

Heat Exchangers



What is a heat exchanger?

Heat Exchangers (HX) are devices where heat is transferred between two fluids at different temperatures without any mixing of fluids

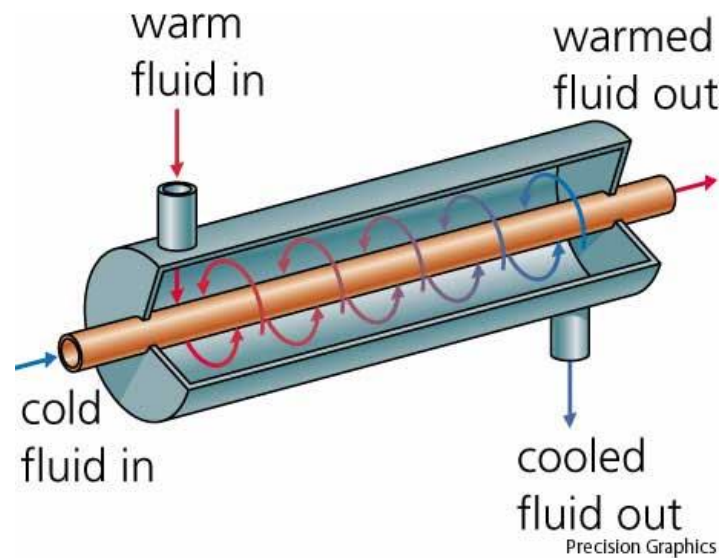
Classification of HX

- Hundreds of types of heat exchangers depending on designs, geometry, flow configurations, materials, etc.
- 3 broad classifications
 - **Direct Transfer type**
 - Storage type
 - Direct contact type

Focus of our course will be on Direct Transfer type

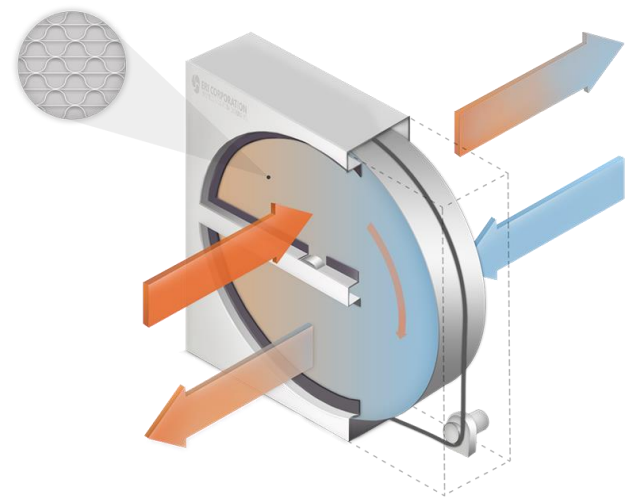
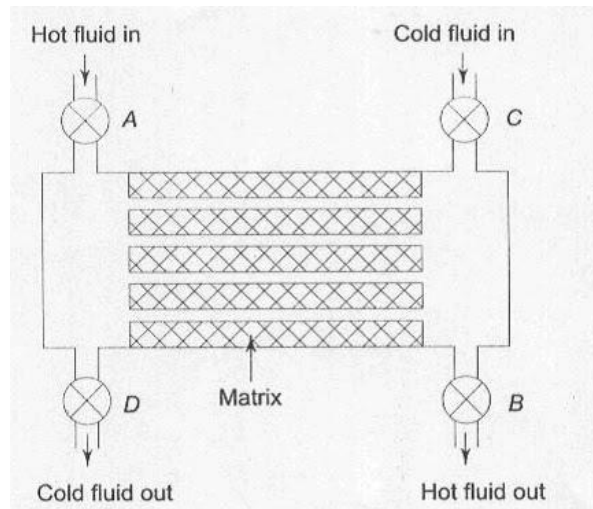
Direct Transfer Type HX

- It is that type of heat exchanger where the hot and cold fluids flow simultaneously through the device and heat is transferred through a wall separating the fluids.



