JUSTIFYING DESIGNS

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Abstract
A distinction is made between non-justified (not 'unjustified') and justified designs. A good justification requires that a description of the solution space and a rule for selecting one solution should be given.
The old but rarely used concept of the planning model is described and it is stressed that it is a useful aid when justifying design decisions. A simple example is presented to illustrate the method.
It is pointed out that the use of computers can be helpful when dealing with large solution spaces, complicated evaluation rules and high demands on the quality of the justification.
An increasing demand for design justification is observed, which may result in increased computer application. The hope is expressed that planning models will be used in this connection for better communication.

One feature of methodical design as compared to non-methodical design or 'usual' design is that the design is accompanied by an explanation or justification, i.e. a statement by the designer why he thinks his design to be good enough or even the best he can present. In order that such a justification be regarded as clear and understandable it is usually claimed that it should contain the alternatives considered and the way they are judged. In the terms of design jargon this means that the solution space and the evaluation system should be presented. The concept for structuring such a presentation is the 'Planning Model'.

It is not a new concept as, for example, Ackoff (1962), Rittel (1970) and Archer (1969) have already written about it. I am going to describe the planning model for two reasons. Firstly, I would like to find examples in design work for the application of the concept, which are - to my knowledge - very rare. Secondly, I would like to draw the attention of people working in CAAD to the concept, as I have done before (Musso 1979), because I think it to be a useful instrument for co-operation in the field and for communication with the outside.

The usefulness of models in general need not be explained. As is well known, a distinction is made between 'iconic' and 'symbolic' models. In architecture iconic models have been used for a long time. Drawings, plans or photographs of buildings are two-dimensional, cardboard or wooden models are three-dimensional iconic models or representations. They serve their purpose if it is a question of providing instructions, e.g. for the brick-layer, or representations of the appearance, e.g. for the user. Other possibly important properties of the object to be planned can, however, not be 'seen' from these models. Also they do not show how I can change these properties and how the properties are related to each other.

Symbolic models are suitable for the representation or the modelling of such properties and relationships, especially the so-called research or prediction models, which show what happens when I change something. They have the general form x = f(d), x being the result, which is of interest to the model maker, and d the variable he can change. x may, however, be dependent on a variable c, on which the model maker has no influence or does not wish to have any. If he is interested in the relationship between several properties x_i on the one hand, and several properties d_k which he can influence and properties c_j which he cannot influence, on the other hand, he can write

$$x_i = f(d_k, c_j).$$

The model, the function, can also be written in the form of a box (Fig. 1). With such models it can then be shown (predicted) how x_i will change under the conditions c_j, if d_k are changed in such and such a way. A part of the reality or the iniagined future reality (an object) is represented or depicted by models, the changes are simulated. Such models are established in the different fields of architecture or building.

A planner or architect is, however, not just interested in 'what happens when' and that just in a particular area. He is interested in making the whole object to be designed as suitable or as 'good' as possible. An evaluation model allows him to show what he understands by more or less good, how his judgement of the object depends on which properties. If x_i are the properties to which he attaches importance and y is the judgement dependent on the properties, he can write $y = f(x_i)$ or also draw a box (Fig. 2).

A planning model is a combination of an evaluation model and an object model, the object model having the form of a prediction model. What both have in common at the 'interface' of both submodels of the planning model are the x_i, the performance variables (Fig. 3).

The model maker or the planner shows by means of a planning model how his judgement y in the evaluation model depends on the properties x_i. the performance variables of the design object, which is represented by the object model, and he also shows by what means or with which desiqn variables d_k he can influence these performance variables, and on which circumstances or context variables c_j. which he cannot or will not influence, these performance variables also depend. In the case of 'methodical design' it is on the one hand a question of establishing planning models, but also how the design variables are to be set or determined so that the judgement will be as good as possible.

This concept of the planning model in this general form can not only be repeated with changing denominations over and over again, but reality can actually be represented for different purposes and it is possible to work with it. A simple example is shown in Fig. 4, a planning model for the construction of a wall having the function of a fence.

