

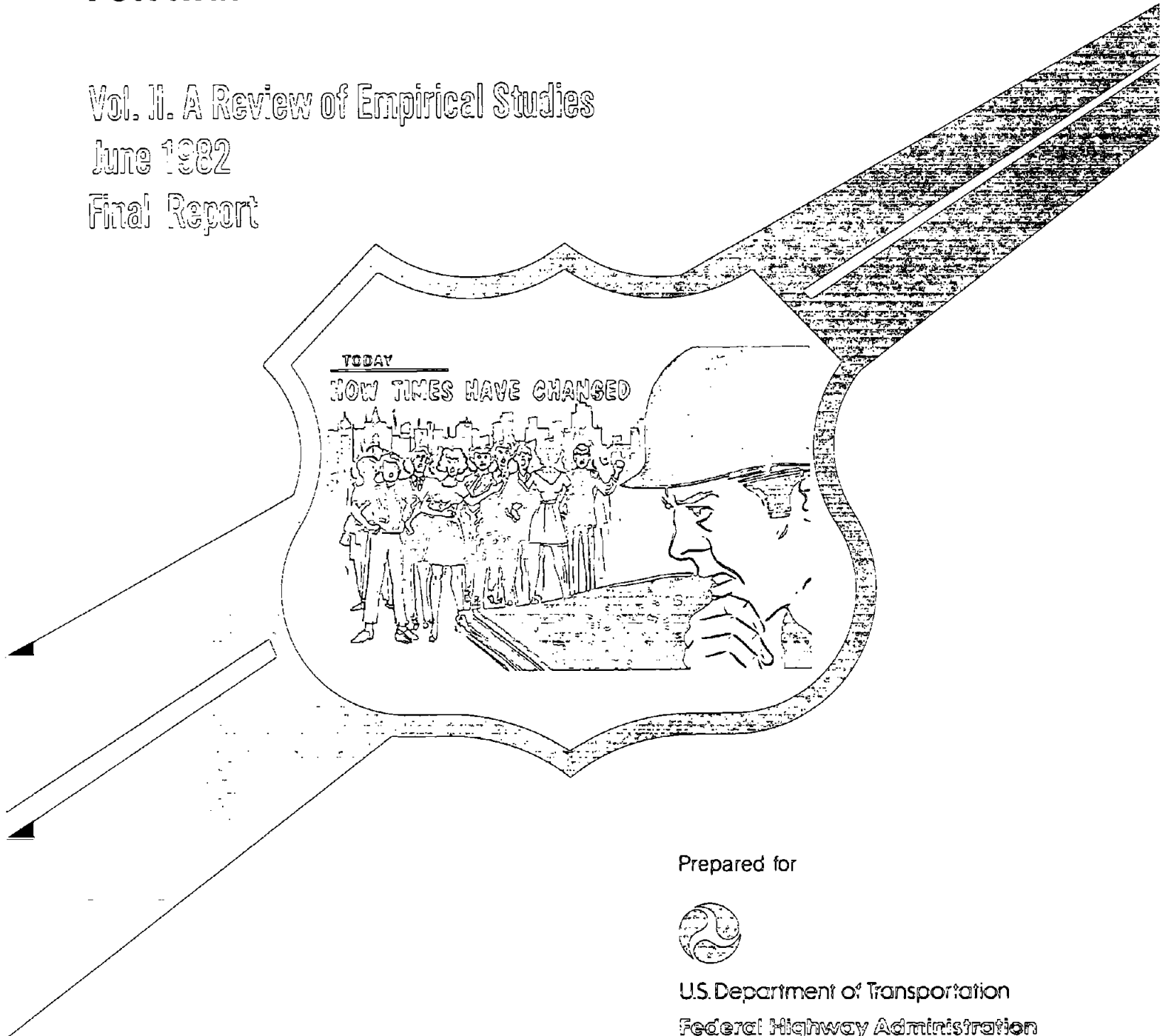


SOCIAL IMPACT ASSESSMENT: A SOURCEBOOK FOR HIGHWAY PLANNERS

Vol. II. A Review of Empirical Studies

June 1982

Final Report



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FOREWORD

This volume critically reviews and analyzes the empirical literature on the social effects of highways. Analyses were performed to determine the extent to which valid data are available on highway-induced change, to evaluate the utility of social impact prediction methodologies, and to delineate areas where there are gaps in information. Planners will find the material in this volume useful for understanding the context and process of social impact assessment.

Research in social and economic impact assessment is included in the Federally Coordinated Program of Highway Research and Development, as Task 1 of Project 3H, "Social and Economic Concerns in Highway Development and Improvement."

Sufficient copies of the report are being distributed to provide a minimum of one copy to each regional office, division office, and State highway agency. Distribution of division and State copies is being made directly to each division office.


for Charles F. Scheffey
Director, Office of Research
Federal Highway Administration

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16. Abstract The seven volume Sourcebook describes the social impacts associated with the planning, design, construction, and operation of highway projects and discusses procedures and techniques available for the assessment of these impacts. Included in the Sourcebook are a number of case study assessments along with descriptions of specific assessment techniques such as obtrusive and unobtrusive forms of surveying and observation. This volume takes a critical look at social impact studies done prior to 1975. The other volumes of the Sourcebook are: Volume I - User's Guide to Social Impact Assessment (FHWA/RD-81/023) Volume III - Inventory of Highway Related Social Impacts (FHWA/RD-81/026) Volume IV - The Use of Social Data Archives in Highway Impact Analysis (FHWA/RD-81/027) Volume V - Surveying Public Images and Opinions by Associative Group Analysis (FHWA/RD-81/028) Volume VI - Development and Administration of Community Surveys (FHWA/RD-81/029) Volume VII - Naturalistic Observation and Social Impact (to be available at a later date).					
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1.0 INTRODUCTION

1.1 BACKGROUND

Recognition that new highways* have considerable impacts on the localities through which they pass is not a recent phenomenon. A cursory examination of the literature discloses that as long ago as the mid-1930's attempts were made to assess the economic impact of road-building on selected communities. Since that time, however, the locus of concern has shifted -- partly as the result of such new programs as the interstate highway system, but perhaps even more so as a consequence of the growth of social conscience in this country. Increased awareness of problems of urban decay and community tensions kindled considerable interest in the effects of highway construction on the quality of life. Additionally, passage of key Congressional legislation, particularly the 1968 Federal Aid to Highways Act and the 1969 National Environmental Policy Act (NEPA), compelled consideration of a much broader spectrum of potential impacts which might result from public works projects. In sum, while there is a long history of economic highway impact research, changing priorities have raised some troublesome questions about the social effects of highways.

1.2 STUDY OBJECTIVE

This volume constitutes a review of the empirical literature on the social effects of highways. Simply stated, the objectives are: (1) to determine the extent to which valid data are available on highway-induced change, and to synthesize research results whenever generalizations appear warranted; (2) to evaluate critically the research designs and general methodologies found in the literature, indicating where procedural variations and lack of adequate controls might account for conflicting results; and (3) to delineate areas where there are gaps in information and where additional research might be useful.

