Program BA4

FOR CALCULATION OF ROOM TEMPERATURES

AND HEATING AND COOLING LOADS

USERS GUIDE

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PROGRAM BA4

for calculation of room temperatures and heating and cooling loads.

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Preface to 2. edition.

Two extensions have been included in the BA4 programme, April 1977 version:

1) An option of running quasistationary conditions, with repeating diurnal cycle. Then the Test Reference Year is not used, and consequently sunradiation and outside air temperature have to be specified (BA2 type card, AIRTEMP 2 time serie, page 13).

2) The direct beam radiation in the Danish Reference Year can be zeroed on certain days in December, January, March and April, thereby bringing the direct radiation in better accordance with the average number of sunshine-hours in the months mentioned. (MODREF type card, page 13). This option shall be used only with the Danish Reference Year published 1974.

A short description of the programme can be found in:
Hans Lund: The model and theory behind the BA4 programme, Thermal Insulation Laboratory, 1978.

January 1979 Hans Lund

Programme BA 4

The programme calculates for a room half-hour values during a whole year of room temperatures, utilizing a simplified method. Further it can calculate heating and cooling loads, taking into account sun radiation, fixed and movable sun shading devices, varying ventilation and infiltration, electric lighting and other heat sources in the room, etc.

The calculations utilize the weather data from the Danish Reference Year.

The results may be presented in several different ways, with a few values for each day, with detailed description for singular days, or for each of the twelve months and for the whole year, sums, mean values, frequencies or fractiles.

The main simplifications in the calculation method consists in:

1) that all surfaces in the room, apart from the window, are assumed to have the same surface temperature.

2) that all heat accumulation takes place in one layer inside the wall, and that the heat accumulating layers of all walls have the same temperature.

3) that all surface resistances are constant (but not necessarily equal).

The programme consists of one main programme and ten subroutines.
Totally 1200 cards, including comments.
By using a condensed Reference Year stored on disc, the execution time will be 16-24 sec. for one room, one year, dependent of numbers of window orientations, sun shading devices etc.
(On an IBM 370/165 system, compiled by a FORTG compiler, compiling time not included, core needed: approx. 83 k + input-output buffers, total 98 k).
Programme BA 4 is developed at the Thermal Insulation Laboratory, the Technical University of Denmark. Special editions exist for certain purposes, and the programme is sometimes changed.
This copy relates to May 76*status of the programme.
The method utilized is proposed and described by Bo Andersen.

The programme is owned by the Thermal Insulation Laboratory, the Technical University of Denmark, Building 118, 2800 Lyngby.
It is supplied free to potential users.

May 1976 Hans Lund

*)This copy relates to the April 1977 version of the programme.

Test Reference Year

(Danish "Reference Year")

The "Test Reference Year" (TRY) is a weather data collection with 8760 hourly weather registrations, containing a considerable number of weather parameters for each hour. It is intended, for a given location, to ideally represent the weather throughout a typical year, on the assumption that a typical year can be defined.

Its main purposes are to make it possible for architects, consulting engineers, and others to make use of computing programs for calculations of energy consumption and indoor climate by an entire year of weather data, and to make it possible to compare different projects throughout a whole year.

For the program mentioned here, the Test Reference Year is normally used in a condensed form, stored on disc, and containing per hour those data only that are relevant to the program.

In those cases where a condensed Test Reference Year is not available, the full Test Reference Year on tape is utilized. The subroutine DISKL is then substituted by a subroutine TAPL (included in this version of the Users Guide). CALL TAPL instead of DISKL in line 106 in MAIN-programme.

For those cases where a Test Reference Year with hourly values of direct, normal radiation and diffuse radiation is not available, the Laboratory possesses algorithms and subroutines that permit calculations of the radiation data from cloud cover observations.

Output from BA 4 programme

The output covers:

- I A reproduction of input data.
- II A "small" list output with a few values for each day of the year.
- III A "big" list output with values for each half hour for a few (up to 10) specified days of the year.
- IV Monthly and yearly frequencies, mean values, sums or fractiles.

I and parts of IV are always produced.
II is produced if it is not specified suppressed.
III and the remaining part of IV have to be specified in order to be produced.

Each page in the output carries the job title from the title card and the date of the execution of job.

I Reproduction of input data. 2 pages.

After title of job follows on page 1 room data with data names. Besides the time interval DT = 0.5 (hour) is written. DT is a constant in the programme.

After that follows a list output of all recorded "type cards" and of the cards giving time series for ventilation and infiltration.

On page 2 are written out full time series (48 half-hour values) from:

AIRTEMP 1 desired room air temperature.
AIRTEMP 3 specified temperature of adjoining room, and
AIRTEMP 4 the temperature of the ventilating air, if this temperature is recorded with a time series. If it is derived from the outer air temperature it will here be zero (or, by repeated calculations, a value without meaning).
QMAX maximum available heating effect } for maintaining
QMIN maximum available cooling effect } AIRTEMP 1.
FLUX specified heat flows, however at least FLUX 10 (heat from electric lighting) and FLUX 1.

Further the daily sums of the individual FLUXes are written out, and the distribution KONVection and RADIation, i.e. to room air and to surfaces, of QMAX, QMIN and FLUXE.

When by means of a 999-card a new calculation follows after ending the first one, again all room data are written out on page 1, but only the type cards and time series which are specified for this new calculation. All other inputs are assumed unchanged from the first calculation. Page 2 is written in full.

NB. This is not rather useful, as list output from the calculations cannot be separated from each other without loosing information of complete input data. Therefore an alteration is being planned in order to write all input data for each calculation.

II "Small" list output.

Per 24 hours is printed out one line with:

MD	Month.
DG	Day.
RLT M	Daily mean of room air temperature.
KL	Hour for
RLTMAX	Daily maximum of room air temperature.
OP-T	Daily maximum (without indication of time) of operative temperature towards the inner walls of the room, if OPERative is specified.
OPTX	Daily maximum of operative temperature towards window wall with window nr. X, if OPERative X is specified.
UDT M	Daily mean of outer air temperature.
Q KOLE	Daily sum of cooling. If both QMIN with time series (for maintenance of AIRTEMP 1) and QMIN NB (for maintenance of the temperature NB °C) are specified, the daily sum is incorrect and invalid.
Q VARM	Daily sum of heat conveyed to the room to maintain AIRTEMP 1.
Q PRIM	Daily sum of heat conveyed to primary air.
Q SOL	Daily sum of heat from sun through window, outer wall and roof.
UVQ	Number of half-hours with either cooling to the temperature NB °C, or extra ventilation.
E-L	Number of half-hours with electric lighting.
B-AX	(X=1 through 4), number of half-hours with movable shading device for the windows nr. 1-4, if specified.

III "Big" list output.

For each day specified with "big" list output one page with 48 half-hour values from 0.30 to 24.00 is written.

RL-T	Room air temperature.
OP-T	Operative temperature towards the walls of the room.
OPTX	Operative temperature towards window wall with window no. X, if OPERativ X is specified. If X is not specified (or X=0), the caption will be OPT*, and the value given will be the operative temperature towards a double-pane without any sun radiation absorbed in the panes.
UDLT	Outer air temperature.
QREG	Heating or cooling effect conveyed to the room. If within a half-hour, cooling effect occurs to both QMIN with time series and to QMIN NB, only the last cooling effect, to the temperature NB, will be written out.
QPRIM	Heating or cooling effect conveyed to the ventilation air.
QTOT	Total heating effect.
SOLIND	Heat from sun radiation through windows.

UVQ Indicator = 1, if within the half-hour there has been cooling to the specified temperature NB or extra ventilation, otherwise 0.

E-L. Indicator = 1, if the electric light has been on.

B-AX (X=1-4), indicator = 1, if movable shading device has been used at window X.

IV Monthly and yearly tables.

2-6 pages are written, dependent of the specification of OPERative.

a. Frequency of the room air temperature, as half-hours, divided into full degree intervals for the 12 months of the year and for the whole year. All 48 half-hours of the day are included and temperatures within the interval 12-40°C, and "below 12°C" and "above 40°C".

Further is written out monthly mean of the room air temperature, and the monthly sum of:

QQ- Cooling to the room.

QQ+ Heat to the room.

QPRIM Heat for preheating of the ventilation air. (If AIRTEMP4 is specified with a time series, cooling of the primary air may occur at high outer air temperatures, reducing the sum QPRIM.

QTOT Total heat effect QPRIM + QQ+ .

QSOL Total sun radiation through windows, walls and roof.

QELYS Total heat from electric light.

UVQ Number of half-hours either with cooling to the temperature NB or with extra ventilation.

Also the corresponding yearly values are written out, and at last the total heating load for the months October - April incl.

b. Frequency ot the room air temperature during the working hours, i.e. during the 18 half-hours between 8.30 and 17.00, if no other time interval is specified.

Besides a fractile calculation which in the area 12-40°C gives the 10%, 50% and 90% fractile, i.e. the temperature under which this percentage of the half-hours is situated.

c. Frequency of the operative temperature for all half-hours of the day. This list output c and d is only calculated if OPERativ is specified.

d. Frequency of the operative temperature during the working hours.
In addition a fractile calculation.

e. Frequency of the operative temperature towards window wall during the working hours. This list output e and f is only calculated if OPERativ X is specified, where X is the number of a window specification (X = 1-10).
In addition a fractile calculation.

f. The difference between the operative temperature towards the window wall and towards the walls of the room during the working hours. Given as a frequency of half-hours in full degree intervals in the area -8°C to 20°C.

In addition a fractile calculation.

Input cards for BA4

The program operates in the SI-system of units. Output is given in kWh or W.

1. Title card. col. 1-72 job title. Is reproduced on output.

2. Room data. Arbitrary succession.

   Col. 1-2: name, col. 3-12:value, with decimal point.

   TU Heat transfer from inside surface to outer air, for the window from room air to outer air. W/°C.

   TK Heat transfer from inside surface to adjoining room with specified temperature (AIRTEMP 3), e.g. corridor.

   TO Heat transfer from room air to all inside surfaces.

   TA Heat transfer from inside surfaces to common accumulating layer.

   S The heat capacity of the common accumulation layer of the room. Wh/°C.

3. Blank card. Terminates room data.

4. Heat flows, air change, window data, output specifications etc. Arbitrary succession and number. Two types of cards can be used: "type cards" and "time series".

   Type cards:

   col 1-8 name (only col 1-4 are significant).
   col 10-11 number NB, integer , units in col 11.
   col 12-21 numerical value CK, with decimal point.
   col 22-31 numerical value CR, with decimal point.

   Time series: consist of two or more cards:

   col 1-5 hour and minute, with decimal point.
   col 11-20 numerical value, with decimal point.

   The first card in a time series shall have the hour 0.00, the last card 24.00, and the numerical value for the two cards must be identical. Between them can be inserted cards for other hours. The half-hour values for the calculation appear by linear interpolation between the given hours.

   Generally, if CK and CR both are equal to 0, the type card must be succeeded by a time series. If CK or CR or both are different from 0, no time series must follow.

Name	NB	
AIRTEMP	1	Desired room air temperature maintained by heating or cooling, given as time series.
AIRTEMP	3	Temperature in adjoining room or corridor, given as time series.
AIRTEMP	4	Temperature of the primary air to the room, given as time series, or
AIRTEMP	4	CK CR Temperature of the primary air follows the outer air temperature with TOVT=CK, temperature increase on primary air from fan and ducts, and TMIT=CR, minimum accepted primary air temperature (maintained through preheating if necessary).
FLUX	1 thru 9	Heat flow to the room, given as a time series. (W). Up to nine different heat flows.
FLUX	10	Heat flow to the room from electric illumination, operated on-off by the level of daylight from the window. Given as a time series.
FLUX	1 thru 10	CK CR CK and/or CR different from 0. CK is a factor for that part of the heat flow which is given off convectively direct to the room air. CR is a factor for that part which is radiated to the surfaces of the room. If CK and CR are not indicated for a FLUX it is assumed that the whole heat flow is radiation to the surfaces (CK=0., CR=1.).
QMAX		Maximum possible heating effect to the room, as a time series, for obtaining AIRTEMP 1.
QMAX		CK CR CK and/or CR not equal to 0. Factors for convective and radiative part of the heating effect. If nothing is specified, default values are CK=1., CR=0., i.e. purely convective.
QMIN		Maximum possible cooling effect to the room, as a time series, for obtaining AIRTEMP 1. (Given with minus sign).
QMIN		CK CR CK and/or CR different from 0. A factor for giving off convection and radiation, analogous to QMAX.
QMIN	NB	Cooling to the temperature NB. CK=CR=0 or blank. This typecard must be followed by a time series, the content of which is without importance, i.e. only the hours 0.00 and 24.00 need to be indicated. This cooling is calculated after any heating effect, there are no limits of the cooling effect, and it is exclusively conveyed to the room air. It makes it possible to specify a higher set-point for room air temperature (NB) by cooling than by heating (AIRTEMP 1).

OBS! MAXVENT and QMIN NB cannot be specified in the same calculation.

VENT NB Heat exchange by forced ventilation. Is given as a time series. The numerical value is in W/°C, corresponding to the air change kg/sec multiplied by the (mean) specific heat of the air J/kg°C. The ventilation is assumed to take place with AIRTEMP 4, which is given either as a time series, or following the outer air temperature without or with a preheating.
VENT 0 (or blank) is valid all the year.
VENT 1-10 is only valid for a period specified by:

VENT NB CK CR,
where NB ≠ 0, and CK and CR each have the form of a date (month.day) and indicates the first and the last day in the period with VENT NB.
OBS! Here the succession is significant, as every new VENT for a given date substitutes the preceding, e.g. VENT 0.

INFILT NB Heat exchange by natural air change. Is given as a time series, analogous to VENT NB, only the air change takes place with outer air.
(At the moment it is not taken into account that the natural air change is dependent of wind velocity or temperature differences).
INFILT 0 (or blank) is valid all the year.
INFILT 1-10 is only valid for a period specified with:

INFILT NB CK CR, analogous to VENT.

The following input data are only given as type cards (name, NB, CK, CR), without time series.

VINDUE NB CK CR
(window)
NB = 1 through 10, up to 10 window specifications can be given. A "window" may consist of several, single windows with the same orientation.
CK glass area, m^2, total.
CR window orientation, -180° to 180° (South=0°, East=-90°).
By the calculation of the sun radiation the window is regarded as double-glazed, 2+4 mm sheet glass, clear.

HORISONT NB CK
NB = 1 through 10. Indicates for window NB the altitude of horizon CK°. The horizon excludes by solar altitudes < CK the direct sun radiation, but not the diffuse sky or ground reflected radiation.

FORMAT NB CK CR
Dimensions of the single window.
NB = 1 through 10, indicates window number.
CK = height of glass for one window.
CR = width of glass - - -
FORMAT is to be specified if UDHAENG (projection) or RIBBE (rib) are specified. "Window NB" may consist of several identical individual windows.

UDHAENG NB CK CR
Shading projection over window NB. Reduces direct radiation and diffuse radiation. The canopy extends very long to both sides of the window.
CK height (in meters) of shading edge over the upper-edge of the window.
CR projection of shading edge in front of glass.
(FORMAT for the window must be indicated).

RIBBE NB CK CR
Shading column, rib or wall edge next to window NB on both sides. Reduces direct radiation only.
CK distance (in meters) of shading edge from the nearest glass edge.
CR projection of shading edge in front of glass.
(FORMAT for the window must be indicated).

BEV.AFSK NB CK CR
Inserts a sun shading device for the window NB, when the mean radiation on the window per m^2 is exceeding a limit value CK. The heat flow is thereby reduced by multiplication with the factor CR (the shading factor).

FORDEL NB CK CR
Distributes the sun radiation from window NB to room air and surfaces.
CK is the fraction of the sun radiation going to room air, when movable sun shading is not in use, the remaining part going to the surfaces.
CR is the fraction to room air when the movable sun shading is in use.
Default values are CK = 0.5, CR = 0.5.

VAEG NB CK CR
(wall)
Calculates the heat flow into the room arising from shortwave radiation on outer wall. The calculation is simplified, with a time delay and a transmission:
$\alpha \cdot CK \cdot CR \cdot mu$, where
α = 0.85 is the absorption coefficient for the exterior of the wall
CK = U-value of the wall
mu = outside surface resistance, 0.05 m^2 $^oC/W$
CR = area of the wall in m^2.
NB indicates a window number with the same orientation as the wall. Should there be no window with this orientation, a window with the area CK = 0. must be specified.
The time delay is obtained by assuming that 20% of the heat is getting through during the first half-hour, and that thereafter the heat flow decreases exponentially with 20% per half-hour. All heat is assumed supported to the inside surface.

TAG CK CR
(roof)
Calculates the heat flow into the room arising from sun on the roof. Analogous to VAEG.
CK ~ the U-value of the roof.
CR ~ the area of the roof.

B.ISOL CK
Reduces the heat exchange TU with outer air through windows and outer walls, e.g. corresponding to insulation draperies or panels covering the windows.
CK reduction factor for TU.
The reduction takes place in the night at 18-7 during the period 28th Oct. to 9th April (day no. 301 to day no. 99), but any other conditions may be inserted (in MAIN).

ELLYS (elec.light) CK
Conveys FLUX 10 to the room if the total sunlight through all windows is less than CK.

MAX-VENT CK CR
Increases the air change in the room (e.g. corresponding to opening of window) if the room air temperature exceeds a given limit value. The increase of the air change takes place with outer air. The increase takes place only if the outer air is colder than the room air, and only to the extent which makes it necessary in order to decrease the room air temperature to the limit value.
CK limit value for the room air temperature.
CR total air change indicated as heat exchange in W/°C (analogous to VENT and INFILT).

OBS! MAX-VENT and QMIN NB may not be specified at the same time.

BA2 NB CK CR
Causes the calculations made for quasi-stationary conditions. The Test Reference Year is not used, and outside air temperature must be specified with AIRTEMP 2, see below. Sunradiation is computed for day CK (month.day), with cloud cover NB (in okta's) and for latitude CR. For CR = 0 or blank, 56 deg. North is assumed.
The calculations run 10 days, first and last day being printed out with half-hourly values ("Big" list output) and the others with one line only.

AIRTEMP 2 Outside air temperature, as time serie, like AIRTEMP 1, 3 and 4. To be used only after the BA2 type card.

The following input-data indicate the wanted presentation of output. If nothing is specified, the following is given:

I A reproduction of input-data.
Calculated time series at 0.30 to 24.00 of AIRTEMP 1, 3 and, if specified, 4, QMAX, QMIN, and FLUXes.

II "Small" list output, that is 1 line per day with diverse temperatures, daily sums of heat flows and enumerations.

IV The distribution of the room air temperature, monthly

and for the whole year, at 0-24, 8.30 - 17.00 (working hours) and monthly and yearly sums of different heat flows.

This can be altered by:

UDSKRIV CK CR
CK = -1. or CR = -1. suppresses "small" list output. (Output II).
CK og CR = month.day gives "big" list output for the date, i.e. for every half-hour: temperatures, heat flows and conditions for sun shading device, electric lighting etc.
Up to 10 dates can be specified with big output (CK or CR = -1 takes the space for one date). Arbitrary succession. (Output III).

A-TID CK CR
Alters the "built-in" working hours (as indicated under output IV) to the time from CK to CR.

OPERativ NB CK
Leads to calculation of operative temperature (as the mean value of air temperature and surface temperature of walls). Is written out monthly and for the whole year, like IV.
For NB $\neq$ 0 is also calculated the operative temperature towards the window wall with VINDUE NB, by which is included that the wall occupies the fraction CK of the total half room seen from the place in the room from where the operative temperature is wanted.
The operative temperature is calculated for the working hours, and so is the difference between operative temperature towards the window wall and towards the inside walls of the room.

A special card to be used in connection with the Danish Reference Year only is:

MODREF Causes direct (beam) radiation to be zeroed on certain days, because the number of hours with clear sun is too large in the Danish Reference Year in those months. The days are January 12, 14, 16, 17, 18, March 18, 19, April 17, 18 and December 1, 13, 14, 15, 20. No time series follows.

5. LASTFLUX-card (col 1-8) indicates that the input cards have ended, and the calculation may begin. After LASTFLUX shall be placed a blank card.

6. Succeeding calculations. Are obtained by inserting a card 999 in col 1-3 after LASTFLUX instead of a blank card.
After that new room data follow. Cards are only inserted for the data which are to be changed as indicated under 2.
After that a blank card is inserted as indicated under 3.
After that new type cards and any time series follow as indicated under 4.
Ending with LASTFLUX and blank card, or 999-card if one more calculation has to be run.
Generally, by more calculations after each other, those data which are not expressly altered are carried unchanged to the next calculation.

MAIN, the main programme

The main programme contains the programme administration, including call of most subroutines, and the central procedure of calculation.

The succession is:

Initializing, i.e. recording of title cards, call of date, and zeroing of all variables, which are not zeroed for each day. This especially goes for the input data recorded through RUMDAT. Some data are given a value different from 0, which are then kept if another value is not recorded in RUMDAT.

Recording through RUMDAT (and EIND and SFLUX) of input data.

Initializing of data before start of a new calculation.

Calculation of the coefficients A1 and A2 for the temperature in the heat accumulating layer.

Recording of one day's weather data from Reference Year in subroutine DISKL (or TAPL), calculation for the day of the angles of the sun in SUNR, calculation of sun radiation through windows, walls and roof in SOLIN, and interpolation to 48 half-hours' values for outer air temperature and ventilation air, if any, in INPOL.

Initializing of data for the day, code for ventilation and infiltration, transmission of calculated values at 24.00 the prededing day to 0.00 for the day which is now calculated.

Output of table headings for "big" output, if any.

Start of half-hours-loop.

Calculation of additional insulation, if any, during winter nights.

Calculation of coefficients B and C for surface temperature and room air temperature.

Summing up of sunlight and of the total heat of the sun, per half-hour.

Switching in electric light, if any, at low levels of sunlight.

Calculation of temperatures without cooling or heating effect.

Calculation of necessary cooling or heating loads to maintain the desired room air temperature AIRTEMP 1.

