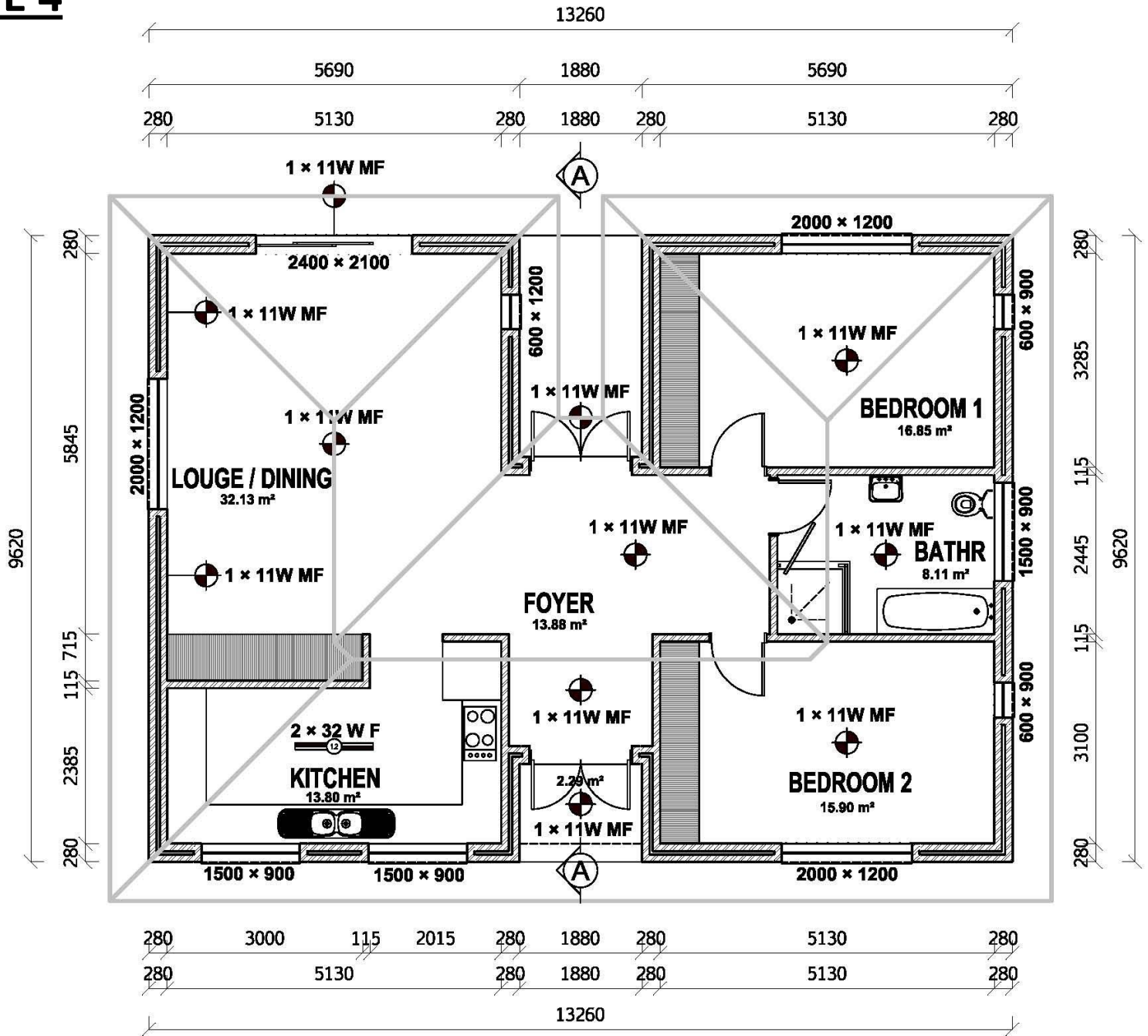
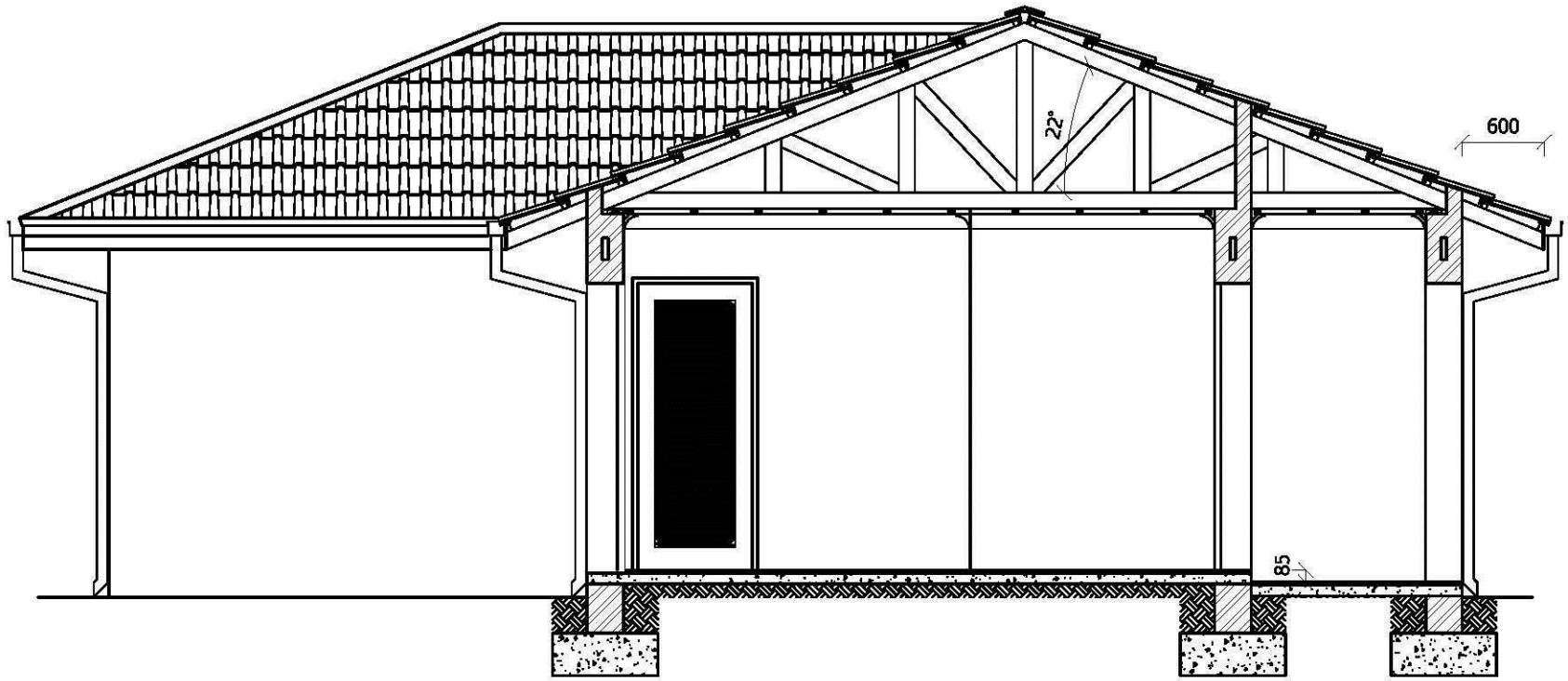


