Sustainable Building 2:
Assignment 2: Heat and Reaction modelling
Opdracht 2: Warmte en reactie modelleren

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Question 1

a) Compute the U-value of glass.

Solar heat influx: $Q_{solar} = g \times H \times W \times q_{solar} = 0.7 \times 3 \times 4 \times 30 = 252$ W
Conductive heat loss: $Q_{cond} = U \times H \times W \times (T_{in} - T_{out}) = U \times 3 \times 4 \times (20\,^{o}C - 6\,^{o}C) = Q_{solar}$
$U = Q / (H * W * (T_{in} - T_{out})) = 252 / (3 \times 4 \times (20-6)) = 1{,}5$ W/m^{2}K
Which yields U-value of the glass U = **1,5 W/m^{2}K**

b) Compute the maximum ventilation rate (in offices per hour)

Solar heat influx: $Q_{solar} = g \times H \times W \times q_{solar} = 0.7 \times 3 \times 4 \times 30 = 252$ W
Conductive heat loss: $Q_{cond} = U \times H \times W \times (T_{in} - T_{out}) = 1{,}5 \times 3 \times 4 \times (17\,^{o}C - 6^{o}C)$
$Q_{cond} = 1{,}5 \times 3 \times 4 \times (17\,^{o}C - 6^{o}C) = 198$ W
$Q_{conv} = 252 - 198 = 54$ W
Convective heat loss: $Q_{conv} = V \times c_{v,air}, \times \rho_{air} \times (T_{in} - T_{out}) = V \times 1023 \times 1.2 \times (17\,^{o}C - 6^{o}C)$
$V = Q_{conv} / (c_{v,air}, \times \rho_{air} \times (T_{in} - T_{out}))$
$V = 54 / (1023 \times 1{,}2 \times (17 - 6)) = 0.004$ m^3/s
$0.004 * 3600 = 14{,}4$ m^3/h
Maximum ventilation rate (in offices per hour)= 14.4 / 60 = **0.24 Offices/h**

Question 2

a) Compute the moles of water (x), involved with the reaction of one mole C_3S.

The mass of 1 mole of C_3S is 3 x 56.08 + 60.09 = 228.33g/mole.
For full reaction of 1 mole of C_3S, X moles of water is required

The water/cement ratio = 0.395
Water/cement ratio * C_3S = Mass of water
$0.395 * 228.33 = 90.19055$ g/mole
$H_2O = 18.02$ g/mole
90.19055 / 18.02 = **5.005 Moles of water**

b) The shrinkage of the mixture (in cm^3) after 1 mole of C_3S has reacted with x moles of H is 13.28 cm^3. Compute the molar volume of the $C_{1.7}SH_{x-1.3}$.

The volume before reaction is 73.18 + 5.005 x 18.02 = 163.37 cm^3/mole.
163.37 – 13.28 = 150.09 cm^3/mole
The volume after reaction is X + 1.3 x 33.05 = 150.09 cm^3/mole.
$C_{1.7}SH_{x-1.3}$ = 150.09 – 1.3 CH
$C_{1.7}SH_{x-1.3}$ = 150.09 – (1.3 x 33.05) = **107.125 cm^3/mole.**