

Interactive thermal design program pocket of family houses

Dr. László Molnár  
Hungarian Institute for Building Science

H-1113 Budapest  
Dávid F.u.6.  
Hungary

KEYWORDS

Heating system planning, thermal design, calculation of heat losses, family houses, computer-aided design, interactive planning.

ABSTRACT

A program pocket is elaborated for a personal computer suitable for the calculations in connection with the thermal insulation of family houses, the heat requirement and the heating system planning. The program pocket is made on the basis of the German Standards, DIN 4108 and DIN 4701. The program can be run in interactive operation way. The inputs and the decisions are made by the user according to the questions on the display. The results appear on the display or can be printed, in a controllable form.

Un système de programme interactif du projet thermique des maisons familiales

Dr. László Molnár

Hungarian Institute for Building Science

H-1113 Budapest  
Dávid F. u. 6.

Hungary

MOTS DE CLEF

Projet de chauffage, projets thermique, calcul de la déperdition de chaleur, conception assistée par ordinateur, projet interactif.

RÉSUMÉ

Un système de programme a été élaboré pour pouvoir faire des calculs de la protection thermique des maisons familiales, de la déperdition de chaleur et du projet de chauffage, en un ordinateur personnel. Le système de programme a été fait à la base des normes allemandes, DIN 4108 et DIN 4701. Les programmes peuvent être utilisés en un mode d'opération interactif. L'entrée et les décisions sont faites par l'utilisateur, conformément aux questions apparues sur le visuel. Les résultats apparaissent sur le visuel ou sont sur l'imprimante ligne par ligne, en une forme bien contrôlable.

## 1. Introduction

In the paper a program pocket for a personal computer is reviewed which is suitable to execute the calculation in connection with the heat protection, heat losses and heating system planning of family houses. The calculations are elaborated on the basis of the German standards, DIN 4701 and DIN 4108. The program pocket is worked out because:

1. In Western Europe there is a growing interest for the individually planned family houses.
2. Nowadays in every engineering bureau there are personal computers.
3. The new edition of the DIN 4701 - prescribing a basically new planning procedure of the calculation of heat requirement of buildings - is published in 1983.

The program pocket is for solving the following problems:

- Planning and controlling of heat protection of buildings
- Heat requirement calculation /heat losses per room/
- Determination of the type of heating
- Distribution of the heating appliances into the rooms
- Sizing of the heating system.

Concerning the geometry of the building the following assumption are taken

- storeys: ground-floor + cellar /if any/ + first floor /if any/ + attic /if any/
- ground plan: max 200 m<sup>2</sup> per storey, with perpendicular walls.

The program can be run in interactive operation way i.e. the user makes a choice of the decision possibilities. The decision possibilities and the other questions are shown on the display. The results too are shown on the display, but they can be printed out.

The program is written in FORTRAN IV.

The following documents are necessary to run the program:

1. The plan of the building in the scale of 1:100 /the rooms, the walls/
2. The data and type of the walls, windows, doors etc.

## 3. The data and type of heating appliances.

At the input the interests of the users are taken into consideration. Therefore:

- The minimum and the maximum values of every variable are stored in the memory. The computer tests every input data if they fall into the given intervall. If not, the computer shows it.
- When data from the standard are to be input the user can ask the computer to show the necessary table on the display and he can choose the needed data.

## 2. The program pocket

### 2.1 Heat protection in buildings

The planning procedure - including the winter and the summer heat protection - has two parts:

- Calculation of the heat conduction through the external and internal walls, doors, windows. Planning of constructions satisfying the conditions of DIN.
- Calculation of the diffusion of vapour through the walls. The control of the external walls concerning the precipitation of moisture.

The main physical parameters /density, heat conduction, diffusion of vapour/ of the materials used in the building industry are stored in the memory. The calculation can simply be made referring to the code of the material. At every control the user can read the display if the material complies with the requirements. If a construction is not appropriate, the user can modify it and control it again as far as it is right.

### 2.2 Calculation of the heat losses

The procedure of the standard DIN determines the heat losses of a room from two factors:

- Standardized conductive heat requirement:

$$\dot{Q}_T = \sum_j A_j \dot{q}_j$$

$\dot{Q}_T$  = conductive heat requirement

$A_j$  = surface of the building element j

$\dot{q}_j$  = heat flow rate density through the element j.

- Standardized ventilating heat requirement:

$$\dot{Q}_L = \dot{Q}_{FL} + \Delta \dot{Q}_{RLT}$$

or 
$$\dot{Q}_L = \dot{Q}_{Lmin}$$

$\dot{Q}_L$  = ventilating heat requirement

$\dot{Q}_{FL}$  = heat requirement of the natural ventilation

$\Delta \dot{Q}_{RLT}$  = heat requirement of the mechanical ventilation

$\dot{Q}_{Lmin}$  = minimum heat requirement which is determined on the basis of a 0.5x air change per hour in the room

From the two  $\dot{Q}_{Lmin}$  the user has to choose the bigger.

On the basis of the heat losses of every rooms the heat requirement of the whole building can be determined:

$$\dot{Q}_B = \sum_j \dot{Q}_{T,j} + 0.5 \sum_j \dot{Q}_{L,j}$$

$\dot{Q}_B$  = heat requirement of the building

$\dot{Q}_{T,j}$  = conductive heat requirement of the jth room

$\dot{Q}_{L,j}$  = ventilating heat requirement of the jth room

At the determination of the heat requirement of the rooms /calculation of the heat losses through walls, windows, doors etc/ the heat protection subprogram is used. In this part the U values have not to be calculated but they can be called from the heat protection subprogram, referring to the codes of the building elements.

It is also sufficient to refer to the external meteorological relations, the orientation of the building, the external and internal temperatures and many other data because they are also stored in the memory of the computer.

The results of the heat requirement calculation subprogram are shown on the display in a form according to the DIN.

### 2.3 The planning of the heating system

The main parts of the planning of the heating are:

- The choice of the type /individual or central/ of the heating system
- The choice of the energy source /coal, gas, fuel, electricity/
- The planning of the warm-water central heating /choise of the heating appliances and hydraulic dimensioning/

In the case of a central heating it was supposed that

- it is a warm-water heating installed with a pump and with separate two pipe radiators or with one pipe radiators
- the structures of the going head and the returning parts of the two pipes warm-water heating system are the same.

With the program the type and the size of the radiators, the dimensions of the heating pipe system and the size of the pump can be determined. On the basis of the results of the program the pressures in the pipe system can be regulated.

The program shows the results also here in a well controllable form, in accordance with the traditional procedure.