PLEA 91, Sevilla, Spain

A THERMAL IMPROVEMENT OF A 9 STORY BUILDING, BUILT IN 1963, SITUATED IN THE SUBURB OF GENEVA (SWITZERLAND)

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ABSTRACT. This study presents an experiment of thermal rehabilitation of a typical prefabricated building of the sixties in Geneva. The rehabilitation of a 126 flat building included a drastic thermal renovation. Insulation of the roof, facades, new windows and blinds permitted to cut by half the heating demand. The building was monitored over four years in order to obtain a detailed case study concerning rehabilitation of buildings from the '60s.

1. Introduction

Between 1960 and 1970 the population of Geneva nearly doubled, creating a need for apartments and leading to the construction of many "satellite towns" around the center of the city.

The rehabilitation of these buildings will represent a large part of architect activity in coming years.

We have the possibility to participate in the thermal rehabilitation of a large building of this type

The CUEPE in collaboration with the "Délégué à l'énergie du canton de Genève", the owner and the architects, decided to take this opportunity and make a detailed case study of this rehabilitation in order to:
- evaluate solar gains before and after renovation
- get some experience in the choice and effectiveness of new windows
- study the behavior of the inhabitants

2. Building description

2.1. GOAL OF THE RENOVATION

"Onex 1", was the first part of the "satellite town" of Onex. It consists of 750 flats, constructed in 1962 with prefabricated concrete elements.

S. Alvarez et al. (eds.), Architecture and Urban Space, 779–784.

Built over very rapidly, these 9 story buildings are badly or not insulated and include large single glass windows (more than 50% of the facades) and many thermal bridges.

After 25 years of use, these buildings are in poor condition and need to be renovated.

One of the buildings (126 flats), oriented north-south, has given us the opportunity to make the case study of thermal rehabilitation [1].

The thermal renovation had three goals:
- improve thermal comfort
- reduce the heat losses
- enhance the use of solar energy with the south facade

2.2. DESCRIPTION OF THE RENOVATION

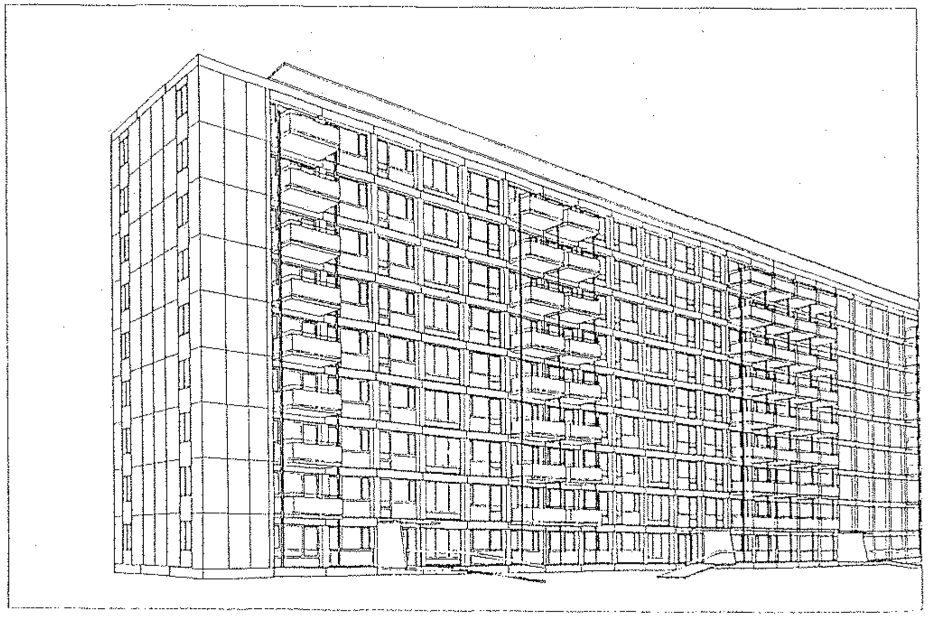
After two years monitoring of the existing building and thermal simulation (LESOSAI, SERIRES) of different types of improvement, the proposed solution was predicted with a reduction of 40 -50% of the energy demand.

