NATIONAL RESEARCH COUNCIL OF CANADA

CONSEIL NATIONAL DE RECHERCHES DU CANADA

NATIONAL BUILDING CODE CHANGES

by

A. T. Hansen

Reprinted from
CANADIAN BUILDING
Vol. XXII, No. 10, October 1972
p. 12 - 14

TECHNICAL PAPER NO. 382
OF THE
DIVISION OF BUILDING RESEARCH

OTTAWA
NOVEMBER 1972

Price 10 cents

NRCC 12904

NATIONAL BUILDING CODE CHANGES:

This second series of revisions is important to all homebuilders

By A. T. HANSEN

Change Series No. 2 of the National Building Code, dated July 1972, contains a number of changes to Part 9 that could have an important effect on construction built under the code, or under the Canadian Code for Residential Construction which is based on Part 9. These changes have now been approved by the Associate Committee on the National Building Code.

This Change Series includes not only the latest changes but also those issued in July 1971 as Change Series No. 1. The second printing of the Canadian Code for Residential Construction which became available last month, includes all the changes issued to date.

One of the most significant aspects of Change Series No. 2 relates to mobile homes. Previous to this Change Series there was some question as to whether the requirements of the National Building Code were applicable to mobile homes. If one interprets the code literally, such structures are covered although mobile homes, as such, were not specifically considered in the preparation of Part 9 requirements.

The Associate Committee, after considering the recommendations of the Standing Committee on Residential Standards, decided that mobile homes should be covered directly in the code rather than by reference to other standards. The Associate Committee agreed that the same standard of health and safety should apply to mobile homes as to site-built structures that perform a similar function.

It was appreciated that there were a number of practices in the mobile home industry, although not exactly conforming to the requirements in Part 9, nevertheless have proved, through use, to be satisfactory. The Associate Committee, therefore, approved about twenty-five changes that will permit most (but not all) of the current mobile home construction practices to be accepted under the requirements of the National Building Code. These changes will apply equally, however, to site-built and factory-built structures such as mobile homes. These will be described in more detail under appropriate headings in the following paragraphs, along with other significant changes in this series.

> Last month a second printing of the Canadian Code for Residential Construction became available. It included a second series of changes, following upon those made in July last year. This second series of changes are significant to all builders under either the CCRC or Part 9 of the National Building Code to which they also apply. The more important of these changes are described here for us specially by A. T. Hansen, Head, Technical Section, Codes and Standards Group, Division of Building Research, NRC. A complete list of changes can be obtained by writing to J. M. Robertson, Secretary, Associate Committee on the National Building Code, National Research Council of Canada, Montreal Road, Ottawa, by whom comments on NBC and its revisions will also be welcomed.

The references in Part 9 to which the revisions apply are given followed by the corresponding references to the Canadian Code for Residential Construction in brackets.

Snow Loads

Subsection 9.4.3.(4.c) now permits the design snow load for roofs to be computed on the basis of 50% of the ground snow load rather than 60% required for other buildings in Part 9, provided the overall width of the structure does not exceed 14 ft. This could affect mobile homes, detached garages, and other very small buildings.

Earthquake Loads

Section 9.4 (Section 4) now includes a section dealing with earthquake forces.

The Associate Committee has been concerned that buildings constructed under Part 9 did not require additional design considerations in those areas of serious earthquake risk. They decided, therefore, that certain limitations should be placed on the types of construction that are prone to earthquake damage.

Unreinforced masonry will be limited to two storeys in Seismic Zone 2, and to one storey in Seismic Zone 3. Masonry buildings of loadbearing masonry construction which exceed these limits will have to have reinforcement with a cross-sectional area equal to 0.002 times the cross-sectional area of the wall and the reinforcing must be applied in the vertical and horizontal directions. This reinforcement for an 8-in. wall could be satisfied by ½-in. diameter steel vertical bars 24 in. o.c., and two ¼-in. diameter horizontal bars at 8-in. vertical intervals.

Concrete and steel frame buildings will have to be designed for earthquake resistance when they exceed the size limits permitted for unreinforced masonry.

Wood-frame construction, however, because of its past history of satisfactory performance in earthquakes, is exempt from such restrictions and will continue to be permitted in all earthquake areas without additional design requirements.