Calculation of new temperatures with the available cooling or heating effect.

Calculation of extra cooling loads, if any, for maintenance of the room air temperature NB.

Calculation of new temperatures with the latest calculated, extra cooling effect.

Switching in extra ventilation if the room air temperature is above the wanted maximum, and if the outer air or ventilation air is cooler, and if extra ventilation is specified and is higher than the actually used ventilation for the half-hour.

Calculation of new temperatures with the extra air change, and the time (~ fraction of the half-hour) in which shall be extra ventilated to keep the temperature below the specified maximum. (Printout of this time is at present omitted).

Calculation of the inside, apparent radiation temperature of the window. (This calculation of which part of it is placed in SOLIN, is uncertain, as it is not clear what reasonably shall be included. Here it is assumed that the measuring area for the radiation temperature of the window does not receive direct sunradiation).
Calculation of operative temperature towards the walls of the room, and towards window wall, of which a part is opaque.

Enumeration of number of half-hours with extra cooling, extra air change, electric lighting, or with movable sun shading device for window 1 thru 4.

"Big" list output, if specified, one line with half-hour values printed.

End of half-hour-loop.

Print out of table heading for "small" output, after change of page in output.

Distribution and enumeration for monthly and yearly tables, including call of ADM 2.

Printout of line with "small" output, daily values, if this output is not suppressed.

If the date is not 31st December, return to DISKL to get weather data for the next day, etc.

If the day is 31st December, call subroutine UDSKR for output of monthly and yearly tables, fractile calculations, etc.

Reading of a new card. If it is a 999-card, return to call of RUMDAT and new calculation, otherwise calculations are stopped here.

Algorithms used in BA4, MAIN

The main program MAIN as a steering program contains calls for most of the subroutines. Besides, in MAIN is placed the central calculation procedure which every half-hour calculates temperatures, heating and cooling effects, or, if specified, increase of ventilation and electric lighting.

1. Formulae:

   Heat accumulating layers, the temperature of the Nth half-hour, N = 1 to 48:

   $$THA(N) = AL \cdot THA(N-1) + A2 \cdot THO(N-1)$$

   Surface temperature:

   $$THO(N) = B1 \cdot THA(N) + B2 \cdot TEXI(3,N) + B3 \cdot TEXI(2,N) + B4 \cdot TEXI(4,N) + B5 \cdot QK(N) + B6 \cdot QR(N)$$

   Room air temperature:

   $$THR(N) = C1 \cdot THO(N) + C2 \cdot TEXI(4,N) + C3 \cdot QK(N)$$

   where

TEXI(2,N)	outer air temperature
TEXI(3,N)	(specified) temperature of adjoining room
TEXI(4,N)	temperature of ventilation air
QK(N)	heat conveyed to room air
QR(N)	heat conveyed to surfaces (radiation)

   The single items can be split, e.g. if there are more than one quantity of ventilation air, with different temperatures.

2. Coefficients for calculation of temperatures: Accumulating layers:

   $$A2 = \frac{TA \cdot DT}{ST} = \frac{TA \cdot 0.5}{ST}$$

   $$A1 = 1. - A2$$

   Here the half-hour cycle starts.

   Intermediate values:

   Total instantaneous air change.

   $$VTSUM = VENT(N) + INFL(N)$$
   $$VTO = 1 + VTSUM/TO$$

3. Coefficients for calculation of temperature of surfaces:

   $$B5 = 1/((TA + TK + TU) \cdot VTO + VTSUM)$$
   $$B4 = B5 \cdot VENT(N)$$

(The corresponding value for infiltration is integrated in the expression, B5·INFL(N)).

B6 = B5·VTO

(B1 = B6·TA, B2 = B6·TK, B3 = B6·TU are integrated in the expressions).

Auxiliary values:

RB5 = 1/B5

4. Coefficients for calculation of room air temperature:

C1 = 1/VTO
C3 = 1/(TO + VTSUM)
RC3 = 1/C3

(C2 = 1-C1 is integrated in the expression).

5. Calculation of new temperatures and heating or cooling.

Temperature of accumulating layers:

THA(J) = THA(J-1)·A1 + THO(J-1)·A2
where J = 2 to 49.

Preliminarily calculated surface temperature:

```
THOJ = THA(J)·B1 + TEXI(2,J-1)·B3
     + TEXI(3,J-1)·B2 + TEXI(4,J-1)·B4
     + TEXI(2,J-1)·B5·INFL(J-1)
     + QK(J-1)·B5 + QR(J-1)·B6
```

First step of calculation of air temperature:

```
TBAS = TEXI(2,J-1)·C3·INFL(J-1)
     + TEXI(4,J-1)·C3·VENT(J-1)
     + QK(J-1)·C1/TO
```

Preliminarily calculated air temperature, without regulation (heating or cooling):

TBAS + THOJ·C1

Desired change of temperature by regulation:

TREG = TEXI(1,J-1) - TBAS - THOJ·C1

To this corresponds a temporarily calculated regulating effect to the room air:

QREG = TREG·TO/C1

Total regulating effect: QQ(J) = QREG/CKK.

New calculation in which is considered the influence of the regulating effect on the surface temperature, and thereby back on air temperature and TREG:

QREG = QREG/(1 + (B6·CRR/CKK + B5)·TO),
where CRR and CKK are the fractions of the regulating effect delivered by radiation and by convection. (CRR + CKK = 1).

If QREG exceeds the part of the available heating and cooling effect delivered by convection, the convectively available effect is used in calculation instead.

Final surface temperature with regulating effect:

THO(J) = THOJ + QQ(J)·(CRR·B6 + CKK·B5)

Final air temperature with regulating effect:

THR(J) = TBAS + THO(J)·C1 + QQ(J)·CKK·CK/TO

6. Limitation of temperature by cooling of room air.

Desired change of air temperature to TLIM:

TREG = TLIM - THR(J)

Necessary cooling effect (convective only):

QLIM = TREG·TO/(C1 + B5·TO) (QLIM negative)

New surface temperature:

THO(J) = THO(J) + QLIM·B5

New room air temperature:

THR(J) = THR(J) + QLIM·(C3 + B5·C1)

7. Limitation of temperature by increased air change.
With outer air (NVU=2) or ventilation air (NVU=4).
Increased air change only if TEXI (NVU,J-1) < THR(J).
VVV maximum air change, VVN increase from normal air change by ventilation

VVN = VVV - VENT(J-1) TVV = VVN

New air temperature:

THR1 = THR(J)/C3 + TEXI(NVU,J-1) · VVN/(VVN + 1/C3)

If THR1 is lower than the desired maximum temperature TVMAX, TVV is reduced proportionally:

TVV = (THR(J) - TVMAX) · (TO + VTSUM)/(TVMAX - TEXI(NVU,J-1))

and new THR(J) is set equal to TVMAX.

After that new VTSUM, VTO, B5, B6, THO(J) are calculated.

8. The heating load for heating the primary air excl. the over-temperature TOVT arising from fan and ducts, in each time interval:

```
QPRIM = (TEXI(4,J-1) - TEXI(2,J-1) - TOVT)·VENT(J-1)
```

9. Calculation of the radiant temperature of the inside of the window. TVIN(J) is calculated in SOLIN as the temperature increase of the window caused by absorbed solar radiation:

```
TVINJ = TVIN(J) +(THR(J) +THO(J))·0.625/2.+TEXI(2,J-1)·0.375
```

This expression is valid only for an ordinary double glass or thermopane.

Calculation of the indoor mean temperature of window and exterior wall. The wall occupies the fraction PRON of the half sphere visible from that position in the room where the directional operative temperature is wanted:

```
TVIN(J) = TVINJ·(1.-PRON) + THO(J)·PRON
```

Blank COMMON MAIN, UDSKR, INPOL, RUMDAT, SFLUX

		To be read or calculated in	To be used in
TEKST (18) (=Z(18) in UDSKR, RUMDAT and SFLUX, =T(18) in INPOL)	Job title, 0-72 characters	MAIN	MAIN, UDSKR, SFLUX
QQ (50)	Regulating effect. Half-hour values	-	MAIN
QK (50)	Total effect to room air - -	-	-
QR (50)	Total effect to surfaces - -	-	-
QMAX (50)	Maximum heating effect - -	RUMDAT	-
QMIN (50)	Maximum cooling effect - -	-	-
TEXI (4,50)	Four air temperatures - -		-
	1 Desired room air temp.	-	
	2 Outer air temp.	INPOL	
	3 Air temp. in adjoining room	RUMDAT	
	4 Ventilation air temp.	RUMDAT or INPOL	
INFL (12,50)	Natural air change - - 12 different ones	RUMDAT	-
VENT (12,50)	Air change by ventilation - -	-	-
COK (10)	Fraction of FLUX (1-10) supplied convectively	-	-
COR (10)	Fraction of FLUX (1-10) supplied by radiation	-	-
QLYS (10)	Heat from elec. light. Half-hour values	-	-

COMMON/KORS/ SOLIN, INPOL, SUNR, DISKL		To be read or calculated in	To be used in
AS (50)	Azimuth of the sun, half-hour values	SUNR	SOLIN
H (50)	Height of the sun, - -	-	-
RNT (24)	Normal radiation from Ref.Year, hour values	DISKL	-
RDT (24)	Diffuse radiation - - - , - -	-	-
TT (24)	Air temperature - - - , - -	-	INPOL
FF (24)	Wind velocity - - - , - -	-	not used
SO	Sunrise	SUNR	SOLIN
SN	Sunset	-	-
RTOT(24)	Total radiation from Ref.Year, is not used	DISKL	not used
TD (24)	Dew point temp. - - - , - - -	-	- - -
NN (24)	Cloud cover - - - , hour values	-	SOLIN
COMMON/SR/	**SOLIN, RUMDAT**		
HORM (10)	Demarcation of horizon, altitude, window no.1-10	RUMDAT	SOLIN
VAEK (10)	Outer wall, U-value·area, (with - - -)	-	-
UDHM (2,10)	Projection, height, overhang, at - - -	-	-
RIBM (2,10)	Rib, distance, overhang, at - - -	-	
BEVM (3,10)	Movable sun shading device, at - - - 1., shading factor, limit value	-	-
FM (2,10)	Window dimensions, height, breadth, - - -	-	-
FORDM(2,10)	Fraction of sunlight to room air, without and with movable sun shading device	-	-
VIN (10)	Window orientation, window no.1-10	-	-
AVT (10)	Window area, - - -	-	-
TGK	Roof (horizontal) U-value·area	-	-

COMMON/AD1/ MAIN, ADM2, UDSKR, FRAKT		To be read or calculated in	To be used in
ITAEL(6,30,13)	Indexes for number of half-hours with 6 variants , 30 full degree intervals and 12 months + the whole year	ADM2	UDSKR, FRAKT
THA (50)	Temp. of accumulating layer, half-hour values	MAIN	
THO (50)	Temp. of surface, - - -	-	ADM2
THR (50)	Room air temperature - - -	-	-
SUM (11,13)	Monthly and yearly sums	-	UDSKR
GLIM (6,2,13)	max. and min. temperatures, 6 variants, 12 months + the whole year	ADM2	FRAKT
COMMON/INTERP/ MAIN, ADM2, SOLIN			
SOL (50,2)	Solar heat through windows, delivered partly to room air, partly by radiation to surfaces. Half-hour values.	SOLIN	MAIN
SOLT (50)	Solar heat through roof and walls, half-hour values	-	-
TVIN (50)	Temperature rise of window due to absorbed sunradiation -	-	-
TOO (50)	Operative temp. towards walls, -	MAIN	ADM2
TO1 (50)	Operative temp. towards window and outer wall	-	-
MBA (4,50)	Indexes for half-hours with movable sun shading device for window 1-4	SOLIN	MAIN

Arrays

ELM (3) — ELM(1) and ELM(3) are not used.
ELM(2) limit value for switching on or off of electric light.

IINF (366) — Code 1-12, time-series number for infiltration to be used for each day during the year.

IVEN (366) — Code 1-12, time-series number for ventilation to be used for each day during the year.

NBQ (4) — Number of half-hours during the day, where movable sun shading device has been used for window 1-4.

ND (10), NM (10) — Dates, and month, for which "big" output, with half-hour values, is wanted.

QELT (50) — Effect of electric lighting, when turned on. Recorded as FLUX 10.

QKK (50) — Total effect to room air, recorded through RUMDAT, i.e. exclusive electric lighting and solar radiation.

QRR (50) — The same to surfaces.

QP (50) — Heat conveyed to primary air for maintenance of specified minimum entry temperature, TMIT.

QQTT (12) — Summation to diverse daily sums.
QQTT(1) and (2) are not used.

3 cooling load
4 heating load in the room
5 heating load in primary air
6 total heating load (4+5)
7 sun radiation
8 heat from electric lighting
9-12 not used

QTT (50) — Total heating load to the room and to primary air, half-hour values.

Variables

AKL — Hour for maximum room air temperature.

AT2 — Summation for calculation of daily mean temperature of outer air.

AXDAG — Maximum room air temperature of the day.

A1, A2 — Coefficients for calculating the temperature of accumulating layer. A1 + A2 = 1.

B4 B5 B6	Coefficients for calculating the surface temperatures.
CAK CAR	Fraction of heating effect supplied to room air and to surfaces. CAK + CAR = 1.
CIK CIR	Fraction of cooling effect supplied to room air and to surfaces. CIK + CIR = 1
CKK CRR	= CAK, CAR or CIK, CIR, depending on whether heating or cooling is needed.
C1 C3	Coefficients for calculating the room air temperature.
DELT	Total time during the 24 hours with max. air change, hours. (At present not printed).
DELTA	Total time during a half-hour with max. air change, hours.
DNT	= 48, number of half-hours during the day.
DT	= 0.5, time interval, not used.
I,J,J1,J2	Index in DO-loops.
ID IM IY	Day, month, year for the job execution. (from NEUCC library routine).
IAR	Not used.
JE JD	Is used to distinguish between full-hours and half-hours by output with half-hour values for 24 hours.
K	Index in DO-loop.
MM	Recorded as indicator for continued calculation (for MM=999).
MDG	Day-number (101-1231) for "big" output.
MEL MVU	Indicator for half-hour with electric lighting or extra cooling or extra ventilation.
NATI NAT	Beginning and end of working hours, given as half-hour number + 1.
NAP (= NOP)	Indicator for number of statistic outputs. -1 room air temperature only 0 besides operative temperature 1,2 -- besides operative temp. towards window no.1,2--
NDAG	Not used.
ND1	Not used.
NDG	Day of month, read in DISKL.
NMD	Month, - - -
NDN	Number of day of the year, 1-365, calculated in SUNR
NDT	= DNT = 48 half-hours per day.

NEL	Number of half-hours during 24 hours with electric lighting.
NFLU	Number of recorded fluxes, 1-9 (excl. electric lighting, FLUX 10).
NMM	Indicator, 0 gives "small" output (one line a day), -1 suppresses the "small" output.
NINF	Not used in MAIN.
NNW	Indicator, 1 gives "big" output, 0 does not.
NOP	= NAP
NOVSK	Indicator for change of page to "small" output.
NRI NRV	Code 1-12, indicating which time-series for infiltration or ventilation should be used for the day, which is being calculated.
NUDS	Number of days with "big" output, max. 10.
NVEN	Not used in MAIN.
NVIN	Number of window specifications, 1-10,
NV=NVIN	but max. 4, for output of status of movable sun shading device.
NVQ	Number of half-hours with extra cooling or extra ventilation.
NVU	= 2, if extra ventilation with outer air, = 4, if extra ventilation with ventilation air.
NW	NM(NW) is next day with "big" output.
PRON	Fraction of the half sphere towards the window wall occupied by wall. Used by calculation of operative temperature towards window wall.
QELK	Heat from electric lighting delivered by convection.
QELR	The same, delivered by radiation.
QLIM	Cooling load by extra cooling of the room air.
QPRIM	Heating load to primary air.
QREG	Cooling or heating load, convective share to room air.
QRMA	Greatest available heating effect, convective share to room air.
QRMI	Greatest available cooling effect, convective share to room air.
RB5	= 1./B5
RC3	= 1./C3
SLIM	Not used.
SOLLYS	Total heat of the sun through windows, also used for switching on/off electric light.
ST	Specified room data, the heat capacity of the room.

SUMTHR	Summing up for calculation of the mean room air temperature of the day.
TA,TK,TO,TR	Specified room data, heat transfer factors.
TU	= TR, or TU=TR·TUU by window night-insulation, if any.
TUU	Reduction of total heat transfer to outer air (excl. air change) by window night-insulation.
TAKU	= TA+TK+TU
TBAS	Intermediate result for calculation of room air temperature.
THOJ	Intermediate result for calculation of surface temperature.
THOO	Highest operative temperature of the day towards walls.
THO1	In half-hour-loop: surface temperature. After CALL ADM2 : highest operative temperature of the day towards window wall.
THR1	Room air temperature.
TLIM	Highest accepted room air temperature. Above this extra cooling is delivered. Specified value.
TMIT	Lowest allowable injection temperature for primary air. Beneath this temperature is preheated. Specified value.
TNUL	Outer air temperature at 24.00 transferred to the following day at 0.00 for interpolation of the temperature at 0.30.
TOVT	Temperature increase of primary air (outer air) in fan and ductwork. Specified value.
TREG	Intermediate result, desired change of room air temperature by heating or cooling effect.
TTM	Daily mean room air temperature.
TVINJ	Intermediate result, the apparent inside temperature of the window.
TVMAX	Highest accepted room air temperature. Above this extra air-change is included, if available.
TVV	The fraction of the half-hour with max. air change for maintenance of TVMAX.
VABS	Absolute value of VVN.
VTO	Intermediate result for calculation of the coefficients B4, B5, B6, C1 and C3.
VTSUM	Total air change by ventilation and infiltration.
VVN	The difference between the normal air change and the max. possible air change (for maintenance of TVMAX).
VVV	Maximum possible air change for maintenance of TVMAX.

Subroutine RUMDAT

This subroutine administrates the recording of all data concerning the room, ventilation, heat sources, movable sun shading devices and desired shape of output.

The subroutine is called ones for every calculation from MAIN. In its present form it is very confused.

Besides recording of data from type cards the subroutine controls call of the subroutine EIND which records time-series. (About type cards and time-series, see "Input Data").

Furthermore is carried out for every half-hour a summing up of heat flows (FLUXE) and a calculation of total heating and cooling effect available for the room.

At last those dates, for which "big" output is wanted, are arranged in true sequential order.

From RUMDAT the subroutine SFLUX is called, which writes out time-series of maximum heating and cooling effect and recorded heat flows.

Argument list: TA, TU, TO, TK, ST, ELM, TLIM, SLIM, TVMAX, VVV, NATI, NAT, CAK, CAR, CIK, CIR, TOVT, TMIT, NFLU, NUDS, NM, IVEN, IINF, NOP, PRON, NVIN, TUU, same names as in MAIN.

COMMON/blank/ and /SR/, Z ~ TEKST in MAIN, the remaining names are the same.

Arrays

E (1,50)	Auxiliary array for use with subroutine EIND.
ELM (3)	ELM(1) and (3) are not used. ELM(2) limit value for turning on electric lighting.
EXI (10,50)	Ten recorded fluxes, half-hour values.
IINF (366)	Code 1-12, time-series, number for infiltration to be used for each day during the year.
IVEN (366)	The same for ventilation.
MD (12)	Number of days before the first day in each month.
ND (10)	Not used.
NM (10)	Number of day (101-1231), where "big" output is wanted.
QMAS (50)	Greatest available heating effect.
QMIS (50)	Greatest available cooling effect.

Variables

A number of (3-characters) variable names correspond to 4-character strings (A-specification) for identification of input data:

AIR	AIRTemp	Air temperature, 1, 3 or 4.
ALA	LASTflux	No more data, start calculation.
ATI	A-TId	Working hours.
BEV	BEV.afsk	Movable sun shading device.
BIS	B.ISolering	Movable insulation at windows.
ELL	ELLYs	Electric illumination.
FMT	FORMat	Window height and width.
FOR	FORDel	Fraction of solar heat to room air.
FLU	FLUX	Heat flows 1-10.
HOR	HORIsont	Angle (altitude for demarcation of horizon).
INF	INFIltr	Natural air-change, infiltration.
OPE	OPERativ	Calculation of operative temperature wanted.
RIB	RIBBe	Shading effect from vertical rib or column.
QMA	QMAX	Greatest available heating effect.
QMI	QMIN	Greatest available cooling effect.
TAG	TAG	Solar heat through (flat) roof.
VAE	VAEG	Solar heat through wall.
VEN	VENT	Ventilation.
VMA	MAX-vent	Extra ventilation at high temperatures.
VND	VINDue	Window, area and orientation.
UDH	UDHAeng	Shading effect of projection over window.
UDS	UDSKriv	Control of output.

A number of variable names correspond to 2-character strings for identification of room data:

T2	TU	Room data, see description p. 9 or 31
T3	TK	- - , - - -
T4	TO	- - , - - -
T5	TA	- - , - - -
TS	S	- - , - - -
TT		Not used.
REP	blank-blank	End of room data.

Remaining variables

AVI	Internal control of infiltration or ventilation code for specified periods of the year.
BB	Recorded input value for room data.
CAK, CAR	Fraction of total heating effect supplied by convection and radiation respectively. CAK + CAR = 1.
CIK, CIR	Fraction of total cooling effect supplied by convection and radiation respectively. CIK + CIR = 1.
CK	Specified data, 1st parameter.
CQAK, CQAR	Factors for convection and radiation heat respectively, for specified time-series for heating effect.
CQIK, CQIR	The same for cooling effect.
CQQ	Factor for total heating or cooling effect in relation to specified time-series.
CR	Recorded data, 2nd parameter.
DT	= 0.5, the length of the time interval.
FEJL	Indicator for errors in input data.
FFFF	Indicator for errors in input data.
I,J,J1,J2	Indexes in DO-loops.
ID,IM,IY	Day, month, year.
I4	Not used.
KGNB, KGNS	Starting and ending dates (day-number) for infiltration code or ventilation code.
MCK	= CK, converted to integer.
MCR	= CR, - - -
MT	Not used.
NATI, NAT	Start and end of working hours, given as half-hour number + 1.
NB	Specified number.
NBB	= NB, but at least = 1.
NB1	= NB + 1.
NCK	= CK, converted to integer
NCR	= CR, - - -
NDT	= 48 half-hour intervals a day.
NFLU	Highest number among the recorded fluxes.
NFLX	Highest number among the recorded fluxes, apart from flux 10, electric illumination.
NJ	Index in DO-loop.
NMJ	Index used by arranging the true sequence of dates with "big" output.