Storage type HX

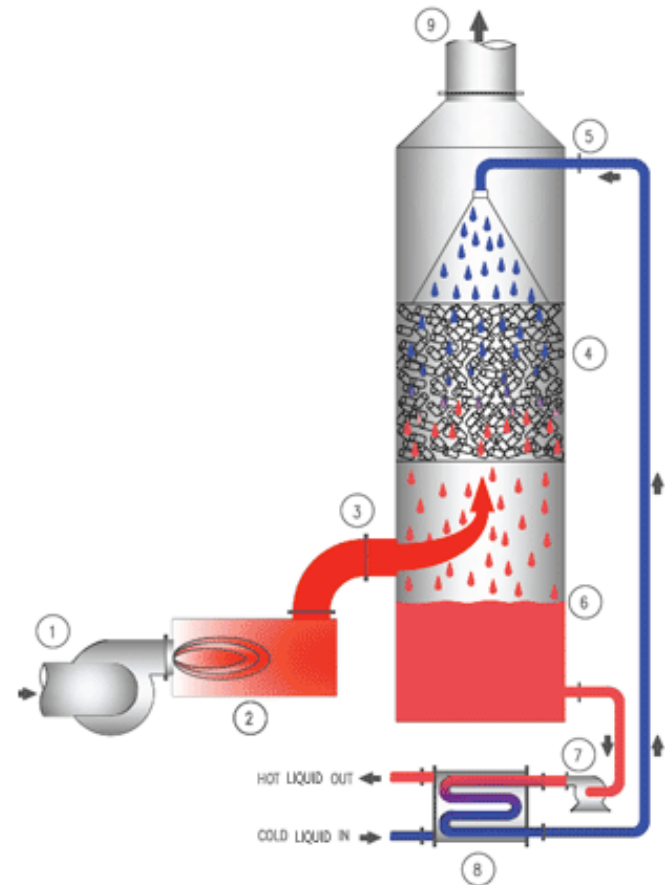
- It is a heat exchanger where heat transfer between the hot and cold fluids occurs through a coupling medium in the form of a porous solid matrix. The hot and cold streams flow alternately through the matrix, the hot fluid storing heat in it and the cold fluid extracting heat out of it.
 - Also called regenerative type HX



Heat Recovery Wheel

Direct Contact HX

- In Direct Contact type HX, the two fluids are NOT separated. If heat is to be transferred between a gas and a liquid (most common), the gas is either bubbled through the liquid or the liquid is sprayed into the gas.