Areas of Canada typical of Seismic Zone 3 are along the Pacific Coast and the eastern half of the St. Lawrence Valley and Saguenay region, and include Vancouver, Victoria, Quebec, Chicoutimi, and Seven Islands. Areas in Seismic Zone 2 include Burlington, Cornwall, Hamil-

NATIONAL RESEARCH COUNCIL OF CANADA
DIVISION OF BUILDING RESEARCH

ERRATA TO

"National Building Code Changes"

by A.T. Hansen

(from Canadian Building, Vol. XXII, No. 10, Oct. 1972, p. 12-14)

NRCC 12904

Changes to be made on last page, middle column:

Sheathing Paper

Article number and bracketed reference number to Canadian Code for Residential Construction should read:

Article 9.23.17.4.(23Q(4))

Flashing and Siding

Third line - should be 30-gauge galvanized metal instead of 28-gauge.

ton, Ottawa, St. Catharines, Montreal, Sherbrooke, Edmundston, Fredericton, Sydney, Yarmouth and St. John's. Further information on the seismic zones for various Canadian cities are found in Supplement No. 1 to the National Building Code.

Ceiling Heights

Table 9.5.2.A. (Table 5A) has been revised to permit 7-ft-high ceilings in bedrooms over the required area. In addition, minimum heights for ceilings in living areas will apply to the required area rather than the total area.

Hallway Widths

Article 9.5.8.1 (5.K (1)) now permits hallway widths to be decreased from 2 ft 10 in. to 2 ft 4 in. in buildings up to 14 ft wide (i.e. mobile homes) provided a second exterior door is installed near the dead end of the hall.

Door Sizes

Table 9.6.3.A. (6A) has been revised to permit all exterior doors for houses to be 6 ft 6 in. in height. Previously, the height of the main entrance door was required to be 6 ft 8 in.

In addition, where the hallway width is permitted to be 2 ft 4 in. wide (14-ft-wide structures) the width of bedroom doors can be reduced from 2 ft 6 in. to 2 ft 0 in.

Safety Glass

It has been estimated that about 10,000 Canadians are injured each year by walking through glass doors. A number of changes have been made, therefore, in an attempt to reduce this problem.

Article 9.6.5.2. (6G (2)) has been changed to require safety glass in glass doors where the glass extends to less than 12 in. from the floor (or sidelights which could be mistaken for doors) at the entrance to dwelling units regardless to whether a muntin bar was provided. Previously, safety glass was not required if muntin bars were provided. Statistics indicated that such bars were not effective in preventing accidents. In addition, all glass doors in public areas will be required to be of safety glass. A new clause, Article 9.6.5.5. (6F (5)), prohibits the use of ordinary glass around shower or bathtub enclosures.

Windows in Exit Stairways

Where windows occur over landings in exit stairways they must be at least 42 in. above the landings or be protected by a railing at least 42 in. in height to keep people away from the glass. This now appears as a new requirement, Article 9.7.6.2. (7F (2)).

Occupant Load

Table 9.9.3.A. for determining occupant loads has been revised; the values for maximum net area per person for "other industrial uses" and "other than shops" have been deleted. It was thought that these terms were too vague and could result in unnecessary restrictions in many instances. In addition, the maximum area per person for commercial parking garages has been changed from 200 to 500 sq. ft per person. This will have the effect of reducing the total width required for exits and the number of toilet facilities.

Fire Protection

The purpose of the fire separation around a service room, such as a furnace room, or an electrical vault, is to contain within that room any fire originating in it. The support elements for the service room, therefore, are not important to fire safety.

Article 9.10.2.1. (10B (1)) has, therefore, been revised to exempt service rooms from the regulation which requires that structures required to have a fire rating be supported by construction having at least the same rating. A furnace room on the third floor, for example, need not change the required rating of the structure supporting it.

Where noncombustible construction is required (which rarely applies to buildings under Part 9) certain combustible elements are permitted. Changes have been made to Article 9.10.6.3. to permit sheathing paper, vapor barriers and adhesives to be used in such construction without a limiting flame spread rating. Plastic pipe, plastic electrical boxes and plastic conduit are also permitted in such construction by a new requirement, Article 9.10.6.8. (10E (8)), provided the flame spread is limited to 25. *(The same limitation against plastic DWV piping being used in systems penetrating a fire separation still applies, however.)