* Throughout this study the terms "new highways", "highway construction", and "highway projects", are used interchangeably to all intents and purposes.

It should be noted that although a broad spectrum of impacts are treated in this study, the central focus is the cumulative effect on people, specifically the highway non-user.* Thus, the topics covered should not be regarded as comprehensive. Rather, areas currently of major concern, which have rarely been reviewed, are emphasized.

The remainder of Chapter 1.0 describes the technical approach used in the literature review, including the bibliographic sources and the criteria employed for acceptance or rejection of individual studies. The chapter concludes with an overview of the contents of the main body of this volume.

1.3 TECHNICAL APPROACH

1.3.1 Sources

Two principal source documents were used to compile a working bibliography for the review. The first was a bibliography on highway impact assessment prepared by the Transportation Center Library at Northwestern University. Secondly, at the authors' request, the Highway Information Service initiated a machine search of the literature based on selected key words relating to highway-induced social change. The two documents were compared and, together with other miscellaneous references, the bibliographies were merged to form a master list which was modified continuously throughout the life of the review. As each document was reviewed its list of references was compared against the master bibliography, with new entries added where appropriate. Altogether, approximately 300 titles were screened for potential inclusion in the review.

Although a preliminary draft was completed in December 1973, additional articles of merit suggested by the sponsor and various contributors to the sourcebook were added after that time. An arbitrary cut-off date on publications had to be established to permit preparation of the manuscript. Thus, studies were reviewed until mid-1974, but coverage for that year may by no means be considered complete.

1.3.2 Criteria for Inclusion

In selecting material for possible use in the literature review, priorities were established for certain types of articles. Primary consideration was given to empirical studies, that is, to research where

*Terms such as "impact" and "highway non-user" defy precise definition. In this review, "impact" is used generically, that is, it refers to any measurable change (or effect) which has been attributed to new highways. (Strictly speaking, noise is not caused by highways, but is a by-product or side effect.) Similarly, the term "non-user" is somewhat ambiguous; in the context of this investigation, it applies to people who work or reside in the proximity of highways whether or not they also use the highways at times.

data (either quantitative or qualitative) were actually reported, or were reflected in review articles summarizing the results of other investigations. A second category included models and simulations of social impact. Of most interest were modeling efforts with attempts at a validation framework. One additional category was comprised of major theoretical works which explored new ground or suggested possible solutions for impact problems. Articles of little substance, such as the texts of speeches or official pronouncements, were excluded from review. Environmental impact statements and unpublished works were also not treated. In a few cases selection could be accomplished by screening titles, page numbers, and determining where the piece was published; more often than not, the document had to be read carefully before it could be discarded. Approximately 43 percent of the articles which were examined were considered relevant for review purposes.

1.3.3 Criteria for Judging Methodology

The technical merit of empirical highway impact research was of overriding concern to the review team. Most of the TAD (Technical Analysis Division) personnel who served as critical reviewers were psychologists, sociologists or, in some cases, operations research analysts with training in those disciplines. Consequently, the questions raised about methodological sophistication reflect the evaluative criteria which most social scientists use in judging empirical research, including the following:

- What methodology was used?
- What was the size of the sample? How was it drawn? Was it representative of the larger community? Did sample attrition (e.g., rate of refusal by respondents) appear to be a problem?
- What were the major independent and dependent variables?
- Were there major methodological flaws in the study (e.g., were appropriate control groups used)? What possible sources of bias or error were apparent?
- Where was the study conducted?
- When were the data collected?
- Who funded or sponsored the study?
- What were the major findings or results? Were appropriate statistics used and, if so, was the level of significance reported?
- What conclusions were drawn? Were they justified by the results? Were the results generalizable to other settings?
- Was the ultimate "user" specified (i.e., the beneficiary of the results)? Could the results be applied or implemented?

It might also be mentioned that, in some cases, the methodological critique of individual studies had to be tempered somewhat because of the mode of presentation. To be more specific, the author's opportunity to provide adequate information about research design is much greater in a volume of several hundred pages than in a journal article. Furthermore, within journals themselves, the editorial policy regarding presentation of study methodology varies tremendously; some adhere to stringent requirements while others appear to have no policy at all. In those cases where journal articles appeared to be abridgments of larger reports, every effort was made to secure the source document. Needless to say, however, this was not always possible due to lack of publication information, out-of-print studies, relocation of primary authors, time constraints, and the like. Nevertheless, despite apparent editorial restrictions on the size of articles, the review team took the position that highway planners and decision-makers would be faced with similar problems when comparing research findings and in trying to determine the validity of specific study results. Consequently, the decision was made not to become "apologists" for highway impact studies where there was a dearth of methodological information.

1.4 OVERVIEW OF STUDY CONTENTS

The main body of this investigation is comprised of five individual chapters covering a wide range of highway-related impacts. Each chapter heading, and the subtopics discussed within specific chapters, were derived from the Federal Highway Administration's list of "social, economic, and environmental effects" found in PPM 20-8, and further modified as additional source material became available. Chapter sizes vary considerably, reflecting the distribution of empirical research on specific areas of highway impact. It should also be noted that articles of exceptional merit and broad scope are sometimes reviewed in more than one topical chapter, as applicable. A sixth chapter provides a brief methodological critique and suggests some new directions for highway impact research. In addition, both subject and author indexes and a complete bibliography of works obtained for review are provided to facilitate access to specific studies or topics which may be of interest. As a guide to the reader, a brief synopsis of chapter content is provided below.

1.4.1 Public Response to Highways (2.0)

The focal point of this chapter is the public's response to highway projects. The values adhered to by various population subgroups, their attitudes toward road improvements as measured by opinion surveys and, in some cases, public commitment to an activist role (as exemplified by the formation of citizen coalitions) are discussed at some length. Techniques for soliciting public participation in the highway planning process are also described.

1.4.2 Displacement and Relocation (3.0)

People must frequently be uprooted to make room for highway improvements. This chapter evaluates the effects on displaced families and businesses. Included in the discussion are such topics as the adequacy of replacement housing, the need for replacement (and auxiliary) facilities, and the question of compensation.

1.4.3 Community Facilities (4.0)

Here the effect of highway construction on the delivery of goods and services is explored. Subject to the limitations of available data, attention is also devoted to the quality of education, access to parks and recreation, shopping, and similar outlets utilized by the local citizenry.

1.4.4 Aesthetics (5.0)

The brevity of this chapter stems partly from the inherent difficulties encountered in superimposing scientific rigor on a philosophical concept. It was David Hume who said that "beauty in things exists merely in the mind which contemplates them." Of interest here are aesthetics from the standpoint of individuals who reside or work in proximity to highways rather than those of the freeway driver. Blight, view, and scale (i.e., the extent to which the road dominates its surroundings) are the ingredients of this discourse.

1.4.5 Noise (6.0)

Most of the research on the environmental effects of highway construction dates back only a few short years and, as a result, solid data are in short supply. This chapter examines the recent evidence for correlations between highway noise levels, annoyance and population characteristics.