NOP	Indicator for number of statistic outputs desired.
NUDS	Number of days with "big" output, max. 10.
NVEN	Highest number + 1 among the recorded ventilation time-series.
NVIN	Number of window specifications, 1-10.
N7,N8	Indexes in DO-loops.
PRON	The fraction of the half sphere towards the window wall occupied by wall. Is used by calculation of operative temperature towards window wall.
SLIM	Indicator for modification of Reference Year.
ST	Room data, heat capacity in accumulation layer.
T	Recorded name for identification of room data or input data.
TA	Room data, conductance, surface to accumulation layer.
TK	Room data, conductance, surface to neighbour room.
TLIM	Maximum accepted room air temperature, at higher temperatures extra cooling is included.
TMIT	Minimum acceptable injection temperature for primary air. Beneath this is preheated.
TO	Room data, conductance, room air to surfaces
TOVT	Temperature increase for primary air in fan and ducts.
TR	Letter 5-8 of the name on "type cards", not used.
TU	Room data, conductance, surface to outside air.
TUU	Room data, reduction of TU for movable insulation at windows.
TVMAX	Maximum accepted room air temperature. Over this extra ventilation is included.
VVV	Maximum possible air-change for maintenance of TVMAX.

EIND

Subroutine EIND

Argument list: E, MAXSUR, MAXINT, ISURF, N1,
corresponding to different variables in RUMDAT.

No COMMON's

Arrays

E(MAXSUR, MAXINT) Either E(1,48) or E(10,48).

Variables

CLOCK	Read hour from time-series card.
FLUX1 FLUX2	Values of the time-series at two hours of the day between which the half-hour values are found by linear interpolation.
I	Index in DO-loop.
ISURF	The number of the flux or the air temperature, if there is more than one.
KONT	Not used.
MAXINT	= 48.
MAXSUR	Maximum dimension of the corresponding array in RUMDAT.
N1	Indicator for list output of input data.
SECINT	Number of seconds in time interval (=1800).
SECSAC	Time in seconds, for which the value in the time-series shall be calculated.
SECS1 SECS2	Time (given in seconds) between which is interpolated.

This subroutine reads time-series with two or more cards and interpolates the half-hour values between the read hours.

For one time-series at least two cards are needed, at 0.00 and at 24.00 respectively, and those two cards must have the same value of function.

The subroutine is called from RUMDAT ones for every time-series which is to be read.

Subroutine SFLUX

Argument list: EXI, NFLU, NDT, QMAS, QMIS, IY, IM, ID,
NFLU ~ NFLX in RUMDAT, otherwise the same names.

COMMON/blank/, Z ~ TEKST in MAIN, otherwise the same names.

Arrays

EXI (10,50)	Read fluxes, half-hour values. EXI(10,xx) is electric lighting.
QMAS (50)	Maximum heating effect, half-hour values.
QMIS (50)	Maximum cooling effect, half-hour values.
NR (10)	Not used.
SEXI (10)	Daily sums of fluxes.
FLU (10)	Headings for table.

Variables

I,N.M	Indexes in DO-loops.
ID,IM,IY	Day, month, year.
IT	Hour for table output.
NDT	= 48, numbers of intervals per 24 hours.
NFLU	Numbers of read fluxes (excl. electric lighting).
M1	= 10, the number of the flux giving the electric lighting.
TDS	Number of time intervals per hour.
TI	= I
TO	Intermediate result for control of output.

This subroutine writes time-series with 48 half-hour values of read FLUXes, and their daily sum, and time-series of maximum cooling and heating effect. There are written as many FLUX as are read, however FLUX 10 (electric illumination) and FLUX 1 are always written.

Furthermore are written time-series for the wanted room air temperature (AIRTEMP1), the specified temperature of adjoining room or corridor (AIRTEMP3) and of the temperature of the ventilation air, if this is specified with a time-series and is not following the temperature of the outer air.

The subroutine is called from RUMDAT once for every calculation.

DISKL, TAPL

Subroutine DISKL

Argument list: NMD, NDG, same names as in MAIN.

COMMON/KORS/, same names as in MAIN.

Arrays

IA (30)	Data read from disc, are converted to the different weather data.

Variables

ICA - ICK	The figures 1-9, 0 and blank, are used for conversion of the cloud cover.
IAA	Intermediate data in the cloud conversion.
J,K	Indexes in DO-loops.
JK,KK	Indexes for distribution of the concentrated data set.
NDG	Day.
NMD	Month.
NQ	Cloud cover.

This subroutine reads the data of the Reference Year from a concentrated data set on disc store.

The data set is available as card pictures, formated, with four hours per record ~ 80 col. punched cards. There are no missing data, except for the cloud cover, where some night hours are missing for some months.

Therefore, if the data used are given with hours 00 thru 23, either the program or the data must be adjusted.

The subroutine distinquishes between 0 and blank, i.e. missing data, for the cloud cover.

The temperatures are given with 0.1°C, radiation with 1 W/m^2, wind velocity with 1 knot as resolution, and the cloud cover is given with octas, i.e. 0-8, and 9 (if it has not been possible to observe the cloud cover).

The subroutine is called once for every day from MAIN.

If a concentrated dataset on disc is not available, a subroutine TAPL can read the relevant data from a complete "Test Reference Year" on tape.

Arrangement of data in the card picture:

col	1 - 3	Month-and-daynumber, 001-031, 051-078, 101-131 - etc.
col	4	1-6, six cards per day
col	5-23 24-42 43-61 62-80	Dry bulb temperature °C(I4), dewpoint temperature, °C(I3), global, diffuse, and normal radiation W/m^2 (3I3), cloud cover N(I1) and wind speed knots (I2).

Subroutine TAPL

This subroutine reads the data of the Danish Reference Year from a tape with the original format. Corresponds generally to DISKL. One card picture per hour.

Subroutine SUNR

Algorithms

This subroutine calculates the time SO and SN for sunrise and sunset, the sun's altitude H and azimuth AS for each half-hour, and the day number DN in the year. Simplified, the longer duration of the summer half than the one of the winter half, the refraction, and the equation of the time are counted in.

DN 1 to 365. Latitude BR, -90 to 90 deg, Copenhagen 56 deg.

Calculation of the equation of time TEQ, in minutes:

```
  1 ≤ DN <  21   TEQ = -2.6 - 0.44·DN
 21 ≤ DN < 136   TEQ = -5.2 - 9.0·cos((DN-43)·0.0357)
136 ≤ DN < 241   TEQ = -1.4 + 5.0·cos((DN-135)·0.0449)
241 ≤ DN < 336   TEQ =  6.3 + 10.0·cos((DN-306)·0.0360)
336 ≤ DN ≤ 365   TEQ = -0.45·(DN-359)
```

The local time, 9.7 min.(for Copenhagen),is added, and TEQ is converted into angle of time:

```
TET = (TEQ - 9.7)/60.
TEQ = TET * π/12.
```

The declination of the sun VA:

```
DF = DN·π/182.5
VA = 0.33 - 22.96·cosDF + 4.0·sinDF - 0.37·cos2DF - 0.15·cos3DF
```

Sunrise and sunset:

```
TON = 12/π·arccos(sinBR·sinVA + 0.0.)/(cosBR·cosVA)
SO = TON - TET          sunrise
SN = 24. - TON - TET    sunset
```

Half-hour angle, I = 1 to 48.

```
TP = I·π/24 + TEQ
```

Altitude of the sun:

```
sinH = sinVA·sinBR - cosVA·cosBR·cosTP
```

Azimuth:

```
cosAS = AN =(sinBR·cosVA·cosTP + cosBR sinVA)/cosH
```

Refraction (when H > -0.005, corresponding to about -0.3^0)

```
H = H + 0.000225/(H + 0.023)
```

If the refraction and the longer duration of the summer half are neglected, it will give the length of the day an error of up to 12 - 13 min. at equinoxes.

SUNR

For quasi-stationary calculations, without a Test Reference Year, radiation has to be computed for the day in year, latitude, and cloud cover.
Clear sky radiation:
Optical air mass:

$$FL = 1.02/(\sin H + 0.02)$$

Distance correction:

$$DA = 1. + 0.0334 \cdot \cos DF$$

Extinction factor EXT specified per month, see table.

Direct radiation (apparent solar constant 1163 W/m^2):

$$SM = 1163. \cdot DA \cdot e^{(-EXT \cdot FL)}$$

Diffuse radiation (empirical expression, using solar constant 1370 W/m^2):

$$HH = 0.333(1370. \cdot DA - SM) \cdot \sin H$$

Extinction factor EXT and coefficients Q and R (used below) are empirically determined values (derived from Danish data) and stored in the programme:

Month	J	F	M	A	M	J	J	A	S	O	N	D
EXT	.09	.12	.14	.16	.18	.21	.23	.23	.23	.18	.15	.11
QQR	-.039		-.0065			0	.0120			.0060	-.0390	
RRQ	-.0078		-.0121			-.0127	-.0142			-.0142	-.0078	

Radiation with cloud cover CC = 0 thru 8:
(CC = 1 corrected to 0.5, CC = 7 corrected to 7.3)
Cloud cover factor for global radiation

$$CCF = 1. + QQR \cdot CC + RRQ \cdot CC^2$$

Cloud cover factor for direct radiation:

$$CQ = 0.58 \cdot CC + 0.025 \cdot CC^3 + 0.000288 \cdot CC^5$$

Direct radiation (J = 1 thru 24)

$$RNT(J) = SM(1. - CQ/8)$$

Global radiation

$$RTOT(J) = (HH + SM \cdot \sin H) \cdot CCF$$

Diffuse radiation

$$RDT(J) = RTOT(J) - RNT(J) \cdot \sin H$$

SUNR

Argument list: NMD, NDG, NDN, same names as in MAIN
NBA2 Cloud cover, in oktas.
BA2 Date (month.day)
BAS Latitude. Default value 56° North.

COMMON/KORS/, same names as in MAIN:

Arrays

DM (12)	Number of days before the first day of each month.
E (12)	Extinction coefficients, per month.
RRQ (12), QQR (12)	Coefficient for Cloud Cover Factor calculations.

Variables

AN	Solar azimuth plus π.
AZ	Solar azimuth.
COSBR	cos(BR), latitude.
COSIH	cos(H2), altitude of the sun.
COSTP	cos(TP), hour angle.
COSVA	Cosine to the declination of the sun.
DF	Day number, given as angle.
DN	Day number of the year, 1.-365.
H2	Altitude of the sun.
I	Index in DO-loop.
NDG,NDN	Day number of the year, 1 - 365.
PI	= π
PJ	= π/180
SINBR	sin(BR), latitude.
SINVA	Sine to the declination of the sun.
SINUH	sin(H2), altitude of the sun.
TEQ, TET	Equation of time
TON	The half length of day, hours.
TP	Hour angle.
CC	= NBA2, Cloud cover, in oktas
CCF	Cloud cover factor for global radiation
CQ	Cloud cover factor for direct radiation

The subroutine is called from MAIN once for every day.

Subroutine SOLIN

This subroutine calculates solar heat through windows, roof and walls into the room.

Hereby is considered: the area and orientation of the window, any shading projection over, or ribs or columns next to the window, horizon screening (owing to other buildings or trees), furthermore transmission through the glass, dependent of angle of incidence, and movable sun shading devices considered activated when the sun radiation per sq.m. through a window exceeds a specified limit. Up to ten different windows can be included in a room.

In the Reference Year hourly values of diffuse radiation on horizontal and direct normal radiation are given, i.e. direct radiation measured on a plane perpendicular to the sun. The directional dependence of the diffuse radiation is included in the calculations and further dependent of the cloud cover.

The subroutine distributes the heat from the sun radiation to the surfaces and to the room air, generally assuming that a considerable part of the sun radiation through the window will hit curtains or lightweight objects without much heat accumulating capacity, from where the heat is very quickly transferred to the room air. If no distribution is specified, 50/50 is assumed.

The sun radiation through flat roof and walls includes the orientation of the wall and the U-value of the wall or the roof. An absorption coefficient of 0.85 and an outside heat transfer resistance of 0.05 m^2 $^oC/W$ are assumed.

The time delay in wall or roof is considered simplified, as 20% of the solar heat during a half-hour is transferred immediately, and the rest is transferred, following an exponentially falling curve, decreasing 20% per half-hour.

The subroutine is called from MAIN once every day.

Algorithms

This subroutine calculates the incoming solar radiation through windows, roof, and walls to the room.

1. Transfer through roof and walls:

   Outside absorption coefficient α = 0.85
   Outside surface resistance m_u = $0.05^0 Cm^2/W$

   A delay in heat transfer is assumed, so that 20% of the transferred heat is transmitted during the first half-hour, and the rest during the following time intervals, decreasing with a factor of 0.8 per time interval. Summa = 1.0. Average delay 2 hours.

SOLT(I) = SOLT(I-1)·0.8

Transmitted during first time interval through roof:

AT = Area·(U-value)·0.05·0.85·0.2 = TGK·0.0085

and wall IP:

VVK = VAEK(IP)·0.0085

2. Radiation on roof, I = 2 to 49 (the time interval).

SOLV = SNT(I)·sinH + SDT(I)
(~normal radiation·sinH + diffuse radiation).

Transmitted through roof:

SOLT(I) = SOLT(I) + SOLV·AT

3. Angle of azimuth, sun/window (~wall):

X = AS(I) - VIN(IP)

Angle of sun/window (~wall):

ZAN = cosH·cosX
FV = ZAN when ZAN > 0, otherwise FV = 0.
VH = arccos(ZAN)

4. Factor for diffuse radiation on vertical, for clear sky:

$F = 0.55 + 0.437 \cdot ZAN + 0.313 \cdot ZAN^2$.
For ZAN < -0.2: F = 0.45.

Correction for cloud cover, N = 0 to 8 (BN = N):

F = (F - 0.5)·(8. - BN)/8. + 0.5

Diffuse sky radiation on vertical:

DIFD = SDT(I)·F

Direct radiation on vertical:

SOLD = SNT(I)·FV

Reflected short-wave radiation:

DIFR = SOLV·0.5·0.25

5. Solar heat transferred through walls and roof:

SOLT(I) = Σ (SOLD + DIFD + DIFR)·VVK + SOLV·AT

6. Solar heat through windows:

Calculation for stationary outside sun shading devices, if any:

COTA = cosX/ tg·H

Canopy:

TG = (canopy protrusion)/(height of canopy over window + ½ window height)

Fraction of the window not shaded:

Direct: ASU = (window height + height of canopy over window/window height) - (canopy protrusion/COTA)

Diffuse: ADU = $1/\sqrt{1+TG^2}$

Rib:

Fraction of the window not shaded:

Distance of rib to window RIBA = RIBM(1,IP)

ASS = protrusion of rib·tgX

Direct: ASR = (window width + RIBA - |ASS|)/window width.
(Diffuse radiation is not considered reduced by vertical ribs).

Both rib and canopy:

ASU = ASU·ASR

7. Factor for direct radiation transmitted through double glass window at the angle VI (0^0-90^0). VI = VH·180./π

TR = 0.76, transmission for VI = 0^0.

FK = TR·(1 - 0.04·VI/100 - 2.933·(VI/100)^6 + 2.13·(VI/100)^{12})

Factor for transmitted diffuse radiation through double pane:

RF = 0.66

SOLD = SOLD·ASU
DIFD = DIFD·ADU

Through window, 1 square m:

SOLG = SOLD·FK + (DIFD + DIFR)·RF

8. Insertion of movable sun shading device, if SOLG > BEVM(3,IP).

   Solar radiation through actual window area:

   SOLK = SOLG·BEVM(1 or 2,IP)·area,
   where
   BEVM(1,IP) = 1, and
   BEVM(2,IP) is the shading factor for the movable sun shading device.

9. Distribution of solar heat to room air:

   SOL(I,1) = SOLK·FORD

   and to surfaces:

   SOL(I,2) = SOLK(1.- FORD)
   where
   FORD is the distribution coefficient, normally 0.50, or as specified for the shading device.

10. Calculation of the apparent indoor overtemperature of the window, included the effect of solar heat absorbed in the glass and again given off from the glass (~no direct radiation to the sensor):

    TVIN(I) = SOLK· 0.008

    If it is desired to include direct solar radiation on the sensor, the following should be used:

    TVIN(I) = SOLK· 0.20.

Argument list: NOP, same name as in MAIN.

COMMON/KORS/, /INTERP/ and /SR/, same names as in MAIN.

Arrays

SDT (50)	Diffuse radiation on horizontal, half-hour values.
SNT (50)	Direct normal radiation, half-hour values.

Variables

ADU	Reduction of diffuse radiation owing to projection over the window.
ASR	Reduction of direct radiation owing to ribs or columns.
ASS	Horizontal shadow length of ribs.
ASU	Reduction of direct radiation owing to projections over the window or ribs.
AT	Intermediate result for solar heat through roof.
AV	(Glass)area of window.

BN	Cloud cover. (0 - 8)
COSIH	=cos(H), altitude of the sun.
COTA	=cos(X)·cos(H)/sin(H).
DIFD	Diffuse sky radiation on vertical surface.
DIFR	Reflected short wave radiation on vertical surface.
F	Direction factor for diffuse sky radiation.
FK	Transmission of direct radiation through double-pane at the angle of incidence VI.
FMB	Window width (glass).
FMH	Window height (glass).
FORD	Fraction of solar heat through windows, which goes directly to room air.
FV	=ZAN, during the hours from sunrise to sunset.
I,J	Indexes in DO-loops.
IA IB	Counters for interpolation to half-hour values for radiation.
IP	Index in DO-loop, window specification number.
ISN	Half-hour number after sunset.
ISO	Half-hour number before sunrise.
NAF	Indicator, = 1 with movable sun shading device not activated, = 2 for activated movable sun shading device.
NOP	Indicator for calculation of the apparent indoor surface temperature of the window (=NOP in MAIN).
PJ	= $\pi/180.$ = 0.01745.
RF	Transmission of diffuse radiation through double pane.
RIBA	Rib (or column), distance from nearest glass edge.
RIBF	Rib, projection in front of glass.
SOLD	Direct radiation on vertical.
SOLG	Total radiation through double pane.
SOLK	The same, with movable sun shading device, if any.
SOLV	Total radiation on horizontal.
TG	Tangent to altitude of edge of projection seen from center of pane. Is used for calculation of reduction of diffuse radiation.
TR	Transmission of direct radiation perpendicular to double pane.
UDHA	Projection, distance from upper glass edge.
UDHF	Projection, overhang in front of glass.
VH	Angle of incidence for direct radiation against pane, radian.

VI	= VH, in degrees.
VVK	Intermediate result for solar heat through wall.
X	Solar azimuth minus azimuth angle of the windows, roof and walls into the room.
ZAN	= cos(H)·cos(X).

Subroutine INPOL

Argument list: NULT, TOVT, TMIT.

NULT ~ TNUL in MAIN, otherwise the same names.

COMMON/KORS/, with same names as in MAIN.

COMMON/blank/, T ~ TEKST in MAIN, otherwise the same names.

No Arrays

Variables

I	Index in DO-loop.
I2, I3	Counters for interpolation.
NULT	Temperature at 24.00 the preceding day.
TEX	Calculation of primary air temperature.
TMIT	Minimum allowable injection temperature for primary air in the room.
TOVT	Temperature increase of primary air in fan and ducts.

This subroutine converts the 24 hourly values of the outer air temperature, read from the Reference Year in subroutine DISKL (or TAPL) into 48 half-hour values. Hereby it is necessary to transfer the value at 24.00 to next day for interpolation at 0.30.

Furthermore, the temperature of the injection air (primary air) is calculated, if the air is outer air, possibly with a temperature increase TOVT from fan and ducts, and possibly with preheating to a minimum accepted injection temperature TMIT.

The subroutine is called from MAIN once every day.

Subroutine ADM2

Argumentlist: IM, NOP, NATI, NAT, THOO, THO1.

IM ~ NMD in MAIN, otherwise the same names.

COMMON/ADI/ and /INTERP/, same names.

No Arrays

Variables

I,J	Indexes in DO-loops.
IM	Month.
IT	Full degree interval for temperature.
NATI, NAT	Start and end of working hours, given as half-hour number + 1.
NOP	Indicator for how many operative temperatures are to be calculated (~ NOP in MAIN).
THOO	Highest operative temperature of the day towards walls.
THO1	Highest operative temperature of the day towards window wall.
TI, TJ	Temperatures.

In this subroutine the maximum value of operative temperature of the day towards the walls is calculated, and if NOP ≥ 1, of the operative temperature towards the window wall.

Furthermore is carried out sorting of the single half-hours for summing up to monthly frequencies of the respective temperatures.

The sorting is carried out both for all half-hours during the day (at 0.30 to 24.00) and for the half-hours within the working hours, NATI to NAT. (Default values: 8.30 - 17.00)

The subroutine is called from MAIN once after each day.

Subroutine UDSKR

This subroutine is called once from MAIN, when the calculations have been finished. It writes, monthly and for the whole year, distributions of the calculated temperatures in full degree intervals.

The distributions are written out for the air temperature, a) all day through, and b) during the working hours. Furthermore, if specified, for the operative temperature towards the walls of the room, c) all day through, and d) during the working hours, and finally e) for the operative temperature towards window and window wall during the working hours, and f) the difference between the operative temperatures towards internal walls and window plus window wall during the working hours.

a) and b) are always written out, c) and d) only if OPERativ is specified in input data, and e) and f) only if a window number, 1-10, is indicated together with OPERativ.

