CONCLUSIONS

Twenty complex wall assemblies were analyzed in this study: 15 wood and steel-stud systems and 5 insulated concrete assemblies (insulated concrete forms (ICF wall), sandwich walls with metal and plastic ties and two-core block masonry walls, with or without insulation inserts).

Response factors for three-dimensional models, calculated with the help of the finite difference computer code HEATING 7.2, for boundary conditions of the first kind, were used as the 'input data', to determine z-transfer function coefficients. The z-transfer coefficients for three-dimensional model were then obtained as the solution of a, primarily infinite, set of linear equations which includes relationships with the response factors and compatibility conditions. For each case different kinds of the cut-off were considered and minimization procedures were applied when seeking for the solutions to satisfy, as best as possible, compatibility conditions. The method of derivation of the conduction z-transfer function coefficients from the response factors, for three-dimensional wall assemblies, gives satisfactory results.

Relationships between thermal structure factors and response factors were used to develop the equivalent wall model. The equivalent wall model gives, in general, very good results in reproducing dynamic thermal properties of complex wall assemblies with thermal bridges, however it produces small delay and amplitude amplification of the heat flux due to rapid temperature excitations.

Test simulations, performed for continuously varying outdoor temperatures, show very good compatibility of the heat flux calculated using 3-D response factors, 3-D z-transfer function coefficients and z-transfer function coefficients for the equivalent wall.

This report presents an easy to implement procedure for incorporating the equivalent wall approach to account for three-dimensional heat transfer effects in whole building energy simulation programs. In DOE-2.1, it simply involves substituting the original wall assembly with the equivalent wall homogenous materials and their prescribed thermo-physical properties.