The renovation of the envelope was achieved during spring and summer 1990 (figure 1).

The envelope was fitted with new windows (plastic frames and double glazing), walls and roof insolation with aluminium cladding.

A careful study of the inhabitant behavior led to the choice of shading and ventilation devices in order to optimize the use of possible solar gains:
- outside aluminium blinds
- manual adjustable ventilation valves in the window frames

Figure 1: South facade of the renovated building



- small windows for ventilation

The heating control was adapted to the new envelope.

The production of hot water was decentralized and 200 m2 of solar panels will be installed at the end of 1992 to preheat this water.

The relation between inside and outside was improved mainly by adding balconies and by requalifying outdoor spaces.

3. Monitoring and results.

3.1. MONITORING

This building is being monitored since 1987.

Only five data are measured:

- heat demand for the two zones of the building (north and south) with two heatmeters;
- external temperature and solar radiation;
- internal temperature in an unoccupied flat in the southern part.

These data are read 20 times per hour, by conventional data acquisition system and stored in hourly values in order to be compatible with software for thermal simulation as SERIRES.

3.2. RESULTS

Results for the heating season 1987-1988 are shown in table 1. The annual consumption is not too high in regards to the bad thermal quality of the envelope. This is due to the temperature of

Table 1: Mesured heating demand between October 1987 to May 1988

Month	Days	Tout	Tint	Qsouth	Qnorth	Qtotal
October	22	12.3	23.6	119727	178751	298478
November	30	6.3	22.3	323994	366183	690177
December	31	4	21.9	410346	426518	836864
January	31	5.2	21.7	366808	395581	762389
February	29	3.4	21.1	324481	409987	734468
March	31	6.4	21.6	279602	351686	631288
April	30	12.1	22.6	133584	205721	339305
May	16	16.6	24.1	41992	56119	98111
YEAR	220.0	7.6	22.2	2000534	2390546	4391080
consumption (MJ/m².an)				373.2	446.0	409.6

Tout : outside temperature, °C

Tint : Internal temperature, °C

Qsouth : heating for south part, MJ

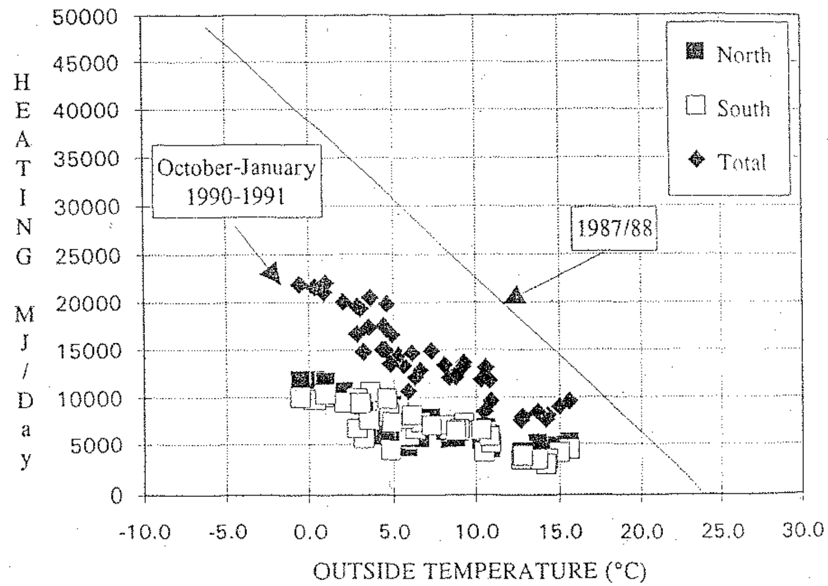
Qnorth : heating for north part, MJ

Qtotal :total heat = Qsouth + Qnorth, MJ

this period that was about 10% higher than average and to the good form factor (volume/envelope surface = 0.36 (1/m).