Together with a) is written the monthly mean value of the room air temperature, and monthly sums of cooling and heating to primary air, to the room and totally, heat from solar radiation and from electric lighting, and number of half-hours with extra cooling or extra ventilation. Analogous values are written for the year.

Together with b), d), e) and f) are calculated (in subroutine FRAKT) and written out for each month three temperatures corresponding to the quantiles 10%, 50% and 90%.

Subroutine UDSKR

Argument list: NOP, NAT, NATI, IY, IM, ID,
same names as in MAIN.

COMMON/ADI/ , with the same names as in MAIN
/blank/ Z ~ TEKST in MAIN.

Arrays

C (11)	Alphameric outputs.
FRAK (3,13)	Calculated temperatures corresponding to 10, 50 and 90% quantiles for 12 months and the whole year.
IS (12)	Monthly number of half-hours with extra cooling.
ITOT (30)	Indicator for the temperature interval to be written. 1 ~ is written, 0 ~ is not written.
LD (6)	Reduces the interval downwards.
LF (6) LS (6)	Figures of first and last possible value in the interval, for table headings.
NC (3)	Figures 10, 50 and 90 for table headings.

Variables

ANATI ANAT	Starting and ending time for working hours, in hours and minutes.
I,J,K,L	Indexes in DO-loops.
ID,IM,IY	Day, month, year.
IRES	Is used for determination of the temperature interval to be written out.
ISUM	Yearly number of half-hours with extra cooling.
JX	Index in DO-loop.
LL M	Indications of temperature interval to be written out.
LNOP	Calculates how many outputs are to be made.
NATI NAT	Starting and ending of working hours, given as half-hour number + 1.
NE	= 11 unit in heading kWh, = 10 - - - Mcal.
NOP	Indicator for number of statistical outputs.
NN,NV,MM	Indexes in DO-loops.
VARME	Summing up of heat consumption, October-April.

Subroutine FRAKT

This subroutine calculates for every month and for the year temperatures corresponding to 10%, 50% and 90% quantiles, i.e. temperatures under which 10%, 50% and 90% of all half-hours are found.

The subroutine is called once for every calculation from UDSKR.

The calculations are carried out by cumulating the number of half-hours, selection of the full degree interval in which the quantile value must be situated, and by linear interpolation within this interval.

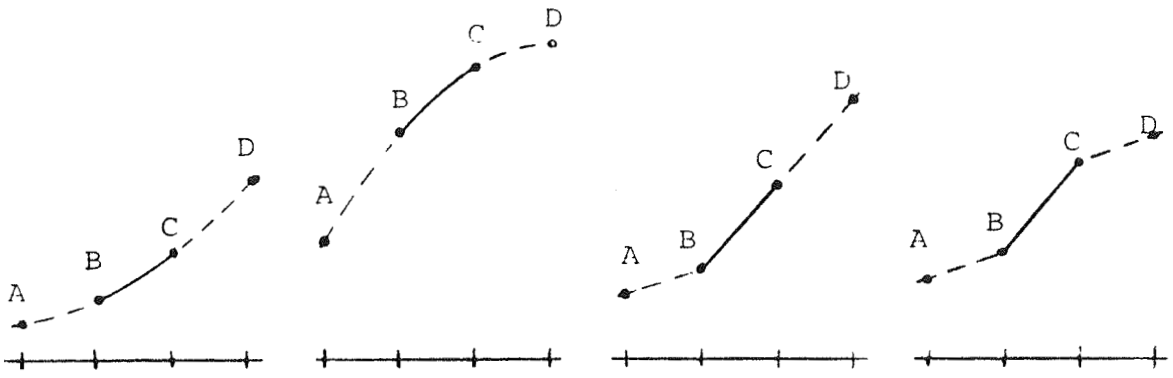
If the maximum or minimum value of the month is placed within the same interval, interpolation is not made over the entire interval, but until the extreme value only.

If the cumulated half-hour figures show a monotonous curvature over the interval and its two adjoining intervals, an interpolation is carried out after a curved line. This adjustment is scarcely significant, and may be omitted.

Algorithms

This subroutine calculates 10%, 50%, and 90% quantiles by linear or non-linear interpolation in the full degree interval in which the quantile value AN lies.

The cumulated numbers at the terminal points of the interval are B and C, and at the adjoining points A and D.



Non-linear (curved) interpolation.

Linear interpolation

10%, 50%, or 90% of the total number (IT(30)) in the series:

$AN = IT(30) \cdot (II \cdot 0.4 - 0.3)$, II = 1,2 or 3

C is found when $IT(IC) > AN$, IC = 1 to 30.

AM: 10-step values 0.05 to 0.95 in the interval in which interpolation shall take place.

AM = (I - 0.5)·o.1, I = 1 to 10.

XM: Linear interpolation in B-C.

XM = B + AM· (C-B)

XR: Correction for non-linear interpolation in B-C.

XR = 0.5·AM· (1-AM)· (B+C-A-D).

Non-linear interpolation is not used if XAO = 0, XDO = 0, XR = 0, or XAD < 0, i.e. for rectilinearity or S-curve.

XAO = 2·B -D -C
XDO = 2·C -B -D
XAD = XAO/XDO

The quantile value ANN is found for that I (and that AM), which gives XM or XM + XR > AN.

Subroutine FRAKT

Argument list: J, FRAK, same names as in UDSKR.

COMMON/ADI/ , same names as in UDSKR and MAIN.

Arrays

IT (30)	Cumulated values of number of half-hours below a certain temperature.
FRAK (3,13)	Temperatures for 10%, 50% and 90% quantiles for 12 months and the whole year.

Variables

A	Cumulated value (number) nearest under B.
AN	Limit value (number) for the quantile.
ANN	Calculated temperature for the quantile.
AM	Step by interpolation in the full degree interval.
B, C	Cumulated values (numbers) between which interpolation shall take place.
D	Cumulated value (number) next after C.
GB, GC	Temperatures (full degree) between which interpolation shall take place.
G6	Addend for transponation of the temperature interval.

I,II,M	Indexes in DO-loops.
IC	The number giving upper limit of the interval in which interpolation shall take place.
XA	Extrapolation from below.
XAD	Determination of monotonous curvature.
XAO	Deviation for final point by extrapolation from below.
XD	Extrapolation from above.
XDO	Deviation for final point by extrapolation from above.
XM	Linear interpolation.
XR	Adjustment for the curvature of the curve.
XX	Calculated value by the interpolation, calculation repeated until XX $\succ$ AN.

References:

1. P. Becher: Varme og Ventilation, vol. 1 (in Danish) Teknisk Forlag 4. ed. 1971.

2. Bo Andersen et al: Meteorological Data for Design of Building and Installation: A Reference Year. (An English translation of the Danish Building Research report no. 89 about the Reference Year, Thermal Insulation Laboratory 1975.

3. Bo Andersen: TEMPFO 4. Calculation of indoor temperatures and Energy Consumption in Buildings using Climatic Data of the Reference Year (in Danish). Danish Building Research Institute, report no. 93, 1974.

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FORTRAN IV G LEVEL  21                  MAIN                DATE = 78125

            C  THERMAL INSULATION LABORATORY, TECHNICAL UNIVERSITY, COPENHAGEN
            C  PROGRAM BA4  FOR CALCULATION OF ROOM TEMPERATURES
            C               AND HEATING AND COOLING LOADS  (APRIL 78)
            C  FOR COPENHAGEN: LOCAL TIME= 9.7 MIN, LATITUDE= 56 DG NORTHERN
0001            COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SD,SN
               1,RTOT(24),TD(24),NN(24)
0002            COMMON/SR/HORM(10),VAEK(10),UDHM(2,10),RIBM(2,10),BEVM(3,10),
               1FM(2,10),FORDM(2,10),VIN(10),AVT(10),TGK
0003            COMMON /AD1/ ITAEL(6,30,13),THA(50),THO(50),THR(50),SUM(11,13)
               1,GLIM(6,2,13)
0004            COMMON /INTERP/ SOL(50,2),SOLT(50),TVIN(50),TOO(50),TO1(50)
               1,MBA(4,50)
0005            COMMON TEKST(18), QQ(50),QK(50),QR(50),QMAX(50),QMIN(50),
               1TEXI(4,50),INFL(12,50),VENT(12,50)
0006            COMMON COK(10),COR(10),QLYS(50)
0007            DIMENSION QKK(50),QRR(50)
0008            DIMENSION IVEN(366),IINF(366)
0009            DIMENSION NM(10),ND(10)
0010            DIMENSION QP(50),QTT(50)
0011            DIMENSION QQTT(12),NBQ(4)
0012            DIMENSION QELT(50)
0013            DIMENSION ELM(3),NSLIM(20)
0014            REAL INFL
0015            DATA NSLIM /   12,14,   16,17,18,77,78,107,108,
               1335,347,348,349,354,0.0,0.0,0.0 /
0016            DATA SLIM / 0. /
0017            DATA NVIN /1 /
0018            DATA BA2,BAS,NBA2 / 2*0., 0 /
0019            DATA NW,NUDS,NINF,NVEN,NM,ND /1,0,1,1,20*0 /
0020            DATA CAK,CIK,CAR,CIR,TNUL,TOVT,TMIT,AXDAG /2*1.,6*0. /
0021            DATA IAR,NDAG,NDT / 1, 1, 48 /
0022            DATA TVMAX,VVV,TLIM,    PRON,ELM / 999.,0.,999.,4*0. /
0023            DATA TUU / 1. /
0024            DATA NOP,NATI,NAT /-1,17,34 /
0025          121 READ (5,200) TEKST
0026          200 FORMAT (18A4)
            C
            C  INITIAL VALUES
0027            CALL DATE(ID,IM,IY)
            C
            C  YEAR, MONTH AND DAY FOR THE RUN (NEUCC LIBRARY ROUTINE)
0028            NMM =0
0029            NN(24) =8
0030            NDI =NDT +1
0031            TGK =0.
0032            SOL(1,1) =0.
0033            SOL(1,2) =0.
0034            SOLT(1)  =0.
0035            TNUL =0.5
0036            DO 65 I=1,366
0037            IVEN(I)=1
0038           65 IINF(I)=1
0039            DO 777 J=1,50
0040            DO 780 I=1,4
0041            TEXI(I,J) =0.
0042          780 CONTINUE
0043            DO 778 I=1,12
0044            VENT(I,J) =0.
0045          778 INFL(I,J) =0.
0046            QMAX(J) =0.
0047          777 QMIN(J) =0.
0048            DO 779 I=1,10
0049            VIN(I) =0.
0050            AVT(I) =0.
0051            HORM(I) =1.
0052            VAEK(I) =0.
0053            DO 776 J=1,2
0054            FORDM(J,I) =0.5
0055            UDHM(J,I) =0.
0056            RIBM(J,I) =0.
0057          776 FM(J,I) =0.
0058            BEVM(1,I) =1.
0059            BEVM(2,I) =1.
0060            BEVM(3,I) =999.
0061            COK(I) =1.
0062          779 COR(I) =0.
0063             NFLU = 1
0064            DT =0.5
0065            SLIM =0.
0066            NNW =0                    NW
0067          926 CONTINUE
0068           18 WRITE (6,111) TEKST,IY,IM,ID
0069          111 FORMAT (1HI,18A4,4H  19,I2,3H - ,I2,3H - ,I2 )
0070            WRITE (6,113)
0071          113 FORMAT (1HO,25X,'THERMAL INSULATION LAB., DANISH TECHNICAL UNIVERS
               1ITY'/26X,'PROGRAM BA4, VERSION APRIL 1977')
            C
            C  READING DATA FOR THE ROOM AND EXITATIONS, AND OUTPUT SPECIFICATIONS
0072            CALL        RUMDAT(TA,TU,TO,TK,ST,ELM,TLIM,SLIM,TVMAX,VVV,NATI,NAT,
               1CAK,CAR,CIK,CIR,TOVT,TMIT,NFLU,NUDS,NM,IVEN,IINF,NOP,PRON,NVIN,
               2TUU,BA2,BAS,NBA2 )
0073            NW=1
0074            IF (NM(10).EQ.-1) NMM=1
0075            NM(10) =0
0076            NSL =1
0077            TR =TU
0078            NV =NVIN
0079            IF (NV.GT.4) NV =4
0080            NAP =NOP
0081            IF (NAP.LE.0) NAP =99
0082            THR(49) =TEXI(1,1)
0083            THO(49) =TEXI(1,1)
0084            THA(49) =TEXI(1,1)
0085            SOLT(49) =0.
0086            QQ(49) =0.
0087            DO 52 J1=1,NDT
0088            QKK(J1) =QK(J1)
0089            QRR(J1) =QR(J1)
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FORTRAN IV G LEVEL  21                  MAIN                DATE = 78125