1.4.6 Observations on the Design and Content of Highway Impact Research (7.0)

The discussion in the last chapter centers on some of the methodological shortcomings which were encountered during the review, the implications for research findings, and some possible new directions for highway impact research. Recommendations for tighter editorial standards in highway research journals, better coordination of research, the use of longitudinal research designs, and a brief discussion of gaps in information complete the chapter.

2.0 PUBLIC RESPONSE TO HIGHWAYS: CONFLICT OR COOPERATION?

2.1 INTRODUCTION

Public participation is rapidly becoming an integral component of the highway planning process. Indeed, PPM-90-4 places great emphasis on the importance of community involvement; yet, this has not always been the case. The failure of urban renewal, racial tension, the growth of an environmental ethic--all played a part in underscoring the need for a meaningful dialogue between planners and concerned citizens. Of primary interest, here, is the evolution of public opposition to highway department actions and the contributions of researchers such as Leonard Duhl¹ and Andrew Euston² who have emphasized the significance of the human rather than the economic costs of highway construction.

In this chapter three major topics are introduced: (1) the general public's reaction to proposed and existing highway projects; (2) sources of conflict between the community and highway officials; and (3) the search for new techniques to resolve conflict and to promote greater community involvement in the decision-making process.

The opening section presents a broad view of public attitudes toward transportation, including the highway/public transportation debate. Attention is also devoted to highway related attitudes in several selected localities such as Houston, Seattle, Chicago, Baltimore and the District of Columbia.

In the next major section the focus narrows to an examination of resistance to highway projects, beginning with an overview of opposition to freeways, then turning to some specific controversies. The Hudson River Expressway dispute, the protest movement in the Brookline-Elm area of Cambridge, Massachusetts, and various others which have been the subject of research are described. The section concludes with a brief discussion of investigations related to the public hearing, a frequent setting for community conflict.

The final two sections constitute brief surveys of research related to community goals and values and new directions in highway planning. Both of these topics represent attempts to promote better understanding between highway officials and those segments of the community who presumably have the most to gain or lose in a highway location controversy.

2.2 PUBLIC ATTITUDES TOWARD TRANSPORTATION

2.2.1 General

McMillan and Assael³ conducted a national survey in 1968 to determine public attitudes toward public and private modes of transportation. Their findings suggested that: (1) the automobile was the preferred mode of transportation; (2) attitudes toward the automobile were generally positive; and (3) most of the people sampled viewed highway planning and facilities favorably, and many felt that the revenues generated by toll roads, license fees, etc. should continue to be applied to highway related projects. In addition, the people surveyed wanted greater emphasis placed on the training and testing of drivers and more research performed relating to highway safety.

Public transportation was viewed somewhat negatively by the people sampled, particularly those living in rural areas and small towns where automobiles are used daily for convenience and periodically for long family trips. Rural residents were also more inclined to support highway improvements rather than the additional or new freeway construction favored by residents of larger cities. The latter were generally the most vocal supporters of public transportation.

Perhaps the most significant finding in the McMillan and Assael study was that the majority of the sample favored an equitable allocation formula for both highway projects and public transportation facilities. That is, regardless of whether individuals preferred public transportation or private automobiles, they indicated that one should not be sacrificed for the other and that research and development efforts should be conducted equally in both areas.

Three additional studies, by Martin Wachs,⁴ Opinion Research Corp., Inc.,⁵ and Charles River Associates,⁶ tended to support the McMillan and Assael findings. In 1967, Wachs surveyed a smaller, more restricted sample on several issues, including citizens' perceptions of the transportation system. His respondents felt that funding of highway projects and public transit systems should continue, and that taxpayers were obtaining a good return on their investment. In general, those who used specified transportation facilities frequently perceived the greatest benefit from the investment.

The study conducted by Opinion Research Corporation in 1971 was based on fourteen questions administered to a national probability sample of 2016 people. The findings indicated that:

- Approximately 80 percent of those interviewed were favorably disposed toward the nation's highway system. These results were generally uniform across all population strata although some differences were noted. For example, Westerners were the most impressed by highways; Northeasterners and non-white groups were the least impressed.

- Eighty percent of the sample thought that the pace of highway building was about right or should be accelerated. Those who disagreed tended to be elderly, poor, non-white, and live in the Northeast.
- A large majority indicated that the use of automobiles should be limited in downtown areas. Those most in favor of such limitations were better educated than others in the sample and worked in professional occupations; in contrast, farmers were most opposed to such limitations.
- The total sample was evenly divided on the issue of whether or not highways harmed the environment. Those groups which thought that highways were harmful were better educated, had the highest incomes, worked in professional jobs, and were disproportionately from the Northeast and West; those living in Southern and North Central states were generally less concerned.
- Nearly 67 percent of the persons interviewed preferred travel by automobile over public transportation; preference for public transportation was highest among the elderly, non-whites, the poor, and residents of large metropolitan areas.

In 1970, Charles River Associates briefly discussed three previously published surveys of public attitudes towards urban expressways and the automobile. The survey results were difficult to evaluate because of the manner in which the findings were reported. Data from the studies appeared to be taken out of context and compared; the reference points were poor and the explanation sparse. Nevertheless, the conclusions presented were generally consistent with those previously mentioned.

2.2.2 Public Attitudes and Proximity to Freeways

2.2.2.1 Houston's Katy Freeway

In a 1971 study* conducted by Buffington et al.,⁷ residents living along sections of the Katy Freeway in Houston, Texas were administered a questionnaire to determine if any preferences for a specific highway location or design existed. Opinions were solicited from those residents abutting the roadway, within the next 600 feet from the road, and

*The work of Buffington et al. is discussed in some detail later in this report. Because the study represents one of the more comprehensive investigations encountered during the course of the literature review, it is summarized here as well.

600-1,200 feet from the freeway (Zones 1, 2, and 3), coinciding with depressed, elevated, and on-grade levels of the freeway. Since the Katy Freeway was constructed in an established residential area, some residents had lived in the area before the freeway was completed, thereby permitting some subjective before and after observations.

The study concluded that the vast majority of the sample liked the highway design, preferred the depressed roadway configuration, and felt that the neighborhood had benefited from the freeway, citing such impacts as convenient access and reduced travel time. Increased noise level was most often cited as a disadvantage by those people abutting the roadway and by those residents who had lived in the area prior to completion of the freeway. Physical deterioration of the neighborhood was considered to be the most deleterious effect of the freeway by most of the sample; however, it was difficult to determine from the data whether a causal relationship existed between the presence of the highway and neighborhood deterioration.

2.2.2.2 Seattle's North Broadway Freeway

In 1965, Sawhill and Ebner⁸ investigated the impact of the North Broadway Freeway which re-routed traffic around a residential Seattle neighborhood. They found that residents viewed the neighborhood as a better place to live primarily because of the decrease in traffic volume and a sharp reduction in accidents. In addition, new and more convenient shopping and commuter routes were created, although some facilities, such as schools, were thought to be less accessible. Accident data and traffic counts compiled prior to construction of the freeway supported the perception that traffic volume and accidents had decreased as a function of re-routing traffic.

