that they can adjust the computer use to the local "culture" and not the other way around that they have to adjust to some kind of equipment.

When such a feeling has settled they might be willing to accept or even help initialize the next step towards the integrated system. And if the company never decides to take this next step it is probably more important to the successful future of the company that creativity and fantasy have been established and retained on site than a proper information system - which the sites do not trust and can't utilize - has been installed to the benefit of head office. Anyhow, with optimum behavior on all sites the total well being of the company can't be too bad.

CONCLUSIONS

No doubt edp equipment is a valuable tool for contractors to control company activities. This fact has practice already clearly shown. But total control requires an integrated system serving both the need of head office and sites. However, Danish experience shows that implementing such a system in one step is unrealistic. To survive such a drastic chance the company has to use a strategy which implies a phased implementation. In choosing this strategy it's most important to ensure motivation and acceptance by the people involved. PS's are in this respect probably superior to any other kind of edp equipment on hand, and a strategy starting with establishing PC environments on sites seems to have a good chance of success.

FOOTNOTES

1. When the machine was purchased it was the only choice also for control purposes. Since the purchase the machine has performed well for accounting etc. and it's hard for the company to realize today that for control purposes it might be regarded as a sunk cost as other solutions today might be preferable. In this way they are in reality "stuck" with this initial solution.
2. Often these companies previously in fact did invest in computers and they might also still be present in the company performing certain tasks but the company has realized years ago the limitations of the equipment and have no intention at the moment to use it for control purposes.
3. Naturally you have to beat a few obstacles but soon the problem might even be the contrary: to control the use and to convince the user that the PC is only a tool to performe a job not a goal in itself!
4. This freedom of choise might naturally be restricted in certain areas to ensure future compatibility etc. This can be done by communicating some musts to the sites but still the freedom of choice must be substantial to ensure responsibility and motivation.

Application of Mathematical Methods While Discovering and Defining Optimal Solutions for Architectural Projects and Construction Subsystems

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KEYWORDS

Construction Subsystems, Mathematical Methods, Optimization.

ABSTRACT

While studying and defining the optimal solutions for a group of architectural projects and construction subsystems there are found appearing as a rule a large number of criteria, entering values and variables, series of limitations which are expressed by group of equations and non-equations, and also numerous undefined conditions (such as function, quality, space useful value, performances of construction subsystems, etc.). A mathematical expression profit - cost = maximum is a basic model for operative researches which is being applied to architectural projects while studying and discovering the optimal solutions.
In the work, the mathematical model is shown through the categories of fundamental, functional, architectural and productive decisions in function of time t→ tk (tk - a physical lasting period of an architectural project).
By a mathematical model would also be considered a period of exploiting a project (t→tk) and entered the categories of flexibility and variability of spaces, as well as a possibility for an appropriate conjugation of user and architect. The construction subsystems deserve an important place while defining the function of aim in a proposed mathematical model.

Application de Méthodes Mathématiques Pendant Découvete et Définition des Solutions Optimales des Architectoniques et Sous-Systémes de Constructions

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SOMMAIRE

Pendant étude et définition des solutions optimales d'un groupe d'objets architectoniques et sous-systémes de constructions il se fût apparaître ordinairement un grand nombre de critétiums, de valeurs d'entrée et variables, séries de limitations qui sont exprimées par les groupes d'équations et non-équations, comme de nombreuses conditions indéfinies (talles que fonction, qualité, espace-valeur utile, performances des sous-systémes de constructions, etc.). L'expréssion mathématique profit - coûte = maximum est un modéle fondamental des recherches opératives qui devait être appliquées sur les objets architectoniques pendant l'étude et découverte des solutions optimales. Dans l'oeuvre, le modéle mathématique est représanté au moyen de catégories des décisionsfondamentales, fonctionnelles, architecturelles et productives dans la fonction de temps t→tk (tk - longeur physique de durée d'objets architectonique). Par un modéle mathématique on aurait consideré la période d'exploitation d'objet (t→tk) et auront introduit les catégories de flexibilité et variabilité des espaces, aussi bien qu'une possibilité de propre conjuction entre l'utiliseur et l'architécte. Les sous-systèmes de constructions font mériter une position importante pendant definir la fonction du but dans le modèle mathématique proposé.

UTILITY - PRICE = MAXIMUM is the basic model of operational research, which is applied in architectural projects at studying and finding the optimal solutions in the time t→tk (tk - physical life of an archtectural structure). From the most general mathematical relation can be observed that an architectural structure, which was rationally build and which has a long-term exploitation, does not mean only inexpensive construction in the given time (the lowest price construction).