ZONE 4





2100
2550
2275

NATURAL VENTILATION

CONSTANTS:

$$\text{CONDUCTANCE:} \quad 100.67 \times 1.4 = 140.94$$

$$\text{SHG:} \quad 100.67 \times 0.13 = 13.09$$

CONDUCTANCE:

Use clear glass in aluminium split frame

$$\begin{aligned} A \times U &= 18.09 \times 5.6 \\ &= 101.30 \quad (< 140.94 \checkmark) \end{aligned}$$

SOLAR HEAT GAIN:

$$P = 600 + 115 = 715$$

$$G = 2275 - 2100 = 175 \quad (< 500)$$

2100 Door: $P/H = 715/2275 = 0.31$
1200 Window: $P/H = 715/1375 = 0.52$
900 Window: $P/H = 715/1075 = 0.66$

NORTH:

$5.04 \times 0.77 \times 0.44 = 1.71$
 $2.40 \times 0.77 \times 0.33 = 0.61$

EAST:

$(0.54 \times 0.77 \times 0.61) \times 2 = 0.51$
 $1.35 \times 0.77 \times 0.61 = 0.63$
 $0.72 \times 0.77 \times 0.66 = 0.37$

SOUTH:

$$2.40 \times 0.77 \times 0.33 = 0.61$$

$$(1.35 \times 0.77 \times 0.31) \times 2 = 0.64$$

WEST:

$$2.40 \times 0.77 \times 0.83 = \underline{1.53}$$

TOTAL = 6.61 (<13.09)

ARTIFICIAL VENTILATION:

ENERGY INDEX:

NORTHERN FAÇADE: $13.26 \times 2.550 = 33.81$
 $33.81 \times 0.220 = 7.44$

EASTERN FAÇADE: F1 $3.4 \times 2.550 = 8.67$
 $8.67 \times 0.220 = 1.91$

F2: $9.62 \times 2.550 = 24.53$
 $24.53 \times 0.220 = 5.40$

SOUTHERN FAÇADE: $13.26 \times 2.550 = 33.81$
 $33.81 \times 0.220 = 7.44$

WESTERN FAÇADE: $9.62 \times 2.550 = 24.53$
 $24.53 \times 0.220 = 5.40$

NORTHERN FAÇADE:

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 5.04[0.77(-0.37 \times 0.99 + 1.53 \times 0.93) + -0.01 \times 5.6] \\ &= 5.04[0.77(-0.37 + 1.42) - 0.06] \\ &= 5.04[0.77(1.05) - 0.06] \\ &= 5.04[0.81 - 0.06] \\ &= 5.04 \times 0.75 \\ &= 3.78 \end{aligned}$$

