Refrigeration and Air conditioning Engineering.

3rd year – refrigeration and Air conditioning Course

Lecture -8- part2

Heating Load Estimation

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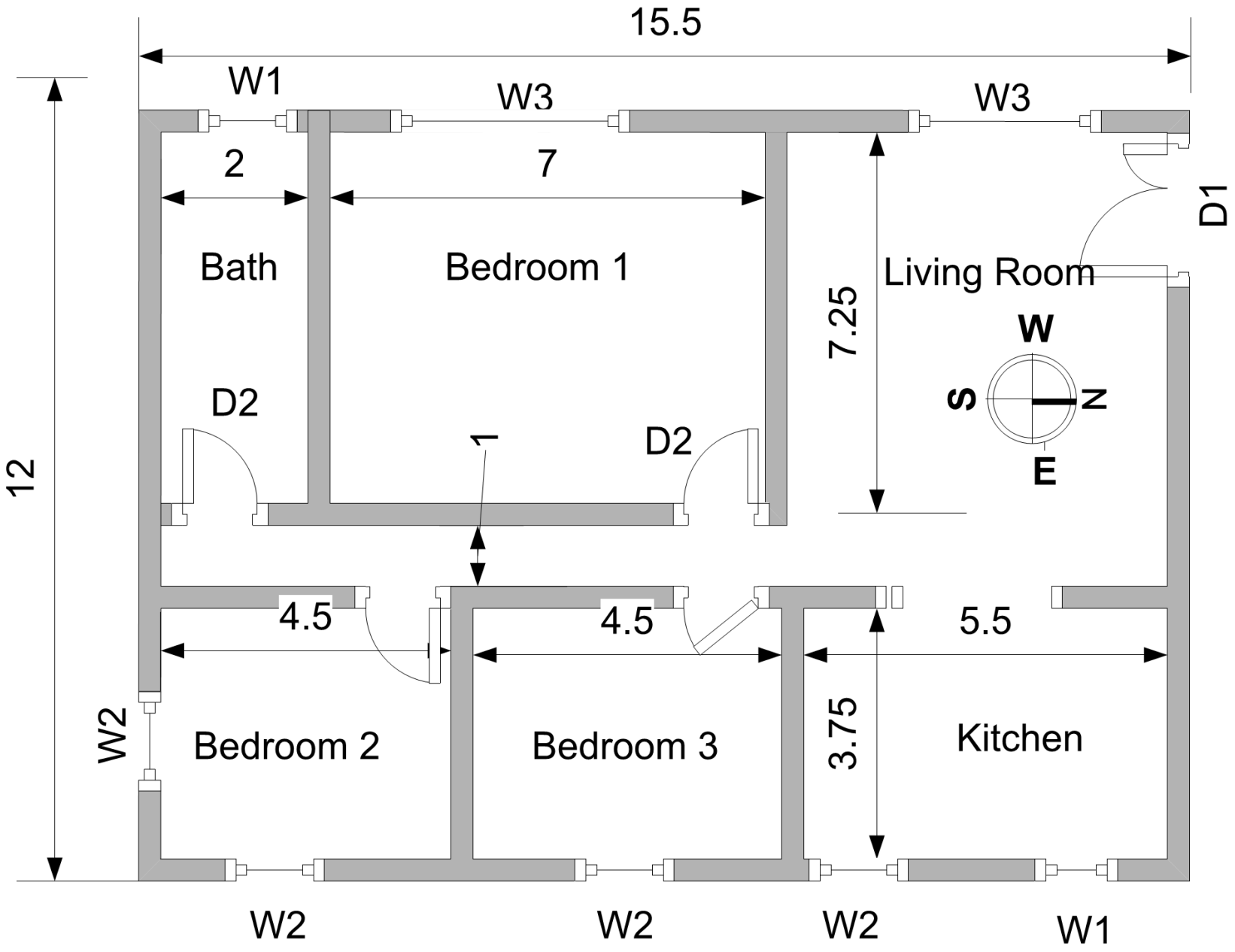
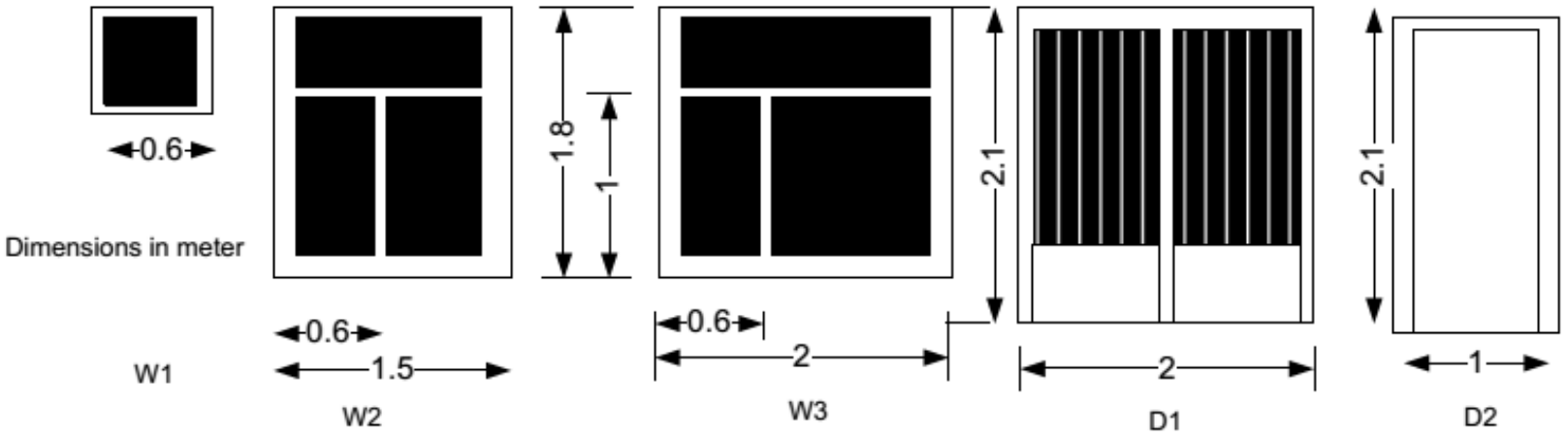
Example 3.

