Information system and intervention technologies programmed to aid the energy saving within the limits of the existing building property rescue.

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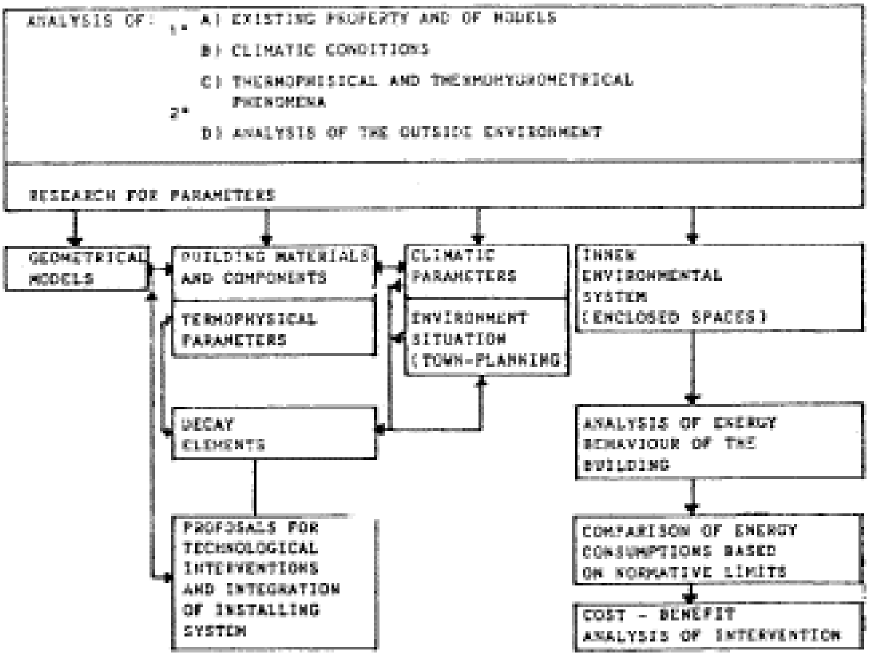
1. INTRODUCTION

In our national territory the rescue of the existing building property is a very important problem. For that reason, starting front the presupposition that the existing buildings, restoration finds its real achievement by means of technological and installing interventions strictly connected with the energy costs and consumptions, this study sets as a planning method on various degrees to analyze, single out and propose the possible solutions based on qualitative and quantitative researches into the thermo-physical behaviour of the above-mentioned buildings.

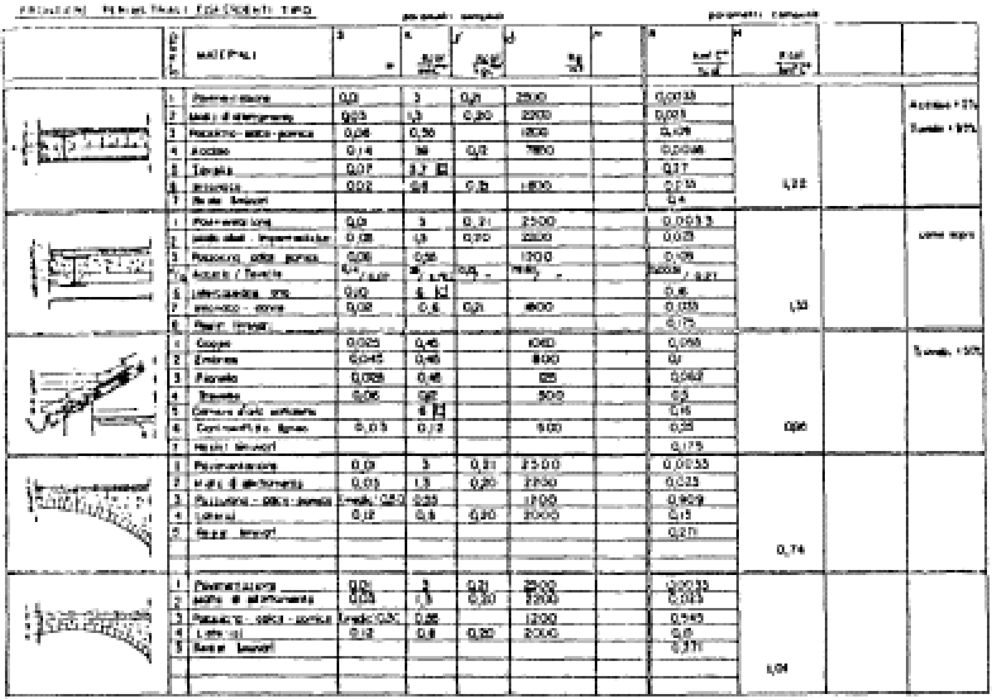
From a research done into the principal building properties related with the different national areas we can single out significant morphological samples and typical technological structures. This first analytical study allows the singling out of significant building models on which it's possible to value the thermal behaviour and possible subsequent restoring interventions by applying computerized mathematical models or by operating diagrams deduced from them. First of all, these mathematical models for simulation allow a valuation of the main thermal parameters (dispersion both in absolute value and in volumetric factor, medium thermal transmittance (U value) of geometrical models deduced from the typical above - mentioned cases.

