



# Refrigeration and Air conditioning Engineering.

3<sup>rd</sup> year – refrigeration and Air  
conditioning Course

Lecture -9- part2

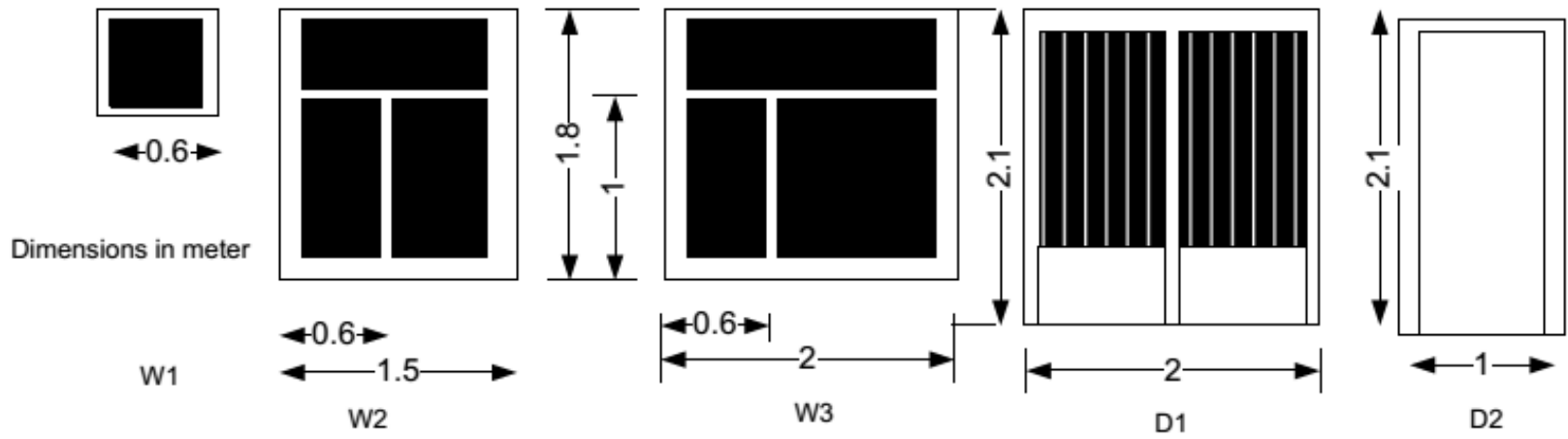
Heating Load Estimation

M.Sc. Zahraa F. Hussain

# Example 3.

A single-family detached house shown in Fig. 1a is located in Iraq- Baghdad. The **Wall** is built from of **13 mm cement plaster**, **20 cm common brick** and **10 mm gypsum plaster**. While the **Partition** is built from **10 cm common brick** and **10 mm gypsum plaster on both sides**. The **Roof** is built from outside to inside from **10 mm cement tail**, **130 mm sand**, **10 mm Expanded polyurethane**, **Asphalt shingles**, **150 mm concrete** and **20 mm gypsum**. The floor consist from outer to inner from carp, cement tile of 25 mm thick., heavy concert of 15 cm thick. Ceiling height is 3 m *Fenestration*. Clear single glass, 3 mm thick. Assume closed, medium-color well fitted, aluminum frame. *Doors* made of wood of 25 mm thickness. *Occupancy*. Four persons, based on two for the master bedroom and one for each additional bedroom. Assign to the living room. *Lights*. Assume 480 W for the kitchen, and 480 W for living room, assign 50% to bed room 1, 25% for bedrooms 2 and 3. *Appliances* : there is one TV,PC laptop, laser printer, and Coffee brewer in living room, The construction of the house is considered medium. Find the sensible, latent, and total Heating load; size the heating unit; and compute the air quantity for each room.





# Area of Building

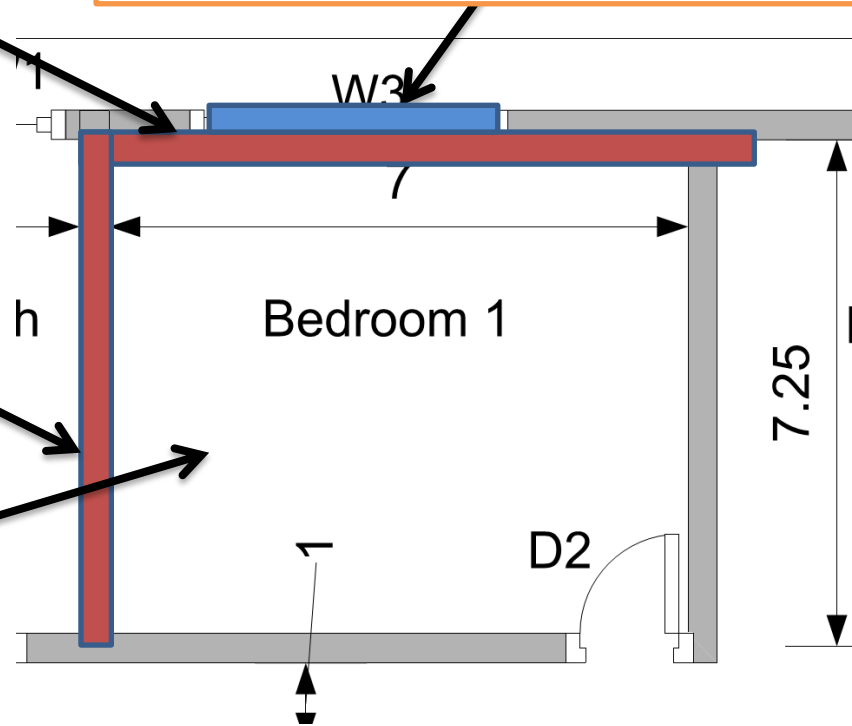
Room name	Net area of outer Walls (m <sup>2</sup> )				Windows					Floor (m <sup>2</sup> )	Roof (m <sup>2</sup> )	Perimeter	Partition
	W	E	N	S	W	E	N	S	Door				
Bed R1	17.4	-	-	-	3.6	-	-	-	2.1	50.75	50.75	2(7+7.25)=28.5	21.5
Living room	12.9	-	20.55		3.6	-	-	-	4.2	45.38	45.34	27.5	-
Bed R2	-	10.8	-	8.55	-	2.7	-	2.7	2.1	16.88	16.88	16.5	11.4
Bed R3	-	10.8		-		2.7			2.1	16.88	16.88	16.5	11.4 11.25

