ch 1

Thermo- fluid

outlines

- fluid thermal system
  (definations and examples)
- Conventional unit systems
  - design process
  - design phases
  - Codes
  - standards
  - product safety

CHAPTER 1 Introduction

Fluid thermal systems is a very broad term that refers to many designs and devices. A pump and pipe combination is an example of a fluid system in which fluid is being conveyed. An air conditioner is a device in which a fluid is conveyed, so it is an example of a fluid system. Moreover, because heat transfer effects are important in the air conditioner, we can consider it a fluid thermal system.

a combination between fluid and thermo

Flow in pipe (fluid)

Heat transfer between the fluid and air[thermal]

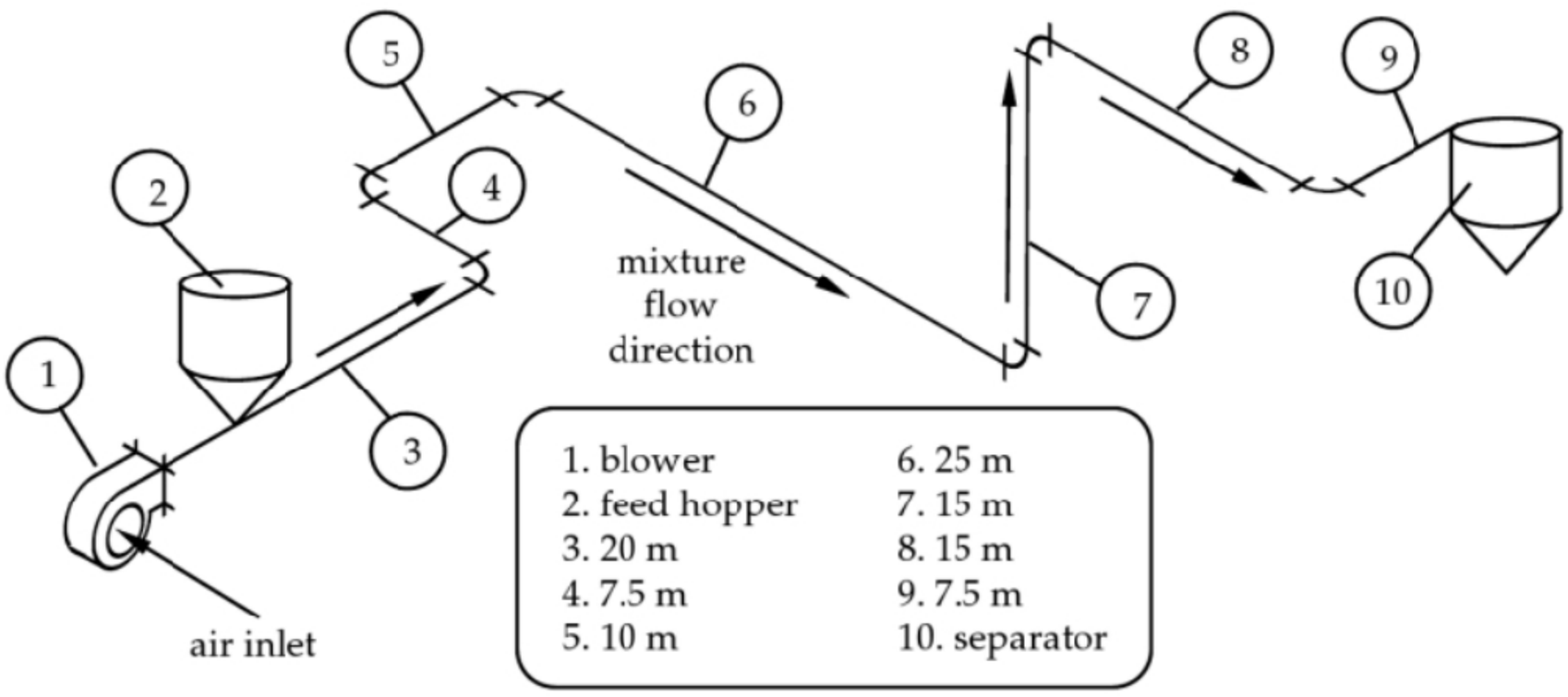

FIGURE 1.1. *Sketch of a freight pipeline.*

Fluid thermal system

هو مصطلح واسع يشمل التصاميم والاجهزة

التي تدمج بينها حركة الموائع وانتقال الحرارة

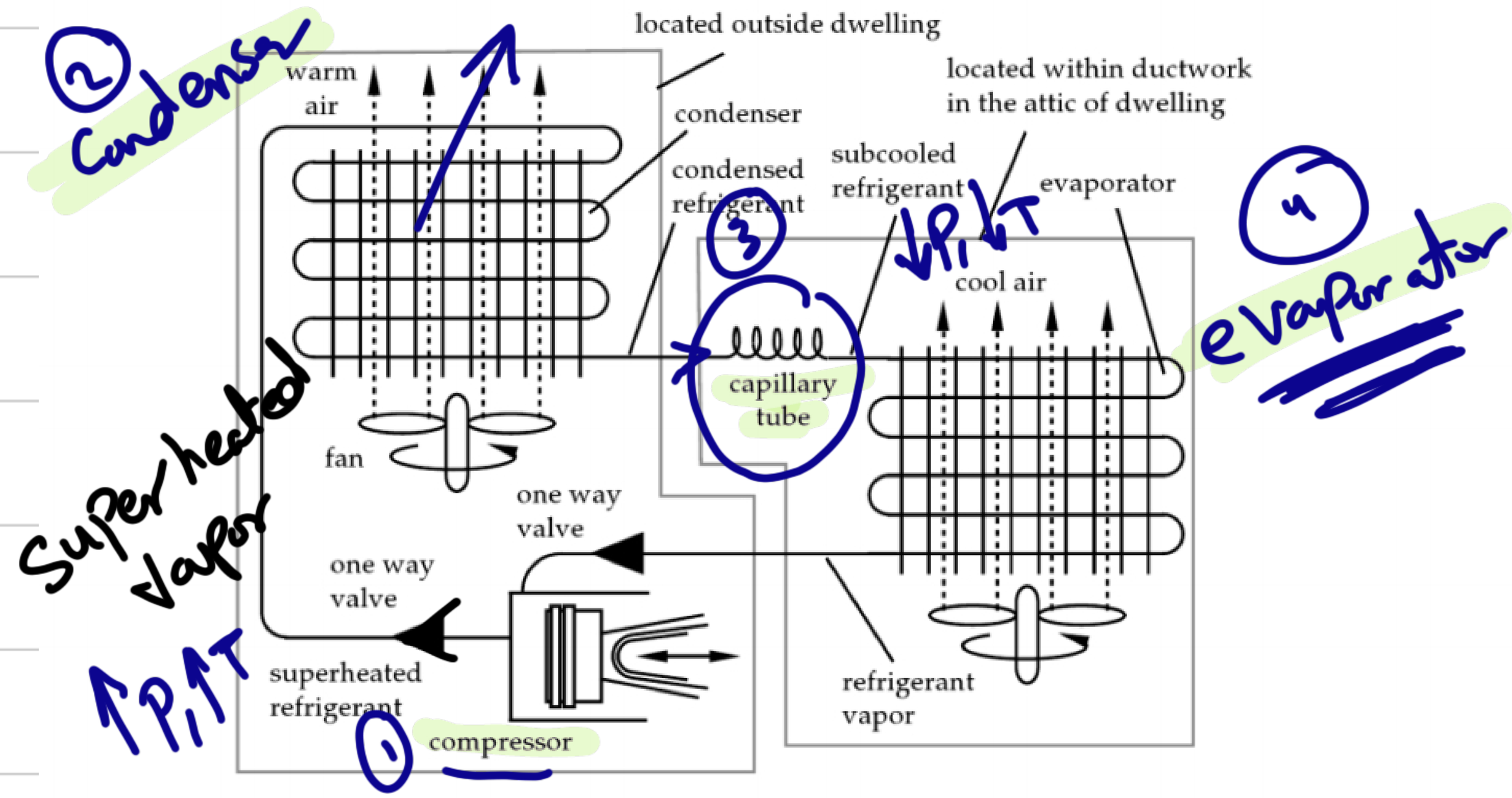

FIGURE 1.2. *Sketch of an air conditioning unit.*

→ the refrigerant flow [fluid]

→ the heat transfer between the refrigerant and air (thermal)

(thermo-fluid system)

TABLE 1.1. *Conventional unit systems.*

Dimension	British Gravitational	SI	Engineering	British Absolute
Mass (M) (derived)	slug			
Mass (M) (fundamental)		kg	lbm	lbm
Force (F) (derived)		N		poundal
Force (F) (fundamental)	lbf		lbf	
Length (L)	ft	m	ft	ft
Time (T)	s	s	s	s
Temperature (t)	°R °F	K† °C	°R °F	·R °F
Conversion Factor g_c	—	—	$32.2\ \frac{\text{lbm·ft}}{\text{lbf·s}^2}$	—

†Note that in SI, the degree Kelvin is properly written without the ° symbol.

1.1 The Design Process

The design process (ranging from accepting a "job" to producing a final report) involves more than merely finding a solution. So in this section, we will discuss several aspects associated with obtaining a solution to a design project. It is prudent to note that in engineering design work, there may be many possible solutions to a design problem. We will discuss the nature of engineering design, the bidding process, project management, and evaluation and assessment of performance.

bidding process عملية تقديم العطاءات

Nature of Engineering Design

The design activity can include looking at drawings, making decisions, gathering information, attending meetings, considering alternatives, and much more. Design is not necessarily a single task but an entire process. An engineer goes through this process to determine how best to use resources to accomplish a required job. Engineers design systems or devices that could be of interest to the public, or to satisfy the desires of a single client.

