Three-Dimensional Model Results

Response factors for three-dimensional models of clear walls and details, together with resistances and capacities, were computed with the accuracy up to 7 decimal places. The 3-D results for all 20 walls are presented in Part II of this report: Tables n.1, n.3. Boundary conditions of the first kind were assumed.

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

Table 0.1 Resistance, Transmittance and Capacitance of the Wall

	IP		*SI*	
R-value	11.39127	ft^2 °F h/Btu	2.00486	m^2 K/W
R^{-1}	0.08779	Btu/h ft^2 °F	0.49879	W/m^2 K
Capacitance	1.79330	Btu/ft^2 °F	36.64396	kJ/m^2 K

Table 0.2 Dimensionless 3D Z-Transfer Function Coefficients

n	b_n	c_n	d_n
0	0.19337	7.64880	1.00000
1	0.24476	-12.33863	-0.91447
2	-0.15501	5.81307	0.23694
3	0.01954	-0.84437	-0.01887
4	0.00097	0.02478	0.00004

$\Sigma\, c_n = 0.30364$, $E_1 = -0.00002$

Table 0.3 3-D Response Factors; calculated with the help of the finite difference computer code HEATING 7.2 [Btu/h ft^2 °F]

n	X_n	Y_n
0	6.7146162E-01	1.6975601E-02
1	-4.6913515E-01	3.7010346E-02
2	-7.7794338E-02	1.6215108E-02
3	-2.1441836E-02	8.0947201E-03
4	-7.8795553E-03	4.3433504E-03
5	-3.5727479E-03	2.3582245E-03
6	-1.8013726E-03	1.2798800E-03
7	-9.4869935E-04	6.9348185E-04
8	-5.0793822E-04	3.7534109E-04
9	-2.7362013E-04	2.0303676E-04
10	-1.4773288E-04	1.0980310E-04
11	-7.9833819E-05	5.9376410E-05
12	-4.3156510E-05	3.2107040E-05
13	-2.3332883E-05	1.7361448E-05
14	-1.2616021E-05	9.3881222E-06
15	-6.8219021E-06	5.0768088E-06
16	-3.6890344E-06	2.7455106E-06
17	-1.9949965E-06	1.4848278E-06
18	-1.0789292E-06	8.0306334E-07
19	-5.8353223E-07	4.3435450E-07
20	-3.1561503E-07	2.3494144E-07

Dimensionless, normalized, response factors, given as $R{\cdot}X_n$, $R{\cdot}Y_n$, for the 20 wall assemblies are presented in Figures 4.1 through Figure 4.6. They represent relationships of the responses to unit triangular temperature excitations after time $n\delta$, to the steady state heat flux, due to the unit boundary temperature difference, equal 1/R.