Roof construction in noncombustible buildings will be governed by Part 3. Article 9.10.9.2.1. now permits doors between a repair garage and a mercantile occupancy. This is a common situation that occurs with auto parts sales and service operations and is considered to be a satisfactory arrangement.

Table 9.10.14.A. (10B) has been amended. It now requires that where 1¾-in.-thick solid-core wood doors are permitted in a fire separation, wood frames, if used, must be of at least 2-in. nominal thickness. Previously, there were no thickness requirements for wood frames. In addition, the sills for such doors may be of combustible material. A new Article has been added (Article 9.10.19.4 (10R (4)) to require that each building have an access to a street, either directly or by means of a 30-ft wide yard.

Foundations

Table 9.12.2.A. (12A) has been amended to permit surface-type foundations in buildings up to 14 ft wide provided the superstructure is capable of withstanding differential movements without damage (i.e. mobile homes). Pier-type foundations must be designed in conformance with good practice.

Contraction Joints

Article 9.15.4.6. (15D (6)) will now permit the crack control joint spacing in masonry foundation walls to be increased from 40 to 50 ft.

Venting of Roof Spaces

A new Article 9.19.1.2 (19A (2)) has been added to dispense with the venting of roof spaces in buildings containing not more than one storey (i.e. basementless bungalows, mobile homes), provided a vapor barrier such as polyethylene film is applied as a single continuous sheet over the entire ceiling and any opening, such as for a plumbing stack, is sealed around the cut edges to maintain the integrity of the barrier.

Masonry Veneer

Article 9.20.12.3. (20L (3)) has been revised to require that brick veneer less than 3⅝ in. thick be limited to not more than a ½ in. projection over the top of the foundation wall rather than 1 in. as previously permitted.

Nail Sizes

Owing to the new lumber sizes (1½ in. thick as opposed to the old 1⅝ in.) the nail lengths required for certain details exceed the thickness of the lumber the nails fasten together. Table 9.23.3.A. (23A) has been revised in some cases, therefore, to permit 3-in. nails instead of 3¼-in. nails. Since the nail shank thickness is the same for both nail sizes this change should not cause a reduction in strength in these details even though the length is reduced.

Stud Sizes

Table 9.23.10.A. (Table 23C) has been revised to permit 2 x 3 studs at 16-in. centres for exterior walls in one-storey buildings provided the wall height does not exceed 8 ft.

Additional changes permit 2 x 2 studs up to 8 ft in height for non-loadbearing interior partitions. Although this size of framing may not be practical for nailing purposes, especially where brittle type finishes are used, it is adequate for staple or screw applications.

Restrictions on the use of swing doors in 2-in. partitions have been deleted.

Wall Plates

Article 9.23.11.1. (23 K(1)) has been changed to permit nominal 1-in. bottom wall plates where the studs are located directly over the joist framing.

Lintels

Since 2x3 loadbearing studs are now permitted, it was necessary to revise the requirements for lintels now specified for 2x4 stud walls. Where 2x3 loadbearing stud walls require lintels over openings, these can be constructed of a 2-in. member and a 1-in. member nailed together. These lintels, however, have to be at least 2 in. deeper than the lintel sizes shown in the table for two 2-in.-thick members. Such lintels are limited to not greater than 8-ft spans.

Roof Trusses

Article 9.23.13.15(23M(15)) has been revised to permit increased roof truss deflections where the ceiling finish consists of other than gypsum board or plaster. Where the truss span is not greater than 14 ft, the deflection is permitted to be 1/180 of the span at 1 1/3 the snow load rather than 1/360. Where the span exceeds 14 ft, this deflection is permitted to be 1/240 of the span.

Sheathing Paper

Article 9.23.14.4.(23N(4)) has been changed to permit the omission of sheathing paper on wood-frame walls where the joints in the siding are formed in a manner to resist the passage of rain and wind. This acknowledges mobile home construction practice which may use sheet-type metal siding with locked seams.

Flashing and Siding

Articles 9.27.4.1.(27D(1)) and 9.28.3.1.(28C(1)) have been revised to permit 20-gauge galvanized metal flashing in lieu of 28-gauge for both siding and roofing. Sheet steel roofing supported on a decking will also be permitted to be 30-gauge rather than 28-gauge.