In this case the model maker or designer shows which means or design variables he has chosen or devised in order to positively influence the object, on what else the properties or performance variables depend, on which context variables, and he shows in the evaluation model how in turn his overall judgement depends on the properties. In this evaluation model he shows how his partial judgements y_1 to y_5 depend on the performance

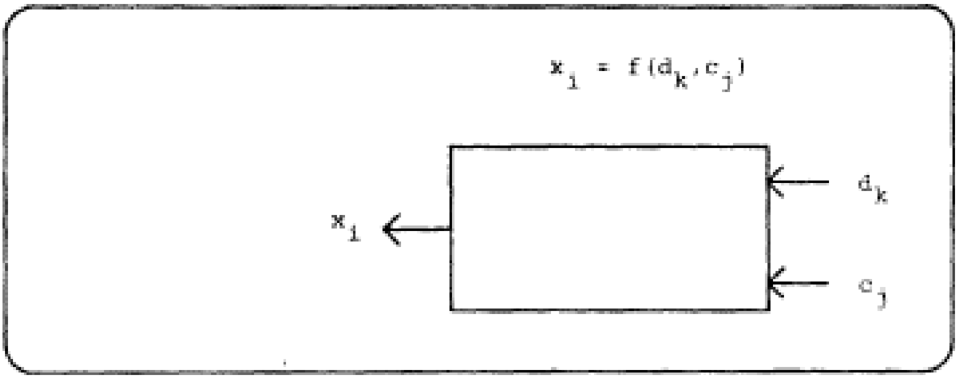

Fig. 1. Prediction Model

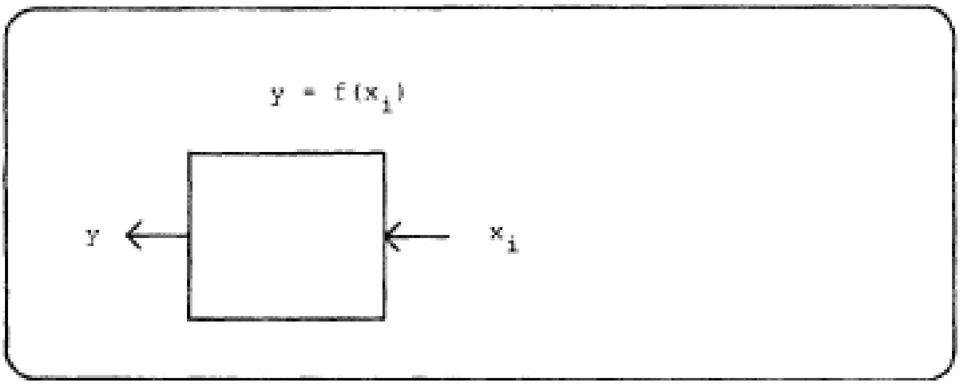

Fig. 2. Evaluation Model

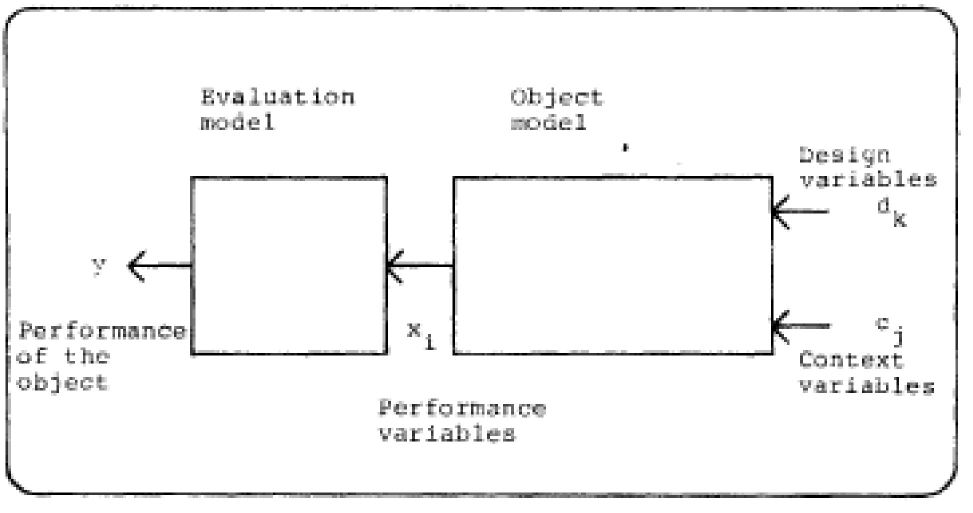

Fig. 3. Planning Model

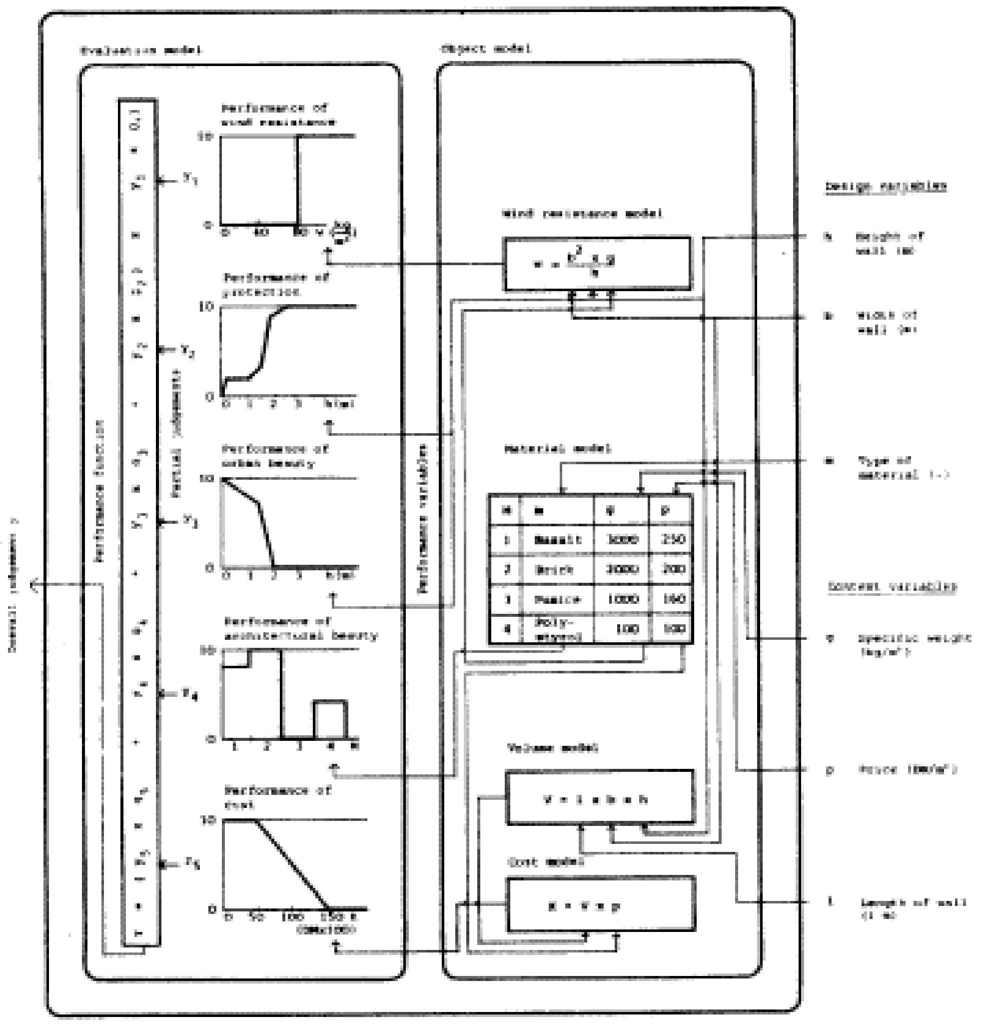

Fig. 4. Planning model for a wall serving as a fence

variables under the five evaluation aspects. Using the evaluation model he transforms the properties into partial judgements by means of transformation functions. He also shows with a performance function how he aggregates the partial judgements to form an overall judgement.

It can be rather tedious to 'read' such planning models. The construction of this particular model is described elsewhere (Fachgebiet Planungsmethoden 1981). But, nevertheless, we can see that only one type of wall with its two design variables and four kinds of material was considered. We can see that this designer has included in his evaluation two contradictory or competing evaluation aspects or criteria. Both partial judgements depend directly on the height of the wall. With increasing height the goodness of protection also increases, but the view of the property, for a pedestrian on the road for instance, becomes worse. Furthermore we can see that the partial models in the object model come from different fields of building or architecture; the volume model from building types, the wind resistance model from statics, the material model from construction and building materials, and the cost model from building economics.

