DESIGN & LAYOUT OF RECREATION FACILITIES

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ABSTRACT. Design and layout of recreation facilities is a problem-solving process that must be divorced from the emotionalism that has shrouded outdoor recreation and must deal deliberately with the growing information concerning people and natural resources.

DESIGN AND LAYOUT of recreation facilities is the last major step in a long chain of events leading to public enjoyment of basic resources. It is in this stage where environments are modified or created after many hours of research and planning aimed at solving the mysteries of man and his needs and the site and its capabilities.

Design, like any other problem-solving process, requires that you know the problem before you can hope to solve it. The more you know the better your solution is apt to be.

The results of poor solution range from no use of the site to failure of the site. No use usually indicates lack of knowledge about the market—people. Site failure is the result of lack of knowledge about the site. Of course there is always the possibility that the designer does not know what to do with the information he does have.

Though it is very rare that no use will result, this is not because we have known much about people. More likely it is the result of overdemand, and that people will use very poor facilities when there is relatively little choice.

Site failure has caused some rather strange reactions: a turning to cure-all plant materials that are both beautiful to behold and will withstand the trampling of thousands of visitors, and frantic poring over fertilizer lists to find something to strengthen vegetative growth.

What causes site failure? Too many people. Too much use.

How many people should a site be able to stand?

If you own or operate a campground or recreational development of some kind, you know very well how many people must stay how many days for you to break even.

What about public agencies? The public should be able to expect—no it's even stronger than that: they have a right to know—that our investment of their money realizes values for them that are at least equal to cost plus the going safe rate of return. In other words: we should make some calculations also.

$$\frac{\text{Total social cost} + \text{safe interest over the amortization period}}{\text{Total social value of one visitor day}} = \text{Number of visitor-day use necessary to justify the development.}$$

$$\frac{\text{Visitor day-use necessary to justify}}{\text{Total possible visitor days in amortization period}} = \text{Percent of theoretical capacity use needed to justify the development.}$$

You will find that it takes 50 to 60 percent of capacity use to justify the cost on a 50-unit campground. If your campground is receiving less use than this, and the site is deteriorating, you are really in trouble. And obviously constructing more of the same to "relieve the pressure" is not the answer.

IMPACT OF USE

The disease producing the symptoms is not just too much use or too few developments. The site is receiving *more impact per visit* than it can stand.

A site has a built-in capacity to withstand impacts. You can exceed this limit by applying the full impact of a few visits or the reduced impact of many visits. Different designs produce different impacts.

We can squander the carrying capacity of the site or we can use it wisely. Most of the impact problems we all have are due to poor utilization of the recreation resource.

We have not thought of recreation as a product. Because it involves the psychological well-being of man and is closely tied to freedom of choice and esthetics, we hesitate to put dollar signs on it. We have feared and rejected with righteous indignation the obviously evil intentions of anyone speaking of economic justification.

This particular stand has done much to retard progress.

The fact is, outdoor recreation is a product, a commodity that our society finds essential, one that vast numbers of people pay for, one so important that it is government-subsidized. It is my belief that significant progress depends on recognizing this and beginning to manage production of recreation as scientifically and as economically as other natural-resource-based commodities.

At least partially because of this "esthetic detachment" from reality, it was thought until recently that facility placement in recreation development was not important as a variable in site deterioration. In actuality it turned out to be second in importance among 38 variables tested in a Forest Service administrative study. Measuring the design potential for creating pedestrian impact was an important problem. A system developed for determining this is known as PPI or Potential Pedestrian Impact.

It was built on the following analysis. Recreation falls under the broad category of an activity of choice and is less subject to control than one of necessity, such as living and work activities; but within the broad category of the activity, recreation, there are subcategories or subsets of activities—knowns, predictables, and unknowns.

Knowns are activities or movements of necessity, those that we know must take place for people to use the site or development. They must be solved for in the design and require definite recognizable design statements. Predictables are activities of choice involving predictable patterns of movement. They are solved for in the design by both definite design statements and the application of design psychology. Unknowns are activities or movements subject to random selection and the whims of the users. They involve design psychology and overdesign (built-in safety factors).