2.2.2.3 The Reaction of Chicago Residents to a Proposed Freeway

Wachs' study,⁹ cited earlier, revealed some citizen anxieties concerning freeway construction. Sixty percent of his sample viewed a freeway as a safety hazard to children, and 68 percent felt that the construction of a freeway within five blocks of their homes would create a serious noise problem. Significantly, the portion of the sample expressing such views were: (1) older residents, (2) more likely to be homeowners, (3) better educated, and (4) professionals or white collar workers. Less concern was manifested by the lower socio-economic segment of the community.

It should be noted that North Broadway residents in the Sawhill and Ebner study were reacting to a real situation, whereas Wachs' survey dealt with a hypothetical freeway, thus precluding direct comparison of the two.

2.2.2.4 The Baltimore Beltway

In 1960, the Maryland State Roads Commission¹⁰ surveyed 88 home owners living in subdivisions adjacent to the Baltimore Beltway

(Interstate 695). The study results suggested that owners were not overly conscious of the Beltway's "presence" and accepted it rather passively. However, properties that were above or at grade were viewed somewhat positively, and those below grade somewhat negatively. Some of the positive aspects cited by individuals living adjacent to the Beltway included greater privacy, ease of travel, improved view, and larger appearing lots. Approximately 22 percent of the sample did complain about noise levels during summer months, while a few others objected to the increased dirt, poor maintenance of the highway, and the danger to children. However, the validity of the results might be questioned on the grounds that the sample was small and not randomly selected.

2.2.2.5 Opinions About Proposed Freeways in the District of Columbia

A comprehensive survey of public opinion concerning freeways was conducted in 1969 by Oliver Quayle¹¹ in Washington, D.C. A sample of 400 residents, selected on the basis of age, sex, and geographic location, were questioned to determine: (1) their feelings toward proposed freeways and why they felt as they did; (2) what freeways should accomplish; (3) the extent of their knowledge about proposed facilities; and (4) who was most likely to favor freeway projects. Approximately 77 percent of the interviews were with blacks, in order to obtain a representative sample of the total population. Furthermore, respondents were interviewed by members of their own ethnic origin.

Although the statistical treatment of the data was relatively simplistic, primarily totals and percentages, the following conclusions appeared to be valid:

- D.C. residents were not satisfied with their transportation system, but neither were they highly critical nor greatly disturbed by their transportation problems.
- More residents favored than opposed the building of new freeways, especially if the roads provided direct access to suburban highways. To the black respondent in particular, such access provided the opportunity for increased suburban employment. Other positive responses included increased efficiency in bus transportation, better access to employment both in the city and the suburbs, and alleviation of congestion on local streets.
- The major argument against freeway construction was fear of displacement and the concomitant inability to locate adequate replacement housing. Although the freeway was not considered to be a racial issue, more blacks than whites felt that they would be forced out of their homes; nevertheless, blacks were more strongly in favor of new freeways than whites.
- Middle class white-collar and blue-collar workers, regardless of race, were the staunchest supporters of new highways.

Those opposed to new freeways were generally from the upper or lower class; older, retired people; or professionals, small business owners, and top level businessmen.

- The more informed residents were about proposed plans for freeway construction, the more negative their feelings toward the projects; however, it was still felt that the new freeways were preferable to the status quo.

In summary, it appeared that District of Columbia residents were in favor of new and better transportation systems despite problems such as the displacement usually associated with new construction. The middle class, rather than the upper or lower classes, generated the most support for new highways, possibly because of increased access to employment opportunities. However, these conclusions should be evaluated cautiously; the literature is replete with specific examples of how residents behave when freeway construction directly alters their homes and life styles.

2.3 PUBLIC RESISTANCE TO HIGHWAY CONSTRUCTION

2.3.1 General

After examining highway controversies in eighteen Standard Metropolitan Statistical Areas, Charles River Associates¹² concluded in 1970 that there were three primary catalysts which promoted public protest: (1) opposition to specific alignments; (2) general disagreement over the need for a freeway; and (3) disenchantment with highway planning procedures. Opposition to alignments reflected public concern about such issues as relocation, just compensation, and preservation and conservation of such amenities as parklands and historical monuments. Other opponents, who felt that alternatives such as mass transit should be developed, questioned the need for a freeway and felt that additional freeway construction would only compound existing congestion. Finally, most protest movements were characterized by disenchantment with planning procedures. Citizens complained bitterly that planners were reluctant to inform the public of decisions or to involve them in any phase of the planning.

Lack of information is sometimes responsible for negative attitudes toward new highway facilities. Jon Burkhardt and Nancy Chinlund¹³ studied the anticipated effects of highway improvements and compared expectations with effects where new construction had been completed. They found that residents and businessmen had expected substantial negative changes in their communities reflected in decreased land

* Problems associated with public hearings and the planning process will be discussed separately in a later section of this chapter.

values, area deterioration, higher noise and pollution levels, changes in traffic patterns, greater danger to children, increased property taxes, etc. Nonetheless, most of the respondents who had experienced new construction thought that highway improvements had afforded more benefits than expected; factors such as increased accessibility to other parts of the metropolitan area were attributed to the new facility.

It seems likely that several variables contributed to the positive attitudes expressed by respondents following highway completion, including the facts that dire predictions had not been realized and tangible benefits could be demonstrated. The authors pointed out that efforts had been made to inform and involve the community during some of the planning phases in order to minimize disruption and enhance benefits. Burkhardt and Chinlund stated, furthermore, that where such efforts to involve the residents are not made, adverse effects are likely to occur; however, they offered no empirical evidence to support this assertion.

2.3.1.1 New York's Hudson River Expressway Controversy

In a 1972 publication, Shaul Amir¹⁴ discussed the factors which contributed to the concerted effort to halt construction of the Hudson River Expressway. Four major issues evolved:

- Relocation of homes and businesses,
- Aesthetics,
- Negative impact on the area's economy,
- Opposition to conventional planning procedures.

Amir observed that although the initial nucleus of the opposition group consisted of people who would not have been directly affected by the proposed route, the Citizens' Committee for the Hudson Valley (CCHV) eventually included all elements of the community, ranging from poor minority groups threatened with displacement to conservationists concerned with the potential damage to the resources of the Hudson River. The citizens presented a united front, maintaining that the purported benefits to be derived from the expressway would not compensate for the ensuing environmental and social destruction of the area. The CCHV ultimately was successful in effecting abandonment of the project.

Amir argued forcefully that traditional highway planning procedures have become obsolete, partly as the result of greater participation by minority groups, the traditional victims of relocation necessitated by new construction. Communities are generally more critical of the alleged insensitivity of planners and are demanding designs and projects more in accord with their

personal "cost-benefit ratios". Amir concluded by urging highway planners and officials to solicit greater citizen involvement at the inception of a project and to give more consideration to the community and human costs in planning.