0090            52 CONTINUE
0091               DO 2 I=1,13
0092               DO 3 J=1,11
0093             3 SUM(J,I) =0.
0094               DO 9 J=1,6
0095               GLIM(J,1,I) =100.
0096               GLIM(J,2,I) =-100.
0097               DO 9 K=1,30
0098             9 ITAEL(J,K,I) =0.
0099             2 CONTINUE
                C
                C  COEFFICIENT TO TEMPERATURE OF THE HEAT ACCUMULATING LAYER
0100               A2=TA*0.5/ST
0101               A1=1.-A2
0102               NMD =BA2
0103               NDG = (BA2 -FLOAT(NMD))*100.01
0104             5 CONTINUE
0105               IF (BA2.NE.0.) GOTO 345
                C
                C  READING WEATHER DATA FOR ONE DAY (24 HOURS)
0106               CALL  TAPL(NMD,NDG)
                C      CALL DISKL(NMD,NDG)
                C
                C  CALCULATING HEIGTH AND AZIMUT OF SUN AND RADIATION IF BA2 IS SPECI-
                C   FIED
0107           345 CALL        SUNR(NMD,NDG,NDN,NBA2,BA2,BAS)
                C
                C  REDUCTION OF THE NORMAL RADIATION IN DECEMBER, JANUARY, MARCH AND
                C   APRIL IF SLIM=1 I.E. IF MODREF IS SPECIFIED
0108               IF (NDN.NE.NSLIM(NSL).OR.SLIM.NE.1.) GOTO 939
0109               NSL =NSL +1
0110               DO 938 I=1,24
0111           938 RNT(I) =0.
0112           939  CONTINUE
                C
                C  SOLAR RADIATION ON WALLS AND ROOF, AND THROUGH WINDOWS, WITH SHADING
0113               CALL        SOLIN(NDP)
                C
                C  HALF-HOUR VALUES OF TEMPERATURES IN OUTDOOR AIR AND VENTILATION
                C             (PRIMARY) AIR
                C   HALVTIMESVAERDIER AF TEMPERATURER I UDELUFT OG PRIMAERLUFT
0114               CALL INPOL(TNUL,TOVT,TMIT,BA2)
0115               NRV = IVEN(NDN)
0116               NRI = IINF(NDN)
0117               LBA2 =0
0118           436 CONTINUE
0119               IF (BA2.NE.0.) LBA2 =LBA2 +1
0120               NVQ =0
0121               NEL =0
0122               DO 838 K=1,4
0123           838 NBQ(K) =0
0124               THA(1)= THA(NDT+1)
0125               THO(1)= THO(NDT+1)
0126               THR(1)= THR(NDT+1)
0127               QQ(1) = QQ(NDT+1)
0128               DO 388 J=1,12
0129           388 QQTT(J) =0.
0130               SUMTHR = 0.
0131               AT2 =0.
0132               AXDAG=0.
0133               DELT =0.
0134               NOVSK =NDN  - (NDN /61)*61
0135               MDG = 100*NMD +NDG +LBA2
0136               IF (MDG.EQ.NM(NW).OR.LBA2.EQ.1.OR.LBA2.EQ.10) GOTO 921
0137               GO TO 950
0138           921 NW =NW +1
0139               NNW =1
0140               WRITE (6,111) TEKST,IY,IM,ID
0141               IF (SLIM.EQ.1.) WRITE (6,81)
0142            81 FORMAT (' MODIFIED REFERENCE YEAR USED ')
0143               WRITE (6,112) NMD,NDG,NAP,(K,K=1,NV)
0144           112 FORMAT (9H0MONTH   ,I2,7H  DAY  ,I2//'  KL   RL-T   OP-T   OPT',
                   111,2X,
                   1' UDLT    QREG   QPRIM    QTOT   SOLIND  UVQ  E-L B-A',I1,I2,2I3/)
0145           950 CONTINUE
                C
                C  START OF HALF-HOUR LOOP
0146            66 DO 50 J2= 1,NDT
0147               J1=J2
0148               J=J2+1
0149               MVU =0
0150               MEL =0
0151               TU =TR
0152               QLIM =0.
0153               SOLLYS =SOL(J,1) +SOL(J,2)
                C
                C  NIGHT-INSULATION, IF ANY
0154               IF (J2.GT.14.AND.J2.LT.36) GOTO 765
0155               IF (NDN.LT.100.OR.NDN.GT.300) TU =TR*TUU
0156           765 CONTINUE
0157               TAKU=TA+TK+TU
0158               VTSUM = VENT(NRV,J1) +INFL(NRI,J1)
0159               VTO =1. +VTSUM/TO
                C
                C  COEFFICIENTS TO ROOM-AIR TEMPERATURE
0160               C1 =1./VTO
0161               RC3 =TO +VTSUM
0162               C3 = 1./RC3
                C
                C  COEFFICIENTS TO SURFACE TEMPERATURE
                C      B1=B6*TA, B2=B6*TK, B3=B6*TU,
0163               B5 =1./(TAKU*VTO +VTSUM)
0164               B4 =B5*VENT(NRV,J1)
0165               B6 =B5*VTO
0166               RB5 =TAKU *VTO +VTSUM
0167               QELT(J) =0.
0168               QK(J2) =QKK(J2) +SOL(J,1)
0169               QR(J2) =QRR(J2) +SOL(J,2) +SOLT(J)
0170               QQTT(7) =QQTT(7) +SOLLYS +SOLT(J)
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                C
                C  SWITCHING ELECTRIC LIGHT, IF ANY (FLUX 10)
0171                    IF (SOLLYS.GE.ELM(2)) GOTO 399
0172                    IF (QLYS(J2).LE.0.) GOTO 399
0173                    QELK =QLYS(J2)*COK(10)
0174                    QELR =QLYS(J2)*COR(10)
0175                    QK(J2) =QK(J2) +QELK
0176                    QR(J2) =QR(J2) +QELR
0177                    QQTT(8) =QQTT(8) +QELR +QELK
0178                    QELT(J) =QELK +QELR
0179                    MEL =1
0180                399 CONTINUE
0181                    AT2 =AT2 +TEXI(2,J2)
                C
                C  CALCULATION OF TEMPERATURES WITHOUT COOLING OR HEATING
0182                    THA(J) =THA(J2)*A1 +THO(J2)*A2
0183                    THOJ = THA(J)*B6*TA +TEXI(2,J2)*B6*TU +TEXI(3,J2)*B6*TK
                       1       +TEXI(4,J2)*B4 + QK(J2)*B5 +QR(J2)*B6
                       2       +TEXI(2,J2)*B5*INFL(NRI,J2)
0184                    TBAS = TEXI(2,J2)*C3*INFL(NRI,J2) +TEXI(4,J2)*C3*VENT(NRV,J2)
                       1       +QK(J2)*C1/TO
0185                    TREG =TEXI(1,J2) -TBAS -THOJ*C1
                C
                C  REGULATION EFFECT (COOLING OR HEATING)
0186                    QREG =TREG*TO/C1
0187                    QRMA =QMAX(J2)*CAK
0188                    QRMI = QMIN(J2)*CIK
0189                    CRR = CAR
0190                    IF (QREG.LT.0.) CRR =CIR
0191                    CKK = 1. -CRR
0192                    QREG =QREG/(1. +(B6*CRR/CKK +B5)*TO)
0193                    QQ(J) =QREG/CKK
0194                    IF (QREG.LT.QRMI) QQ(J) =QMIN(J2)
0195                    IF (QREG.GT.QRMA) QQ(J) =QMAX(J2)
0196                    THO(J) =THOJ +QQ(J)*(CRR*B6 +CKK*B5)
0197                    THR(J) =TBAS +THO(J)*C1 +QQ(J)*CKK*C1/TO
0198                    IF (QREG.LT.0.) QQTT(3) =QQTT(3) +QQ(J)
0199                    IF (QREG.GT.0.) QQTT(4) =QQTT(4) +QQ(J)
                C
                C  TEMPERATURE LIMITATION THROUGH ADDITIONAL COOLING OF ROOM AIR
0200                    IF (THR(J).LE.TLIM) GOTO 525
0201                    TREG =TLIM -THR(J)
0202                    QLIM =TREG*TO/(C1 +B5*TO)
0203                    THO(J) =THO(J) +QLIM*B5
0204                    THR(J) =THR(J) +QLIM*(C3 +B5*C1)
0205                    QQTT(3) =QQTT(3) +QLIM
0206                    QQ(J) =QLIM
0207                    SUM(9,NMD) =SUM(9,NMD) +1.
0208                    MVU =1
0209                525 CONTINUE
0210                    THR1 =THR(J)
0211                    THO1 =THO(J)
                C
                C  TEMPERATURE LIMITATION BY INCREASED VENTILATION, CALCULATED AFTER
                C           COOLING, IF ANY.
0212                    IF (THR(J).LE.TVMAX) GOTO 526
                C
                C  NVU=2 INCREASE WITH OUTSIDE AIR, NVU=4 INCREASE WITH VENTILATION AIR
0213                    NVU =2
                C
                C  INCREASED AIRCHANGE, ONLY IF IT GIVES LOWER ROOM TEMPERATURE
0214                    IF (THR(J).LT.TEXI(NVU,J2)) GOTO 526
0215                    DELTA =0.5
0216                    VVN = VVV -VENT(NRV,J2)
0217                    TVV =VVN
0218                    IF (VVN.LT.0.1) GOTO 526
0219                    THR1 =(THR(J)*RC3 +TEXI(NVU,J2)*VVN)/(RC3 +VVN)
                C
                C  (INFLUENCE ON THO1 NEGLECTED)
0220                    IF (THR1.GE.TVMAX) GOTO 527
                C
                C  INCREASE OF AIRCHANGE ONLY UNTIL TVMAX IS REACHED
0221                    TVV =(THR(J) -TVMAX)*RC3/(TVMAX -TEXI(NVU,J2))
0222                    DELTA =0.5*TVV/VVN
0223                    THR1 =TVMAX
0224                527 THR(J) =THR1
0225                    VTSUM =VTSUM +TVV
0226                    VTO =1. +VTSUM/TO
0227                    B5 =1./(TAKU*VTO +VTSUM)
0228                    B6 =B5*VTO
0229                    THO1 =(THA(J)*TA +TEXI(2,J2)*TU +TEXI(3,J2)*TK +QR(J2))*B6
                       1 +QQ(J)*(CRR*B6 +CKK*B5) +QLIM*B5
                       2 +(TEXI(4,J2)*VENT(NRV,J2) +TEXI(2,J2)*INFL(NRI,J2) +QK(J2))*B5
                       3 +TEXI(NVU,J2)*TVV*B5
0230                    THO(J) =THO1
                C
                C  COUNTING HOURS WITH MAX. AIRCHANGE
0231                    DELT =DELT +DELTA
0232                    MVU =1
0233                526 CONTINUE
0234                    QPRIM = (TEXI(4,J2) -TEXI(2,J2) -TOVT)*VENT(NRV,J2)
0235                    QTT(J) =QPRIM
0236                    QP(J) =QPRIM
0237                    IF (QQ(J).GT.0.) QTT(J) =QTT(J) +QQ(J)
0238                    QQTT(5) =QQTT(5) +QPRIM
                C
                C  TEMPERATURE OF INSIDE SURFACE OF WINDOW AND WALL
0239                    TVINJ =TVIN(J) +(THR(J) +THO(J))/3.2+TEXI(2,J2)*0.375
0240                    TOO(J) =(THR1 +THO1)/2.
0241                    TOI(J) =(THR1 +TVINJ*(1.-PRON) +THO(J)*PRON)/2
0242                    SUMTHR =SUMTHR +THR1
0243                    IF (AXDAG.GE.THR1) GOTO 901
0244                    AXDAG =THR1
0245                    AKL =FLOAT(J2 -(J2/2)*2)*0.3 +FLOAT(J2/2)
0246                901 CONTINUE
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            C
            C  NUMBER OF HALF-HOURS WITH ADDITIONAL COOLING, INCREASED VENTILATION,
            C          ELECTRIC LIGHT OR MOVABLE SUNSHADING FOR WINDOW NO 1 -4
0247                NVQ =NVQ +MVU
0248                NEL =NEL +MEL
0249                DO 837 K=1,NV
0250              837 NBQ(K) =NBQ(K) +MBA(K,J)
0251                IF (NNW.EQ.0) GOTO 50
0252                JD =J1/2
0253                JE =J/2
            C
            C  PRINTOUT OF HALF-HOUR VALUES FOR AN ENTIRE DAY
0254                IF (JE.NE.JD) GOTO 444
0255                WRITE (6,953) JD,THR1,TOO(J),TO1(J),TEXI(2,J2),QQ(J),QP(J),
                   1QTT(J),SOLLYS,MVU,MEL,(MBA(K,J),K=1,NV)
0256              953 FORMAT (1H ,I3,4F7.1,4F8.1,3I5,3I3 )
0257                IF (J2.EQ.NDT) NNW=0
0258                NOVSK =1
0259                GO TO 50
0260              444 WRITE (6,954)     THR1,TOO(J),TO1(J),TEX (2,J2),QQ(J),QP(J),
                   1QTT(J),SOLLYS,MVU,MEL,(MBA(K,J),K=1,NV)
0261              954 FORMAT (1H ,3X,4F7.1,4F8.1,3I5,3I3 )
0262               50 CONTINUE
            C
            C  END OF HALF-HOUR LOOP
0263                IF (NOVSK.NE.1) GOTO 955
0264              956 NNW =0
0265                IF (NMM.EQ.1) GOTO 955
0266                WRITE (6,111) TEKST,IY,IM,ID
0267              913 FORMAT (1H1)
0268                WRITE (6,912) NAP,(I,I=1,NV)
0269              912 FORMAT (1H ,'MD DG  RLT M   KL FLT MAX   QP-T   QPT',I1,'  UDT M',
                   1'   Q KOLE   Q VARM   Q PRIM    Q SOL    UVQ   E-L  B-A',I1,3I4)
0270              955 CONTINUE
            C
            C  DISTRIBUTING AND COUNTING VALUES FOR MONTHLY AND YEARLY TABLES
0271                CALL ADM2(NMD,NOP,NATI,NAT,THOO,THO1 )
0272                DNT =NDT
0273                TTM =SUMTHR/DNT
0274                AT2 =AT2/DNT
0275                DO 389 J=3,8
0276              389 QQTT(J) =QQTT(J)*DT
0277                QQTT(6) =QQTT(4) +QQTT(5)
0278                SUM(1,NMD) =SUM(1,NMD) +TTM
0279                DO 390 J=2,7
0280              390 SUM(J,NMD) =SUM(J,NMD) +QQTT(J+1)
0281                SUM(11,NMD) =SUM(11,NMD) +1.
0282                IF (NMM.EQ.1) GOTO 982
            C
            C  PRINTOUT OF LINE OF DAILY VALUES
0283                WRITE (6,902) NMD,NDG,TTM,AKL,AXDAG,THOO,THO1,AT2,(QQTT(J),J=3,5),
                   1QQTT(7),NVQ,NEL,(NBQ(I),I=1,NV)
0284              902 FORMAT (1H ,I2,I3, F7.1,F8.2,F5.1,3F7.1,4F9.0,3I6,3I4)
0285                IF (DELT.NE.0.) WRITE (6,528) DELT
0286              528 FORMAT (1H ,F5.1)
0287              982 CONTINUE
0288                IF (LBA2.GT.0.AND.LBA2.LT.10) GOTO 436
0289                IF (BA2.NE.0.) GOTO 985
0290                IF (NMD.NE.12.OR.NDG.NE.31) GOTO 5
            C
            C  TERMINATION AND PRINTOUT AFTER DECEMBER 31.
0291                CALL        UDSKR(NOP,NAT,NATI,IY,IM,ID,SLIM)
0292              985 CONTINUE
0293                READ (5,925) MM
0294              925 FORMAT (I3)
0295                IF (MM.NE.999) STOP
            C
            C  NEW CALCULATION IF MM=999, OTHERWISE STOP
0296                REWIND 1
0297                GOTO 926
0298                END
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0001                SUBROUTINE EINDE(E,MAXSUR,MAXINT,ISURF,N1)
            C  READ TIME-DEPENDANT VARIABLES, GENERATE TIME-SERIES, 48 HALF-HOURS
0002                DIMENSION E(MAXSUR,MAXINT)
0003                IF (N1. 0.2) WRITE(6,31)
0004             31 FORMAT (1H )
0005                SECINT=24*60*60/MAXINT
0006                KONT=1
0007                SECS2=-999999999
0008                DO 10 I=1,MAXINT
0009                SECSAC=FLOAT(I)*SECINT
0010                IF(SECSAC.GT.SECS2) GO TO 20
0011             19 CONTINUE
0012                SECS1=SECS2
0013                FLUX1=FLUX2
0014                READ(5,100) CLOCK,FLUX2
0015            100 FORMAT( ..,5X,E10.5)
0016                IF (N1.EQ.2) WRITE(6,30) CLOCK,FLUX2
0017             30 FORMAT (1H ,F5.2,5X,E10.5)
0018                SECS2=60*(100*IFIX(CLOCK)+IFIX(100.*(CLOCK-FLOAT(IFIX(CLOCK)))))
0019                IF(SECSAC.GT.SECS2) GO TO 19
0020             20 CONTINUE
0021                E(ISURF,I)=FLUX1    +(FLUX2-FLUX1)*(SECSAC-SECS1)/(SECS2-SECS1)
0022             10 CONTINUE
0023                RETURN
0024                END
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0001                  SUBROUTINE RUMDAT(TA,TU,TO,TK,ST,ELM,TLIM,SLIM,TVMAX,VVV,NATI,NAT,
                     1CAK,CAR,CIK,CIR,TOVT,TMIT,NFLU,NUDS,NM,IVEN,IINF,NOP,PRON,NVIN,
                     2TUU,BA2,BAS,NBA2 )
                C   READING FROM CARDS CONSTANTS FOR THE ROOM (TU, TO, TK, TA AND S)
                C            HEATFLUXES AS TIMESERIES (FLUX)
                C            AVAILABLE HEATING- AND COOLING EFFECT (QMAX AND QMIN) FOR
                C                KEEPING THE DESIRED TEMPERATURE (AIRTEMP 1)
                C            DISTRIBUTION OF FLUX, QMAX AND QMIN ON RADIATION -CONVECTION
                C            TEMPERATURE IN ADJACENT ROOMS AND OF VENTILATION AIR
                C                (AIRTEMP 3 AND 4)
                C            VENTILATION AND INFILTRATION (VENT AND INFILT)
                C            WINDOW AREAS AND ORENTATIONS  (VINDUE)
                C            FIXED, OUTSIDE SUNSHADINGS, CANOPIES, RIBS (UDHAENG, RIBBE)
                C            MOVABLE SUNSHADINGS, SETVALUES AND SHADING FACTOR (BEV,AFSK)
                C            MOVABLE NIGHT INSULATION, E.G. AT THE WINDOW (B,ISOL)
                C            ALTITUDE OF HORIZON, DEGREES (HORIZON)
                C            SETVALUE OF TEMPERATURE FOR INCREASED VENTILATION OR COOLING
                C            ELECTRIC LIGHT, POWER AND SETVALUE FOR SWITCHING (ELLYS)
                C            ROOF AND WALLS WITH SUN, AREAS AND U-VALUES (TAG  OG VAEG)
                C            WORKING HOURS (A-TID)
                C          SPECIFICATION OF DESIRED OR SUPRESSED OUTPUT
                C   THIS SUBROUTINE IS A VERY CLUMSY PATCHWORK
                C
0002                  COMMON Z(18), QQ(50),QK(50),QR(50),QMAX(50),QMIN(50),
                     1TEXI(4,50),INFL(12,50),VENT(12,50)
0003                  COMMON COK(10),COR(10),QLYS(50)
0004                  COMMON/SR/HORM(10),VAEK(10),UDHM(2,10),RIBM(2,10),BEVM(3,10),
                     1RM(2,10),FOFDM(2,10),VIN(10),AVT(10),TGK
0005                  DIMENSION NM(10),ND(10),ELM(3)
0006                  DIMENSION QMAS(50),QMIS(50)
0007                  DIMENSION EXI(10,50), E(1,50)
0008                  DIMENSION IVEN(366),IINF(366),MD(12)
0009                  INTEGER FEJL
0010                  REAL INFL,INF
0011                  DATA AIR, FLU,QMA,QMI,VEN/4HAIRT, 4HFLUX, 4HQMAX, 4HQMIN, 4HVENT /
0012                  DATA INF,UDS,HOR,VAE,UDH,RIB,BEV,ELL,FOF / 4HINFI,4HUDSK,4HHORI,
                     14HVAEG,4HUDHA,4HRIBB,4HBEV,,4HELLY,4HFORD    /
0013                  DATA CQAK,CQAF,CQIK,CQIR /1.,0.,1.,0. /
0014                  DATA REFMO / 4HMODF /
0015                  DATA BIS,BAA / 4HB,IS,4HBA2  /
0016                  DATA VND,TAG,ALA /4HVIND,4HTAG ,4HLAST /
0017                  DATA REP,T2,T3,T4,T5,TS,TT /2H  ,2HTU,2HTK,2HTO,2HTA,2HS ,2HDT /
0018                  DATA INF,FMT,VMA,ATI,OPE   / 4HINFI,4HFORM,4HMAX-,4HA-TI,4HOPER /
0019                  DATA MD / 0,31,59,90,120,151,181,212,243,273,304,334 /
0020                  DATA NFLX / 0 /
0021                  DATA QMAS,QMIS,EXI / 600*0. /
0022                  FFFF =1
0023                  NDT =48
0024                  DT =0.5
0025                  FEJL = 1
0026                21 READ (5,101) T,BB
0027               101 FORMAT (A2,F10.2)
0028                  MT = 1
0029                  J4 =1
                C   FOR A FURTHER CALCULATION IN THE SAME ROOM A BLANK CARD ONLY INDICA-
                C            TES NO CHANGES IN THE ROOM CONSTANTS
                C   FOR A FURTHER CALCULATION WITH THE SAME EXITATIONS ETC A "LASTFLUX"
                C            CARD ONLY INDICATES NO CHANGES
0030                11 IF(T.NE.T2) GOTO 12
0031                   TU=BB
0032                   GO TO 21
0033                12 IF(T.NE.T3) GOTO 13
0034                   TK=BB
0035                   GO TO 21
0036                13 IF(T.NE.T4) GOTO 14
0037                   TO=BB
0038                   GO TO 21
0039                14 IF(T.NE.T5) GOTO 15
0040                   TA=BB
0041                   GO TO 21
0042                15 IF(T.NE.TS) GOTO 16
0043                   ST=BB
0044                   GO TO 21
0045                16 CONTINUE
0046                17 IF (T.EQ.REP) GOTO 18
0047                19 WRITE (6,112)
0048               112 FORMAT(1H0,'INPUTERROR, WRONG T-CODE, OR S AND TO CANNOT BE ZERO')
0049                   FEJL = 2
0050                   GO TO 21
0051                18 CONTINUE
0052                   WRITE (6,102) TU,TK,TO,TA,ST,DT
0053               102 FORMAT (1H0, 4HTU =,F10.2, 5X,4HTK = ,F10.2, 5X,4HTO =, F10.2,
                     15X,4HTA =,F10.2/1X,4HS = ,F10.2,5X,4HDT =, F10.2 )
0054                   IF (FEJL.GT.1.1) STOP
0055                   IF (TO.LE.0.) GOTO 19
0056                   IF (ST.LE.0.) GOTO19
0057                   IF ((TA+TK+TU).LE.0.) GOTO 19
0058                41 READ (5,703) T,TR,NB,CK,CR
0059               709 WRITE (6,104) T,TR,NB,CK,CR
0060               104 FORMAT (1H0,2A4,I2,2F10.3 )
0061               703 FORMAT (2A4,I3,2F10.3)
0062                   AVI =2
0063                   NB1 =NB +1
0064                   NBB =NB
0065                   IF (NBB.LE.0) NBB=1
0066                   FEJL =1
0067                   IF (T.EQ.ALA) GOTO 43
0068                   IF (T.EQ.REFMO) GOTO 400
0069                   IF (NB.LT.0) FEJL=3
0070                   IF (T.EQ.QMI.AND.NB.GE.0) GOTO 401
0071                   IF (NB.GT.10) FEJL =3
0072                   IF (T.EQ.VMA) GOTO 481
0073                   IF (T.EQ.ATI) GOTO 482
0074                   IF (T.EQ.OPE) GOTO 483
0075                   IF (T.EQ.BAA) GOTO 1414
0076                   IF (T.EQ.HOP) GOTO 1431
0077                   IF (T.EQ.UDH) GOTO 1433
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0073                IF (T.EQ.RIB) GOTO 434
0079                IF (T.EQ.FOR) GOTO 437
0080                IF (T.EQ.BIS) GOTO 467
0081                IF (NB.LE.12) FEJL=1
0082           401  IF (CK.EQ.0..AND.CR.EQ.0.) GOTO 774
0083                IF (T.EQ.QMI) GOTO 404
0084                IF (T.EQ.INF.AND.NB.LE.12) GOTO 406
0085                IF (T.EQ.VEN.AND.NB.LE.12) GOTO 407
0086                IF (NB.GT.10) FEJL=3
0087                IF (T.EQ.UDS) GOTO 405
0088                IF (T.EQ.TAG) GOTO 402
0089                IF (T.EQ.QMA) GOTO 403
0090                IF (T.EQ.ELL) GOTO 436
0091                IF (T.EQ.VAE) GOTO 432
0092                IF (T.EQ.BEV) GOTO 435
0093                IF (T.EQ.FMT) GOTO 438
0094                IF (NB.LT.1) FEJL =3
0095                IF (T.EQ.VND) GOTO 408
0096                IF (T.EQ.FLU) GOTO 409
0097                IF (T.EQ.AIR) GOTO 410
0098                FEJL =22
0099           774  CONTINUE
0100                IF (T.EQ.QMA) GOTO 421
0101                IF (T.EQ.QMI) GOTO 422
0102                IF (T.EQ.INF) GOTO 423
0103                IF (T.EQ.VEN) GOTO 424
0104                IF (NB.LT.1.OR.NB.GT.10) FEJL =3
0105                IF (T.EQ.FLU) GOTO 425
0106                IF (T.EQ.AIR) GOTO 426
0107                FEJL =2
0108                GO TO 418
0109           467  TUU =CK
0110                GOTO 418
0111           481  TVMAX =CK
0112                VVV =CR
0113                GO TO 418
0114           482  NCK= IFIX(CK)
0115                NATI =NCK*2+IFIX((CK -FLOAT(NCK)+0.001)/0.6)
0116                NCR= IFIX(CR)
0117                NAT =NCR*2 +IFIX((CR -FLOAT(NCR) +0.001)/0.6)
0118                GO TO 418
0119           483  NOP =NB
0120                PRON = CK
0121                GO TO 418
0122           400  SLIM =1.
0123                GO TO 418
0124           402  TGK = CR*CK
0125                GO TO 418
0126           403  CQAK =CK
0127                CQAR =CR
0128                GO TO 411
0129           404  CQIK =CK
0130                CQIR =CR
0131                IF (NB.GT.0) TLIM =NB
0132           411  IF (CK.LE.0..AND.CR.GT.0.) WRITE (6,117)
0133                GO TO 418
0134           117  FORMAT (1H0,'INPUTERROR, QMAX AND QMIN MUST DELIVER SOME PART OF',
                   1 ' THE EFFECT CONVECTIVELY')
0135           405  IF (CK.LT.0..OR.CR.LT.0.) NM(10)=-1
0136                IF (CK.LE.0.) GOTO 451
0137                NUDS =NUDS +1
0138                IF (NUDS.GT.10) GOTO 418
0139                NM(NUDS) =CK*100.001
0140           451  IF (CR.LE.0.) GOTO 418
0141                NUDS =NUDS +1
0142                IF (NUDS.GT.10) GOTO 418
0143                NM(NUDS) =CR*100.001
0144                GO TO 418
0145          1414  BA2 =CK
0146                BAS =CR
0147                NBA2 = NB
                C  BA2-SPECIFICATION MUST PRECEED THE AIRTEMP 2 SPECIFATION
                C  BA2 DAY FOR SUN-CALCULATION, BAS LATITUDE, NBA2 CLOUD COVER 0 - 8
0148                GO TO 41
0149           406  IF (NB.LE.NINF) GOTO 412
0150                WRITE (6,114)
0151           114  FORMAT (1H0,'WRONG TIMESERIES SPECIFIED FOR VENT. OR INFILTR.')
0152           412  AVI =1
0153           416  MCK =CK
0154                MCR =CR
0155                KGNS = MD(MCR) +IFIX((CR-FLOAT(MCR))*100.)
0156                KGNB = MD(MCK) +IFIX((CK-FLOAT(MCK))*100.)
0157                IF (AVI.EQ.2.) GOTO 417
0158                DO 413 J=KGNB,KGNS
0159           413  IINF(J) =NB1
0160                GO TO 418
0161           407  IF (NB.LE.NVEN) GOTO 414
0162                WRITE (6,114)
0163           414  GO TO 416
0164           417  DO 415 J=KGNB,KGNS
0165           415  IVEN(J) =NB1
0166                GO TO 418
0167           408  AVT(NB) =CK
0168                VIN(NB) =CR
0169                IF (NB.GT.NVIN) NVIN =NB
0170                GO TO 418
0171           409  COK(NB) =CK
0172                COR(NB) =CR
0173                GO TO 418
0174           410  IF (NB.NE.4.AND.NB.NE.10) FEJL =3
0175                TOVT =CK
0176                TMIT =CR
0177                GO TO 418
0178          1431  HORM(NBB) =CK
0179                GO TO 418
0180           432  VAEK(NBB) =CK*CR
0181                GO TO 418
```

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FORTRAN IV G LEVEL  21                  RUMDAT              DATE = 78125

0182          1433 UDHM(1,NBB) =CK
0183               UDHM(2,NBB) =CR
0184               GO TO 418
0185           434 RIBM(1,NBB) =CK
0186               RIBM(2,NBB) =CR
0187               GO TO 418
0188           435 BEVM(3,NBB) =CK
0189               BEVM(2,NBB) =CR
0190               GO TO 418
0191           436 ELM(2) =CK
0192               GO TO 418
0193           437 FORDM(1,NBB) =CK
0194               FORDM(2,NBB) =CR
0195               GO TO 418
0196           438 FM(1,NBB) =CK
0197               FM(2,NBB) =CR
0198               GO TO 418
0199           421 CALL EIND(QMAS,1,NDT,1,1)
0200               GOTO 418
0201           422 CALL EIND(QMIS,1,NDT,1,1)
0202               IF (NB.GT.0) TLIM =NB
0203               GO TO 418
0204           423 IF (NINF.LT.NB1) NINF=NB1
0205               CALL EIND(E,1,NDT,1,2)
0206               DO 431 J=1,NDT
0207           431 INFL(NB1,J) =E(1,J)
0208               GO TO 418
0209           424 IF (NVEN.LT.NB1) NVEN=NB1
0210               CALL EIND(E,1,NDT,1,2)
0211               DO 433 J =1,NDT
0212           433 VENT(NB1,J) =E(1,J)
0213               GO TO 418
0214           425 IF (NB.GT.NFLU) NFLU=NB
0215               IF (NB.NE.10.AND.NB.GT.NFLX) NFLX =NB
0216               CALL EIND(EXI,10,NDT,NB,1)
0217               GO TO 418
0218           426 IF (NB.EQ.10) NB=4
0219               IF (NB.GT.4) FEJL =3
0220               IF (NB.EQ.2.AND.BA2.EQ.0.) FEJL =3
0221               IF (NB.EQ.4) TMIT =0.
0222               IF (NB.EQ.4) TOVT =0.
0223               CALL EIND(E,1,NDT,1,1)
0224               DO 427 J=1,NDT
0225           427 TEXI(NB,J) =E(1,J)
0226           418 IF (FEJL.EQ.1) GOTO 41
0227               WRITE (6,965) FEJL
0228           965 FORMAT (1H ,I6)
0229               FFFF =2
0230               IF (FEJL.NE.3) GOTO 621
0231               WRITE (6,108)
0232               GO TO 41
0233           621 WRITE (6,113)
0234           108 FORMAT (1H0,'INPUTERROR, INVALID NUMBER' )
0235           113 FORMAT (1H0,'INPUTERROR, WRONG EXITATION CODE ' )
0236               GO TO 41
0237            43 IF (FFFF.EQ.2) GO TO 300
                C
                C  CRONOLOGISATION OF SPECIFIED DAYS WITH "BIG" LIST OUTPUT
0238               DO 958 I=1,9
0239               DO 957 J=1,9
0240               IF (BA2.NE.0.) NM(I)= BA2
0241               IF (NM(J+1).EQ.0) GOTO 958
0242               IF (NM(J).LE.NM(J+1)) GOTO 957
0243               NMJ =NM(J)
0244               NM(J) =NM(J+1)
0245               NM(J+1) =NMJ
0246           957 CONTINUE
0247           958 CONTINUE
                C
                C  CALCULATION OF TOTAL HEAT FLUX EXCL. ELECTRIC LIGHT AND
                C   POSSIBLE VENTILATION AIR
0248               DO 48 J1=1,NDT
0249               IF (TMIT.NE.0.) TEXI(4,J1) =0.
0250               IF (BA2.NE.0.) TEXI(4,J1) =TEXI(2,J1) +TOVT
0251               IF(BA2.NE.0..AND.TMIT.NE.0..AND.TEXI(4,J1).LT.TMIT)TEXI(4,J1)=TMIT
0252               QK(J1) = 0.
0253               QR(J1) = 0.
0254               DO 47 NJ=1,NFLX
0255               QK(J1) =QK(J1) + EXI(NJ,J1)*COK(NJ)
0256            47 QR(J1) =QR(J1) + EXI(NJ,J1)*COR(NJ)
0257               J2 =J1+1
0258               QLYS(J1) =EXI(10,J1)
0259            48 CONTINUE
                C
                C  CALCULATION OF TOTAL HEATING OR COOLING EFFECT
0260               DO 232 J=1,NDT
0261           232 QMAX(J) = QMAS(J)*(CQAK+CQAR)
0262               CQQ = CQAK +CQAR
0263               IF (CQQ.EQ.0.)  GOTO 41
0264               CAK = CQAK/CQQ
0265               CAR = CQAR/CQQ
0266               DO 233 J=1,NDT
0267           233 QMIN(J) = QMIS(J)*(CQIK+CQIR)
0268               CQQ = CQIK +CQIR
0269               IF (CQQ.EQ.0.)  GOTO 41
0270               CIR =CQIR/CQQ
0271               CIK =CQIK/CQQ
0272               DO 181 J2 =1,4
0273               TEXI(J2,NDT+1) = TEXI(J2,1)
0274           181 CONTINUE
                C
                C  PRINTOUT OF TIMESERIES FOR INPUT TEMPERATURES, FLUXES AND HEATING-
                C            AND COOLING EFFECTS
0275               CALL SFLUX(EXI,NFLX,NDT,QMAS,QMIS,IY,IM,ID)
0276               WRITE (6,782) CQAK,CQIK,(COK(N7),N7=1,NFLX),COK(10)
0277               WRITE (6,783) CQAR,CQIR,(COR(N8),N8=1,NFLX),COR(10)
0278           782 FORMAT (1H ,30X,4HKONV ,F9.4,(8F10.4))
0279           783 FORMAT (1H ,30X,4HRADI ,F9.4,(8F10.4))
0280               RETURN
0281           300 STOP
0282               END
```