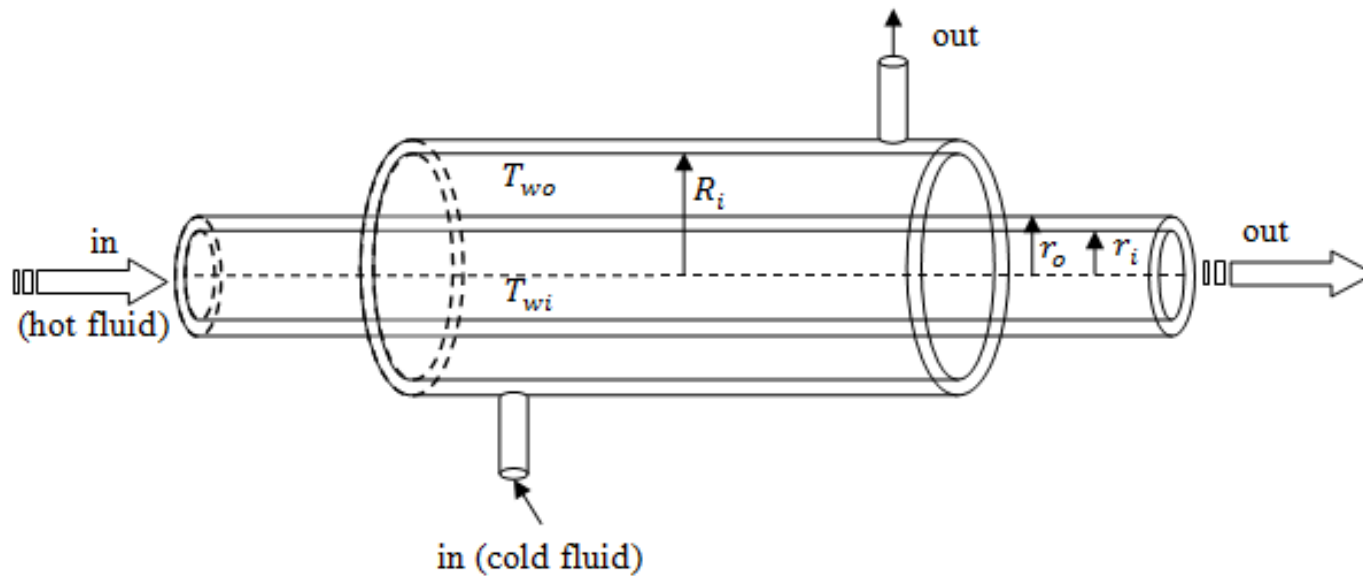


Direct Transfer HX - Classification

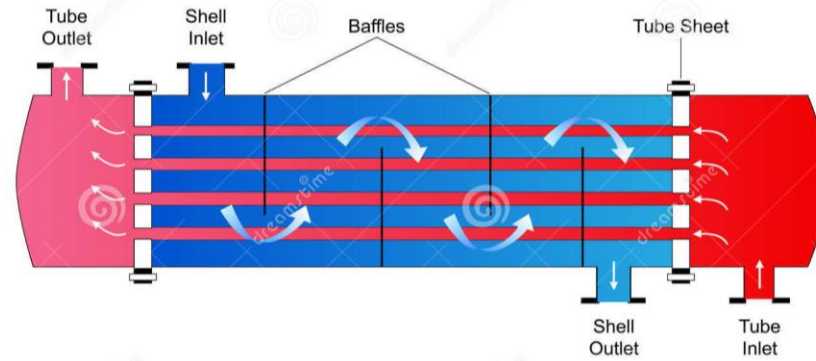
- Classification by Design Type
 - Tubular
 - Concentric Tube or Double pipe
 - Shell and Tube
 - Parallel Plate
 - Extended Surfaces

Note: many other designs are possible; above three are the most commonly encountered ones