Windows

A new Article 9.28.3.5.(28C(5)), has been added that will permit windows to be installed without head flashing provided the window has a flange that can be screwed down into a bed of nonhardening caulking to form a water-proof assembly. This is a common practice in the mobile home industry.

Stucco

Table 9.29.4.A. has been revised to require that welded or woven wire or expanded metal stucco mesh reinforcing (large openings) is to be used on vertical surfaces only.

Plywood Interior Finish

Subsection 9.30.9.(30I) has been revised by the addition of a table of minimum plywood thicknesses which will permit 5/32-in. (4 mm) thick plywood on studs 16 in. o.c. provided blocking is installed at midwall height. Previously 3/16-in. plywood was required regardless of whether or not blocking was installed. In addition, such plywood may be grooved and where the groove extends into the core ply the thickness must be increased by the amount of penetration into the core.

Underlay

Article 9.31.2.2.(31B(2)) has been changed to permit resilient flooring or ceramic tile to be installed directly over particleboard subfloors without separate panel-type underlay.

Finish Flooring

Table 9.31.3.A.(31A) and 9.31.3.B. (31B) which specify minimum thickness of and nailing for wood flooring have been revised to incorporate the new standard sizes for lumber. Where the listed size differed from the new standard sizes, the minimum thickness was reduced to the next standard size.

Basement Ventilation

Table 9.33.4.(33A) has been changed to permit the vent area for natural ventilation in unfinished basements which are common to two or more dwelling units to be reduced from 1 per cent to 0.2 per cent of the basement floor area. This will now be the same as required for basements serving a single dwelling unit.

Lighting

Table 9.35.2.A. (35A) now permits a minimum lighting intensity of 5 foot-candles (½ watt per sq ft) in public corridors and public stairways to conform to Part 3.

Fire and Sound Ratings

Table 1A (A-1), Item 35 contains an important typographical error. This item contains a reference to Item 31, it should refer to Item 34.

Canadian Code for Residential Construction

A new subsection (7F) has been included to regulate hardware used on windows. These requirements are the same as appeared in the 1965 Residential Standards but were inadvertently omitted in the first printing of the Canadian Code for Residential Construction.

PRINTED IN CANADA

NATIONAL RESEARCH COUNCIL OF CANADA
CONSEIL NATIONAL DE RECHERCHES DU CANADA

Transfer Function Method of Calculating Cooling Loads, Heat Extraction And Space Temperature

by
Gintas P. Mitalas

Reprinted from
ASHRAE JOURNAL
Vol. 14, No. 12, December 1972
p. 54-56

Technical Paper No. 383
of the
Division of Building Research

OTTAWA
January 1973

Price 10 cents

NRCC 13019

LA METHODE DE FONCTION DE TRANSFERT ET LE CALCUL DE L'EFFORT DE REFROIDISSEMENT, DE L'ENLEVEMENT DE LA CHALEUR ET DE LA TEMPERATURE AMBIANTE

SOMMAIRE

Une nouvelle méthode de calcul de l'effort de refroidissement, la méthode de fonction de transfert, a été introduite dans l'édition de 1972 du *Handbook of Fundamentals*. Le présent article est une brève étude des modalités de calcul de cette méthode, mais il s'agit surtout de montrer que celle-ci possède un champ d'application plus vaste que l'"ancienne" méthode. On compare l'"ancienne" méthode et la méthode élargie quant au calcul des profils d'effort de refroidissement. Les résultats d'un calcul-échantillon montrent graphiquement les applications élargies de cette méthode relativement à un programme d'exploitation variable, au calcul de l'enlèvement de la chaleur à une température ambiante variable de l'air et aux caractéristiques d'enlèvement de la chaleur d'une borne de conditionnement de l'air (y compris les organes de commande).

Transfer Function Method of Calculating Cooling Loads, Heat Extraction & Space Temperature

GINTAS P. MITALAS
Member ASHRAE

A new cooling load calculation procedure, the transfer function method, has been incorporated in the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS. This article presents a short discussion of the calculation procedure based on the transfer function method, and demonstrates the extended capability of this new, computer-oriented, method.

THE growing concern about energy consumption and the consequent urge to analyze more thoroughly the design of alternative systems for the heating and cooling of buildings has led to a demand for improved methods of predicting the performance of air-conditioning systems.