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FORTRAN IV G LEVEL  21                  SFLUX                   DATE = 76133

0001                  SUBROUTINE SFLUX(EXI,NFLU,NDT,QMAS,QMIS,IY,IM,ID)
                C  PRINTOUT OF TIMESERIES FOR INPUT TEMPERATURES, FLUXES AND HEATING-
                C                 AND COOLING EFFECTS
0002                  COMMON Z(18),  QQ(50),QK(50),QR(50),QMAX(50),QMI  (50),
                     1TEXI(4,50),FLU(12,50),VENT(12,50)
0003                  RE    INFL
0004                  DIMENSION EXI(10,50),QMAS(50),QMIS(50),NR(10)
0005                  DIMENSION SEXI(10)
0006                  DIMENSION FLU(10)
0007                  DATA FLU / 10*4HFLUX /
0008                  DO 10 N=1,10
0009                10 SEXI(N) = 0.
0010                  WRITE (6,111) Z
0011               111 FORMAT (1H1,18A4)
0012                  M1=10
0013                  WRITE (6,19) (  FLU(M),M ,M=1,NFLU),FLU(10),M1
0014                  DO 11 I=1,NDT
0015                  IT = I
0016                  IF (NDT.EQ.24) GO TO 12
0017                  TDS = NDT/24
0018                  TI = I
0019                  IT = TI/TDS
0020                  TD = (FLOAT(IT))*TDS
0021                  IF (TD.EQ.TI) GO TO 12
0022                  WRITE (6,15)    TEXI(1,I),TEXI(3,I),TEXI(4,I),QMAS(I),QMIS(I),
                     1(EXI(N,I),N=1,NFLU),EXI(10,I)
0023                  GO TO 14
0024               12 WRITE (6,16) IT,TEXI(1,I),TEXI(3,I),TEXI(4,I),QMAS(I),QMIS(I),
                     1(EXI(N,I),N=1,NFLU),  XI(10,I)
0025               14 CONTINUE
0026                  DO 17 N=1,NFLU
0027               17 SEXI(N) = SEXI(N) + EXI(N,I)
0028                  SEXI(10) =SEXI(10) +EXI(10,I)
0029               11 CONTINUE
0030                  DO 20 N=1,10
0031               20 SEXI(N) = SEXI(N) *24./FLOAT(NDT)
0032                  WRITE (6,18) (SEXI(N),N=1,NFLU),SEXI(10)
0033               15 FORMAT (1H ,3X,(12F10.1))
0034               16 FORMAT (1H ,I3,(12F10.1))
0035               18 FORMAT (1H0,3HSUM ,50X,10F10.1)
0036               19 FORMAT (1H0,'SPECIFIED TEMPERATURES AND FLUXES'//' H       AIRT 1'
                     1,'     AIRT 3    (AIRT 4)     QMAX       QMIN ',(6(4X,A4,I2)) )
0037                  RETURN
0038                  END
```

```
0001                  SUBROUTINE DISKL(NMD,NDG)
                C  READS WEATHER DATA FROM CONCENTRATED 'TEST REFERENCE YEAR' ON DISK
0002                  COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SO,SN
                     1,RTOT(24),TD(24),NN(24)
0003                  DIMENSION IA(30)
0004                  DATA ICA,ICB,ICC,ICD,ICE,ICF,ICG,ICH,ICI,ICJ,ICK / 1H1,1H2,1H3,
                     11H4,1H5,1H6,1H7,1H8,1H9,1H0,1H  /
                C  FOR DECODING CLOUD COVER DATA
0005                  NQ =NN(24)
0006                  DO 1 J=1,6
0007                  READ (1,5) IA
0008                5 FORMAT (I3,I1,4(I4,4I3,A1,I2))
0009                  DO 2 K=1,4
0010                  KK =K*7 -4
0011                  JK =J*4 +K -4
0012                  TT(JK)  =FLOAT(IA(KK))/10.
                C
                C  DEWPOINT TEMPERATURE, IN DATASET INCREASED WITH 50.
0013                  TD(JK) =FLOAT(IA(KK+1))/10. -50.
0014                  RTOT(JK) = IA(KK+2)
0015                  RDT(JK) =IA(KK+3)
0016                  RNT(JK) =IA(KK+4)
0017                  IAA = IA(KK+5)
0018                  FF(JK) =IA(KK+6)
                C
                C  MISSING CLOUD COVER IS SUBSTITUTED BY PRECEDING VALUE
0019                  IF (IAA.EQ.ICJ) NQ =0
0020                  IF (IAA.EQ.ICA) NQ =1
0021                  IF (IAA.EQ.ICB) NQ =2
0022                  IF (IAA.EQ.ICC) NQ =3
0023                  IF (IAA.EQ.ICD) NQ =4
0024                  IF (IAA.EQ.ICE) NQ =5
0025                  IF (IAA.EQ.ICF) NQ =6
0026                  IF (IAA.EQ.ICG) NQ =7
0027                  IF (IAA.EQ.ICH) NQ =8
                C
                C  N =9 SUBSTITUTED WITH N =8
0028                  IF (IAA.EQ.ICI) NQ =8
0029                6 NN(JK) =NQ
0030                2 CONTINUE
0031                1 CONTINUE
0032                  NMD =IA(1)/50
0033                  NDG =IA(1) -NMD*50
0034                  NMD =NMD +1
0035                  RETURN
0036                  END
```