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 2.4[0.77(-0.37 \times 0.96 + 1.53 \times 0.79) + -0.01 \times 5.6] \\ &= 2.4[0.77(-0.36 + 1.21) - 0.06] \\ &= 2.4[0.77(0.85) - 0.06] \\ &= 2.4(0.65 - 0.06) \\ &= 2.4 \times 0.59 \\ &= 1.42 \end{aligned}$$

$$3.78 + 1.42 = 5.20 (<7.44 \checkmark)$$

EASTERN FAÇADE:

F1

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 0.72[0.77(-0.59 \times 0.86 + 1.39 \times 0.85) + 0.03 \times 5.6] \\ &= 1.35[0.77(-0.51 + 1.18) + 0.17] \\ &= 1.35[0.77(0.67) + 0.17] \\ &= 1.35(0.52 + 0.17) \\ &= 1.35 \times 0.69 \\ &= 0.93 (<1.91 \checkmark) \end{aligned}$$

F2

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 1.35[0.77(-0.59 \times 0.83 + 1.39 \times 0.75) + 0.03 \times 5.6] \\ &= 1.35[0.77(-0.49 + 1.04) + 0.17] \\ &= 1.35[0.77(0.55) + 0.17] \\ &= 1.35(0.42 + 0.17) \\ &= 1.35 \times 0.59 \\ &= 0.80 \end{aligned}$$

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 0.54[0.77(-0.59 \times 0.83 + 1.39 \times 0.75) + 0.03 \times 5.6] \\ &= 0.54[0.77(-0.49 + 1.04) + 0.17] \\ &= 0.54[0.77(0.55) + 0.17] \\ &= 0.54(0.42 + 0.11) \\ &= 0.54 \times 0.59 \\ &= 0.32 \end{aligned}$$

$$2 \text{ Windows} = 0.32 \times 2 = 0.64$$

$$0.80 + 0.64 = 1.44 \quad (< 5.40 \checkmark)$$

SOUTHERN FAÇADE:

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 2.4[0.77(-0.87 \times 0.88 + 0.38 \times 0.84) + 0.15 \times 5.6] \\ &= 2.4[0.77(-0.77 + 0.32) + 0.84] \\ &= 2.4[0.77(-0.45) + 0.84] \\ &= 2.4(-0.35 + 0.84) \\ &= 2.4 \times 0.49 \\ &= 1.18 \end{aligned}$$

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 1.35[0.77(-0.87 \times 0.87 + 0.38 \times 0.81) + 0.15 \times 5.6] \\ &= 1.35[0.77(-0.76 + 0.31) + 0.84] \\ &= 1.35[0.77(-0.24) + 0.84] \\ &= 1.35(-0.18 + 0.84) \\ &= 1.35 \times 0.66 \\ &= 0.89 \end{aligned}$$

$$2 \text{ Windows} = 0.89 \times 2 = 1.78$$

$$1.18 + 1.78 = 2.96 (<7.44 \checkmark)$$

WESTERN FAÇADE:

$$\begin{aligned} A[S(C_A \times S_H + C_B \times S_C) + C_C \times U] &= 2.4[0.77(-0.85 \times 0.91 + 1.07 \times 0.85) + 0.08 \times 5.6] \\ &= 2.4[0.77(-0.77 + 0.91) + 0.45] \\ &= 2.4[0.77(0.14) + 0.45] \\ &= 2.4(0.11 + 0.45) \\ &= 2.4 \times 0.56 \\ &= 1.34 (<5.40 \checkmark) \end{aligned}$$

BUILDING SUITABLE FOR AIRCONDITIONING / MECHANICAL VENTILATION

LIGHTING

ENERGY DEMAND:

ALLOWED: $5\text{W}/\text{m}^2$

$$5\text{W}/\text{m}^2 \times 121.92\text{m}^2 = 609.60\text{W}$$

$$11 \times 11\text{W lamps} + 2 \times 32\text{W lamps} = 185\text{W} (< 609.60\text{W } \checkmark)$$

or

$$185\text{W} / 121.92\text{m}^2 = 1.52\text{W}/\text{m}^2 (< 5\text{W}/\text{m}^2)$$

ENERGY CONSUMPTION:

ALLOWED: 5kWh/m².a or 5kWh/m² [a = 1 (year)]

$$5\text{kWh/m}^2.\text{a} \times 121.92\text{m}^2 = 609.60\text{kWh.a}$$

Assume lights are on from 17:00 – 22:00 each day/year

That is 5h/day

$$52 \text{ (weeks)} \times 7 \text{ (days)} \times 5 \text{ (h)} = 1\,820\text{h.a}$$

$$\begin{aligned} \text{There are } 11 \times 11\text{W lamps, } 2 \times 32\text{W lamps} &= (11 \times 11\text{W}) + (2 \times 32\text{W}) \\ &= 121\text{W} + 64\text{W} \\ &= 185\text{W} \\ &= 0.185\text{kW} \end{aligned}$$

$$0.185\text{kW} \times 1\,820\text{h.a} = 336.7\text{kWh.a} (< 609.60\text{kWh.a } \checkmark)$$