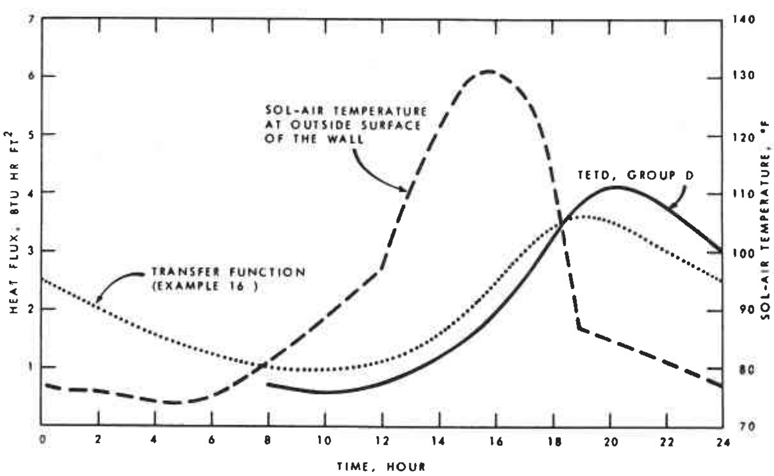

Fig. 1 Heat fluxes at inside surface of outside wall calculated by transfer function & TETD

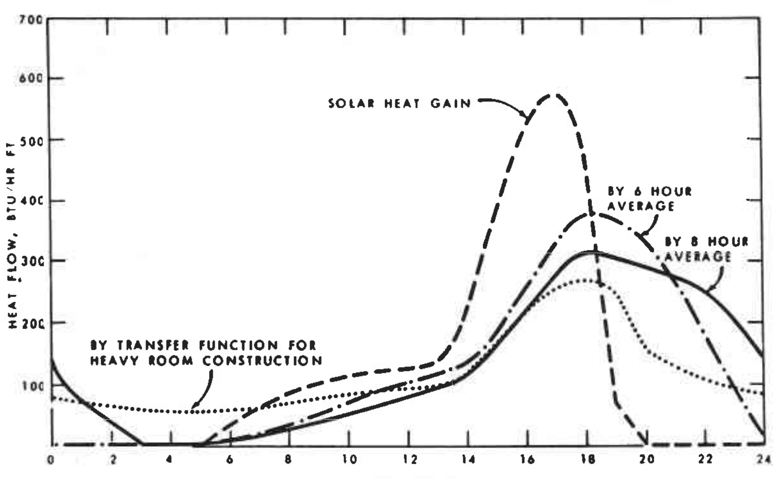

Fig. 2 Cooling load profiles calculated by transfer function & averaging methods

The ASHRAE Task Group on Energy Requirements after five year's work, developed a computer-oriented method that has now been incorporated in the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS. This new method has been designated as the transfer function method because it utilizes the transfer function concept to relate cooling load to heat gain, and heat extraction rate to cooling load and room air temperature.

A transfer function is a set of coefficients that relate an output function at some specific time to the value of one or more driving functions at that time and to previous values of both the input and output functions. For example, a component of cooling load at time τ, Q_τ, can be related to the corresponding component of the heat gain q_τ by an expression of the form

$$Q_\tau = v_0 q_{e,\tau} + v_1 q_{e,\tau-\Delta} + v_2 q_{e,\tau-2\Delta} + \cdots$$
$$= w_1 Q_{\tau-\Delta} - w_2 Q_{\tau-2\Delta} - w_3 Q_{\tau-3\Delta} - \cdots$$

Values of the v_0, V_1 · · · and the w_1, w_2 · · · coefficients depend on heat storage characteristics of the building and on the nature of the particular heat gain component. Table I (Table 44 in Chapter 22) lists values of these coefficients for various components of heat gain and for three classes of building, viz., heavy, medium and light-weight construction.

The new computer-oriented procedure is an extension and development of the old familiar methods. It uses the standard approach to calculate most of the components of heat gain: heat gain from lights is the power supplied to the lights, etc. The heat gain through opaque wall and roof elements is the only exception in that it is not calculated using Total Equivalent Temperature Difference (TETD), but rather by using the appropriate sol-air temperature data and combining them with a wall heat transfer function, i.e., this component of heat gain is found by using a transfer function approach. Transfer function coefficients for many widely used types of walls and roofs are listed in Tables 39 and 40 of the 1972 HANDBOOK.