If we wish to attain the optimal solution on the level of the project as a whole (the complex system - the assembly of the subsystems of the structure) it is necessary, at forming the task and setting the model, to include the following global fields:

1. Basic decisions (flexible construction systems, planned construction by stages /Fig.1/, spaceurbane flexibility, internal architectural flexibility, etc.).
2. Functional decisions (financial effects, the weight of structure - resources - seismics, the construction technology, "open" or "closed" construction system, exploitation costs, etc.).
3. Design decisions (construction height, story height, number of standard elements, depth of structure, number of appartments per stairway, number of stories, etc.).
4. Production characteristics (production flexibility, selective production program, transport, erection, using constructional plants, etc.).

In Fig. 2 is given the schematic presentation of all the decisions levels and processes, which occur at each architectural projects, beginning with the basic decisions till the planned physical life of the structure. In the period of exploitation (t→tk) are introduced the flexibility and variability categories, as well as the continuous joint activity of the user and the designer, which rank as the basic and functional decisions.

The optimization of a subsystem or of the assembly of subsystems of architectural structures by conventional methods of calculation technique virtually is impossible. The solutions are sought by the methods of operational researches (linear, non-linear, dynamic, heuristic programming, networ planning, etc.).

Theoretically, from the basic view point, the optimization problem was solved. The problem is being solved by finding the extremes of the function, when it expresses the selected optimum criterion. In the field of construction, mostly is selected the function which represents the total price of the selected parts of a structure subsystem. Obviously, such approaches cannot provide right unswers.

According to the present knowlege we are still far from formulating the optimum criterion in the whole, for whole structure. When the optimum criterion (the function of the target and the limitations assembly) is reduced to a narrower level, we will obtain a partial unswer. At subsystems of architectural structures are established the following optimum criteria:

1.Economy criterion
1.1 minimal material consuption
1.2 minimum construction time
1.3 minimal duration of working operations, etc.

2.Criterion of construction with prefabricated elements
2.1 cross-section reduction
2.2 optimal use of constructional plants
2.3 rational types of joints for prefabricated elements, etc.

3.Criterion of work and resources
3.1 amount of works
3.2 economy of the industry (development, using deficient materials, etc.)
3.3 using constructional plants, working outputs, productivity, etc.

When formulating a problem and finding the optimum solution of an architectural structure as a whole (the assembly of subsystems), it is most convenient, parallelly with designing the subsystem, to establish a unique mathematical model through which will be analized the economic consequences of the designed system and subsystems, both individually and collectively.

The economic effects are best monitored by synthetic mathematical models.

By the synthetic models are considered and analyzed simultaneously the total cost of the structure, as follows:

1. investment (contractor´s) cost
2. runnung costs

3. maintenance costs
4. costs of changing the conditions of the system (flexibiliti, variability or destroying)

By the synthetic methods is formed the dynamic mathematical model. The time of duration (life) of the structure (tk) is the time period in which is analyzed the structure. The level of a satisfactory value in use of the space must be incorporated into the mathematical model (the flexibility of space and the variability of the structure, the flexibile construction system, etc.).

The total costs, as a function of the subsystem elements in the synthetic model may be expressed by the following target function in the general form:

$$F(X)=\left\{T+\sum_{i=1}^{n}\cdot\sum_{\substack{j=1\\k=1}}^{n}\cdot c_i x_i^{ti} x_j^{tj}\dots x_k^{tk}\left[1+\sum(p_{im}+o_{im})/q^m\right]\right\}Q$$

$$Q=(q^V(q-1)/(q^V-1))s(1+\Delta\beta)$$

Where:

T - factor which includes all indirect costs expressed in relation with direct costs
c_i=Mi Pi (i=1,2,....,n)
Mi - quantity of elements (i) of all the subsystems of the structure
Pi - cost per element unit (i)
i - subsystem element
n - number of analized subsystem elements (i)
p - runing cost per element unit (i) and per space unit
o - maintenance costs per element unit (i) and per space unit
m - requirement level for running maintenance costs/factor of time (flexibility and variability of space)
q - interest factor (1+a/100); a(%)
v - planned time of using the structure with out change
s - coefficient depending on the scope of change of the system
t_i, t_j, t_k - linearity and/or non-linearity factors
$q^V(q-1)/(q^V-1)$ - annual instalments or annuities of investments (for appartments annual rent)