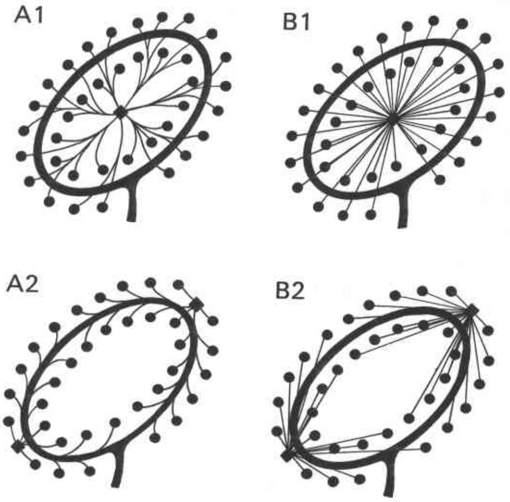

Figure 1.—Patterns of movement. A1 and A2 show actual pedestrian travel from a camping unit to known points of use. B1 and B2 show the travel as straight lines.

Since activities of necessity or knowns are usually repeated in the same pattern of movement, thus creating repeated impact, they are of vital concern when considering impacts on the ecological balance being disturbed by site design, construction, and use. It is also the portion of site impact resulting from use that is most controllable through design and is thus an indication of the "quality" of the design.

For example, how a pedestrian might actually travel from his camping unit to points of known circulation is shown in figure 1, A1 and A2. The problem here is that if 12 different people made diagrams on a particular site, you would get 12 separate answers, all different.

The use of straight lines between these same known points of circulation is shown in figure 1, B1 and B2. Though people do not actually travel in straight lines, a straight line between two points will be drawn the same, no matter who does it. The relative difference in potential impact between A1 and A2 is the same as that between B1 and B2.

In actual practice, the lines are drawn on an accurate scale drawing of the design, such as the 50 scale general plan (fig. 2). The portions of the lines that do not fall on facilities or reinforced points of the site such as tent pads, parking spurs, roads, and surfaced paths are measured to scale, totaled, multiplied by 3, and divided by the total area within 50 feet of all units.

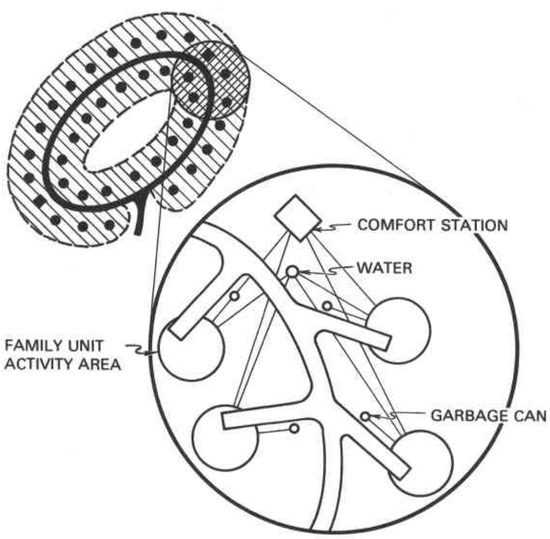

Figure 2.—Detail of PPI diagramming in family camping units.

This method measures potential only, but actual pedestrian impact will vary in proportion with the measured potential.

Measuring this potential impact was only part of the problem. How this fits in with other variables in determining site carrying capacity was still unknown.

What happens when a recreation site deteriorates? Like a 10-ton bridge, when its load exceeds the limit, it falls down. The site falls down physically when it loses its vegetative cover and invites erosion. It also falls down esthetically when it loses its vegetative cover. Bare ground and erosion are not visually pleasing.

It was concluded that we could measure the loss of vegetative cover, and therefore measure the amount of site deterioration by measuring the amount of ground cover on the site. We call this the ground-cover index and define it as:

> The percent of that portion of the site, which is not surfaced or reinforced, and which is covered by ground-level vegetation, litter, moss, or rock.

This definition does not mean that site carrying capacity is reached when: (1) use reaches a certain amount; (2) certain soil characteristics are present; (3) slope is so much; and (4) site design is such and such.

This allowed all these factors to be tossed into a pot and stirred together so the answer that eventually surfaces and is skimmed off the top reflects the interaction of all these factors at each individual site.

The objective of the study was to measure the ecological factors, use, and design factors at each site and to see which combination of these factors resulted in the best correlation with ground-cover index.