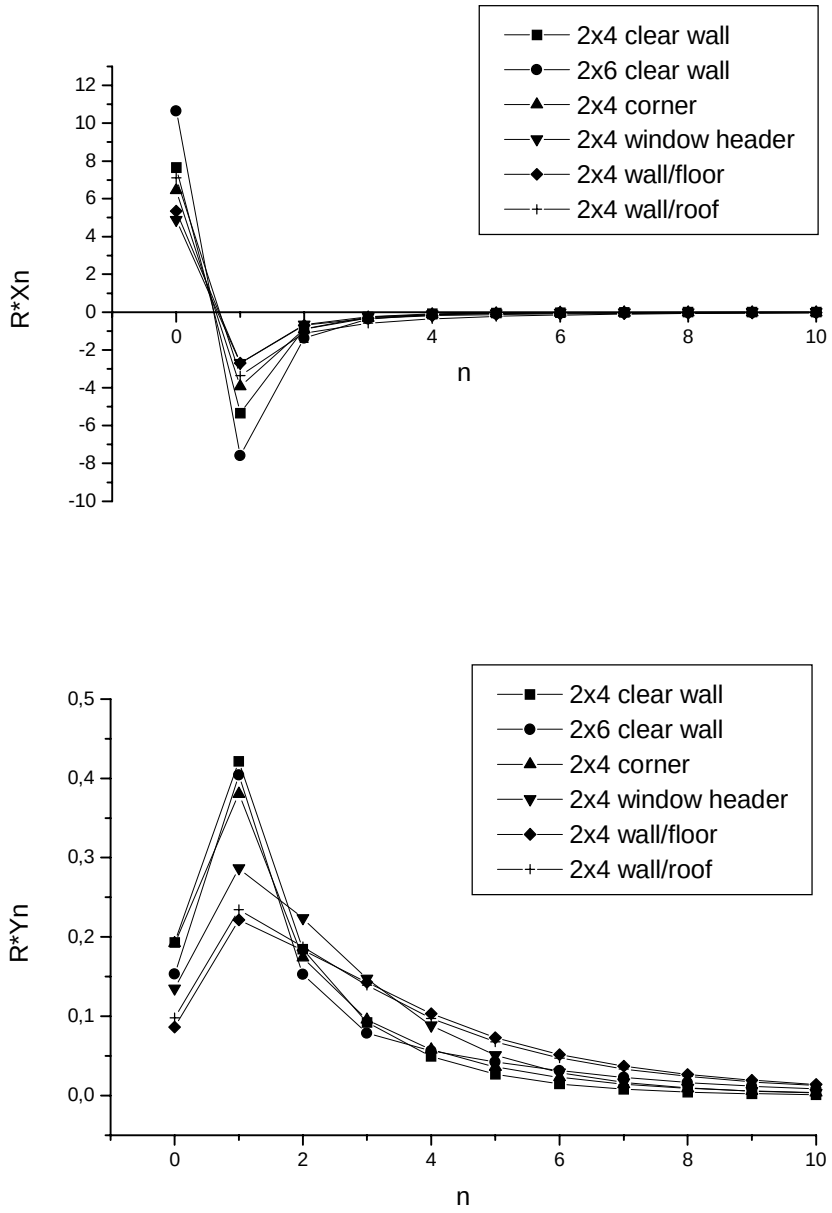

Figure 0.1 Dimensionless response factors, $R \cdot X_n$ and $R \cdot Y_n$, for the wood-framed wall system assemblies

