GROUP C

DESIGN CONSIDERATIONS

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The objective of Group C was taken to be that of describing the entire pavement design process. The process was considered to be largely one of making decisions (based on structural or engineering, economic, or other considerations, some of which can be described as matters of policy) by using a system similar to that shown in Figure 3 in the paper by Hudson. However, the group members did not unanimously support this objective. Some members felt that the design engineer is not concerned with the entire design process but is concerned only with that part of it that considers traffic, soil strength, and present serviceability levels. In the somewhat lengthy discussions, some agreement was reached on this matter, but, for the most part, the disagreement was not resolved. It is hoped that these differences of opinion are reflected in what follows.

SYSTEM DESCRIPTION

A simple description of the pavement design process is shown in schematic form in Figure 1. This form was not discussed specifically by the group, but it seems to meet the needs of most members. It is offered with the knowledge that considerable work needs to be done before it can be called a working framework on which to build an acceptable design system. A number of investigators have attempted to formulate a framework for subsystems, as suggested by the references to the papers in Part III. The group in general agreed that desirable input variables are those described in box 2 of Figure 1. There was considerable discussion, however, as to how much detail should be considered. In particular, the need to predict the variables of traffic and materials was impressed on the group by those who now actually design pavements.

There was less agreement on desirable output. However, in one way or another, group members wanted the design system to give them the capability of designing to prevent cracking, for example, as well as PSI, and the capability of dealing directly with the primary output variables, if they so desired.

There seemed to be some confusion as to the role of economic and other "soft" design criteria and a reluctance at first to admit them into the system. Perhaps these should have been treated as constraints on the system rather than criteria. It is suggested in the schematic that they might be either or both.

SOME NEEDS AND PRIORITIES

Needs and priorities were discussed and agreed on by the group. High priority was given to only three items:

1. Techniques need to be developed, preferably from current knowledge, for transforming the input variables (box 2, Fig. 1) into the primary output variables (box 3). Group members felt that the capability of predicting states of stress and the like was needed by the design engineer who might not be too concerned about how the stress, for example, was calculated but who would be concerned with making use of these calculated stresses. For this reason, deflection was left as a desirable output variable. It was recognized that separate subsystems might be needed, considering the present status of knowledge, for each primary output response variable. Potential use of the system for