The heat fluxes at the inside surface of the outside wall, given in Fig. 1, show the results of the two calculation methods i.e., transfer function and TETD. The heat fluxes calculated by the two methods agree reasonably well.

The transfer function approach to converting a component of heat gain into the associated component of cooling load is, in principle, very similar to the time-averaging approach that was recommended in the 1967 ASHRAE HANDBOOK. The new technique differs in that it applies a different weighting factor to each of the preceding values of heat gain rather than giving exactly the same weight to several values of heat gain. The calculated values of cooling load are more accurate when the new factors are used.

G.P. Mitalas is Assistant Research Officer, National Research Council, Div. of Building Research, Ottawa, Ont., Canada.

Table I. Coefficients of Room Transfer Functions[a]
(Table 44 of Chapter 22, 1972 ASHRAE HANDBOOK OF FUNDAMENTALS)

Heat Gain Component	C[b]	v_0 (Dimensionless)	v_1	v_2	v_3
Solar heat gain through glass[c] with no interior shading device	L	0.2727	−0.3400	0.1169	−0.0064
	M	0.2217	−0.3354	0.1448	−0.0128
	H	0.2155	−0.3712	0.1790	−0.0166
Conduction heat gain through roofs, exterior walls, partitions & doors, & windows with blinds or drapes	L	0.6982	−1.2017	0.6617	−0.1150
	M	0.7108	−1.4456	0.9639	−0.2108
	H	0.7055	−1.5668	1.1378	−0.2698
Heat generated by the lights[d]	L	0.3178	−0.4507	0.2089	−0.0328
	M	0.2605	−0.4662	0.2819	−0.0579
	H	0.2430	−0.5085	0.3547	−0.0825
Heat generated by equipment & people & dissipated by radiation	L	0.3251	−0.4267	0.1524	−0.0076
	M	0.2574	−0.4038	0.1830	−0.0183
	H	0.2503	−0.4446	0.2255	−0.0245
Heat generated by equipment & people & dissipated by convection and Sensible heat gain by ventilation & infiltration	These heat gain components appear as cooling load on air-conditioning unit without delay. Thus $v_o = 1.0$. $v_1 = v_2 = v_3 = w_1 = w_2 = w_3 = 0.0$				
The w coefficients[e]		w_0	w_1	w_2	w_3
	L	1.0000	−1.8260	1.0697	−0.2005
	M	1.0000	−2.1092	1.4606	−0.3331
	H	1.0000	−2.2908	1.7252	−0.4277

[a] The coefficients of the transfer function given in this table were calculated by procedures outlined in Ref. 44. These coefficients are applicable for the case where all the heat gain energy appears eventually as cooling load. The computer program used for these calculations was developed at the National Research Council of Canada, Division of Building Research.
[b] The letters L, M and H denote the following room construction features used to calculate the above room transfer functions:
L = Light construction: frame exterior wall, 2 in. concrete floor slab, approximately 30 lb of material per sq ft of floor area.
M = Medium construction: 4 in. concrete exterior wall, 4 in. concrete floor slab, approximately 70 lb of building material per sq. ft. of floor area.
H = Heavy construction: 6 in. concrete exterior wall, 6 in. concrete floor slab, approximately 130 lb of building materials per sq ft of floor area.
For all cases, the room was assumed to be furnished.
[c] The coefficients of the transfer function that relate room cooling load to the solar heat gain through glass depend on where the solar energy is absorbed. If the window is shaded by an inside blind or curtain, most of the solar energy is absorbed by the shade and is transferred to the room by convection and long-wave radiation in about the same proportion as the heat gain through walls and roofs. Thus the heat gain through windows with inside shading devices can be combined with the wall and roof heat gain and converted to cooling load using the transfer function for heat gain through walls.
[d] If the ventilating air is exhausted through the space above the ceiling, it removes some of the heat from the lights before it enters the room. This heat is a load on the air-conditioning plant if the air is recirculated, even though it is not part of the heat gain of the room. The percent of heat gain appearing in the room depends on the type of lighting fixture, its mounting, and the exhaust air flow.
[e] The w_i coefficients (of the denominator) apply to all components of input except for the convection part of heat gain from people and equipment.