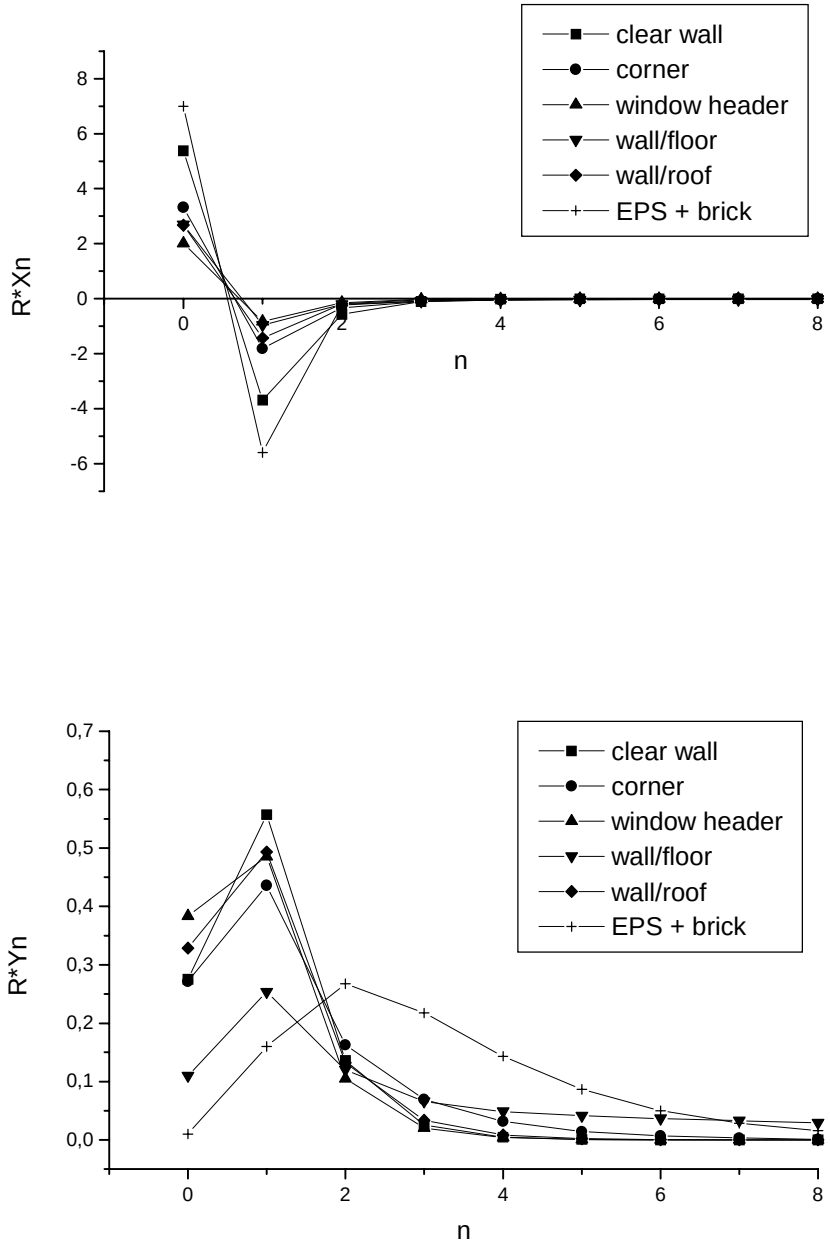

Figure 0.2 Dimensionless response factors, $R{\cdot}X_n$ and $R{\cdot}Y_n$, for the 2x4 steel stud system wall assemblies

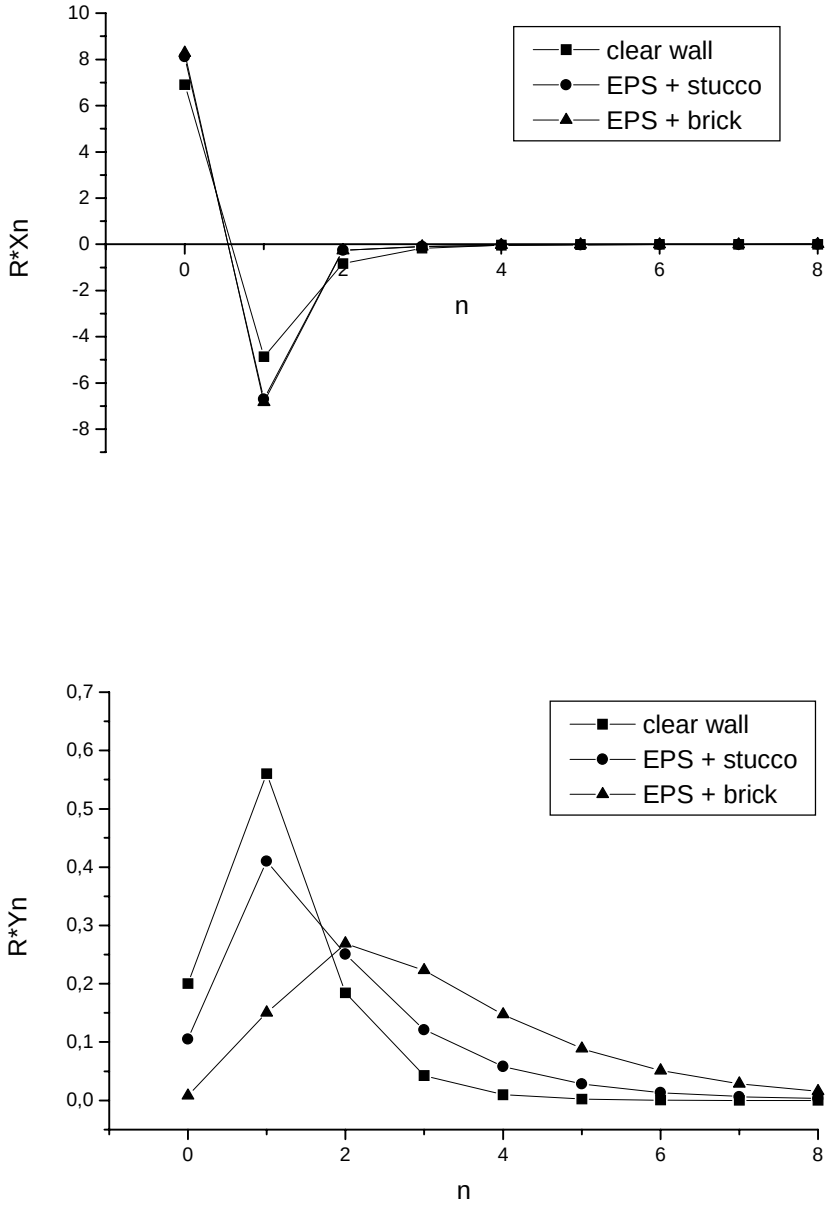

Figure 0.3 Dimensionless response factors, $R{\cdot}X_n$ and $R{\cdot}Y_n$, for the 2x6 steel stud system wall assemblies