**Heat loss - Outer wall**

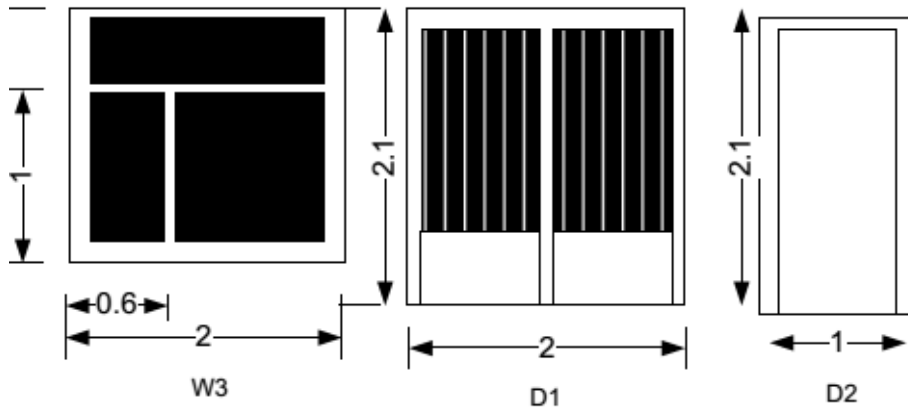
**Heat loss - Glass (Window)**

**Heat loss - Partition**

**Heat loss - Floor**



**Heat loss - Roof**



The floor consist from outer to inner from carp, cement tile of 25 mm thick., heavy concert of 15 cm thick

Description	$L$ <i>mm</i>	$K$ <i>W/mK</i>	$P$ $\text{kg/m}^3$	$R$ $\text{m}^2\text{K/W}$	Mass $\text{kg/m}^2$
high density concrete	150	1.731	2243	0.088	341.60
Inside surface resistance	---	0.000	---	0.121	0.00
Carpet and Rubber Pad	25			0.71	
Concrete Tile	10	0.27	1921	0.037	23

### Carpet

$$R_{\text{Carprt}} = 0.71 \text{ m}^2\text{K/W}$$

### Concrete Tile

$$x = 250 \text{ mm}$$

$$k_{\text{tile.}} = 0.1$$

$$R_{\text{tile.}} = \frac{x}{k} = \frac{0.025}{0.27} = 0.1 \text{ m}^2\text{K/W}$$

### high density concrete

$$x = 150 \text{ mm}$$

$$R_{\text{Conc}} = 0.088 \text{ m}^2\text{K/W}$$

### Inside resistance

$$R_i = 0.121 \frac{\text{m}^2\text{K}}{\text{W}}$$

**Overall heat transfer coefficient and weight of exposed roof**

$$R_e = R_i + R_{carpt} + R_{tile} + R_{conc}$$

$$R_e = 0.121 + 0.71 + 0.1 + 0.088 = 1.019$$

$$U_{floor} = \frac{1}{1.019} = 0.98 \text{ W/m}^2\text{K}$$

Outer wall	Partition	Roof	Window	Door	Floor
U	U	U	U	U	U
W/m <sup>2</sup> .K	W/m <sup>2</sup> .K	W/m <sup>2</sup> .K	W/m <sup>2</sup> .K	W/m <sup>2</sup> .K	W/m <sup>2</sup> .K
1.916	2.45	1.457	6.42	3.92	0.98



# Heating Load Building: Home Room name: Bed Room 1

Indoor Design condition 23°C & RH 50 %

Outdoor Design condition 1.5 °C & RH 84%

Heat Loss									
Eq	Q		U		A		$\Delta T$		
1	Q/ Glass	=	6.42	×	3.6	×	21.5	=	496.908 W
2	Q/ Door	=		×		×		=	0
3	Q/Wall	=	1.916	×	17.4	×	21.5	=	716.776 W
4	Q/Roof	=	1.457	×	50.75	×	21.5	=	1589.77 W
5	Q/Partitions	=	2.45	×	21.75	×	12.5	=	666 W

Floor									
	Q		U		A		$\Delta T$		
6	Q/Floor edges	=	0.8	×	28.5	×	13	=	296.4 W
7	Q/Floor base area	=	0.98	×	50.75	×	13	=	647

# Ventilation and infiltration

Ventilation and infiltration												
	Lc	=	Nos.	x	fac	(L +	H)	+ H				
	Lc		1		2	0.6	1		0		3.2	
	IOA	=	3.2	×	0.3			=			0.96	
	V	=	2	x	2.5		1	=			5	
	VOA	=	Lit/s	+			Lit/s	=			5.96	
			F		VOA		$\Delta T$					
7	OASH	=	1.21	×	5.96	×	21.5	=			155.049	W
			F		VOA		$\Delta \omega$					
8	OALH	=	3000	×	5.96	×	0.00506	=			90.4728	W
	OATH	=		+		=		=			245.522	W
10	Total Load	=						=			3068	W