Table II. Normalized Coefficients of Room Air Transfer Function[a,b]
(Table 46 of Chapter 22, 1972 ASHRAE HANDBOOK OF FUNDAMENTALS)

Construction	g_0^*	g_1^* Btu/(hr) (sq ft) (F deg)	g_2^*	g_3^*	p_0	p_1 dimensionless	p_2	p_3	$\sum_{i=0}^{3} p_i$
Light	1.73	−3.50	2.22	−0.45	1.0000	−1.8260	1.0697	−0.2005	0.0432
Medium	1.88	−4.22	3.08	−0.74	1.0000	−2.1092	1.4606	−0.3331	0.0183
Heavy	1.89	−4.55	3.61	−0.95	1.0000	−2.2908	1.7252	−0.4277	0.0067

[a] A simplified procedure for calculating room air transfer function coefficients is given in Ref. 45.
[b] The g* coefficients given in this table are for a room with zero heat conductance to surrounding spaces and are normalized to unit floor area. To get the g coefficients for a room with a total conductance K between room air and surroundings, ventilation rate V_T and infiltration rate VI_T it is necessary to multiply each g_i^* value by room floor area and then add $[K+(V_T+VI_T)1.08]\Sigma_{i=0}^{3}p_i$ to the resulting g_0 value (where V_T and VI_T are in cfm).
Note that g_0 value changes with the changes of V_T and VI_T values.

Daily profiles of cooling load calculated using transfer function and averaging methods as well as the heat gain used for these calculations are shown in Fig. 2. These curves show that the averaging method gives a substantially different cooling load profile as compared to the profile calculated by the transfer function method.

The main advantage of the new procedure, however, is that it takes the calculation a step beyond the determination of cooling load and evaluates the rate at which heat will be removed from a space and the temperature of the space when a specific size and type of cooling unit is used. This phase of the analysis also allows the designer to evaluate the effects of different schedules of operation. This was not possible with the old methods. By enabling the designer to evaluate the deviations of room air temperature from the nominal design value it is possible for him to exploit the finite width of the comfort zone and select equipment that can maintain conditions within the zone, albeit not always at the center of the zone.

Results of a calculation are given in Fig. 3 to illustrate the flexibility of this method. In one case, room air temperature control is set at 77 F all the time; in the other case the thermostat set point is at 77 F only during the occupancy period; the rest of the time it is set at 85 F. The transfer function coefficients used for this calculation are given in Table II (Table 46 in Chapter 22).

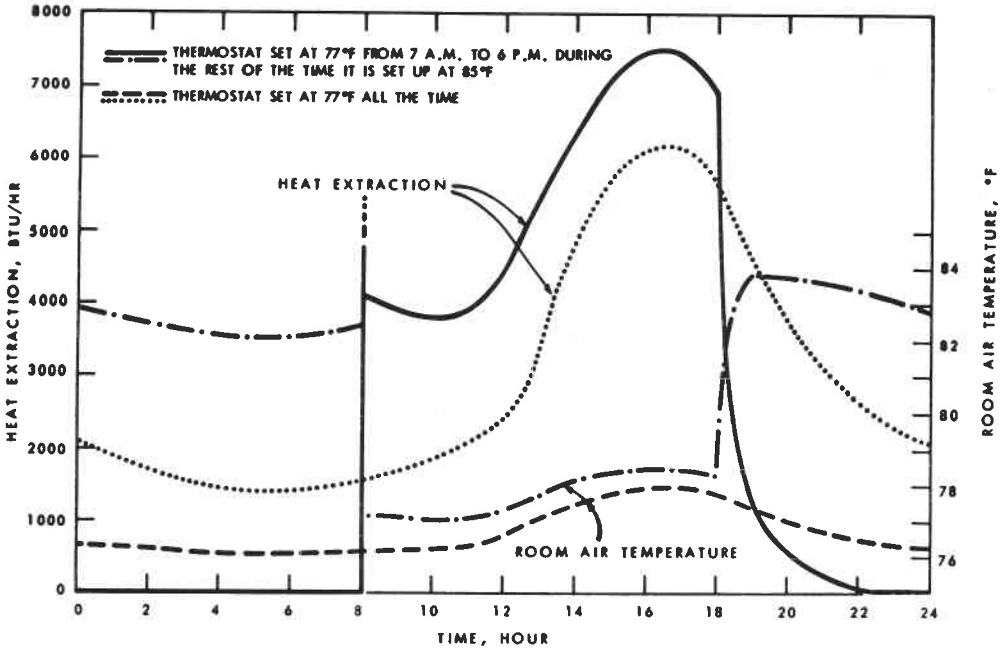

Fig. 3 Room air temperatures & heat extraction rates for continuous & intermittent operation