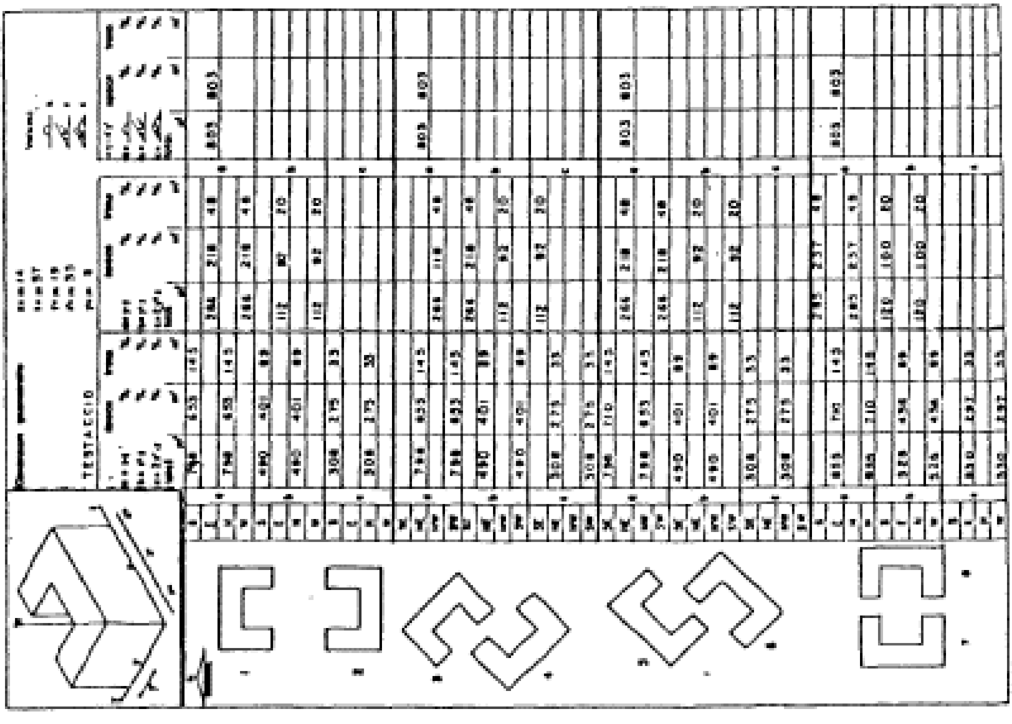
On such basic models for simulation, by the amplification of the calculation programme and by the introduction of determinate factors like increase or decrease of thermal dispersion, we can consider phenomena or facts that influence the thermal behaviour of the building and single out possible technological interventions.