```
FORTRAN IV G LEVEL  21                    SUNR                    DATE = 78125

0001                  SUBROUTINE SUNR(NMD,NDG,NDN,NBA2,BA2,BAS)
                C  CALCULATION OF SOLAR ANGLES PER HALF-HOUR, AND SUNRISE AND SUNSET
0002                  COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SD,SN
                     1,RTOT(24),TD(24),NN(24)
0003                  DIMENSION DM(12),E(12),QQR(12),RRQ(12)
0004                  DATA DM /0.,31.,59.,90.,120.,151.,181.,212.,243.,273.,304.,334./
0005                  DATA E /.09,.12,.14,.16,.18,.21,.23,.23,.23,.18,.15,.11 /
0006                  DATA QQR /2*.39,3*.065,0.0,3*-.12,-.06,2*.39 /
0007                  DATA RRQ /2*.078,3*.121,.127,3*.142,.142,2*.078 /
                C  FOR 56 DG NORTHERN LATITUDE (SINBR, COSBR)
                C  SINBR=SIN(LOCAL LATITUDE); TO BE INSERTED IN THE FOLLOWING STATEMENT
0008                  DATA SINBR /0.829 /
0009                  PJ=0.01745
0010                  PI =3.14159
0011                  IF (BA2.EQ.0.) GOTO 180
0012                  DO 179 I=1,24
0013                179 NN(I) =NBA2
0014                  IF (BAS.EQ.0.) GOTO 180
0015                  SINBR =SIN(BAS*PJ)
0016                180 CONTINUE
0017                  COSBR =SQRT(1. -SINBR**2)
0018                  DN =DM(NMD) +FLOAT(NDG)
0019                  DA =COS(DN*PI/182.5)
0020                  DA =1. +0.0334*DA
0021                  NDN =DN
0022                  H(1) =0.
                C  TIMEEQUATION, AND LOCAL TIME FOR COPENHAGEN 9.7 MINUTES
0023                  IF (DN.GE.21.) GOTO 187
0024                  TEQ = -2.6 -.44*DN
0025                  GO TO 186
0026                187 IF (DN.GE.136.) GOTO 188
0027                  TEQ = -5.2 -9.*COS((DN-43.)*.0357)
0028                  GO TO 186
0029                188 IF (DN.GE.241) GOTO 189
0030                  TEQ = -1.4 +5.*COS((DN- 135.)*.0449)
0031                  GO TO 186
0032                189 IF (DN.GE.336) GOTO 190
0033                  TEQ =  6.3 + 10.*COS((DN-306.)*.0360)
0034                  GO TO 186
0035                190 TEQ =-0.46*(DN -359.)
0036                186 CONTINUE
                C  LOCAL TIME IS INSERTED IN THE FOLLOWING STATEMENT
0037                  TET =(TEQ -9.7)/60.
0038                  TEQ =TET*PI/12.
0039                  DF =DN*PI/182.5
0040                  VA =(0.37 -22.96*COS(DF) -0.37*COS(2.*DF) -0.15*COS(3.*DF)
                     1 +4.00*SIN(DF))*PJ
0041                  SINVA =SIN(VA)
0042                  COSVA =COS(VA)
                C  SUNRISE AND SUNSET, INCLUDING REFRACTION
0043                  TON =(SINBR*SINVA +0.01)/(COSBR*COSVA)
0044                  TON =(12./PI)*ARCOS(TON)
0045                  SD =TON -TET
0046                  SN =24. -TON -TET
                C  SOLAR HEIGTH AND AZIMUTH, PER HALF-HOUR, DEGREES
0047                  DO 80 I=1,48
0048                  TP =PI*FLOAT(I)/24. +TEQ
0049                  COSTP= COS(TP)
0050                  SINUH=SINVA*SINBR-COSVA*COSBR*COSTP
0051                  H2=ARSIN(SINUH)
0052                  COSIH=COS(H2)
0053                  IF (H2.GT.-0.005) H2 =H2 +0.000225/(H2 +0.023)
0054                  SINUH =SIN(H2)
0055                100 AN = SINBR*COSVA*COSTP + COSBR*SINVA
0056                  AN =  AN/COSIH
0057                  IF ((AN+1.).LT.1.E-5) GOTO 755
0058                  AN = ARCOS(AN)
0059                  GO TO 786
0060                755 AN = PI
0061                786 AZ =AN -PI
0062                  IF (TP.GT.PI) AZ =-AZ
0063                  H(I+1) =H2/PJ
0064                  AS(I+1) =AZ/PJ
0065                  IF (BA2.EQ.0.) GOTO 80
0066                  EXT =E(NMD)
0067                  CC =NBA2
0068                  IF (CC.EQ.1.) CC =0.5
0069                  IF (CC.EQ.7.) CC =7.3
0070                  IF (CC.GT.8.) CC =8.
0071                  Q =-QQR(NMD)*0.1
0072                  R =-RRQ(NMD)*0.1
0073                  CCF =1.0 +Q*CC +R*CC*CC
0074                  CQ =(.58 +.025*CC*CC -.000288*CC**4)*CC
0075                  IF (CQ.GT.8.) CQ =8.
0076                  J =(I+1)/2
0077                  IF ((I-2*J).EQ.0) GOTO 80
0078                  IF (H2.LE.0.) GOTO 81
0079                  FL =1.02/(SINUH +.02)
0080                  SM =1163.*EXP(-EXT*FL) *DA
0081                  HH =0.333*(1370.*DA -SM)*SINUH
0082                  RNT(J) =SM*(1.-CQ/8.)
0083                  RTOT(J) =(HH +SM*SINUH)*CCF
0084                  RDT(J) =RTOT(J) -RNT(J)*SINUH
0085                  GO TO 80
0086                 81 RNT(J) =0.
0087                  RDT(J) =0.
0088                  RTOT(J) =0.
0089                 80 CONTINUE
0090                  RETURN
0091                  END
```

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FORTRAN IV G LEVEL  21                    SOLIN                DATE = 75133

0001                  SUBROUTINE SOLIN(NOP)
                C  SOLAR HEAT LOAD THROUGH ROOF, WALLS AND WINDOWS, WITH SUNSHADING
                C  HORM =ALTITUDE OF HORIZON, DG,
                C  RIBM =RIB,ADJACENT TO WINDOW, DISTANCE AND PROTRUSION
                C  UDHM =CANOPY, DISTANCE AND PROTRUSION
                C  FM =WINDOW, GLASS, HEIGTH AND WIDTH
                C  BEVM =MOVABLE SUNSHADING, SETTING VALUE AND REDUCTION
                C  FORDM =FRACTION OF SOLAR GIVEN CONVECTIVELY, WITHOUT AND WITH SHADING
                C  TGK = ROOFAREA*(U-VALUE) ,VAEK =WALLAREA*(U-VALUE)
0002                  COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SO,SN
                     1,RTOT(24),TD(24),NN(24)
0003                  COMMON /INTERP/ SOL(50,2),SOLT(50),TVIN(50),TOO(50),TD1(50)
                     1,MBA(4,50)
0004                  COMMON/SR/HORM(10),VAEK(10),UDHM(2,10),RIBM(2,10),BEVM(3,10),
                     1FM(2,10),FORDM(2,10),VIN(10),AVT(10),TGK
0005                  DIMENSION SNT(50),SDT(50)
0006                  PJ =0.01745
0007                  TR =0.76
0008                  RF =0.66
0009                  AT =TGK*0.0085
0010                  ISO =2.*SO +1.1
0011                  ISN =2.*SN +1.9
0012                  SOLT(1) =SOLT(49)
0013                  DO  2 I=2,49
0014                  SNT(I) =0.
0015               12 SDT(I) =0.
0016                  DO 11 I=ISO,ISN
0017                  IA =I/2
0018                  IB =(I-1)/2
0019                  SNT(I) =(RNT(IA) +RNT(IB))/2.
0020                  SDT(I) =(RDT(IA) +RDT(IB))/2.
0021               11 CONTINUE
0022                  DO 20 I=2,49
0023                  DO 13 J=1,4
0024               13 MBA(J,I) =0
0025                  TVIN(I) =0
0026                  SOL(I,1) =0.
0027                  SOL(I,2) =0.
0028                  SOLT(I) =SOLT(I-1)*0.6
0029                  IF (I.LT.ISO.OR.I.GT.ISN) GOTO 20
0030                  SOLV =SNT(I)*SIN(H(I)*PJ) +SDT(I)
                C  SOLAR HEAT THROUGH ROOF
0031                  SOLT(I) =SOLT(I) +SOLV*AT
0032                  COSIH =COS(H(I)*PJ)
0033                  DO 10 IP=1,10
0034                  VVK =VAEK(IP)*0.0085
0035                  AV  =AVT(IP)
0036                  IF (AV.LE.0..AND.VVK.LE.0.) GOTO 10
0037               14 X =(AS(I) -VIN(IP))*PJ
0038                  ZAN =COSIH*COS(X)
0039                  VH =ASIN(ZAN)
0040                  NAF =1
0041                  FK =0.
0042                  FV =0.
0043                  F =0.45+0.437*ZAN +0.313*ZAN*ZAN
0044                  IF (ZAN.LT.-.2) F =0.45
                C  CORRECTION FOR CLOUD COVER
0045                  J =I/2
0046                  BN =NN(J)
0047                  F = (F-.5)*(8.-BN)/8. +.5
0048                  DIFD =SDT(I)*F
0049                  IF (ZAN) 16,16,201
0050              201 VI =VH/PJ
0051                  FV =ZAN
0052                  FK=TR*(1.-0.04*(VI/100.)-2.933*(VI/100.)**6+2.13*(VI/100.)**12)
0053               16 IF (H(I).LT.HORM(IP)) GOTO 17
0054                  SOLD =SNT(I)*FV
0055                  DIFR =SOLV*0.125
0056                  GO TO 18
0057               17 SOLD =0
0058                  DIFR =SDT(I)*0.125
                C  SOLAR HEAT THROUGH WALLS
0059               18 SOLT(I) =SOLT(I) +(SOLD +DIFD +DIFR)*VVK
                C  FIXED, OUTSIDE SUNSHADINGS, CANOPIES AND VERTICAL FINS
0060                  FMH =FM(1,IP)
0061                  FMB =FM(2,IP)
0062                  ASU =1.
0063                  ASR =1.
0064                  ADJ =1.
0065                  UDHF = UDHM(2,IP)
0066                  RIBF = RIBM(2,IP)
0067                  IF (UDHF.LE.0.) GOTO 71
0068                  COTA = COS(X)*COSIH/ SIN(H(I)*PJ)
0069                  UDHA =UDHM(1,IP)
0070                  ASU =  (FMH -UDHF/COTA +UDHA)/FMH
0071                  IF (ASU.GT.1.) ASU =1.
0072                  IF (ASU.LT.0.) ASU =0.
0073                  TG = UDHF/(UDHA +FMH/2.)
0074                  ADJ = 1./SQRT(1.+TG*TG)
0075               71 IF (RIBF.LE.0.) GOTO 72
0076                  RIBA =RIBM(1,IP)
0077                  ASS = RIBF *TAN(X)
0078                  ASR =(FMB +RIBA -ABS(ASS))/FMB
0079                  IF (ASR.GT.1.) ASR=1.
0080                  IF (ASR.LT.0.) ASR=0.
0081               72 ASU = ASU*ASR
0082                  SOLD =SOLD*ASU
0083                  DIFD =DIFD*ADJ
                C  SOLAR HEAT THROUGH WINDOWS
0084                  IF (AV.LE.0.) GOTO 10
0085                  SOLG =SOLD*FK +(DIFD +DIFR)*RF
                C  MOVABLE SUNSHADING
0086                  IF (SOLG.GT.BEVM(3,IP)) NAF =2
0087                  FORD =FORDM(NAF,IP)
0088                  SOLA =SOLG*BEVM(NAF,IP)*AV
0089                  SOL(I,1) =SOL(I,1) +SOLK*FORD
0090                  SOL(I,2) =SOL(I,2) +SOLK*(1.-FORD)
0091                  IF (NAF.EQ.2.AND.IP.LE.4) MBA(IP,I) =1
0092                  IF (NAF.NE.IP) GOTO 10
                C  INSIDE SURFACE OF WINDOW, OVERTEMPERATURE
0093                  TVIN(I) = SOLG*BEVM(NAF,IP)*0.008
0094               10 CONTINUE
0095               20 CONTINUE
0096                  RETURN
0097                  END
```

```
FORTRAN IV G LEVEL  21                    ADM2                    DATE = 76133

0001                  SUBROUTINE ADM2(IM,NDP,NATI,NAT,THDO,THDI)
                C  ADMINSTRATION OF OUTPUT TABLES
                C  NDP=-1 GIVES TABLES WITH ROOM AIR TEMPERATURES
                C         0 GIVES FURTHERMORE OPERATIVE TEMPERATURE (AIR - SURFACE MEAN)
                C         1 (OR 2,3,4) GIVES FURTHERMORE OP. TEMP TOWARDS WINDOW 1 (2,3,4)
0002                  COMMON /AD1/ ITAEL(6,30,13),THA(50),THO(50),THR(50),SUM(11,13)
                     1,GLIM(6,2,13)
0003                  COMMON /INTERP/ SOL(50,2),SOLT(50),TVIN(50),TDO(50),TDI(50)
                     1,M3A(4,50)
0004                  THDO =-999999.
0005                  THDI =-999999.
0006                  DO 10 I=2,49
0007                  IF (NDP) 11,12,13
0008             11   J =1
                C  ROOM AIR TEMPERATURE
0009                  TJ =THR(I)
0010                  GO TO 16
0011             12   J=3
                C  OPERATIVE TEMPERATURE TOWARDS WALLS
0012                  TJ =TDO(I)
0013                  IF (TJ.GT.THDO) THDO =TJ
0014             16   IT =TJ -9.95
0015             14   IF (IT.LT.1) IT=1
0016                  IF (IT.GT.30) IT=30
0017                  ITAEL(J,IT,IM) = ITAEL(J,IT,IM) +1
0018                  IF (GLIM(J,1,IM).GT.TJ) GLIM(J,1,IM) =TJ
0019                  IF (GLIM(J,2,IM).LT.TJ) GLIM(J,2,IM) =TJ
0020                  J=J +1
0021                  IF (I.LT.NATI.OR.I.GT.NAT) GOTO 20
0022                  ITAEL(J,IT,IM) =ITAEL(J,IT,IM) +1
0023                  IF (GLIM(J,1,IM).GT.TJ) GLIM(J,1,IM) =TJ
0024                  IF (GLIM(J,2,IM).LT.TJ) GLIM(J,2,IM) =TJ
0025             20   IF (J-4) 10,13,12
0026             13   J=5
0027                  IF (I.LT.NATI.OR.I.GT.NAT) GOTO 12
                C  OPERATIVE TEMPERATURE TOWARDS WINDOW
0028                  TI =TDI(I)
0029                  IF (TI.GT.THDI) THDI =TI
0030                  IT =TI -9.95
0031             17   IF (IT.LT.1) IT=1
0032                  IF (IT.GT.30) IT=30
0033                  ITAEL(J,IT,IM) =ITAEL(J,IT,IM) +1
0034                  IF (GLIM(J,1,IM).GT.TI) GLIM(J,1,IM) =TI
0035                  IF (GLIM(J,2,IM).LT.TI) GLIM(J,2,IM) =TI
                C  DIFFERENTIAL OPERATIVE TEMPERATURE WINDOW - WALLS.
0036                  TI =TI -(THR(I) +THO(I))/2.
0037                  IT =TI +10.
0038                  J =J +1
0039                  IF (J.EQ.6) GOTO 17
0040                  GO TO 12
0041             10   CONTINUE
0042                  RETURN
0043                  END


FORTRAN IV G LEVEL  21                    INPOL                   DATE = 76133

0001                  SUBROUTINE INPOL(NULT,TOVT,TMIT)
                C  INTERPOLATES OUTDOOR AIR TEMP. AND VENTILATION TEMP., HALF-HOUR VALUE
0002                  COMMON T(18), QQ(50),QK(50),QR(50),QMAX(50),QMIN(50),
                     1TEXI(4,50),INFL(12,50),VENT(12,50)
0003                  COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SD,SN
                     1,RTOT(24),TD(24),NN(24)
0004                  REAL NULT
0005                  DO 111 I=2,24
0006                  I3 =I*2
0007                  I2 =I3 -1
0008                  TEXI(2,I3) =TT(I)
0009             111  TEXI(2,I2) =(TT(I) +TT(I-1))/2.
0010                  TEXI(2,1) =(TT(1) +NULT)/2.
0011                  TEXI(2,2) =TT(1)
0012                  NULT =TT(24)
0013                  IF (TMIT.EQ.0.) GOTO 114
0014                  DO 113 I=1,48
0015                  TEX =TEXI(2,I) +TOVT
0016                  IF (TEX.LT.TMIT) TEX =TMIT
0017                  TEXI(4,I) =TEX
0018             113  CONTINUE
0019             114  CONTINUE
0020                  RETURN
0021                  END
```

```
FORTRAN IV G LEVEL  21                  UDSKR                DATE = 76133

0001                  SUBROUTINE UDSKR(NOP,NAT,NATI,IY,IM,ID)
                C  PRINTOUT OF MONTHLY AND YEARLY TABLES
0002                  COMMON Z(18)
0003                  COMMON /AD1/ ITAEL(6,30,13),THA(50),THO(50),THR(50),SUM(11,13)
                     1,GLIM(6,2,13)
0004                  DIMENSION NC(3),C(11),IS(12)
0005                  DIMENSION FRAK(3,13),LD(6),LF(6),LS(6),ITOT(30)
0006                  DATA LD,LF,LS /5*10,-10,5*12, -8,5*40,20 /
0007                  DATA NC / 10,50,90 /
0008                  DATA C /4H    Q,4HQ-  ,4HQ+  ,4HPRIM,4HTOT ,4HSOL ,4HELYS,4HLIM ,
                     1 4H    ,4HMCAL,4HKWH  /
                C
                C  NE=11 GIVES UNITS KWH, NE=10 GIVES UNITS MCAL
0009                  NE=11
0010                  ISUM =0
0011                  ANAT =24.
0012                  ANATI =0.
0013                  DO 33 J=1,6
0014                  WRITE (6,111) Z,IY,IM,ID
0015                111 FORMAT (1H1,18A4,4H  19,I2,3H - ,I2,3H - ,I2 )
0016                 13 IF (J.NE.2) WRITE (6,40) ANATI,ANAT
0017                  IF (J.EQ.3.OR.J.EQ.4) WRITE (6,41) ANATI,ANAT
0018                  IF (J.EQ.5) WRITE(6,42) NOP,ANATI,ANAT
0019                  IF (J.EQ.6) WRITE(6,43) NOP,ANATI,ANAT
0020                 40 FORMAT (1H0,'AIRTEMPERATURE, FROM ',F5.2,' TO ',F5.2 )
0021                 41 FORMAT (1H0,'OPERATIVE TEMPERATURE TOWARD WALLS, FROM ',
                     1F5.2,' TO ',F5.2 )
0022                 42 FORMAT (1H0,'OPERATIVE TEMPERATURE TOWARD WINDOW ',I2,', FROM ',
                     1F5.2,' TO ',F5.2 )
0023                 43 FORMAT (1H0,'DIFFERENTIAL OPERATIVE TEMP, WINDOW ',I2,' - WALLS,',
                     1' FROM ',F5.2,' TO ',F5.2 )
0024                  WRITE (6,15)
0025                 15 FORMAT (1H0,'HALF-HOURS IN   JAN     FEB     MAR     APR     MAY     ',
                     1'JUN     JUL     AUG     SEP     OCT     NOV     DEC     YEAR ' // )
0026                  DO 11 I=1,30
0027                  ITOT(I) =1
0028                  DO 12 K=1,12
0029                  IF (GLIM(J,1,13).GT.GLIM(J,1,K)) GLIM(J,1,13) =GLIM(J,1,K)
0030                  IF (GLIM(J,2,13).LT.GLIM(J,2,K)) GLIM(J,2,13) =GLIM(J,2,K)
0031                 12 ITAEL(J,I,13) =ITAEL(J,I,13) +ITAEL(J,I,K)
0032                 11 CONTINUE
0033                  DO 47 I=1,30
0034                  IF (ITAEL(J,I,13).NE.0) GOTO 48
0035                 47 ITOT(I) =0
0036                 48 CONTINUE
0037                  DO 49 I=1,30
0038                  IRES =ITAEL(J,31-I,13)
0039                  IF (IRES.NE.0) GOTO 50
0040                 49 ITOT(31-I) =0
0041                 50 CONTINUE
                C
                C  PRINTOUT OF DISTRIBUTION OF VALUES
0042                  IF (ITOT(1).EQ.1) WRITE (6,19) LF(J),(ITAEL(J,I,JX),JX=1,13)
0043                 19 FORMAT (6H BELOW ,I3,4H GDC,12(I6,1X),I8)
0044                  DO 26 K=2,29
0045                  IF (ITOT(K).EQ.0) GOTO 26
0046                  LL =LD(J) +K
0047                  M=LL+1
0048                  WRITE (6,25)LL,M,(ITAEL(J,K,JX),JX=1,13)
0049                 25 FORMAT (1H ,2X,I3,3H-0-,I3,1X,12(I6,1X),I8)
0050                 26 CONTINUE
0051                  IF (ITOT(30).EQ.1) WRITE (6,28) LS(J),(ITAEL(J,30,JX),JX=1,13)
0052                 28 FORMAT (6H OVER  ,I3,4H GDC,12(I6,1X),I8)
0053                  ANAT = FLOAT(NAT -(NAT/2)*2)*0.3 +FLOAT(NAT/2)
0054                  ANATI= FLOAT(NATI -(NATI/2)*2)*0.3 +FLOAT(NATI/2)
0055                  IF (J.EQ.2) GOTO 34
0056                  IF (J.EQ.3) GOTO 33
0057                  IF (J.GT.3) GOTO 35
                C
                C  PRINTOUT OF MONTHLY AND YEARLY MEAN AND SUMS
0058                  WRITE (6,105)
0059                105 FORMAT (1H0,'MEAN, DEGREE CENTIGRADE ')
0060                  DO 24 I=1,12
0061                  SUM(5,I) =SUM(4,I) +SUM(3,I)
0062                  SUM(I,13) =SUM(I,13) +SUM(1,I)
0063                  DO 22 K=2,8
0064                  SUM(K,I) =SUM(K,I)/1000.
0065                 22 SUM(K,13) =SUM(K,13) +SUM(K,I)
0066                  SUM(1,I) =SUM(1,I)/SUM(11,I)
0067                  IS(I) =SUM(9,I)
0068                  ISUM =ISUM +IS(I)
0069                  SUM(11,13) =SUM(11,13) +SUM(11,I)
0070                 24 CONTINUE
0071                  SUM(1,13) =SUM(1,13) /365.
0072                  VARME =SUM(5,4)
0073                  DO 101 NV=1,3
0074                101 VARME =VARME +SUM(5,NV) +SUM(5,NV+9)
0075                  WRITE (6,123) ((SUM(I,K),K=1,13),(C(I),C(NE),(SUM(I,L),
                     1L=1,13),I=2,7)
0076                123 FORMAT (1H ,11X,12F7.1,F9.1//(   2A4,1X,A4,12F7.1,F9.1  //))
0077                  WRITE (6,124) (IS(K),K=1,12),ISUM
0078                124 FORMAT (1H ,14HUVO, HALFHOURS,I4,1117,I9)
0079                  WRITE (6,102) VARME
0080                102 FORMAT (1H0,'QTOT OCTOBER - APRIL INCL. ',F10.1 )
0081                  GO TO 33
0082                 34 ANAT =24.
0083                  ANATI= 0.
0084                 35 CONTINUE
                C
                C  CALCULATION AND PRINTOUT OF FRACTILES FOR J=2,4,5 AND 6
0085                  CALL FRAKT(J,FRAK)
0086                  WRITE (6,16) (NC(NN),(FRAK(NN,MM),MM=1,13),NN=1,3)
0087                 16 FORMAT (1H0 //24H FRACTILES, TEMPERATURES  //(1X,I2,' 0/0 ',4X,
                     112(3X,F5.1),4X,F5.1 ))
0088                  NOP = J -2*NOP -4
0089                  IF (NOP.EQ.0) GOTO 100
0090                 33 CONTINUE
0091                100 CONTINUE
0092                  RETURN
0093                  END
```

```
FORTRAN IV G LEVEL  21                    FRAKT                DATE = 76133

0001                  SUBROUTINE FRAKT(J,FRAK)
                C  CALCULATION OF FRACTILES, [illegible] 0/0, 50 0/0 AND 90 0/0
0002                  COMMON /ADD/ ITAEL(5,30,[illegible],THA(50),THD(50),T[illegible]50),SUM(11,13)
                     1,GLIM(6,2,13)
0003                  DIMENSION IT(30),FRAK(11,13)
0004                  REAL IT
0005                  G6 =0.
0006                  IF (J.EQ.6) G6 =-20.
0007                  DO 11 M=1,13
0008                  IT(1) =ITAEL(J,1,M)
0009                  DO 10 I=2,30
0010               10 IT(I) =IT(I-1) +FLOAT(ITAEL(J,I,M))
0011                  DO 12 II=1,3
0012                  AN =IT(30)*(II*0.4 -0.3)
0013                  DO 13 I=1,30
0014               13 IF (AN.GT.IT(I)) IC =I +1
                C  STRAIGHT OR CURVED INTERPOLATION, DEPENDANT ON THE CURVATURE OF
                C                THE ADJACENT SEGMENTS.
0015                  IF (IC.LT.3.OR.IC.GT.28) GOTO 101
0016                  A =IT(IC-2)
0017                  D =IT(IC+1)
0018               94 C =IT(IC)
0019                  B =IT(IC-1)
0020                  GC =FLOAT(IC) +11. +G6
0021                  GB =GC -1.
0022                  IF (GLIM(J,1,M).GT.GB) GB =GLIM(J,1,M)
0023                  IF (GLIM(J,2,M).LT.GC) GC =GLIM(J,2,M)
0024                  DO 90 I=1,10
0025                  AM =(FLOAT(I) -0.5)*0.1
0026                  XA = B +AM*(B -A)
0027                  XD = C -(1.-AM)*(D-C)
0028                  XR = 0.5*AM*(1.-AM)*(B +C -A -D)
0029                  XM = B +AM*(C -B)
0030                  XX = XM +XR
0031                  XAD = 2*B -A -C
0032                  XDD = 2*C -D -B
0033                  IF (XAD.EQ.0..OR.XDD.EQ.0..OR.XR.EQ.0.) GOTO 51
0034                  XAD =XAD/XDD
0035                  IF (XAD.LT.0.) GOTO 51
0036                  IF (XR.GT.0.)  GOTO 53
0037                  IF (XX.GE.XA.AND.XX.GE.XD) GOTO 52
0038                  XX =XA
0039                  IF (XD.GT.XA) XX =XD
0040                  GO TO 52
0041               53 IF (XX.LE.XA.AND.XX.LE.XD) GOTO 52
0042                  XX =XA
0043                  IF (XD.LT.XA) XX =XD
0044                  GO TO 52
0045               51 XX =XM
0046               52 IF (XX.GT.AN) GOTO 91
0047               90 CONTINUE
0048               91 ANN =FLOAT(I-1)*(GC -GB)*0.1 +GB
0049                  GO TO 92
0050              101 IF (IC.NE.2.AND.IC.NE.29) GOTO 102
0051                  A =IT(IC-1)
0052                  D =IT(IC)
0053                  GOTO 94
0054              102 ANN =999999.
0055               92 FRAK(II,M) =ANN
0056               12 CONTINUE
0057               11 CONTINUE
0058                  RETURN
0059                  END
```

```
FORTRAN IV G LEVEL  21                    TAPE                 DATE = 78125

0001                  SUBROUTINE  TAPE(NMD,NDG)
                C  READS WEATHER DATA FROM 'TEST REFERENCE YEAR' ON TAPE
0002                  COMMON /KORS/ AS(50),H(50),RNT(24),RDT(24),TT(24),FF(24),SO,SN
                     1,RTOT(24),TD(24),NN(24)
0003                  DATA ICA,ICB,ICC,ICD,ICE,ICF,ICG,ICH,ICI,ICJ,ICK / 1H1,1H2,1H3,
                     11H4,1H5,1H6,1H7,1H8,1H9,1H0,1H  /
                C  FOR DECODING CLOUD COVER DATA
0004                  NQ =NN(24)
0005                  DO 1 J=1, 24
0006                  READ (1,5) I1,I2,I3,I4,I5,IAA,I6,NMD,NDG
0007               5  FORMAT (2I4,15X,3I3,3X,A1,2X,I2,34X,2I2,2X)
0008                  TT(J)= FLOAT(I1)/10.
0009                  TD(J)= FLOAT(I2)/10.
0010                  RTOT(J)= FLOAT(I3)
0011                  RDT(J)= FLOAT(I4)
0012                  RNT(J)= FLOAT(I5)
0013                  FF(J)= FLOAT(I6)
                C
                C  MISSING CLOUD COVER IS SUBSTITUTED BY PRECEDING VALUE
0014                  IF (IAA.EQ.ICJ) NQ =0
0015                  IF (IAA.EQ.ICA) NQ =1
0016                  IF (IAA.EQ.ICB) NQ =2
0017                  IF (IAA.EQ.ICC) NQ =3
0018                  IF (IAA.EQ.ICD) NQ =4
0019                  IF (IAA.EQ.ICE) NQ =5
0020                  IF (IAA.EQ.ICF) NQ =6
0021                  IF (IAA.EQ.ICG) NQ =7
0022                  IF (IAA.EQ.ICH) NQ =8
                C
                C  N =9 SUBSTITUTED WITH N =8
0023                  IF (IAA.EQ.ICI) NQ =8
0024                  NN(J)= NQ
0025               1  CONTINUE
0026                  RETURN
0027                  END
```

BA4 PROGRAM. Example of input cards and output

Input Cards:

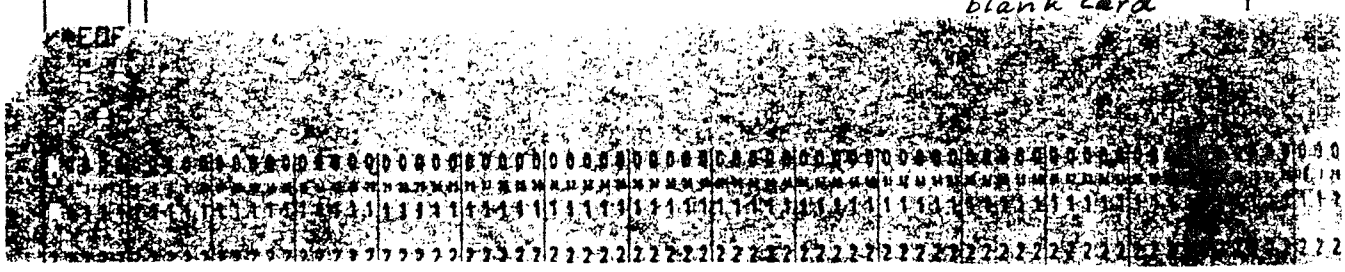
```
KONTROLBEREGNING BA/HL, MAJ 1974. REFERENCEÅAR
TU    21.
TD    40.
TA    50.
TK     0.
S    1740.

VINDUE     1   3.0      -45.
HORISONT       7.
BEV.AFSK   1   150.      0.6
FORIEL     1   0.5       0.5
AIRTEMF    1
C
4
AIRTEMF    4   0.        -30.
FLUX       1
0.
8.3
FLUX       1 0.5        0.5
ELLYS        100.
FLUX      10
 0.           0.
 8.           0.
8.25         150.
17.          150.
17.25          0.
24.            0.
FLUX      10 0.5        0.5
VENT
 0.          30.
 6.10        30.
 6.20        60.
18.10        60.
18.20        30.
24.          30.
QMAX
 0.        3000.
24.        3000.
OPER       1
UDSKRIV        6.00     12.01
LASTFLUX

ENDF
```

title card

room data

blank card exitations

blank card



Printout from run:

Year Month Day of job run.
1976 - 5 - 13

KONTROLBEREGNING BA/HL. MAJ 1974. REFERENCEAAR Title

LAB. FOR VARMEISOLERING, DTH, PROGRAM BA4(MAJ76)

TU = 21.00 TK = 0.0 TO = 240.00 TA = 690.00 } Room data
S = 1740.00 DT = 0.50

VINDUE	1	3.000	-45.000	Window, area m^2 and direction SE
HORISONT	0	7.000	0.0	Horizon 7°
BEV.AFSK	1	150.000	0.600	Movable sunshading
FORDEL	1	0.500	0.500	Convective part without and with sunshading
AIRTEMP	1	0.0	0.0	Desired airtemperature, see next page
AIRTEMP	4	0.0	-30.000	Ventilation air (primary air) outside, no temperature increase
FLUX	1	0.0	0.0	Time serie, see next page (persons)
FLUX	1	0.500	0.500	Convective and radiative part
ELLYS	0	100.000	0.0	Electric light if sunradiation less than 100 W through the window
FLUX	10	0.0	0.0	" " , time serie
FLUX	10	0.500	0.500	Convective and radiative part
VENT	0	0.0	0.0	Ventilation, time serie

0.0	30.00000
6.10	30.00000
6.20	60.00000
18.10	60.00000
18.20	30.00000
24.00	30.00000

Reduced ventilation during the nigth.