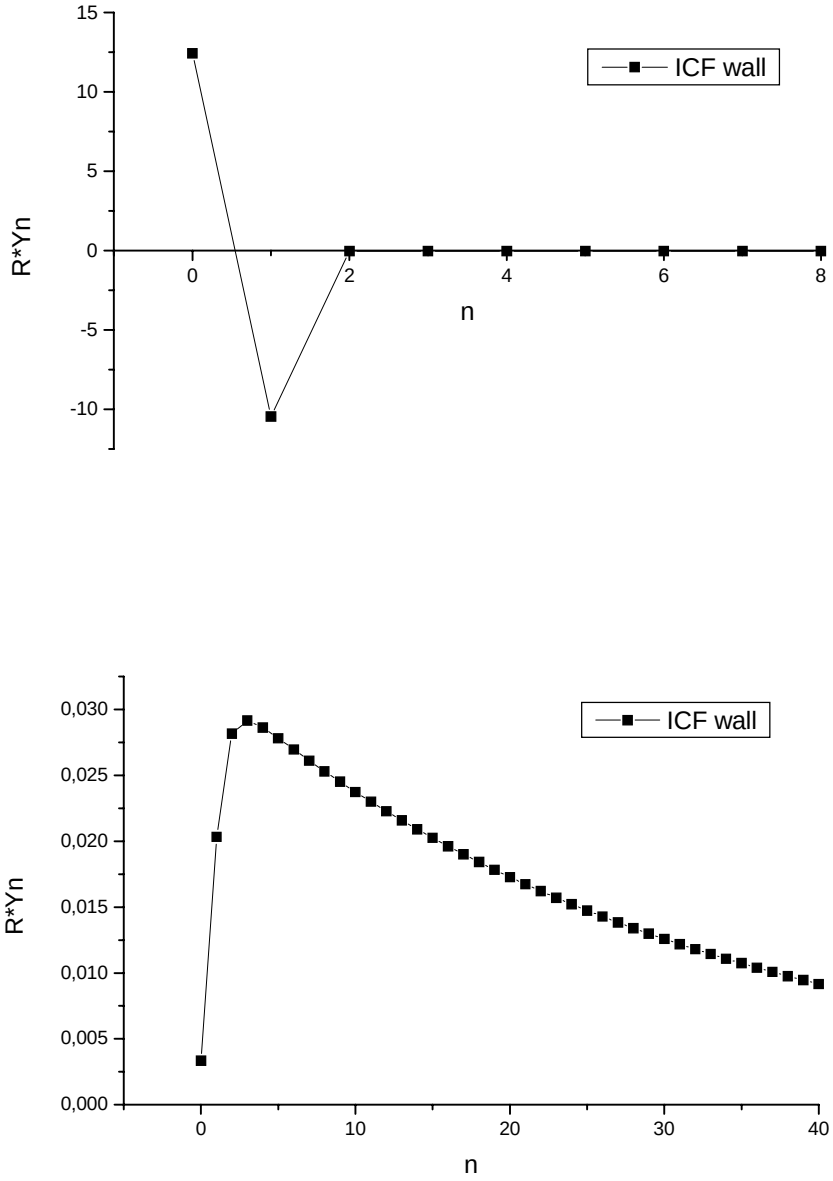

Figure 0.4 Dimensionless response factors, $R \cdot X_n$ and $R \cdot Y_n$, for the ICF wall