Such a method of computerized evaluation allows us to have a first orientation, on various degrees, based on characteristic parameters, on the thermo-physical problems and the energy consumptions of the buildings taken as samples. on the contrary, the calculation models, applied to a specific scale for a building make it possible to value exactly the thermal behaviour of the building itself and the required technological and installing interventions to conform it to the environmental comfort requirements. In this report only the main elaboration models and the more significant aspects deduced from the study which was the subject of a publication are carried [1]. The treated subjects concern the evaluations of the phenomena of heat transmission at steady state conditions and consequently the increase and decrease indices so far introduced into processing don't include the indices which may be deduced from calculations at unsteady state conditions.



[1] V. Calderaro, G.Carrara, C.Platone, "Sistema infor tivo e tecnologie d'intervento programmate per favorire ...", 1986 Roma.





2. OPERATING SCHEME

The considered parameters and elements are applied to supposed building models in winter climate conditions and here below are showed.

1. Geometrical characteristics of the building.
    a. P/A = Perimeter/Area ratio of the reference surface
    b. Z = Axis orthogonal to the reference surface.
    c. V = Volume of the building.
2. Medium V value (Hm): function of every single dispersing surface referred to its relative areas, therefore:
3. Coefficient of dispersions' increase owing to the exposure,
4. Coefficient of decrease for temperatures expressed in °C different from exterior temperatures of the plan,
5. Coefficient of increase for thermal bridges,
    a. by analytical method;
    b. by experimental tests of recording and comparisons with the analytical results (next programme of study).
6. Coefficient for phenomena of thermal accumation,
    a. Analytical evaluation.
    b. Experimental tests and comparison of the results.
7. Coefficient for thermo-hygrometrical phenomena,
    a. by analytical method with comparison of the obtained results with the experimental ones (for condensation, imbibition and evaporation phenomena);
    b. by experimental tests and comparison with analytical methods (for: condensing surfaces, quantities of water, accumulation by condensation and/or imbibition, temperatures of the resulting components); (future programme of study).

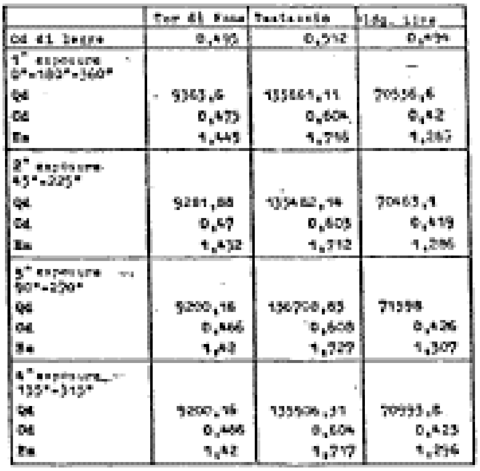
3. MODELS FOR SIMULATION

MODELS FOR SIMULATION A, B.

The models for simulation (A and B) here reported have been elaborated to value quickly the thermal behaviour of the buildings, by the aid of the graphs (fig. A and fig. 13) deduced from the models themselves according to the thermo-physical and geometrical characteristics of the components of the building and of its morphology. To complete the prospectus, a further model for simulation (C) allows the exact evaluation of the thermal behaviour of every single building. The above - mentioned models allow us to value thermal facts and phenomena according to the increase and decrease parameters previously mentioned.