2.3.1.2 The Brookline-Elm Controversy

Protest activities often do not gain the momentum or magnitude to be truly effective. Gordon Fellman and Barbara Brandt^{15, 16, 17} published several articles describing the plight of residents living in the Brookline-Elm area of Cambridge, Massachusetts, where an eight-lane highway was planned. Brookline-Elm was characterized as a low to lower-middle income area with low income housing. Opposition to the proposed beltway was strongest among those who were: (1) long-term residents; (2) older, widowed or divorced, and heads of large families; and (3) economically and emotionally tied to their community. A second group of new residents, comprised mainly of students and young families, were generally not concerned about the threat of relocation, but viewed it as an opportunity to up-grade their life styles.

A citizen protest organization, Save Our Cities (SOC), soon evolved, consisting of many people who did not reside in the affected area. Only about one third of the affected residents attended any SOC meetings, and these were predominately older residents. Most of the Brookline-Elm community viewed the meetings as useless and were convinced that such activities could be successful only if the participants were influential in the community. SOC's failure to attract active participation was based on the residents' perception that it was an ineffective organization led by members of the middle class who were intent on promoting decisions for the residents without a basic understanding of the community's life style and values.

2.3.2 Protests and Protesters

2.3.2.1 Geiser

Several studies have investigated the type of person likely to initiate protest movements. Geiser,¹⁸ for example, conducted unstructured interviews and analyzed press accounts of controversies in Seattle, Baltimore, and Boston. In his opinion, inner-city resistance was often organized by individuals not directly affected by the freeway, but motivated by a sense of personal satisfaction or the achievement of political objectives. According to Geiser, this group frequently included:

middle class academics, students, civic matrons, architects and planners, social workers, clergymen, or those whose motives are hidden in investments or political deals. In every case studied where inner city controversy developed, one or several representatives from this group carried out critical functions in the controversy.¹⁹

2.3.2.2 Lathrop

In a 1971 publication Lathrop²⁰ traced the history of the San Francisco freeway "revolt" which culminated in the cancellation in 1965 of an extensive freeway plan that had been approved fifteen years earlier. A coalition of neighborhoods, each concerned with individual segments of the proposed freeway system, successfully fought City and State freeway proponents on the grounds of potential safety hazards, destruction of neighborhoods, excessive noise, air pollution, disruption of businesses, and aesthetic degradation. According to Lathrop, citizen groups had not been asked to take part in the planning process nor was the Division of Highways adequately prepared to defend the San Francisco Master Plan in public hearings. The author concluded that poverty, lack of organization, and ethnic fragmentation characterized some areas where freeway opposition was not successful; only when spearheaded by an alliance of neighborhoods, many of which were comprised of merchants and influential property owners, were the protests effective.

2.3.2.3 Goldstein

The ineffectiveness of protests in the Houston area was investigated by Goldstein.²¹ Freeway opposition in that area was strongest among members of the black community with additional support from special interest groups such as architects. Goldstein's study suggested that a combination of several factors might have prevented the controversy from gaining momentum: (1) most of the construction was completed in the early 1960's, a period when blacks were concerned more about integration than political unity; (2) opponents were led to believe that public transportation systems would improve with the addition of new routes; (3) highway routes coincided with the location of deteriorating business districts where merchants were amenable to relocation; and (4) those citizens who were capable of mounting an effective protest were dependent on automobiles, which they owned in abundance. Unfortunately, whereas public officials and influential citizens were lauded for exceptional planning designs, little attention was given to minority groups or to the conditions which sparked their discontent.

2.3.2.4 Sleight

Sleight's investigation²² of characteristics of freeway opponents in Los Angeles and San Francisco found surprisingly little difference between detractors and supporters. The former expressed greater "fear" of the freeway, associating it with fast driving. They were more likely to have lived most of their lives in the city, a finding similar to that reported in other studies. Loss of data (the results appeared to be based on less than 20 percent of the total interviews) as well as some methodological inadequacies in Sleight's study raises some serious questions about the validity of his findings, however.

2.3.3 Public Hearings

The public hearing, as presently constituted, is often a battlefield where citizens confront highway planners. Researchers in this area have urged extensive changes in the hearing process, including greater cooperation with participating citizens.

2.3.3.1 Walton and Sarnoff

Ellis Walton and Jerome Sarnoff²³ attended 25 Virginia public hearings (fifteen in urban areas, ten in rural areas) during May-June, 1970. At each hearing, they requested that attendants answer a seventeen item self-administered questionnaire designed to: (1) compile descriptive and/or behavioral data on citizens at public hearings; (2) analyze citizens' comments relative to problems encountered with public hearings; and (3) generate recommendations for the improvement of future highway hearings. Based on a return rate of approximately 84 percent, the authors came to the following conclusions:

- Slightly less than half (46.8 percent) of those attending public hearings were private citizens.
- Of those individuals who completed the questionnaire, over 84 percent had attended two or more hearings, and over 40 percent had participated in five or more. For the most part, respondents attended public hearings to protest proposed plans; less than 20 percent attended to obtain additional information.
- Although plans of proposed changes were available, respondents indicated that there was difficulty in obtaining them due to conflicts between their working hours and those of the planning office. The majority of the citizens were therefore not adequately informed of plans before the public hearing.
- The initial 20-30 minutes of the hearings were consumed in official rhetoric which was viewed by the citizens as superfluous and confusing. Testimony was felt to be too formal and intimidated many of the citizens who otherwise would have spoken. Additionally, the visual aids used at the hearings were felt to be inferior and in need of upgrading.
- Only 9 percent of those citizens attending did so because of public notices; the remainder attended at the urging of local civic associations or other personal contacts.

Walton and Sarnoff gleaned a number of recommendations from hearing participants. The respondents indicated that efforts should be made to convince citizens that their participation is not only tolerated but desired and to assure them that public officials are responsive to their constructive criticisms. It was felt that hearings

should routinely be held at night. Written testimony, statements, questions, etc., should be requested of the participants at the hearing and the disposition or acknowledgment of each one should be made by the highway officials. Also, the testifying process should be made less formal to encourage more citizen input.

Some additional suggestions included the following: (a) wider publication and notification of hearings by mail, radio, television, etc., should be made 90 days prior to the hearing and again three to four days prior to the meeting; (b) signs should be erected at both ends of the project site detailing the time, date, and place; (c) a set time prior to the hearing should be established which would allow citizens to interact with the engineers and planners; (d) personal letters inviting informal discussion should be sent to local groups soliciting their attendance at such meetings; and (e) project plans should be more readily available prior to the hearing at times and locations more convenient to the citizens with planning personnel available to explain and answer questions.

Finally, the respondents indicated that a notification system should be set up to inform participants of the Highway Commission's decision.

2.3.3.2 Mason and Moore

As one facet of their research in Alabama, Mason and Moore²⁴ also investigated the public hearing process. The general recommendations they obtained from hearing participants were quite similar to those noted by Walton and Sarnoff, but with two important additions. They suggested that hearings should be held in the affected areas to permit more citizens to attend and participate actively, and that transportation should be supplied to those citizens who otherwise would be unable to attend the hearing.

2.4 COMMUNITY GOALS AND VALUES

"Community goals and values" is an ill-defined, grab-bag concept whose etymology can be traced to recent efforts to obtain better cooperation between the general public and local decision-makers. It stems from a desire to obtain valid estimates of human needs which can then be translated into priorities for the allocation of funds for specific projects, presumably with the approval and active involvement of the community. The research in this area to date has been exploratory and generally lacks continuity, particularly in the context of transportation requirements. A representative sample of relevant work is summarized below.