QMAX	0	0.0	0.0	Max heat load, time serie
OPER	1	0.0	0.0	Operative temp. and directional operative temp. desired
UDSKRIV	0	6.030	12.010	Print-out of June, 3td and December 1st desired
LASTFLUX	0	0.0	0.0	No more exitations

SPECIFIED TEMPERATURES AND FLUXES

H	AIRT 1	AIRT 3	(AIRT 4)	QMAX	QMIN	FLUX 1	FLUX10
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
1	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
2	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
3	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
4	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
5	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
6	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
7	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
8	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
9	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
10	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
11	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
12	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
13	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
14	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
15	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
16	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
17	21.0	0.0	0.0	3000.0	0.0	120.0	150.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
18	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
19	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
20	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
21	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
22	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
23	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
24	21.0	0.0	0.0	3000.0	0.0	0.0	0.0
SUM						1080.0	1350.0
			KONV	1.0000	1.0000	0.5000	0.5000
			RADI	0.0	0.0	0.5000	0.5000

KONTROLBEREGNING BA/HL, MAJ 1974. REFERENCEAAR 1976 - 5 - 13

MD	DG	RLT M	KL RLT MAX	OP-T	OPT1	UDT M	Q KOLE	Q VARM	Q PRIM	Q SOL	UVQ	E-L	B-A1
1	1	21.0	5.30 21.0	20.8	17.3	1.2	0.	26149.	0.	92.	0	18	0
1	2	21.0	0.30 21.0	20.5	17.5	2.3	0.	26189.	0.	309.	0	18	0
1	3	21.0	2.30 21.0	20.5	17.7	2.4	0.	26209.	0.	56.	0	18	0
1	4	21.0	21.30 21.0	20.5	17.9	2.3	0.	26080.	0.	581.	0	15	0
1	5	21.0	1.30 21.0	20.4	17.2	1.3	0.	27648.	0.	184.	0	18	0
1	6	21.0	6.30 21.0	20.4	17.7	1.5	0.	27365.	0.	676.	0	12	0
1	7	21.0	0.30 21.0	20.4	17.3	1.3	0.	27821.	0.	218.	0	18	0
1	8	21.0	4.00 21.0	20.4	17.1	0.3	0.	29390.	0.	379.	0	18	0
1	9	21.0	1.00 21.0	20.5	17.5	2.5	0.	26214.	0.	212.	0	18	0
1	10	21.0	2.00 21.0	20.4	17.3	1.6	0.	27214.	0.	137.	0	18	0
1	11	21.0	4.30 21.0	20.4	16.9	-0.6	0.	30417.	0.	292.	0	18	0
1	12	21.0	22.00 21.0	20.6	18.3	-.6	0.	29359.	0.	4620.	0	6	9
1	13	21.0	0.30 21.0	20.5	17.6	2.2	0.	26425.	0.	127.	0	18	0
1	14	21.0	0.30 21.0	20.7	18.6	1.5	0.	24983.	0.	3567.	0	8	9
1	15	21.0	3.00 21.0	20.5	17.9	2.3	0.	25766.	0.	872.	0	14	2
1	16	21.0	0.30 21.0	20.6	18.6	0.8	0.	25825.	0.	3833.	0	8	8
1	17	21.0	6.00 21.0	20.4	17.5	0.2	0.	29123.	0.	955.	0	9	0
1	18	21.0	3.00 21.0	20.6	18.3	-1.6	0.	29403.	0.	3985.	0	8	9
1	19	21.0	0.30 21.0	20.6	18.2	-1.6	0.	29529.	0.	3771.	0	8	9
1	20	21.0	1.30 21.0	20.5	18.0	-1.1	0.	29216.	0.	3247.	0	8	8
1	21	21.0	0.30 21.0	20.5	18.2	-0.6	0.	28435.	0.	3225.	0	8	8
1	22	21.0	6.30 21.0	20.4	17.4	-1.3	0.	30514.	0.	2038.	0	8	8
1	23	21.0	23.00 21.0	20.4	17.9	-1.2	0.	30908.	0.	995.	0	15	2
1	24	21.0	7.00 21.0	20.4	17.1	-3.7	0.	33739.	0.	2751.	0	7	9
1	25	21.0	7.00 21.0	20.4	17.4	-5.6	0.	35180.	0.	3943.	0	8	9
1	26	21.0	9.30 21.0	20.4	17.8	-6.5	0.	36168.	0.	4463.	0	6	8
1	27	21.0	2.00 21.0	20.4	17.7	-5.1	0.	34906.	0.	4228.	0	6	10
1	28	21.0	2.30 21.0	20.4	17.1	-0.0	0.	29910.	0.	308.	0	18	0
1	29	21.0	1.00 21.0	20.5	18.0	3.1	0.	25270.	0.	604.	0	14	0
1	30	21.0	1.00 21.0	20.8	19.4	5.2	0.	20738.	0.	2090.	0	10	6
1	31	21.0	1.30 21.0	20.5	18.2	3.3	0.	24116.	0.	1235.	0	10	0
2	1	21.0	0.30 21.0	20.6	18.5	5.1	0.	21891.	0.	620.	0	12	0
2	2	21.0	23.00 21.0	20.8	19.3	4.2	0.	20563.	0.	3801.	0	6	10
2	3	21.0	22.30 21.0	20.6	18.2	4.6	0.	22295.	0.	470.	0	18	0
2	4	21.0	0.30 21.0	20.7	18.7	3.0	0.	23205.	0.	2821.	0	6	9
2	5	21.0	4.00 21.0	20.6	18.3	-0.9	0.	28794.	0.	2906.	0	7	10
2	6	21.0	1.30 21.0	20.6	17.9	-2.7	0.	30628.	0.	4395.	0	6	10
2	7	21.0	22.30 21.0	20.4	17.3	-0.7	0.	30797.	0.	489.	0	16	0
2	8	21.0	4.00 21.0	20.7	18.9	2.4	0.	23369.	0.	4164.	0	5	11
2	9	21.0	3.30 21.0	20.8	18.9	2.0	0.	23181.	0.	4477.	0	5	11
2	10	21.0	2.00 21.0	20.5	18.2	2.3	0.	25884.	0.	627.	0	13	0
2	11	21.0	20.00 21.0	20.8	19.1	1.1	0.	24304.	0.	4706.	0	5	11
2	12	21.0	6.30 21.0	20.4	17.0	-4.7	0.	34977.	0.	1826.	0	8	4
2	13	21.0	22.30 21.0	20.4	17.4	-5.1	0.	35799.	0.	3632.	0	6	7
2	14	21.0	1.00 21.0	20.4	17.4	-0.5	0.	30537.	0.	1296.	0	6	0
2	15	21.0	7.00 21.0	20.3	16.8	-2.3	0.	33204.	0.	980.	0	9	0
2	16	21.0	15.30 21.0	20.4	17.2	-2.4	0.	32814.	0.	1830.	0	6	3
2	17	21.0	6.30 21.0	20.3	16.7	-2.7	0.	33842.	0.	1095.	0	5	0
2	18	21.0	6.30 21.0	20.3	16.8	-5.3	0.	36354.	0.	2416.	0	6	7

KONTROLBEREGNING BA/HL, MAJ 1974. REFERENCEAAR 1976 - 5 - 13

MONTH 6 DAY 3

KL	RL-T	OP-T	OPTI	UDLT	QREG	QPRIM	QTOT	SOLIND	UVQ	E-L	B-A
	21.5	21.9	20.3	14.5	0.0	0.0	0.0	0.0	0	0	0
1	21.4	21.8	20.2	14.4	0.0	0.0	0.0	0.0	0	0	0
	21.3	21.7	20.1	14.3	0.0	0.0	0.0	0.0	0	0	0
2	21.2	21.6	20.0	14.2	0.0	0.0	0.0	0.0	0	0	0
	21.0	21.5	19.8	13.9	0.0	0.0	0.0	0.0	0	0	0
3	21.0	21.4	19.7	13.6	23.8	0.0	23.8	0.0	0	0	0
	21.0	21.4	19.7	13.5	44.1	0.0	44.1	0.0	0	0	0
4	21.0	21.3	19.7	13.5	63.5	0.0	63.5	0.0	0	0	0
	21.0	21.3	19.7	13.6	61.8	0.0	61.8	23.6	0	0	0
5	21.0	21.3	19.8	13.7	58.1	0.0	58.1	48.3	0	0	0
	21.0	21.3	20.0	14.5	35.5	0.0	35.5	58.7	0	0	0
6	21.0	21.3	20.1	15.4	11.5	0.0	11.5	68.7	0	0	0
	21.0	21.3	20.3	15.8	113.0	0.0	113.0	150.5	0	0	0
7	21.0	21.3	20.5	16.2	36.3	0.0	36.3	244.8	0	0	0
	21.3	21.5	21.0	16.8	0.0	0.0	0.0	372.6	0	0	1
8	22.1	22.0	22.0	17.4	0.0	0.0	0.0	600.2	0	0	1
	23.0	22.7	23.1	18.4	0.0	0.0	0.0	723.4	0	0	1
9	23.7	23.2	23.9	19.5	0.0	0.0	0.0	826.2	0	0	1
	24.0	23.5	24.3	20.1	0.0	0.0	0.0	843.8	0	0	1
10	24.3	23.8	24.6	20.7	0.0	0.0	0.0	842.0	0	0	1
	24.5	24.0	24.9	21.3	0.0	0.0	0.0	826.4	0	0	1
11	24.8	24.2	25.1	22.0	0.0	0.0	0.0	774.4	0	0	1
	24.9	24.3	25.2	22.7	0.0	0.0	0.0	680.0	0	0	1
12	24.9	24.4	25.3	23.4	0.0	0.0	0.0	571.9	0	0	1
	24.7	24.3	24.9	23.4	0.0	0.0	0.0	442.7	0	0	1
13	24.5	24.2	24.6	23.4	0.0	0.0	0.0	326.9	0	0	1
	24.9	24.5	25.2	24.0	0.0	0.0	0.0	391.8	0	0	0
14	25.0	24.6	25.2	24.6	0.0	0.0	0.0	315.5	0	0	0
	25.3	24.8	25.6	25.6	0.0	0.0	0.0	288.1	0	0	0
15	25.5	25.1	26.0	26.7	0.0	0.0	0.0	263.3	0	0	0
	25.7	25.2	26.0	26.6	0.0	0.0	0.0	245.2	0	0	0
16	25.7	25.2	26.0	26.6	0.0	0.0	0.0	231.3	0	0	0
	25.7	25.2	26.0	26.4	0.0	0.0	0.0	206.2	0	0	0
17	25.6	25.3	25.9	26.2	0.0	0.0	0.0	181.6	0	0	0
	25.2	25.0	25.4	25.7	0.0	0.0	0.0	154.2	0	0	0
18	25.0	24.9	25.2	25.2	0.0	0.0	0.0	128.9	0	0	0
	24.7	24.7	24.7	23.8	0.0	0.0	0.0	101.7	0	0	0
19	24.4	24.5	24.2	22.4	0.0	0.0	0.0	77.3	0	0	0
	24.2	24.3	23.7	21.2	0.0	0.0	0.0	54.0	0	0	0
20	23.9	24.1	23.3	20.1	0.0	0.0	0.0	32.2	0	0	0
	23.5	23.9	22.8	18.7	0.0	0.0	0.0	16.3	0	0	0
21	23.2	23.6	22.3	17.4	0.0	0.0	0.0	0.0	0	0	0
	23.1	23.5	22.1	17.1	0.0	0.0	0.0	0.0	0	0	0
22	23.0	23.4	21.9	16.8	0.0	0.0	0.0	0.0	0	0	0
	22.8	23.2	21.8	16.4	0.0	0.0	0.0	0.0	0	0	0
23	22.7	23.1	21.6	16.1	0.0	0.0	0.0	0.0	0	0	0
	22.6	23.0	21.4	15.7	0.0	0.0	0.0	0.0	0	0	0
24	22.4	22.8	21.2	15.4	0.0	0.0	0.0	0.0	0	0	0

KONTROLBEREGNING BA/HL, MAJ 1974. REFERENCEAAR 1976 - 5 - 13

AIRTEMPERATURE. FROM 0.0 TO 24.00

HALF-HOURS IN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
21.0- 22	1488	1344	1488	1432	1350	950	907	1085	1350	1479	1440	1488	15801
22.0- 23	0	0	0	8	85	207	265	211	73	7	0	0	856
23.0- 24	0	0	0	0	51	109	150	81	17	2	0	0	410
24.0- 25	0	0	0	0	2	65	75	47	0	0	0	0	189
25.0- 26	0	0	0	0	0	42	57	33	0	0	0	0	132
26.0- 27	0	0	0	0	0	46	34	29	0	0	0	0	109
27.0- 28	0	0	0	0	0	21	0	2	0	0	0	0	23
MEAN. DEGREE CENTIGRADE	21.0	21.0	21.0	21.0	21.2	22.0	22.0	21.7	21.1	21.0	21.0	21.0	21.3
QQ- KWH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
QQ+ KWH	880.2	805.1	738.8	513.8	271.6	74.2	68.9	89.7	185.4	433.6	637.2	917.5	5615.9
QPRIM KWH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
QTOT KWH	880.2	805.1	738.8	513.8	271.6	74.2	68.9	89.7	185.4	433.6	637.2	917.5	5615.9
QSOL KWH	54.0	73.0	122.1	152.1	153.6	162.7	154.6	136.9	113.8	74.8	43.4	42.6	1283.5
QELYS KWH	28.9	15.7	9.0	2.1	1.5	0.4	0.8	1.7	5.9	16.5	25.6	29.7	138.0
UVQ. HALFHOURS	0	0	0	0	0	0	0	0	0	0	0	0	0

QTOT OCTOBER - APRIL INCL. 4926.1

KONTROLBEREGNING BA/HL. MAJ 1974. REFERENCEAAR 1976 - 5 - 13

AIRTEMPERATURE. FROM 8.30 TO 17.00

HALF-HOURS IN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
21.0- 22	558	504	558	532	441	251	209	306	451	549	540	558	5457
22.0- 23	0	0	0	8	66	128	139	132	72	7	0	0	552
23.0- 24	0	0	0	0	49	58	89	36	17	2	0	0	251
24.0- 25	0	0	0	0	2	25	50	31	0	0	0	0	108
25.0- 26	0	0	0	0	0	21	39	24	0	0	0	0	84
26.0- 27	0	0	0	0	0	36	32	27	0	0	0	0	95
27.0- 28	0	0	0	0	0	21	0	2	0	0	0	0	23

FRACTILES. TEMPERATURES

10 0/0	21.0	21.0	21.0	21.1	21.1	21.2	21.3	21.2	21.1	21.1	21.0	21.0	21.1
50 0/0	21.0	21.0	21.0	21.5	21.6	22.1	22.4	21.9	21.6	21.5	21.0	21.0	21.6
90 0/0	21.0	21.0	21.0	21.9	22.9	26.1	25.3	24.9	22.1	21.9	21.0	21.0	22.6

KONTROLBEREGNING BA/HL. MAJ 1974. REFERENCEAAR 1976 - 5 - 13

OPERATIVE TEMPERATURE TOWARD WINDOW 1. FROM 8.30 TO 17.00

HALF-HOURS IN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
13.0- 14	0	0	0	0	0	0	0	0	0	0	0	1	1
14.0- 15	0	2	0	0	0	0	0	0	0	0	0	3	5
15.0- 16	14	9	0	0	0	0	0	0	0	0	0	60	83
16.0- 17	122	164	26	0	0	0	0	0	0	0	29	136	477
17.0- 18	361	198	240	20	6	0	0	0	0	3	138	291	1257
18.0- 19	59	125	175	261	40	0	0	0	0	145	328	58	1191
19.0- 20	2	6	113	206	174	9	15	18	101	306	45	9	1004
20.0- 21	0	0	4	40	176	146	123	154	255	77	0	0	975
21.0- 22	0	0	0	7	54	122	103	160	108	21	0	0	575
22.0- 23	0	0	0	6	61	102	123	108	58	3	0	0	461
23.0- 24	0	0	0	0	43	55	67	31	18	3	0	0	217
24.0- 25	0	0	0	0	4	19	51	34	0	0	0	0	108
25.0- 26	0	0	0	0	0	26	40	15	0	0	0	0	81
26.0- 27	0	0	0	0	0	33	33	28	0	0	0	0	94
27.0- 28	0	0	0	0	0	28	3	10	0	0	0	0	41

FRACTILES. TEMPERATURES

10 0/0	16.7	16.4	17.1	18.1	19.1	20.3	20.3	20.3	19.8	18.6	17.4	15.9	17.1
50 0/0	17.4	17.4	18.1	18.9	20.3	21.9	22.3	21.7	20.7	19.4	18.3	17.3	19.2
90 0/0	18.0	18.5	19.4	19.9	22.9	26.2	25.4	24.9	22.2	20.3	18.9	18.1	22.7

Modifications in the BA4 programme

October 1981

The BA4 programme has been modified to enable its use for the "Short Reference Year" research programme. A few other modifications have also been included at the same time.

The new version (October 1981) contains all the facilities from earlier versions (April 78 or November 80). Input data for earlier versions can be used without any change with only a few exception.

This paper gives the modifications only and must be considered as an appendix to "BA4 Users Guide", 2. edition 1979.

The new facilities are:

- week and weekend programme for loads, schedules, light and ventilation rates.
- a new specification of deadband between heating and cooling setpoint, and throttling ranges.
- termostat setpoints specified as room air temperature alone, or a combination of room air temperature and radiation (surface) temperature
- printout of some daily max loads
- latitude and local time (longitude)
- calculation with multiyear periods, selected shorter periods or "Short Reference Years" and weighting of results to full months or year.

The only limitations regarding earlier input data are:

- cooling to a setpoint other than AIRTemp 1 is now specified with T-STat instead of QMIN NB
- VENT 1 and VENT (blank) overrides each other

Weekend programmes

The programme can handle three sorts of days:
Weekdays, Saturdays and Sundays.

The following new typecard is used:
(FORMAT: A4, 5X, I2, 2F10.3)

WEEKend NB CK CR

This typecard calls the weekend programme. If this typecard is not present all days are handled as weekdays.

NB Week-day-number of the first day on the weather file (e.g. January 1 in the Test Reference Year). 1 = Monday, 2 = Tuesday, etc. Default value = 7 = Sunday.

CK Time for switch-off of daylight-dependant electic light (FLUX 10) or Saturdays. (Blank is read as 0.0).

CR Item for Sundays.

If WEEKend is specified a number of parameters (typecards) can be specified with a weekend programme. They are:

AIRTemp	1	(desired room temperature)
FLUX	1	(heat load to the room)
VENT	1	(ventilation)
QMAX	1	(max. heating effect)
QMIN	1	(max. cooling effect)
A-TID	1	(working hours, used for output purposes)

NB = 1 indicates that these are valid for weekdays, Monday through Friday, and they must all, but A-TID, be followed by time series (as previously).

AIRTemp 6, FLUX 6, VENT 6, QMAX 6 and QMIN 6 again followed by timeseries, and A-TID 6, give the Saturday values, and AIRTemp 7 etc. give the Sunday values.

AIRTemp 0 (or blank) will be read as AIRTemp 1. The same applies to typecards with FLUX, VENT, QMAX, QMIN and A-TID, and also INFI (infiltration).

If WEEKend is specified, Saturday and Sunday values for AIRTemp, FLUX, VENT etc. must be given, otherwise the corresponding time-series will be zeroed.

Remarks:

1) AIRTemp 2, 3, 4 or 5, and FLUX 2, 3 etc. cannot be used for giving specific values for Tuesday, Wednesday etc. Only Saturdays and Sundays and weekdays can be specified. Only AIRTemp 1 and FLUX 1 can be changed by a weekend programme.

   AIRTemp 5 and FLUX 8 and 9 are not allowed and will cause an error message.

2) VENT 2, 3 etc. can still be used for changing VENT 1 for weekdays through specified part of the year.

3) No weekend programme is included for INFIltration.

4) QMAX 2, 3, 4 and 5 and QMIN 2, 3, 4 and 5 have no meaning and will cause an error message.

5) The previously used specification of a cooling temperature thermostat setpoint, different from the heating setpoint, QMIN NB, where NB was the cooling setpoint, is no longer useable. See the following description of thermostat programme.

If the WEEKend typecard is not specified, AIRTemp 1, FLUX 1 etc. will be used for all days.

Latitude

The typecard LATItude gives the geographical location and the type weather input data:

LATItude NB CK CR

NB Weather data reading subroutine
1 (default value) special concentrated "BA4-format", Test Reference Year (TRY), Short Reference Year (SRY) or several years.

2 Full Test Reference Year format (Danish).

(3 Special format, for 15-year-dataset. Not included in the present BA4 programme. Can be used for user designed input formats).

CK latitude. deg North. (Negative value for southern hemisphere). Default value 56 deg N, Copenhagen).

CR Local time, minutes. Locations west of time zone longitude negative sign, east of time zone longitude positive sign. Default value - 9.7 minutes, Copenhagen.

Short Reference Year

This typecard contains specifications often used in connection with runs with Short Reference Years (SRY). It is, however, neither mandatory nor exclusively used with SRY-runs.

SRY NB CK

NB Presentation of monthly or trimonthly output. Default value 1.

1 Monthly sums for the actual number of days computed.

2 Trimonthly sums for the actual number of days computed.
December through February printed as January.
March through May printed as April.
June through August printed as July.
September through November printed as October.

3 As 1, but weighted to a full month (28-31 days).

4 As 2, but weighted to a full season.

CK Number of repetitions of the first day in the dataset - TRY or SRY - in order to remove the initial transients in the resulting temperatures and loads. Default values 0.

Thermostat programme

It is now possible to specify more detailed parameters for the thermostat. Typecard is:

T-STat NB CK CR

NB Thermostat setpoint for cooling, deg. C. If 0 or blank or less than AIRTemp 1 (or 6 or 7), the latter is used.

CK Fraction of thermostat sensitivity from room air temperature. The remaining part (1-CK) is then from mean surface temperature.

CR Throttling range, deg. C, identical for heating and cooling effect. Default value 0.

Remark:

If CK = 0.5 and CR = 0. the thermostat will try to keep the operative temperature (mean of air temperature and surface temperature) at defined value, AIRTemp 1 (or 6 or 7), or NB if cooling.

Running selected periods

The typecard DATO makes it possible to run specified parts of a weather data set

DATO NB CK CR

NB Year for start (e.g. 60 ~ 1960). Default value 11 because the Danish TRY is called year 11.

CK Month.day (~XX.YY) for beginning of calculation. (Default 1.01)

CR Month.day (~XX.YY) for end of calculation. (Default 12.31)

If the calculation includes more than one year two cards are specified:

DATO	NB	CK	year and month.day for start
DATO	NB	CR	year and month.day for end of the calculation

Up to 20 periods, in chronological order, can be specified in one run.

Printout

The typecard UDSK has now one more parameter, NB:

UDSKriv NB CK CR

NB Daily printout

-1 Suppresses daily printout (like CK = -1. or CR = -1. does).

2 Adds a line with max. heating and cooling effect and corresponding hour, and number of hours with increased ventilation (MAX-vent).

(Other modifications are in preparation).

Hans Lund