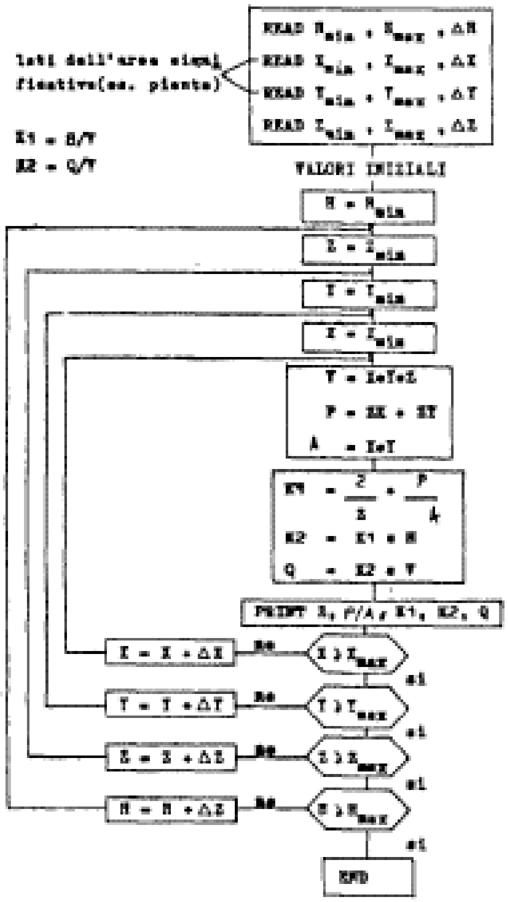
MODEL FOR SIMULATION C

From the previously mentioned analytical research three building samples have been deduced and the calculation models reported below have been applied to them to value their thermo-physical characteristics (thermal dispersion, volumetric dispersion and medium U value). Such characteristics have been calculated by operating a rotation of the building samples in order to value the effects of the different exposures. Besides, the obtained results have been compared with the values imposed by the Italian Law n. 373, issued in 1976 directed to the containment of energy consumption in building.