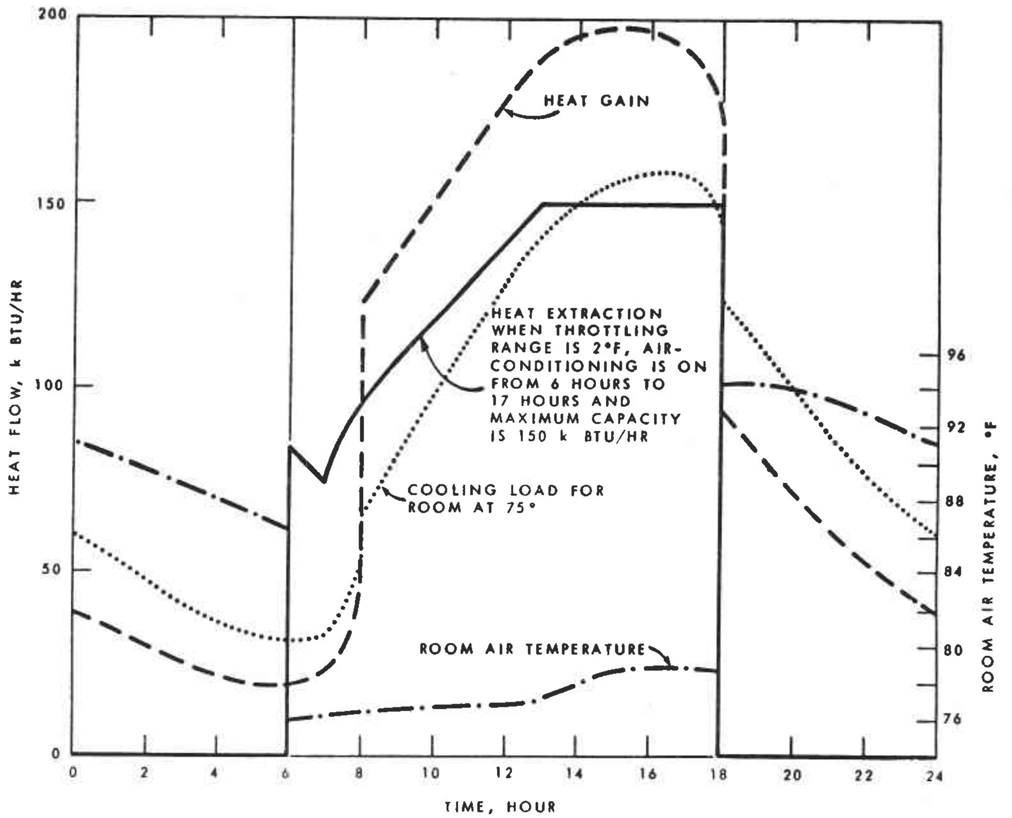

Fig. 4 Sample of results for Example 19 (see Table 48, Chapter 22, ASHRAE HANDBOOK OF FUNDAMENTALS, *1972)*

Example 19 (from Chapter 22) and the curves in Fig. 4 indicate the sort of result that can be obtained using the new methods. It is interesting to note that in this example the peak heat gain is 197 MBh,* but that the peak cooling load is only 158 MBh. Furthermore, if the cooling unit has a maximum capability of 150 kBtu/hr, it wil be able to keep the room temperature between 75.4 and 77 F. Results also show the consequences of using different throttling ranges for the control system and the conditions that would occur if the cooling system were shut down during the night. Attention is drawn to this example because it illustrates the kind of analysis that the new method makes possible. The actual results are of little intrinsic interest as it is not intended to imply that the same ratio of heat extraction to heat gain would obtain for other situations. Every case should be examined on its own.

CONCLUSION

This is the first time that the transfer function method has been presented in this form for practical design calculation. It can be anticipated, therefore, that some minor difficulties may arise in its application. It is hoped that difficulties, if there are any, will not deter the majority of ASHRAE HANDBOOK users from trying the method.

* *1000's Btuh.*