2.4.1 Creighton

In a 1969 report, Creighton²⁵ summarized the results of a conference dealing with the interrelationship between transportation and community values in an urban environment. Conference members identified four areas in which the interface of community goals and transportation facilities seemed to be most critical:

- Social (e.g., personal identity, security, safety),
- Environmental (e.g., low noise levels),
- Access (e.g., travel time, travel cost),
- Economic (e.g., property values, preservation of tax base).

One of the conclusions drawn by the conferees was that neighborhood improvements and transportation improvements must be joint undertakings in order to minimize controversy.

2.4.2 Voorhees

Several years ago, Voorhees²⁶ commented that the most commonly used techniques for identifying community values were focus groups, rating panels, and attitude surveys.

Focus groups are essentially discussion groups comprised of individuals with common backgrounds and interests. With the assistance of a discussion leader, the members explore topics with which they are familiar in an effort to develop insight into values associated with the problem at hand. In some cases, an understanding of the motivating factors behind individual values can thus be obtained. Since the purpose of this technique, however, is to develop ideas and concepts, it is impossible to measure the values derived from such groups with any statistical precision.

Rating panels, on the other hand, can be subjected to statistical evaluation. Members of the panel are given an itemized list of alternatives which they are to rank order by preference. Discussion follows and, based on the findings of the rankings, it is often possible to agree on a compromise course of action. The resultant decision, however, is only a reflection of the panel members' values and thus should not be viewed as general consensus of the community at large.

According to Voorhees, attitude surveys, when well designed and administered to an adequate sample, are probably the best way to determine community values. Unfortunately, such surveys have been used primarily to obtain information on existing attitudes rather than to measure the reaction of the public to proposed alternatives.

Voorhees criticizes the above methods for being only partially applied to the highway planning problem and feels that not only must these tools be improved, but that there is a need for more sophisticated techniques in order to supply highway planners with accurate and complete information.

2.4.3 Fellman

Gordon Fellman,²⁷ referred to earlier in the context of the Brookline-Elm controversy, has suggested sociological fieldwork and participant observation as alternatives to surveys and standard statistical measurements to arrive at indicators of community goals and values. Although these techniques are by no means incompatible, the advantage of the former is that planners and engineers would become personally familiar with areas potentially affected by highway construction.

2.4.4 Haney

Haney²⁸ compiled a list of five areas of community values and subjected them to a three-stage analysis. His taxonomy contained the following items:

1. Accessibility to education, cultural, and social opportunities;
2. Real estate, property development, and property tax base effects;
3. Disruption and relocation;
4. Air and noise pollution;
5. Aesthetics and open space preservation.

In the first analytic phase, each concept was identified, defined, and scored by means of economic, psychological, and physical measurement techniques in order to predict the effect of transportation systems on each area. Planning strategies and simulation techniques were applied in the second phase in an effort to determine gaps in the available data and the best methods for utilizing the data on hand. The final phase specified areas of needed research and appropriate tactics which might be employed. The long range utility of Haney's elaborate scheme had not been demonstrated at the time his paper was presented in 1971; nevertheless, it was touted as a useful tool for incorporating community values in the evaluation of alternative transportation networks.

2.4.5 Mason and Moore

The earlier mentioned work of Mason and Moore²⁹ illustrated another potentially useful method of identifying community goals and values. A sample of 61 influential private citizens and public officials participated in a forced-choice procedure for ranking

highway planning goals and criteria for goal implementation on the basis of desirability and importance. A measure of internal consistency between the two groups of respondents indicated high agreement on their judgments of priorities. However, since the two groups were quite similar (the sample of "influential private citizens" was drawn largely from the same socio-economic strata as the public officials) and since they were not representative of the population that has been traditionally most seriously affected by transportation planning, the results might be discounted.

2.5 THE PLANNING PROCESS

The predominant theme of research related to highway planning is the importance of increased interaction between the community and planners. Clearly, the absence of total community involvement in some highway planning efforts has contributed to the "freeway revolt". Attempts to elicit greater support for citizen involvement have been increasing for a number of years. Leonard Duhl³⁰ urged planners to consider the human element in planning; "man", rather than the monetary cost of a project, ought to be the paramount concern. Duhl's admonitions, in concert with those of other authorities, has provided the impetus for multi-disciplinary highway planning. In the opinion of Andrew Euston,³¹ the planning process should incorporate city and government representation, input from the community, and design team considerations.

Highway officials have also been concerned about the human element in planning and have encouraged research to determine community priorities:

Planning agencies should emphasize the identification and evaluation of urban values and goals as an integral part of comprehensive transportation planning. There should be encouragement of research to develop more systematic techniques for rating all values and costs to be weighted in evaluating urban plans.... The planning and development of facilities to move people and goods in urban areas must be directed toward rising urban standards and enhancing the aggregate of community values, both quantifiable and subjective; it should be recognized that transportation values... are a part of, and are to be given proper weight in, the total set of community values.³²

2.5.1 Attitudes Toward Freeway Planning

Bishop, Oglesby, and Willeke³³ conducted a mail survey of public officials and private citizens in a community where a freeway project had recently been completed. Their objective was to sample attitudes towards the California Division of Highways' methods of planning freeways. They found that citizen involvement in the planning process

took place only during the public hearing stage, with virtually no impact on overall planning.

The respondents generally felt that the Division of Highways had the capability and expertise to study and plan freeway locations effectively and had been responsive to community inputs and recommendations. However, the strength of these attitudes varied directly with the degree of success experienced by individuals who had tried to obtain alterations in the proposed plans. Furthermore, the planning system was viewed as primarily attracting those citizens who might be adversely affected by new construction.

To Bishop, Oglesby, and Willeke, the survey results were indicative of the need for modification of current planning procedures to involve all facets of the community, not merely the affected parties. Essentially, their suggested revisions called for greater community involvement and the establishment of a continuous dialogue between the public and planners at all stages of planning in order to arrive at a community consensus of needs and values.

2.5.2 Citizen Participation Techniques

Although most of the research on planning methodology and citizen participation was theoretical, efforts have been made to involve citizens in the planning process with varying degrees of success.

2.5.2.1 Combined Home Interview and Data Comparison

Grigsby and Campbell³⁴ implemented a technique combining home interviews designed to elicit citizens' attitudes towards transportation and the government's role, and a photo-comparison task which asked the respondents to indicate preferences for various road designs and configurations. For example, one photo-comparison task showed three slides depicting low, medium, and high density tree plantings on the same road, and the respondent was asked which he preferred.

Although this technique was highly successful in establishing the majority's design preference, the authors concluded that citizen involvement was usually "...a series of hollow gestures,"³⁵ that transportation was not generally regarded as a major concern, and that the people surveyed felt that only the government could remedy traffic problems. Although respondents indicated that any community development plans should involve the active participation of local residents, they still maintained that city officials should be held responsible for the plans eventually adopted.