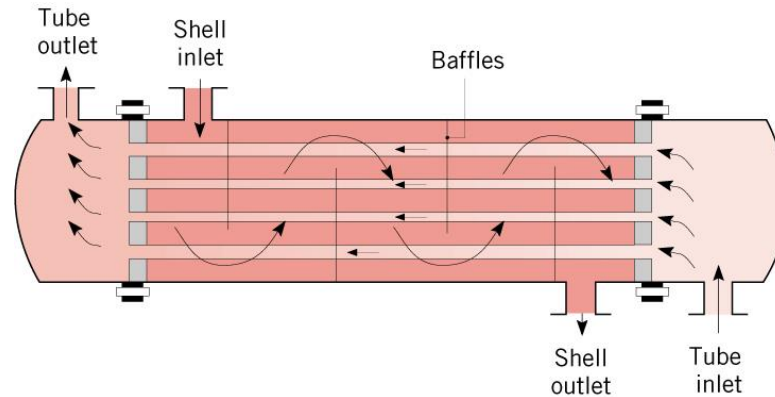
Concentric tube



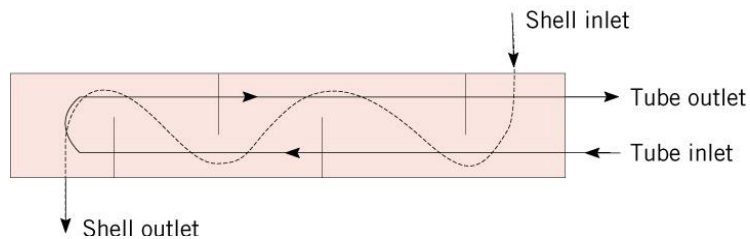
Shell and Tube



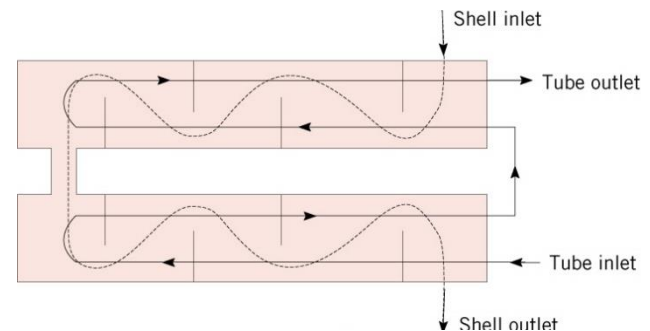
Shell and Tube types



One Shell Pass and One Tube Pass

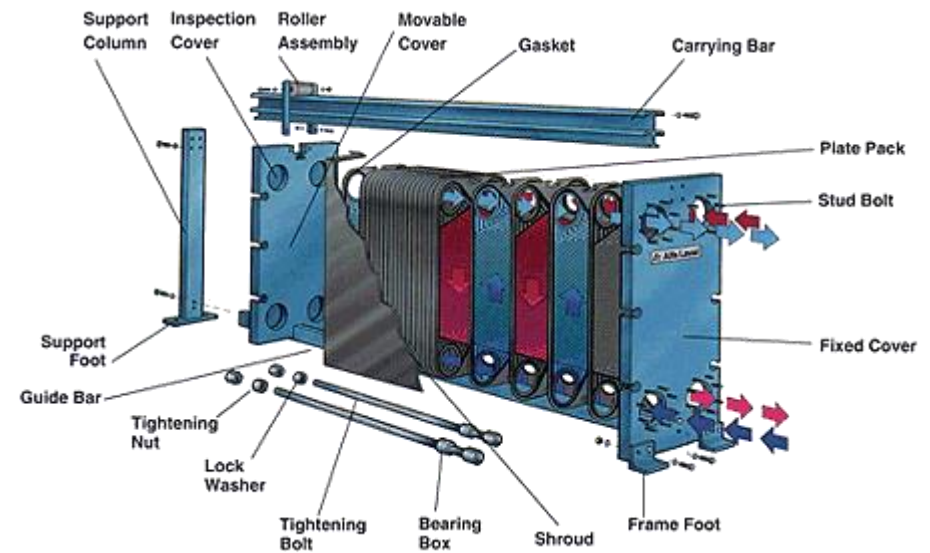
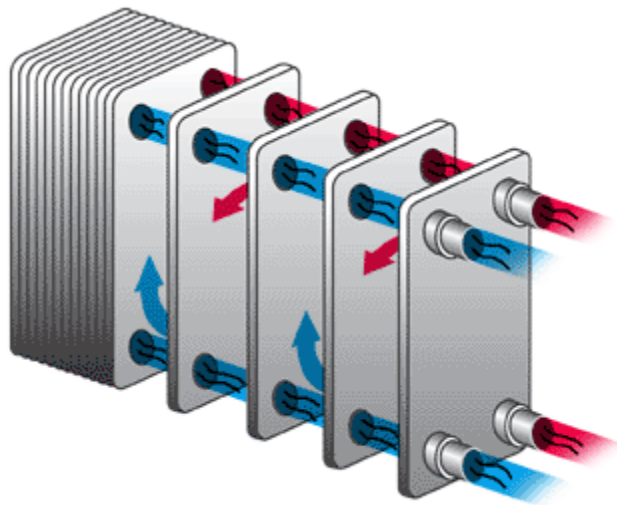
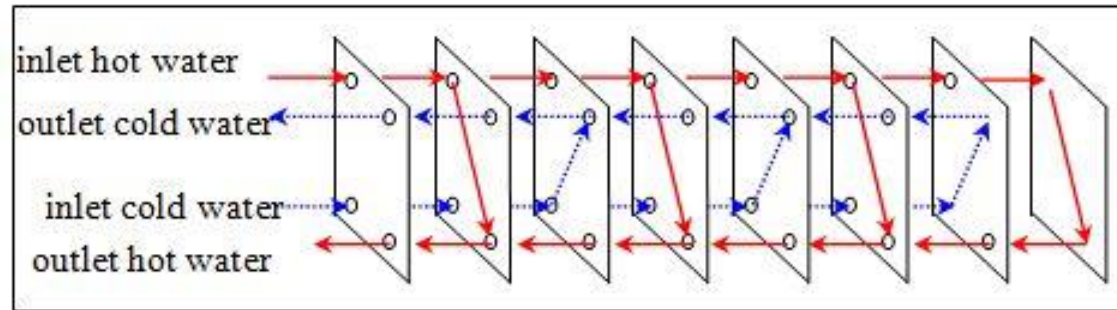