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. L*ights.* 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.


15.5
W1
W3
W3
2
7
D1
Bath
Bedroom 1
Living Room
7.25
W
S
N
E
D2
1
D2
12
4.5
4.5
5.5
W2
Bedroom 2
Bedroom 3
3.75
Kitchen
W2
W2
W2
W1


0.6
Dimensions in meter
W1
0.6
1.5
W2
1.8
1
0.6
2
W3
2.1
2
D1
2.1
1
D2

Area of Building

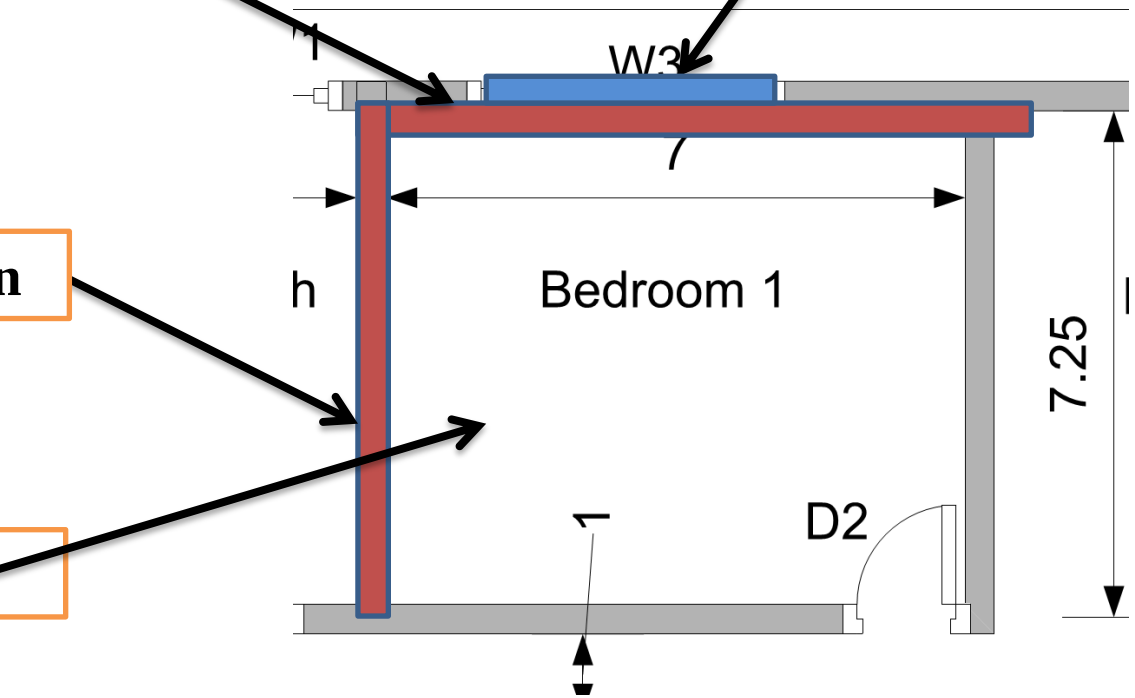
Room name	Net area of outer Walls (m^2)				Windows					Floor (m^2)	Roof (m^2)	Perimeter	Partition
	W	E	N	S	W	E	N	S	Door				
Bed R1	17.4	-	-	-	3.6	-	-	-	2.1	50.75	50.75	2(7+7.25)=28.5	21.5
Living room	12.9	-	20.55		3.6	-	-	-	4.2	45.38	45.34	27.5	-
Bed R2	-	10.8	-	8.55	-	2.7	-	2.7	2.1	16.88	16.88	16.5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

Heat loss - Outer wall

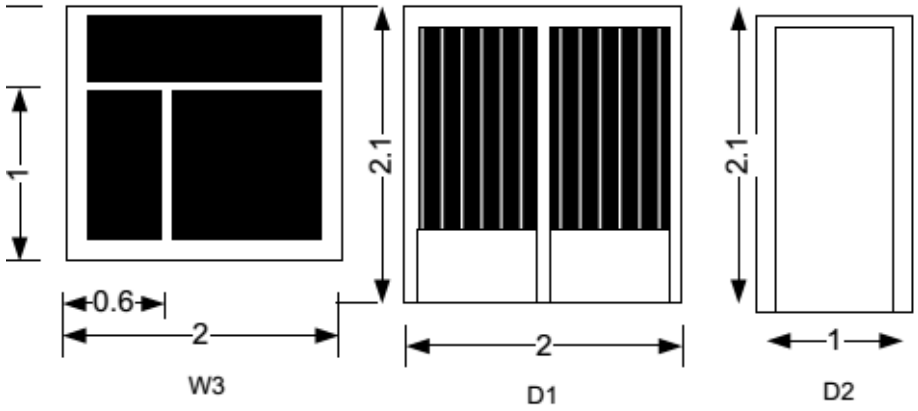
Heat loss - Glass (Window)

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 mm	K W/mK	P kg/m^3	R m^2K/W	Mass 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

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

Concrete Tile

$x = 250 \ mm$

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

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

high density concrete

$x = 150 \ mm$

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

Inside resistance

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

Overall heat transfer coefficient and weight of exposed roof

$$R_e = \mathrm{R}_i + \mathrm{R}_{carpt} + \mathrm{R}_{tile} + \mathrm{R}_{conc}$$

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

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

Outer wall	Partition	Roof	Window	Door	Floor
U	U	U	U	U	U
W/m².K	W/m².K	W/m².K	W/m².K	W/m².K	W/m².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℃ & RH 50 %
Outdoor Design condition 1.5 ℃ & RH 84%

	Heat Loss								
Eq	Q		U		A		ΔT		
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		ΔT		
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

	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			ΔT				
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