2.5.2.2 Rank-Ordering of Impacts

In a study conducted by Weiner and Deak,³⁶ members of planning boards in various areas of Connecticut were asked to rank a list of potential freeway impacts and judge which items on the list were

beneficial or detrimental. The importance of the impact was determined by the average ranking it received; its stability was determined by the amount of variation in the ranking. An important, but highly unstable impact was considered of little value as a factor in decision-making during the highway planning process. The results yielded several general observations:

- There was considerable variation in highway-related concerns among geographically definable regions within the state.
- Economic, health, and safety factors were consistently rated as important.
- Differences in highway-related attitudes were found between individual citizens and local organized groups.
- Local representatives could be encouraged to participate with planners in a manner that served as a mutual learning experience.

2.5.2.3 Design Team Approach

In theory, a design team is a multi-disciplinary group staffed by experts representing the social, economic, environmental and engineering sciences who apply their joint skills to highway planning and whose objective, "... is to ensure adequate attention is given to preservation and enhancement of the quality of the environment,... [and] related social and economic factors."³⁷

Under the sponsorship of the California Division of Highways, Gruen Associates³⁸ examined the design team concept and evaluated the multidisciplinary approach. Several consultants were retained from various disciplines to identify and analyze "... the various community impacts and opportunities the freeway would produce... [and to explore] the legal, financial, design, social and political implications and methods of implementing...recommendations."³⁹

The results of this effort reinforced the notion that freeway impacts in different communities cannot be equated. In addition, several problem areas were identified concerning attempts to involve communities and citizens constructively in freeway development.

Briefly, the communities mentioned the following difficulties: (1) the entire highway planning process from inception of the project to property acquisition was viewed as too lengthy; (2) available design plans were insufficient in that most failed to consider the environmental impact of the project on the community; and (3) the need for a new freeway was questionable.

The Department of Highways' comments were critical of the community: (1) community plans and objectives were ill-defined; (2) it was difficult to determine if the vocal political segment

of the community represented the attitudes of the entire community; and (3) community groups evolved during the lengthy planning process whose attitudes were in conflict with those held by the group which had originally been consulted on the project.

Problems identified by both the community and the planners were the lack of comprehensive planning (e.g., transportation and environmental factors were neglected) and the lack of effective citizen input on the projects.

2.5.2.4 Value Analysis

Gordon Fielding⁴⁰ used a value analysis technique as part of an attempt to coordinate community groups and highway planners in their efforts to select and design the best route for a freeway. Five categories of interest were identified: (1) economic considerations, (2) social considerations, (3) traffic improvement within the community, (4) user considerations, and (5) community considerations. Each category contained a list of relevant items (such as property tax base, community identity, accessibility, safety, noise abatement, etc.) rated on a scale from most beneficial to most detrimental to community goals by citizens and highway planners. Items within a category were then summed and means calculated for purpose of comparison.

The outputs of the analysis included the preferred route, the intensity of preference, and the relative importance of an item for inclusion as a factor in selecting one route over another. However, since Fielding employed his technique in a neighborhood where construction had been halted, the value of the method as a determinant of the preferred freeway route could not be assessed.

2.5.3 Planning Strategies

Perhaps the most publicized research dealing with the planning process has been conducted by Marvin L. Manheim⁴¹ and his associates at the Massachusetts Institute of Technology. The underlying principle of their research was that the role of the highway professional must be to assist the community in reaching a decision, not to attempt to make that decision for the community.

To achieve this goal, Manheim advocated the use of a location team whose function would be to identify and assess community attitudes and values, and to work as an information center and liaison between the people and the planners. The location team would assist the community in developing alternatives to highway plans, arbitrate when necessary, and in general exert as little influence as possible, acting rather as a coordinator and catalytic agent.

Manheim has also developed a four-stage planning strategy within which the location team would function:

1. Initial survey: The location team assesses the interests, needs, and desires of the potentially affected groups in the community and acquires basic data on the area.
2. Issue analysis: With the assistance of the location team, community groups identify, develop and propose alternative plans.
3. Design and negotiation: If agreement is possible, one of the various alternatives is selected.
4. Ratification: A public hearing is conducted on the proposed design if agreement was reached.

The authors recognized several inherent dangers in this approach; it would be costly in terms of the time involved and the expense of the location team, the agreed route could result in greater expenditures than originally allocated by planners, and the process would permit the no-build option, that is, the project should not be constructed at all.

Bishop, Oglesby, and Willeke⁴² proposed six feasible alternative planning strategies, some of which could be viewed as variations of Manheim's scheme. Their strategies, described below, were developed to accommodate varying degrees of community and planning involvement.

1. Strategy of information: The highway planner controls and conducts the planning studies, contacting the community only to present the findings of highway studies or to gather information.
2. Information with feedback: The planner designs and develops routes and alternatives which are then presented to community officials for comment and feedback. These inputs may or may not influence the final route adoption or be given any consideration in the final planning process.
3. The coordinator: The planner contacts the influential community groups, assesses their objectives, and obtains feedback; however, integration among the various community interests is not encouraged.
4. The coordinator-catalyst: Community participation in the planning stages is encouraged, primarily in the context of workshops where planners and citizens work together to arrive at a compromise decision.

5. Community advocacy planning--the Ombudsman: The community sponsors an expert who directly interacts with the planners on their behalf. Through this spokesman, data and information on goals and values are transmitted to the planners to assist in developing acceptable alternatives.

6. Arbitrative planning: a Hearing Officer: An independent hearing officer arbitrates between the community and the planners at various stages during the planning process. His task is to assimilate the testimony from both groups and to make appropriate recommendations for changes. This individual might also select the final route.

Although the coordinator-catalyst strategy appears to closely resemble Manheim's location team, it should be noted that the latter emphasized valuable field experience, while in the former interaction with the community was confined to a workshop environment.

2.6 SUMMARY AND CONCLUSIONS

This chapter has explored public reaction to highways, efforts to define community goals and values, and research efforts to promote greater citizen involvement in transportation planning. While extensive generalizations are not warranted because of the diversity of the investigations and, to some extent, insufficient research procedures, the findings do provide some limited insights with respect to highway controversies:

1. The public, for the most part, approves of highway construction. Furthermore, once highways are completed, the majority of those who live nearby see more advantages than disadvantages in their presence. On the other hand, opposition to certain types of highway projects, particularly interstate freeways, appears to be increasing. Opinion surveys and case studies of freeway controversies suggest that some groups are more likely than others to resist freeways, for varying reasons. The elderly, as they become increasingly dependent on public transportation, avoid freeways, possibly because they fear high speeds. Low income, non-white, inner-city residents oppose freeways on the grounds of community disruption and the high probability that, if anyone is to be displaced (with inadequate compensation and inferior replacement housing), they will be the victims. Those with higher incomes and more education, especially professionals, frequently combat freeways on environmental and aesthetic grounds. Concern about the safety of children and the physical deterioration of neighborhoods is common to several population groups. It is also interesting that those in the forefront of freeway opposition groups are often "outsiders" or individuals who may be least affected by the facility.