**One Shell Pass,
Two Tube Passes**

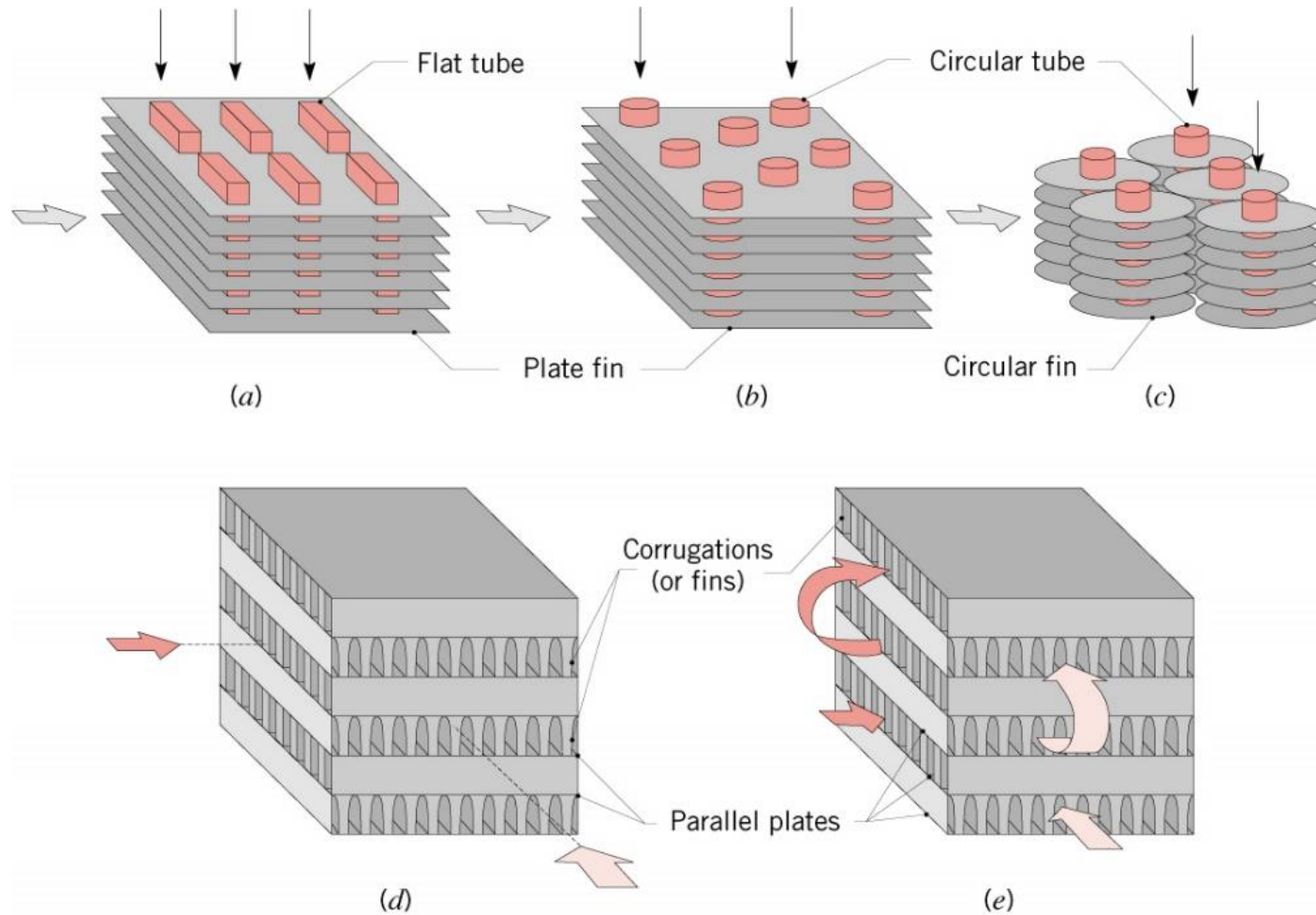


**Two Shell Passes,
Four Tube Passes**

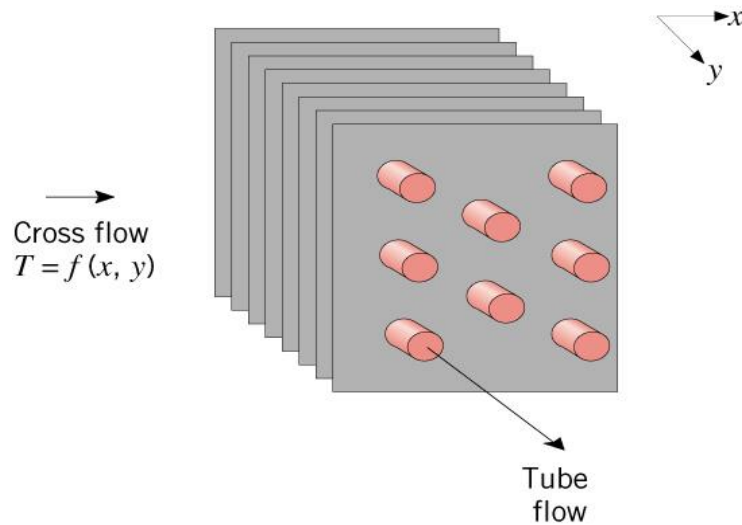
Parallel plate HX



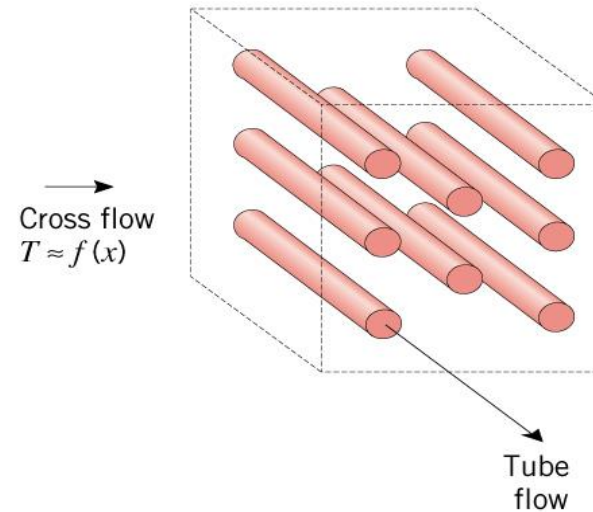
Extended Surfaces



Cross Flow HX – mixed/unmixed



**Finned-Both Fluids
Unmixed**



**Unfinned-One Fluid Mixed
the Other Unmixed**

Note: Finned tube HX is BOTH FLUIDS UNMIXED

Class Notes topics

- Parallel & Counter Flow
 - Concept of Overall Heat Transfer Coefficient (U)
 - Fouling
 - Mean temperature difference – LMTD
 - Parallel Flow
 - Counter Flow
 - Cross Flow & Shell and Tube (*F charts*)
 - Refer to any text book on Heat Transfer
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Effectiveness – NTU Method

Refer to Class Notes

- Definition of Effectiveness
 - Calculation of Effectiveness for Parallel and Counter Flow HX
 - NTU and Heat Capacity Ratio (C) definitions
 - Charts for different types of HX
 - Refer to any text book on Heat Transfer
 - Special case of $C = 0$
 - Expected to remember ϵ – NTU relationship
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Thank You!

