

Equivalent Wall Model Results

Three-layer equivalent wall models were developed for all wall assemblies considered; thermal structure factors and time constants are included in Part II: Tables n.5. Thermo-physical properties of the layers are presented in Part II: Tables n.6a, n.6b, response factors and dimensional z-transfer function coefficients, calculated using Laplace transform method [Kusuda 1969, Stephenson and Mitalas 1971, Clarke 1985] are listed in Part II: Tables n.7 and n.8.

Sample results generated by the equivalent wall model are shown below, for the 2x4 wood stud – clear wall assembly.

Table 4.5 Structure factors and time constants

| Structure factors | | Time constants [h] | |
|--------------------------|---------|--------------------------------|--------|
| φ_{ii} | 0.41451 | $R \cdot C \cdot \varphi_{ii}$ | 8.468 |
| φ_{ie} | 0.07970 | $R \cdot C \cdot \varphi_{ie}$ | 1.628 |
| φ_{ee} | 0.41346 | $R \cdot C \cdot \varphi_{ee}$ | 8.446 |
| | | $R \cdot C$ | 20.428 |

Table 4.6 Thermophysical properties of the equivalent wall - IP units

| Layer | R_n | C_n | I_n | k_n | ρ_n | c_{pn} |
|-----------------------|---------------------------|-------------------------|-------------------------|------------------------------|----------------------------|----------------------------|
| n | ft ² -°F-h/Btu | Btu/ft ² -°F | in | Btu-in/h-ft ² -°F | lb/ft ³ | Btu/lb-°F |
| 1 | 0.58189 | 0.62500 | 0.75 | 1.289 | 40 | 0.25 |
| 2 | 9.64545 | 0.50626 | 3.25 | 0.337 | 7.48 | 0.25 |
| 3 | 1.16393 | 0.66204 | 1 | 0.859 | 31.78 | 0.25 |

Table 4.7 Dimensionless z-transfer function coefficients and first time constants for the equivalent wall

| n | b_n | c_n | d_n | τ_n |
|-----------------------|-------------------------|-------------------------|-------------------------|----------------------------|
| 0 | 0.05080 | 9.12250 | 1.00000 | |
| 1 | 0.45323 | -10.47223 | -0.30686 | 0.769 |
| 2 | 0.19302 | 2.10285 | 0.00942 | 0.291 |
| 3 | 0.00547 | -0.05063 | -0.00002 | 0.163 |
| 4 | 0.00001 | 0.00005 | | 0.100 |

$$\Sigma c_n = 0.70254, \alpha = 0.27257$$

Table 4.8 Response Factors for the Equivalent Wall [Btu/h ft² °F]

| <i>n</i> | <i>X_n</i> | <i>Y_n</i> |
|----------|----------------------|----------------------|
| 0 | 8.008323E-01 | 4.459567E-03 |
| 1 | -6.735756E-01 | 4.115655E-02 |
| 2 | -2.963588E-02 | 2.953197E-02 |
| 3 | -7.178884E-03 | 9.155234E-03 |
| 4 | -1.932449E-03 | 2.532557E-03 |
| 5 | -5.259544E-04 | 6.914873E-04 |
| 6 | -1.433335E-04 | 1.885153E-04 |
| 7 | -3.906729E-05 | 5.138440E-05 |
| 8 | -1.064845E-05 | 1.400577E-05 |
| 9 | -2.902423E-06 | 3.817519E-06 |
| 10 | -7.911066E-07 | 1.040532E-06 |
| 11 | -2.156300E-07 | 2.836154E-07 |
| 12 | -5.877376E-08 | 7.730438E-08 |
| 13 | -1.601983E-08 | 2.107067E-08 |
| 14 | -4.366485E-09 | 5.743183E-09 |
| 15 | -1.190163E-09 | 1.565406E-09 |
| 16 | -3.243998E-10 | 4.266789E-10 |
| 17 | -8.842090E-11 | 1.162989E-10 |
| 18 | -2.410067E-11 | 3.169931E-11 |
| 19 | -6.569063E-12 | 8.640205E-12 |
| 20 | -1.790514E-12 | 2.355040E-12 |