$\Delta\beta=(A\cdot\beta+B\beta)/E$ or $\Delta\beta=(C\beta+D\beta)/E$

$$\text{if} \quad A\beta + B\beta = C\beta + D\beta \qquad \text{then} \quad \Delta\beta = 0$$
$$(\beta = 1, 2, \ldots, 1)$$

$$A\beta = A - S\beta$$

Where:

$\Delta\beta$ - space flexibility and variability factor
β - number of possible combinations and planned sequence of space change
$A\beta$ - value (in use, commercial value, etc.) in the time of realization of new condition ($t = t\beta$)
A - starting structure value
$S\beta$ - depreciation value of the structure in the time of realization of the new condition ($t = t\beta$)
$B\beta$ - cost of change of the system (space flexibility and variability) in the time $t = t\beta$
$C\beta$ - destroying costs (time, labour, power, constructional plant, recycling of material, etc.) for the structure in the time $t=t\beta$ (space value in use does not satisfies the minimum permissible limits - the standards)
$D\beta$ - value of construction of the new structure in the time $t=t\beta$ (value in use satisfies the time $t\beta$ standard)
E - operational price per unit of time - investment utility factor (discontinous total costs)

The basic problem at formulating the synthetic models is the limitation of costs and the time of duration (life) of the subsystem assembly.

In addition, it is necessary to bring into accorde the two different qualitative categories, i.e. the physical life of the primary subsystems to define the time (tk), in which the level of the value in use of the space is risen.

At forming the assembly of limitations L, in an adequate way must be established the inter-relations between the selected subsystem elements of the structure, and the disturbance factors must be incorporated.

In the scientific and professional practice till now the synthetic models were applied as static models, i.e. the incorporated level of value in use of space was fixed through all time of duration (life) of the structure (t=tk).

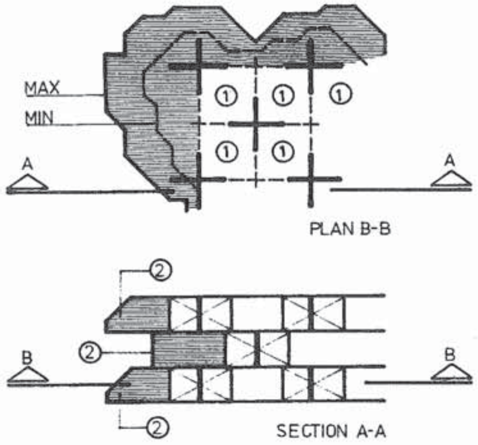

Figure 1. Schematic presentation of planned construction in stages
1. First construction stage
2. Second construction stage (min-max)

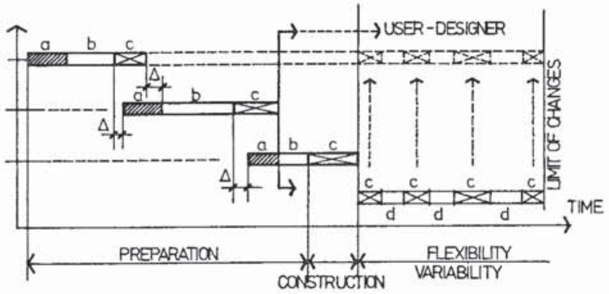

Figure 2. Schematic presentation -global areas at realization and exploitation of architectural structure, which must be taken into consideration when finding the total optimum

a - conception stages (optimization)
b - preliminary stages
c - realization
d - unchangeability period of system
Δ - simultaneity sectors

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Computerisation of Natural Language Work Descriptions

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KEYWORDS

On Site, Work Description, Natural Language, Database.

ABSTRACT

Accounting for construction costs requires various cost models, in which the main variables are: the work package description, the quantity of work, the resources required, and the costs of each resource. Computerisation requires specification of the cost model, assembly of databases relating to work packages, resources needed and resource costs, and the use of standard descriptions of work packages.

Early attempts at computerisation of these descriptions using mainframe computers were not very successful, for a number of reasons. Computerisation was only feasible in offices and not on site for the obvious hardware restrictions.

This paper describes a method of direct computer entry ON SITE of work descriptions and quantities, using a natural language shorthand currently used in the manual operation. A database management system is used to translate freeform shorthand into standard descriptions of work, obviating the need for codes, and requiring little user training. The method is largely independent of the cost model in use, and so can be used for a variety of applications using different cost databases and cost models.

The system is in operation with a firm of British quantity surveyors.