Week 3 Exercise:

- A 3 m high and 5 m wide wall consists of long 32 cm and 22 cm cross section horizontal brick with k= 0,72 W/m°C, divided by 3 cm of plaster layers with k= 0,22 W/m°C) There are also a layers of plaster on each side of the brick and a 3 cm thick rigid foam on the inner side of the wall with k= 0,026 W/m°C. The indoor and the outdoor temperature are respectively 20 and - 10 degrees and the convection heat transfer coefficients are h1 = 10 W/m2 (inner surface) and h2 = 40 W/m2 (external surface). Assuming one dimensional heat transfer and disregarding radiation, determine the rate of heat transfer through the wall.

$R_i = \frac{1}{10x0.25} = 0.4\ ^{o}C/W$

$R_{Foam} = \frac{0.03}{0.026x(0.015+0.22+0.015)x1} = 4.62\ ^{o}C/W$

$R_{Plaster(up\&down)} = \frac{0.32}{0.22x0.015x1} = 96.97\ ^{o}C/W$

$R_{Brick} = \frac{0.32}{0.72x0.22} = 2.02\ ^{o}C/W$

$\frac{1}{Rtotal-Parallel} = \frac{1}{Rplaster(up)} + \frac{1}{Rplaster(down)} + \frac{1}{RBrick} = \frac{1}{96.97} + \frac{1}{96.97} + \frac{1}{2.02} = 0.516\ ^{o}C/W$

Therefore (R_{Total} – Parallel) = 1.94 ° C/W

$R_o = \frac{1}{40x(0.015+0.22+0.015)x1} = 0.1\ ^{o}C/W$

$R_{Plaster(Right\&Left)} = \frac{0.03}{0.22x(0.015+0.22+0.015)x1} = 0.36^{o}C/W$

$R_{Total} = 7.84\ °C/W$

$Q = \frac{20+10}{7.841} = 3.87\ W$

$-R_{Total(16mm\ Wall)} = 6.81\ ^{o}C/W$

$Q = \frac{30}{6.81} = 4.41\ W$

- A wood frame wall that is built around 38-mm 90-mm wood studs with a center-to-center distance of 400 mm. The 90 mm wide cavity between the studs is filled with glass fiber insulation. The inside is finished with 13-mm gypsum wallboard and the outside with 13-mm wood fiberboard and 13- mm 200-mm wood bevel lapped siding. The insulated cavity constitutes 75% of the heat transmission area while the studs, plates, and sills constitute 21 percent. The headers constitute 4 percent of the area, and they can be treated as studs. Wood bevel

	Wood	insulation
Outside Air	0.03	0.03
Wood Bevel 13x200mm	0.14	0.14
Plywood 13mm	0.11	0.11
Urethane Rigid Foam 90mm	-	0.98 x $(\frac{90}{25})$ = 3.53
Wood Studs 90mm	0.63	-
Gypsum Board 13mm	79	79
Inside Surface	0.12	0.12

R with Wood = 1.11 m^2 °C/W
R with Insulation = 4.01 m^2 °C/W