An unfortunate aspect of design is that, in most cases, what the client wants may be unclear to both the engineer and to the client. Problem statements are often filled with uncertainty and are poorly articulated. For this reason a good design engineer will spend considerable time defining the problem and planning the way it will be solved. Work on a project should not be delayed until the last minute when failure to meet an unanticipated requirement leaves no time for correction. Project work requires careful planning and sound management methods.

مراحل التصميم الأساسية

١- ادراك الحاجة : احتياج العميل لحل مشكلة ما

٢- تحديد المشكلة : تشمل وضع المواصفات الدقيقة مثل الابعاد والتكاليف ومعروف التشغيل والقيود

٣- توليف الحلول : تحليل التصميم والوصول لافضل حلول وهي عملية تكرارية للوصول لافضل نتيجة

٤- التقييم : اثبات نجاح التصميم وقدرته على أداء المهمة

Design Phases

مراحل التصميم ①

The design process encompasses many phases including: recognizing a need, ② identifying the problem, ③ synthesizing a solution, re-designing (if necessary) for optimizing the design ④ evaluating the design, and communicating the results. Figure 1.4 illustrates one (of many) ways that the steps in a design can be synthesized.

Design begins when a client recognizes a need and begins working on satisfying that need. The need can be something obvious or merely a sense that something is "not right." Recognition of the need may be triggered by an adverse circumstance.

Recognizing a need and identifying or defining the problem are different things. We might recognize the need for cleaner air in a building, and the problem might be an inadequate filtering system. Defining the problem must include all specifications for the system to be designed. This includes its dimensions, characteristics, location, costs, expected life, operating conditions and limitations. Restrictions often encountered include available manufacturing processes, labor skills, materials to be used, and sizes in stock.

An optimum solution can be sought once the problem has been defined and its contraints have been identified. Synthesis of the optimum solution requires analysis and optimization. The design must comply with the specifications and if it is not optimum, a re-design is necessary. This part of the process is iterative in nature and continues until the "best" solution is found.

Evaluation of the design is a significant aspect of the design process. Evaluation is proof that the design is successful.

الكود (code) ← هو عبارة عن مواصفات لتحليل وتصميم أو بناء الأشياء لضمان الحد الأدنى من الأمان

المعيار (standard) ← هو مواصفات لأحجام القطع أو انواع المواد لضمان التوحيد في القياس والجودة

Codes and Standards

A **code** is a specification for the analysis, design, or construction of something that specifies the minimum acceptable level of safety for constructed objects. For example, each locality has a code for the size of tubing to use in the plumbing of a house. The purpose of a code is to guarantee a certain degree of safety, performance, and quality. *Absolute* safety is not necessarily assured by a code, but a reasonable level can be met. There are many established standards and codes, enacted by the appropriate authority. Each organization deals with a specific area, such as plumbing, construction, parking lots, and pedestrian walkways. Codes and standards are sometimes established by manufacturers, and sometimes by engineers who work in the industry. Establishment of a code or standard in almost all cases is in response to a perceived need.

A **standard** is a specification for sizes of parts, types of materials, or manufacturing processes. The purpose of a standard is to provide the public or the customer with uniformity in size and quality. A bolt standard, for example, is 1/4-20. All 1/4-20 bolts and nuts have the same thread specifications or standards. There are standards for clothing sizes, paper sizes, wire sizes, shoe sizes, can sizes, furniture sizes, newspaper sizes, as well as bolts and nuts.

يتضح باستخدام الاكواد القياسية المتوفرة في السوق العملي وبهدف تقليل التكلفة

Economics

Cost considerations play an important role in the design process. Unfortunately, costs are sometimes unpredictable. The designer may have missed a hidden cost. Furthermore, some costs change from year to year depending on the economy of the nation. Cost must be considered, however, as thoroughly as possible in the design process.

Using standard sizes is almost a necessity in keeping costs low. A good example is pipe and tubing, both of which are available in discrete sizes. Pumps, motors, fasteners, and the like., are all manufactured to certain standards, and using stock sizes is an excellent idea.

Product Safety

The engineer should make every effort to ensure that the design is safe and has no defects. An engineer or manufacturer can be held liable for unforseen defects, even those that surface years after the design was finalized. Public safety is the engineer's chief concern.

الامان العام هو الهم الشاغل للمهندس حيث يمكن محاسبته قانونياً عن اي عيوب غير متوقعه قد تبدو بعد سنوات من التصميم.