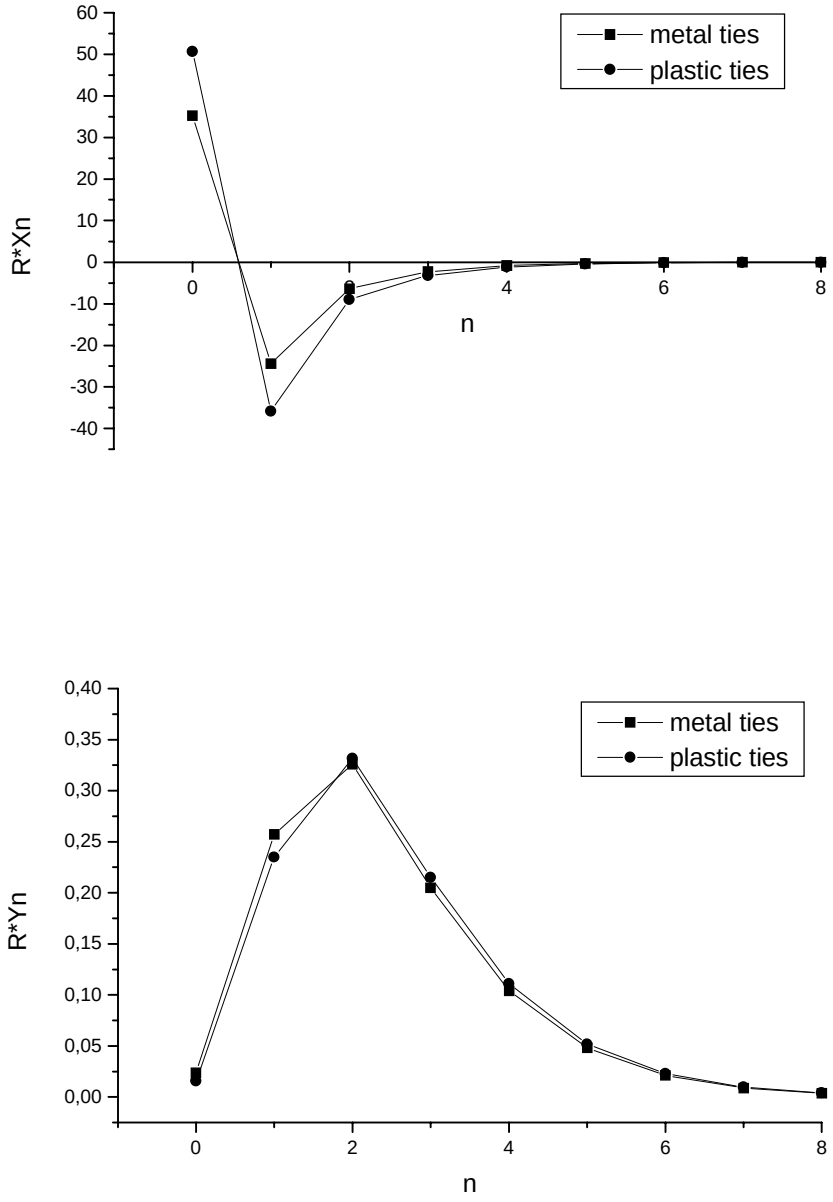

Figure 0.5 Dimensionless response factors, $R{\cdot}X_n$ and $R{\cdot}Y_n$, for sandwich walls