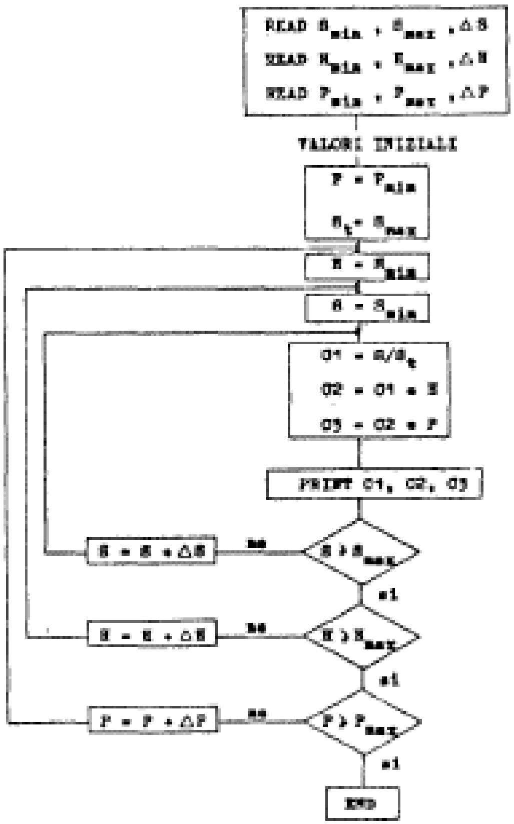


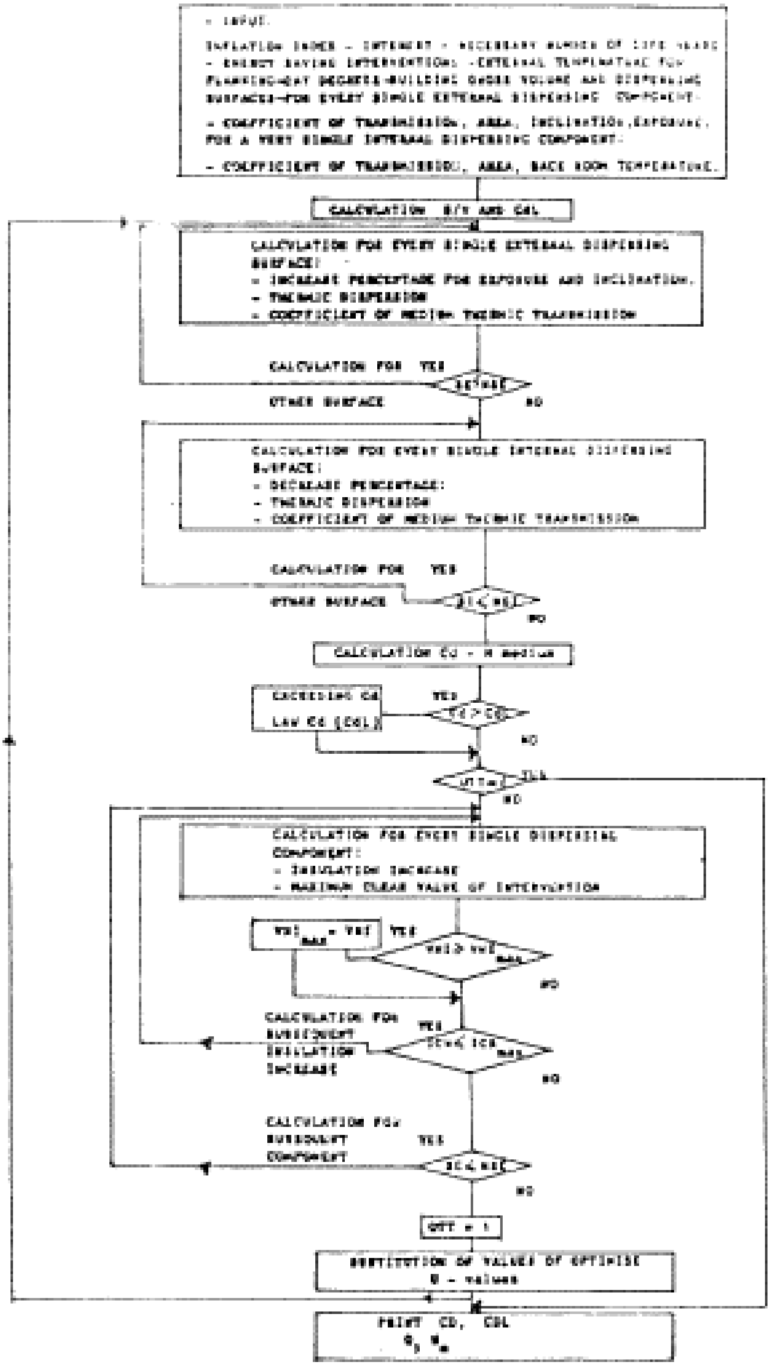
	Tor di Nona	Testaccio	Bldg. line
Cd di legge	0,495	0,592	0,494
1° exposure 0°-180°-360°			—
Qd	9363,6	135861,11	70536,4
Cd	0,473	0,604	0,42
Em	1,445	1,716	1,283
2° exposure 45°-225°			
Qd	9281,88	135482,14	70463,1
Cd	0,47	0,603	0,419
Em	1,432	1,712	1,286
3° exposure 90°-270°			
Qd	9200,18	136708,63	71598
Cd	0,466	0,608	0,426
Em	1,42	1,727	1,307
4° exposure 135°-315°			
Qd	9200,16	135936,31	70933,6
Cd	0,466	0,604	0,423
Em	1,42	1,717	1,296