Here I can point out the first instance where the application of computers may be of assistance. When putting together planning models one rummages in one's memory or searches for partial models in books. The search is on the one hand time-consuming and boring and on the other hand it is difficult to compile whatever has been found, because the partial models do not fit together or are not compatible. So what I suggest to people dealing with data processing in architecture is nothing less than that they participate in a further development of the system of denominations, so that partial models will fit together, and that they will show the makers of partial models how to supply their models in a compatible form. Furthermore it would be convenient for a designer or maker of planning models if the partial models could be filed or stored in a problem-oriented fashion, i.e. that on the basis of a performance variable he could find the associated partial models. These expectations add up to my imagining a model building kit, in which the knowledge of individual fields is readily available, ideally coupled with a data bank for the independent context variables, as e.g. prices and specific weights.

The second instance where a computer could be of assistance is the search for a good or the best solution. The solution or design consists of a certain combination of settings of the design variables. If in the case of the wall we consider a maximum height of 2.5 metres, a maximum width of 1 metre, allow intervals of 10 cm and have the 4 materials we get 25 . 10 . 4 = 1000 alternative designs from which to chose. Although in this case the prediction of performance and calculating the overall performance score 'by hand' is fairly easy, it can be imagined that in more complicated cases it would take too long to ascertain that a much better solution is not left undetected in the solution space.

Having indicated two areas where computer application can be helpful when justifying a design, I shall now turn to the question why designs should be justified. In recent years there has been an increase in regulations demanding that designs should be justified.

According to the budget regulations of the Federal Republic of Germany alternative solutions are to be examined and evaluated in the case of public enterprises of considerable financial importance. 'Considerable' is defined in a subsidiary regulation as investment costs of more than DM 1 million or at least half a million a year in current costs. Although most public building projects fall under that provision, none of the authorities responsible has regarded building projects as suitable for these considerations. Apart from that, planners are required by the same budget regulations 'to observe the principles of efficiency and economy' in order to achieve 'the best result' possible with the money used. But neither the parliaments nor the courts of audit seem to require the planners to state clearly how they observe these principles. Such explanations would certainly require that the possible solutions and the evaluation systems for choosing the best solution be set out.

According to the 'Bundesbaugesetz' (Federal Building Act) local authorities have to prepare land use and zoning plans. They have 'to make public the planning goals and purposes', to provide 'different essentially distinct solutions' and to demonstrate 'the expected effects of the plans'. However, I do not know of any instance in which this has explicitly been done.

The Federal Government has established a scale of fees for architectural work, which requires the architect to prepare a list of objectives at the stage of preliminary planning, to coordinate objectives with other parties involved, and to work out and evaluate alternative possible solutions. In the design phase he should, for an additional fee, be able to prepare 'an analysis of the alternative solutions and their evaluations, including an investigation of the costs involved (optimization)'. Not even as far as public construction projects are concerned do I know of any example indicating that this has been done.

Having mentioned these regulations, which demand justifications for designs, and having stated that they are not observed, I should perhaps say why I think this is so. In a book on computer application in architecture I find the sentence: 'Notably, for the individual designer, CAD systems pose threats of stress and anxiety, through intensifying his work rate and making public and assessable his decision making" (Cross 1977). This is exactly the reason for the regulations: to make planning or design decisions public and assessable. Fears in this connection may well stem from the poor basis of the decisions and the divergence of the designer's values from those of the clients, users or general public. It is a nice privilege not to have to justify one's decisions. This privilege is threatened and one should not be surprised when it is defended.

The defense is made easy by raising the questions: What is a proper justification? Where are the examples? One difficulty in dealing with the first question is that there is no logical end to justification. All the assumptions and decisions assembled in a planning model can be subject to further justification, and so forth. On the other hand a minimum standard for justifications need not be the demand to present a whole planning model. In many cases it may suffice to ask for the evaluation model and a distinct set of alternatives, preferably designed by different people.

As for the examples, I hope that the number and quality will increase, if in the field of CAAD design justifications will be regarded as a common goal and the concept of the planning model will be used as a common base for co-operation.

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