A Note on Dimension and Unit

Dimensions: any physical quantity

mass, length, time, temperature, pressure, velocity, force, work, energy, thermal conductivity, electric current ……..

Primary Dimension : Basic Dimension (Table 1-1)

Secondary (derived) Dimensions : the dimensions which are expressed in terms of the primary dimensions

Unit: The arbitrary magnitude assigned to the dimension.

A number of unit system have been developed over the years

SI System : International System

English Engineering System: United States Customary System
American Engineering System (AE)

AE System: has no numerical base, various units are related to each other in a rather arbitrary way, confusing and difficult to learn.

length: ft, mass: lb, force: lbf, pressure: psi, energy: BTU

SI System: simple, logic, units are related by physical law, based on decimal relationship (Table 1-2).

Force = mass x acceleration ; $F = m \times a$

SI System: 1 Newton = 1 kg x 1 m/sec^2

AE System: 1 poundal = 1 lb x 1 ft/sec^2

1 lbf = 32.174 lbm x 1 ft/sec^2 (pound force)

or 1 lbf = 1 lbm x 32.174 ft/sec^2

Work (energy, heat) = force x distance; $W = F \times D$

SI System : 1 Joule = 1 Newton x 1 m

AE System : 1 ? = 1 lbf x 1 ft

BTU : British Thermal Unit

1 BTU: the energy required to raise the temperature of 1 lbm of water at 68 F by 1 F 1 BTU = 778.1 lbf-ft

1 cal : the energy required to raise the temperature of 1 g of water at 15 C by 1 C (calorie)

1 cal = 4.1868 j (1 大仟 = 1000 cal, 1Cal = 1 kcal)

Dimension Homogeneity:

$$A = B \times C + D \times E \times F$$

The formula that is not dimensionally homogenous is definitely wrong.

But a dimensionally homogenous formula is not necessary right

Decimal Relationship:

10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{-1}
Pico(p)	nano(n)	micro(μ)	milli(m)	centi(c)	deci(d)
pm	nm	μm	mm	cm	dm
	奈米	微米	毫米	公分	公寸

10^{1}	10^{2}	10^{3}	10^{6}	10^{9}	10^{12}
deka	hecto	kilo(k)	mega(M)	giga (G)	tetra(T)
		km (公里)	Mm	Gm	Tm
		kW	MW	GW	TW
		千瓦	百萬瓦	十億瓦	

100 1,000 (10^3) 10,000 1,000,000 (10^6)

百: hundred; 千: thousand; 萬: ten thousands; 百萬: million

10,000,000 100,000,000 1,000,000,000 (10^9)

千萬: ten million; 億: hundred million; 十億: billion

1,000,000,000,000 (10^{12})

兆 (萬億) : trillion