MODELLO GENERALE 4



MODELLO GENERALE 5




- INPUT.
INFLATION INDEX - INTEREST - NECESSARY NUMBER OF LIFE YEARS
- ENERGY SAVING INTERVENTIONS -EXTERNAL TEMPERATURE FOR
PLANNING-DAY DEGREES-BUILDING GROSS VOLUME AND DISPERSING
SURFACES-FOR EVERY SINGLE EXTERNAL DISPERSING COMPONENT-
- COEFFICIENT OF TRANSMISSION, AREA, INCLINATION,EXPOSURE,
FOR A VERY SINGLE INTERNAL DISPERSING COMPONENT:
- COEFFICIENT OF TRANSMISSION, AREA, BACK ROOM TEMPERATURE.
CALCULATION S/V AND CdL
CALCULATION FOR EVERY SINGLE EXTERNAL DISPERSING SURFACE:
- INCREASE PERCENTAGE FOR EXPOSURE AND INCLINATION.
- THERMIC DISPERSION
- COEFFICIENT OF MEDIUM THERMIC TRANSMISSION
CALCULATION FOR OTHER SURFACE
YES
NO
CALCULATION FOR EVERY SINGLE INTERNAL DISPERSING SURFACE:
- DECREASE PERCENTAGE:
- THERMIC DISPERSION
- COEFFICIENT OF MEDIUM THERMIC TRANSMISSION
CALCULATION FOR OTHER SURFACE
YES
NO
CALCULATION Cd - M MEDIUM
EXCEEDING Cd
LAW Cd (CdL)
YES
Cd > CdL
NO
OTT = 1
YES
NO
CALCULATION FOR EVERY SINGLE DISPERSING COMPONENT:
- INSULATION INCREASE
- MAXIMUM CLEAR VALUE OF INTERVENTION
VNi MAX = VNi
YES
VNi > VNi MAX
NO
CALCULATION FOR SUBSEQUENT INSULATION INCREASE
YES
ICi ≤ ICi MAX
NO
CALCULATION FOR SUBSEQUENT COMPONENT
YES
NO
OTT = 1
SUBSTITUTION OF VALUES OF OPTIMISE U - values
PRINT Cd, CdL
U_i U_m

MODEL C

The optimization takes place through the singling out, for every single component, of the maximum clear value of intervention "VNI", intended like the maximum value of the "VNI" which is obtained by calculating the correspondent VNI, for every single insulation increase. VNI (investment clear value) represents the difference between the total saving which is obtained in N years and the spent sum to produce this saving.

4. EVALUATION BY INDICATORS

In order to value comparatively the obtained results, three global indicators have been singled out and they are showed here below.

First indicator (I_1)
It is defined by the following relation:

$$I_1 = Cd_{min} / Cd;$$

where: Cd_{min} = Minimum value found among the calculated Cd (the coefficients of volumetric dispersion) for the considered buildings.

Cd = value of the calculated Cd relative to the considered building.

In substance, the I_1 indicator expresses, therefore, the approximation percentage in comparison with the building which has minimum Cd. In the best case $Cd_{min} = Cd$; and consequently $I_1 = 1$

Second indicator (1_2)
It is defined by the following relation:

$$I_2 = (Cd / Cd_L)_{min} / (Cd / Cd_L);$$

where: Cd_L = values of the Cd deduced from the Law 373/1976.

In practice, the I_2 indicator has the same sense of the I_1 indicator but in the former the results are related to a value which is objective in one sense, that is the one of the Law volumetric coefficient of dispersion (Cd).

Third indicator (I_3)
It is defined by the following relation:

$$I_3 = H_{min} \ H_i = \left(\frac{Cd}{S/V}\right)_{min} / \left(\frac{Cd}{S/V}\right);$$

where: H_{min} = minimum value of U value
H_1 = indefinite value of U value
S/V = from factor calculated according to the Law. n. 373.

At last, the I_3 indicator expresses the dispersion characteristics of the considered building in relation to those of the building which has less medium U value. The indicators' values calculated for the considered buildings are showed in the following table.

EXPOSURES	I_1	I_2	I_3
	TOR DI NONA (sample 1)		
1-5	0,8821	0,8839	0,8883
2-6	0,8915	0,8933	0,8978
3-7-4-8	0,8991	0,9010	0,9055
	TESTACCIO (sample 2)		
1-4-5-8	0,6937	0,7190	0,7490
2-6	0,6949	0,7202	0,7503
3-7	0,6891	0,7142	0,7441
	BUILDING LINE (sample 3)		
1-5	0,9976	0,9976	0,9976
2-6	1	1	1
3-7	0,9836	0,9836	0,9836
4-8	0,9905	0,9905	0,9905