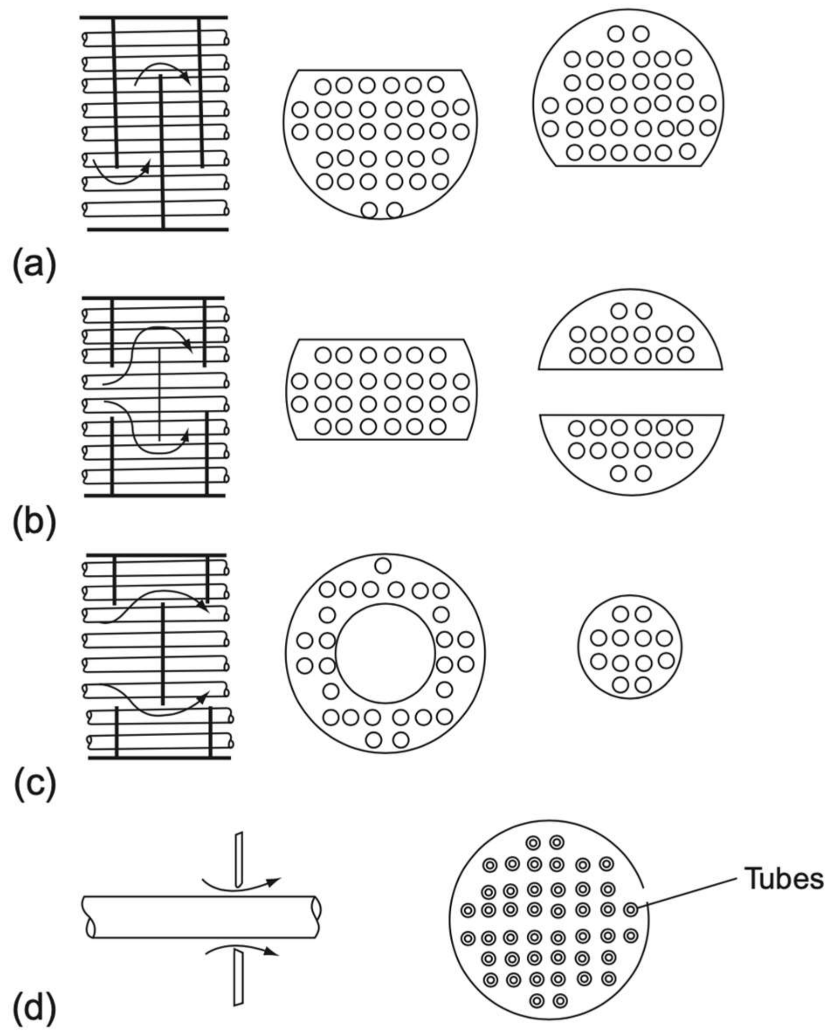
CEN4415
PROCESS DESIGN I

Shell Types:

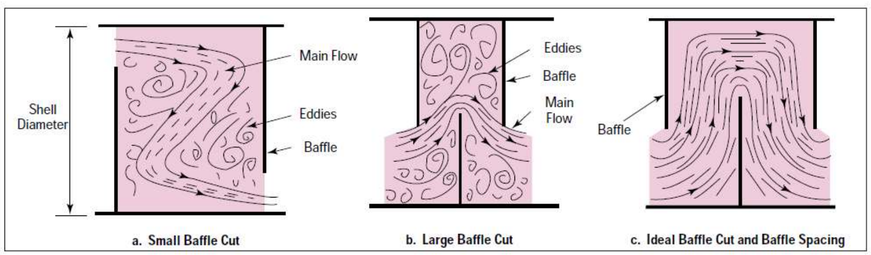


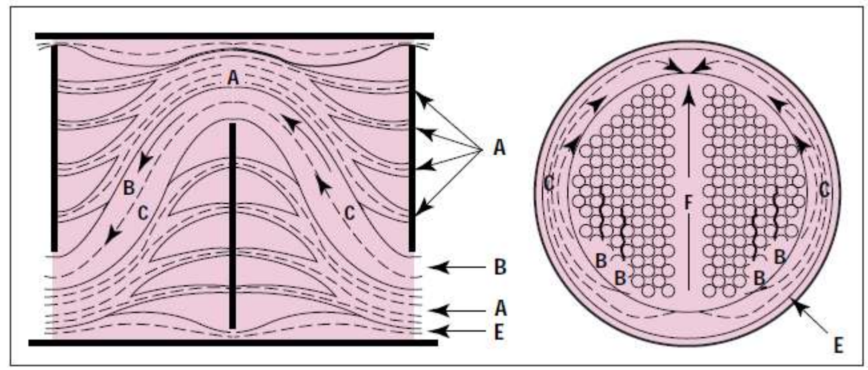
V
E: One-Pass Shell
V
F: Two-Pass Shell
with Longitude Baffle
V
G: Split Flow
V
V
H: Double Split Flow
V
J: Crossflow
(Conbined Flow
for Condenser)
V
X: Crossflow

Baffles



Types of baffle used in shell and tube heat exchangers. (a) Segmental (b) Segmental and strip (c) Disc and doughnut (d) Orifice


Shell
Diameter
Main Flow
Eddies
Baffle
Eddies
Baffle
Main
Flow
Baffle
a. Small Baffle Cut
b. Large Baffle Cut
c. Ideal Baffle Cut and Baffle Spacing


A
B
C
C
A
B
A
E
C
C
F
B
B
B
B
E

TUBE-SIDE HEAT-TRANSFER COEFFICIENT AND PRESSURE DROP (SINGLE PHASE)

Turbulent Flow Inside Conduits of Uniform Cross-Section

$$Nu = C\,\mathrm{Re}^{a}\,\mathrm{Pr}^{b}\,(\mu / \mu_w)^{c}$$

$$Nu = \frac{h_i d_e}{k_f}, \quad \mathrm{Re} = \frac{u_t \rho d_e}{\mu} = \frac{G_t d_e}{\mu}, \quad \mathrm{Pr} = \frac{C_p \mu}{k_f}$$

h_i: inside heat transfer coefficient, W/m^2 °C
d_e : equivalent (or hydraulic mean) diameter, m

u_t : fluid velocity, m/s
k_f : fluid thermal conductivity, W/m.°C
G_t: mass velocity, mass flow per unit area, kg/s.m^2
μ, μ_w : fluid viscosity at the bulk fluid and wall temperature, Ns/m^2
C_p : fluid heat capacity, J/kg.°C
C : constant

$$\mathrm{Nu} = C\,\mathrm{Re}^{0.8}\,\mathrm{Pr}^{0.33}\left(\frac{\mu}{\mu_w}\right)^{0.14}$$

General Equation for Heat Exchanger Design for « Turbulent Flow in Tubes »:

- C=0.021 (gases)
- C=0.023 (non-viscous liquids)
- C=0.027 (viscous liquids)

General Equation for Heat Exchanger Design for « Laminar Flow in Tubes »:

$$Nu = 1.86(Re\,Pr)^{0.33}\left(\frac{d_e}{L}\right)^{0.33}\left(\frac{\mu}{\mu_w}\right)^{0.14}$$

REFERENCES

1. Sinnot, R.K. 1999, Coulson's & Richardson's Chemical Engineering, Volume 6, Chemical Engineering Design, ButterWorth Heinemann, Oxford.

2. Turton R., Bailie R.C., Whitin W.C., Shaeiwitz J.A. 1998, Analysis, Synthesis and Design of Chemical Processes, Prentice Hall, New Jersey.