Results of the last heating season, after the thermal improvement of the facade, show a saving of around 50% (figure 2). For this period no regulation of the heating was working, so night temperature of the water was as high as during the day. It means that the final results should be even better and the building will still have to be monitored during winter 91 to 92.

Figure 2: Daily heat demand for last winter, October 1990 to January 1991



4. Photography

By scanning pictures of the south facade of the building (212 windows), taken every two hours during a week in March, we obtained rich information on how the occupants deal with external blinds, internal curtains and window opening.

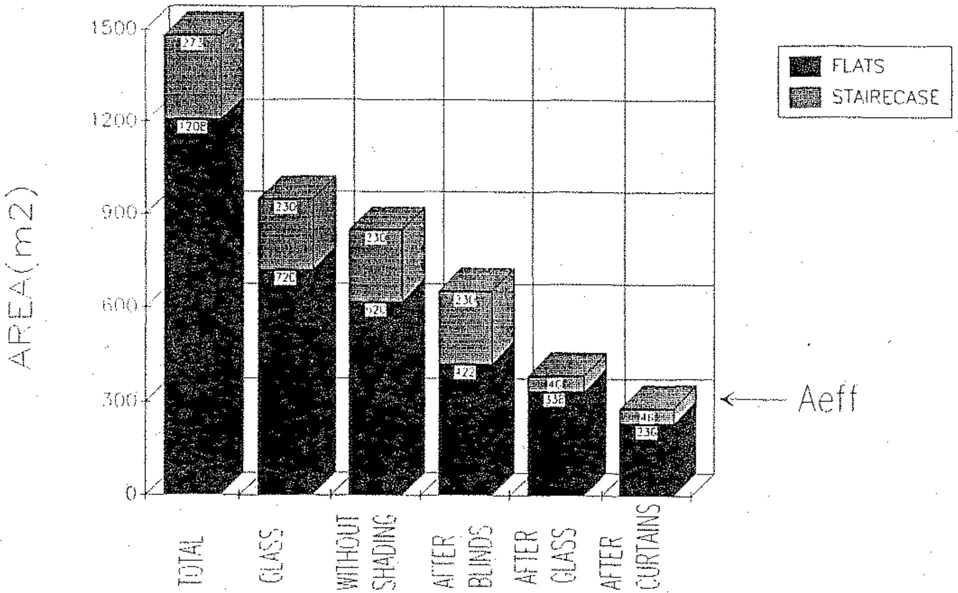
These observations combined with the use HM diagrams [2], enabled us to explain the observed value for effective solar gain area (figure 3).

Solar gains are reduced because of different effects:

- the total window area includes frames. We have to consider the net glass area;
- shadings of different kinds;
- use of external blinds (30% are always closed);
- glass transmission, and in the staircase, useful fraction of solar gains (30%);
- use of curtains (75% are usually drawn).

By referring to the temperature measured in an unoccupied flat, we may deduce that occupants react mainly to an internal temperature increase rather than to solar radiation. These reactions are strongly connected to the comfort and highlight the importance of good regulation and thermal inertia in order to obtain a high utility of solar energy in the building

Figure 3: Analyse of the effective solar area



5. Conclusion

This study shows that the three goals of this thermal rehabilitation can be easily achieved with actual technics of building and good collaboration between architects and ingineers:
- thermal comfort was improved;
- the heat losses were reduce by about 50%;
- the part of solar energy was increased in the thermal balance.

However an investment of 4 000 000 SFr for a maximum of 40 000 Sfr savings a year means a pay back of over 100 years with actual fuel prices.

So drastic thermal rehabilitation of buildings of this type, without the help or regulation of the administration, are not profitable and can only be done if owner:
- takes the opportunity of a general renovation that they have to do anyway;
- wants to take into account the thermal comfort and environmental preservation;
- understands that the thermal renovation of the envelope will preserve and give value to his building.

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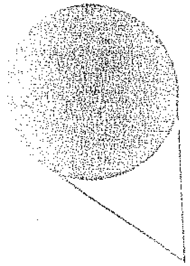

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