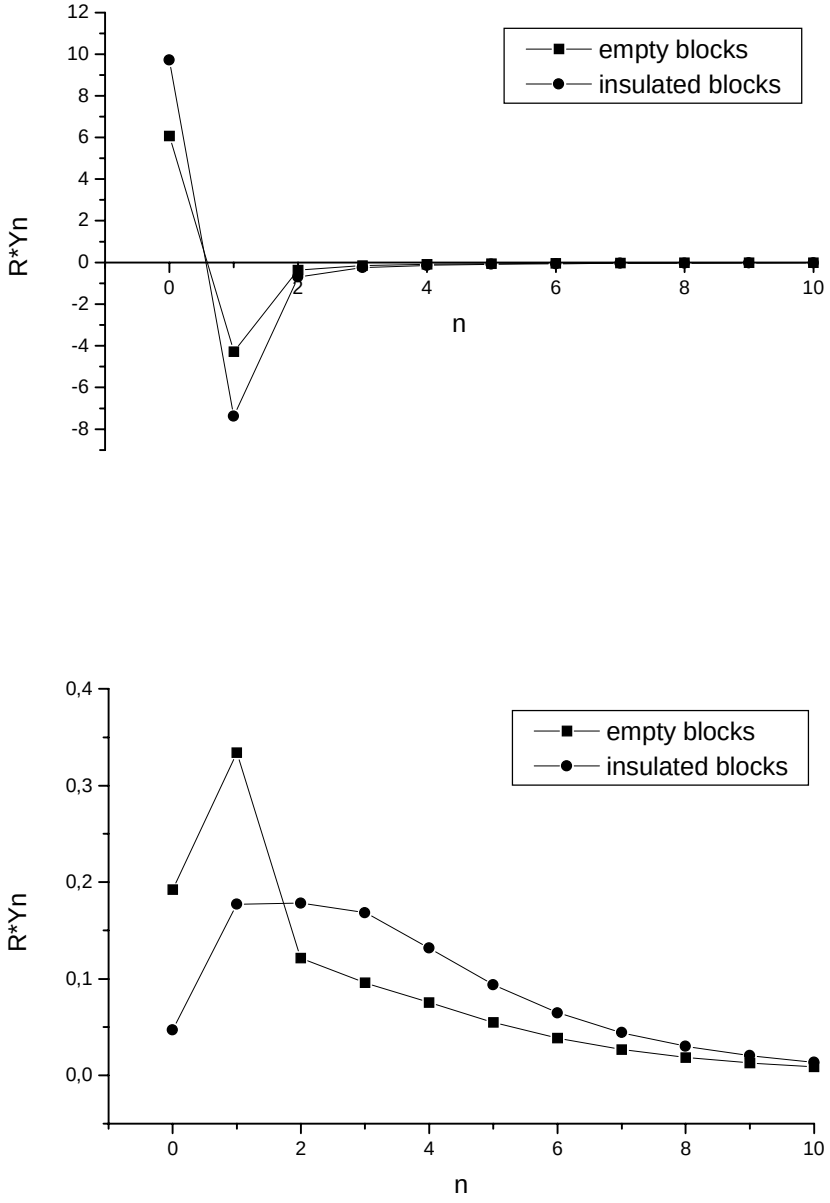

Figure 0.6 Dimensionless response factors, $R \cdot X_n$ and $R \cdot Y_n$, for concrete blocks wall assemblies

Dimensionless transfer functions of the first order, together with dimensionless 3-D response factors and response factors ratios, are listed in Part II: Tables n.4. To avoid additional denotations we write $R{\cdot}X_n$', $R{\cdot}Y_n$'. For the majority of lightweight wood- and steel-stud wall assemblies transfer functions of the fist order Y_n' with high indices are negative, whereas for plane walls they are always positive. Sample results are shown below, for the 2x4 wood stud – clear wall assembly.

Table 0.4 3-D Response Factors Ratio, Dimensionless 3-D response Factors and Z-Transfer Functions of the First Order

n	X_n/X_{n-1}	Y_n/Y_{n-1}	$R*X_n$	$R*Y_n$	$R*X'_n$	$R*Y'_n$
0			7.64880	0.19337	7.64880	0.19337
1	-0.69868	2.18021	-5.34405	0.42159	-9.48116	0.31700
2	0.16583	0.43812	-0.88618	0.18471	2.00433	-0.04332
3	0.27562	0.49921	-0.24425	0.09221	0.23507	-0.00770
4	0.36749	0.53657	-0.08976	0.04948	0.04235	-0.00040
5	0.45342	0.54295	-0.04070	0.02686	0.00785	0.00010
6	0.50420	0.54273	-0.02052	0.01458	0.00149	0.00005
7	0.52665	0.54183	-0.01081	0.00790	0.00029	0.00001
8	0.53540	0.54124	-0.00579	0.00428	0.00006	
9	0.53869	0.54094	-0.00312	0.00231	0.00001	
10	0.53992	0.54080	-0.00168	0.00125		
11	0.54039	0.54075	-0.00091	0.00068		
12	0.54058	0.54074	-0.00049	0.00037		
13	0.54066	0.54074	-0.00027	0.00020		
14	0.54070	0.54075	-0.00014	0.00011		
15	0.54073	0.54077	-0.00008	0.00006		
16	0.54076	0.54079	-0.00004	0.00003		
17	0.54079	0.54082	-0.00002	0.00002		
18	0.54082	0.54085	-0.00001	0.00001		
19	0.54084	0.54087	-0.00001			
20	0.54087	0.54090				

α = 0.54088, τ_1 = 1.62721