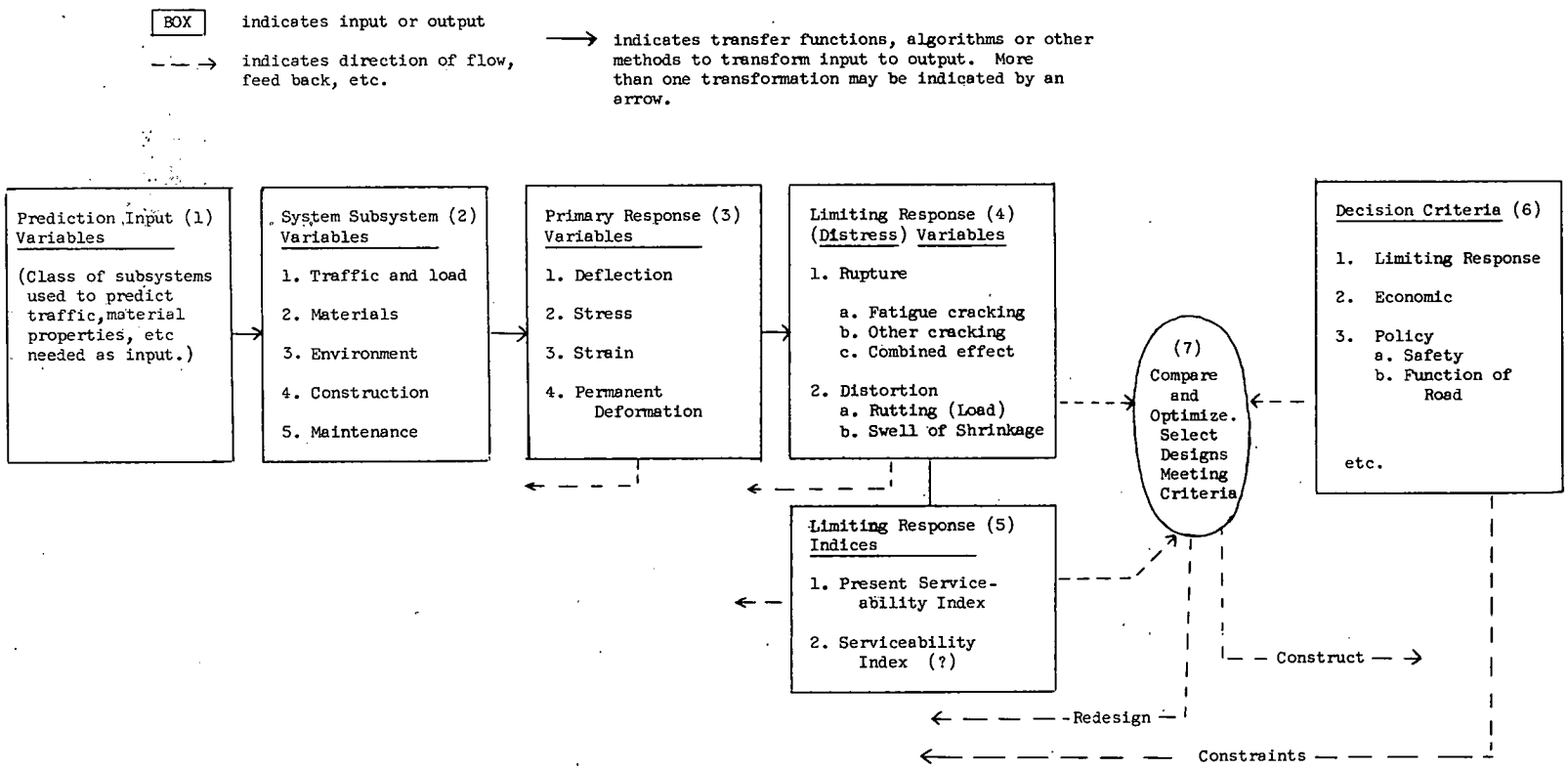

Figure 1. Schematic of pavement design system.

overlay design was mentioned by some group members. It was felt that the designer should exercise as much control and as many options as possible at any major step in this phase of the design process. The group felt that technology is available for constructing at least a primitive form of the required transfer functions.

2. Techniques are needed that will allow the designer to predict the limiting response variables (box 4) from the primary response variables (box 3). It was implied that the designer may want to exercise control over this step in the process. For example, he may want the capability of relating strain directly to fatigue life or, if possible, of predicting the quantity of cracking that he feels represents a desirable end point. (In a related manner, he also would like the option of selecting a desirable level of rutting and PSI.) It was felt by the group that developing at least a primitive subsystem to accomplish this need is within the capabilities of currently available knowledge.

3. One problem with input variables was selected as a high priority need. It was felt that many times it is impossible (a) to characterize material properties as they actually will exist in the field, or (b) to predict effects of environmental changes on the condition of the entire pavement system. This is particularly a problem with subgrade soils where environmental changes often occur after construction. High priority should be given to this problem as it relates to soils. Present technology is weak, and little effort is being made to accelerate such studies.

Lower priorities were assigned to many other elements in the system, either because they were less critical, because sufficient progress was already being made in the area, or because sufficient means were available to effect an interim solution if the necessary effort were put forth. Some of the items discussed follow.

1. Traffic and load variables—Better prediction techniques and the capability of handling new tires, increased tire pressures, loads, and so forth are necessary.

2. Materials variables—Better methods for predicting characteristics that actually represent field conditions, more reliable methods for characterizing materials, and a better understanding of effects of variability on design life are needed. Some capability in the last area will be available through sensitivity analyses using present knowledge of materials and testing variability and the design system if it is developed.

3. Environment—Never completely defined, this item was recognized as important in that environmental changes affect material properties. It was felt that temperature prediction techniques were well along in development but that moisture prediction techniques were not. It was not decided whether moisture or some other measure such as soil suction was really the prime variable. Study is clearly needed in this area.

4. Construction variables—Study is needed in two main areas. The group felt that it is very difficult to be sure that we get in the field the property or condition needed for optimum performance. Also, the effects of variations in construction operations need to be evaluated. Here the group felt that, once a design system is available, the necessary sensitivity analyses could be performed relatively easily by using currently available knowledge of construction material variability.

5. Maintenance variables—Maintenance variables were recognized as valid input but were not defined or discussed. This needs to be done.

6. Safety—Study needs to be initiated into methods for quantifying relationships between decision criteria such as safety and limiting response variables such as rutting.

The group chairman recommends that immediate steps be initiated by FHWA to synthesize available knowledge into a working model of the pavement design system by using as much as possible of the knowledge discussed at this workshop, that this system be made available to designers and researchers, and that study and use of the system be encouraged to determine whether we are on the right track. This step might show that many elements in the system now considered to be important may not be important, and many considered to be unimportant may be more important. Some steps thought impossible may prove to be possible, and vice versa. We should stop looking at pieces of the puzzle, start putting the puzzle together, and see what the picture looks like.