DEVELOPMENT

All together, 38 factors or variables were measured. A multiple regression was run, using ground-cover index as the dependent variable and the remaining 37 variables as the independent variables. The multiple regression indicated that:

1. Six independent variables made a highly significant contribution to the correlation with ground-cover index.
2. Six variables explained 85 percent of the variation in the correlation.
3. The addition of more variables to the correlation did not make a significant contribution to the correlation.

The six independent variables, in order of their importance, were:

1. Subsurface depth (thickness of B horizon, in inches).
2. PPI (the percent of the total area of the site that is not surfaced or reinforced and covered by anticipated pedestrian circulation).
3. Percent surface rock.
4. Substratum silt (percent silt in C horizon).
5. Percent slope.
6. Depth to water table, in inches.

The multiple regression also resulted in an equation using the six independent variables for estimating ground-cover index.

$$\text{Ground-Cover Index} = 81.28 + (-0.71A) + 0.21B + (-11.73C) + (-0.24D) + 0.82E - 0.19F$$

Where:
A = PPI
B = Depth of subsurface, in inches
C = Percent surface rock
D = Percent silt in substratum
E = Percent slope
F = Depth to water table, in inches

This equation has a standard error of estimate of 4.7, which means that the calculated ground-cover index will be within $\pm$ 4.7 of the actual ground-cover index 68 percent of the time.

In other words, by plugging the values for the five soils and slope variables and the PPI (or site design variable) into the equation, the amount of site deterioration can be predicted. This can be done for existing sites, or it can be used to predict what will happen on new sites planned for development or on sites being redesigned and reconstructed.

Obviously the dependent variable is important. How was a 75 ground-cover index selected? The key is the question, "What is unacceptable site deterioration?" Another way of stating it may be, "At what point does the balance between site conditions and use get out of control or beyond repair?"

After studying many sites and conferring with soils people, range people, timber people, everyone available, it was determined that the critical point is the set of conditions that allows significant soil movement. Very simply: if the ground is less than 75 percent covered with dead or living vegetative material, whether due to lack of moisture, compaction, or slope, you will have significant soil movement under use.

If you are starting with only 75 percent ground cover, you know that that particular set of conditions will not stand any additional impact.

So far, with only an administrative study as a foundation, we have a fairly crude tool. Even in its crude stage, its use is extremely important in design, and the future—with thorough research—may hold the key to enlightened recreation-resource management. We are using this tool now in the review of site selection, in the planning stage, and in design review in the site-design stages.

We required detailed soil surveys and reports on all development sites. We determine the PPI that these soils will support and then check for PPI on all design studies under consideration. Designs having excessive PPI ratings are not approved.

LOOKING AHEAD

What of the future? We know that these results were produced with limited study and should be used intelligently.

We know that we can increase carrying capacity by manipulating the key variables and even some variables that at this time are not indicated as being key. Crown closure of the overstory is one factor. Thinning to a point produces more ground-cover growth. We need to know how much this changes carrying capacity and at what point loss of litter from falling leaves overtakes gain in growing ground cover.

All the variables can be discussed similarly. We need to know how much manipulation of variables is economically feasible.

Another factor of extreme importance for more detailed investigation is use. Any recreation use, no matter how slight, starts the ecological situation into a process of adjustment. We need to know how much use produces adjustment that is critical to the recreation product: how rapidly it will adjust under what conditions. It would, for instance, make a great deal of difference whether $10/unit/year in the manipulation of variables would hold adjustment to an acceptable stage, or $100/unit.

We may choose to accept $10/year but could not normally accept $100/year.

Since design was the number 2 variable in correlation importance and can be affected most easily, look to it first. Determine what PPI rating your design has and what PPI's your soils can stand. Find out how much you must reduce PPI in order to maintain the development.

If a minor adjustment is involved, you can probably handle it by minor design changes such as modification of trail system. Major adjustments may require redesign and a totally new development. It may be the cheapest thing you can do in the long run.

Let me repeat, *design* is the number 2 variable in site deterioration. As such, its relative success will have much effect on how well a development provides for the desired uses within the capability of the site to withstand them. It must then be as accurate a solution to the development problem as possible. It will not happen by accident. Design and layout of facilities must be a problem-solving process—and one that requires highly analytical and creative capabilities.

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