2. Public hearings are more likely to bring out freeway opponents than supporters, and few of these attend to become better informed. Recent investigations also suggest that the hearing format leaves much to be desired. Greater cooperation and better communication with the community before, during, and after public hearings appears to be a real requirement for gaining wider acceptance of highway projects.

3. Considerable research has been done with respect to identifying community goals and values and eliciting public participation in the planning process. However, few, if any, techniques have been implemented with any degree of success. Some appear too costly to be practical; others are either too sophisticated for less educated audiences or they have yet to be tried with anyone except "influentials" or high prestige groups. In summary, the present need is not for additional developmental or theoretical research efforts, but for testing, modification, and validation of existing methods, particularly applied to those groups most likely to be affected by highway construction.

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3.0 DISPLACEMENT AND RELOCATION

3.1 INTRODUCTION

According to estimates by the Bureau of Public Roads,¹ the Federal-state highway program has been responsible for 50,000 displacements annually since 1970.* Approximately one-fourth of these were in rural areas; three-fourths were in urban areas. Of the annual total about 87 percent involved residences, ten percent businesses and nonprofit organizations, and the remaining three percent farms. Over half of all displacements were related to Interstate Highway projects. The majority of residential displacements affected housing costing less than \$15,000 each or renting for less than \$110 monthly.

City planner Chester Hartman² has suggested a broad range of problems related to right-of-way acquisition:

Large-scale relocation of families and individuals, such as that occasioned by highway construction and urban renewal, necessarily raises basic questions of social welfare and public policy...how relocation affects the family's ability to meet the society's minimum standards for quality and quantity of living space; the extent to which the family can fulfill its needs and desires in terms of housing and neighborhood characteristics and convenience to employment, community facilities, family, and friends; the costs -- financial, social, and emotional -- involved in experiencing forced change, and the unintended consequences of such changes; the differential incidence of benefits and costs on various subgroups within the relocation population...and how these more general effects influence the individual family's housing experience.

In this chapter research concerning these issues and various others relating to highway right-of-way acquisition will be described and critiqued.

Since right-of-way clearing is a process, there is a general chronological order of events: the households and businesses along the route are removed from their premises, the prior inhabitants are resettled, and buildings are moved or demolished. However, more detailed description of the sequence is impossible since it varies by locale. The emphasis here is on what happens to displacees throughout those processes of the building of a highway which directly affect them. Therefore the remainder of this chapter is presented in the following format. Sections 3.2 and 3.3, respectively, are concerned with displacement and relocation problems. Section 3.4 compares the results of the various studies and makes some general conclusions, discusses the state-of-the-art of research in this field, and mentions some likely areas for further research.

* Floyd Thiel, in a personal communication, suggests that dislocations are currently running well below this figure (approximately 21,000 in 1975). It is not known, however, to what extent this is due to a change in policy or simply to a decline in new highway construction.

3.2 DISPLACEMENT

3.2.1 Route Selection

Expressways are often routed through the more deteriorated sections of a city, and those who are displaced are the poor, the aged, and minority groups -- those who are frequently the least able to take care of themselves, and the least likely to use the expressway that displaces them. Arthur Christensen and Alvin Jackson,³ of the Department of Housing and Community Development in Baltimore, cited supporting figures for that city in 1969. At that time the expressway program was expected to displace some 3,800 families with an estimated 15,000 persons. Approximately 80 percent of these families were non-white, less than 40 percent owned their own homes, and nearly 75 percent had incomes so low that they qualified for either public housing or other government subsidized housing programs. A large number were elderly, and many had large families. In addition, some 500 businesses would have been displaced. The authors stated:

"One may be inclined to say that displacement of this magnitude is the price of progress, and such may be the case. It goes almost without saying, though, that no individual should be required to pay more for such progress than the share he would normally pay as a taxpayer; yet practically every person and every business which must move is injured far beyond any benefit which they will derive from the new road. These poor people are the ones who can least afford to subsidize highway construction or, for that matter, any public improvement. Few of them even own automobiles, and those few who do will seldom use the section of the expressway which is constructed over their former homes."

Very little empirical work has been attempted to establish differential effects of displacement on poverty neighborhoods. The exception was a study by David Colony.⁴ Colony obtained interviews at 228 households displaced for right-of-way acquisition for Interstate 90 on the west side of Cleveland. Independent variables considered were age, income, occupation, education, and anomia (the degree of hopelessness and social dysfunction or disorganization in a given population).

The Srole anomia scale consists of a set of five affirmative statements, each one intended to measure one aspect of social dysfunction. The test is scored by counting the number of statements to which the subject expresses unequivocal agreement. The score ranges from 0 to 5, with the higher score indicating a higher degree of anomia. Colony included the test in his survey questionnaire. From correlations made with the other variables, he concluded that hopelessness is associated with negative attitudes toward the relocation experience. The impact of relocation increased with age and with the expenditure of time

required for the household head to earn a dollar. The social and psychological impacts of displacement were shown to be relatively more severe on the poor, the elderly, and the poorly educated.

Disadvantaged, low-income, and minority households tend to locate in older, substandard housing in each metropolitan neighborhood because such housing is the least expensive available. Also, their choice of alternative locations is restricted by discrimination in housing markets. Anthony Downs⁵ listed four reasons why urban highways are concentrated in areas where such housing is found:

1. City planners often use such programs as a means of eliminating the oldest and least desirable housing in the existing inventory.
2. Since U.S. cities developed outward from the center, the oldest housing is usually found in proximity to central business districts. Major highways also focus on the area peripheral to central business districts as the optimal location for traffic arteries serving the downtown area.
3. Property in such areas is less expensive than elsewhere, since it is older and more dilapidated. Therefore, routing highways through such neighborhoods reduces total acquisition costs.
4. Historically, members of low-income ethnic minorities have not been sufficiently organized to oppose the routing of highways through their neighborhoods. Residents of higher income areas have the financial and organizational capability to offer resistance. Officials responsible for such projects are motivated to follow the path of least resistance through lowest-income neighborhoods.

Oliver Quayle and Company⁶ investigated public support for and opposition to new freeways in Washington, D.C. Personal interviews were conducted with 400 residents, 21 years of age or older, selected according to a modified area probability sample. Of the total interviews, 77 percent were with blacks. The results indicated that blacks wanted new freeways more than whites even though many felt they were more likely than whites to be forced out of their homes. The findings also suggested that those residents who most strongly opposed new freeways tended to come from either the upper or the lower segments of the city's population. Significantly, the one overwhelming reason for opposing new freeways was the fear that people would be evicted from their homes, and that the victims would be unable to find adequate and decent replacement housing.

3.2.2 Availability of Housing

The housing issue deserves further attention. Barbara Kemp's⁷ analysis of the problem was focused on Washington, D.C., but the situation is similar in most urban areas. She stated that minority groups have a limited housing supply to select from, regardless of income.

Low-income groups, regardless of race, have a small supply of decent housing from which to choose. Many new housing units are added to the city-wide supply, but the overwhelming majority are of such size and price that they are unavailable to about 25 percent of the Washington population.

Areas of low-cost housing are steadily diminishing due to such factors as slum clearance, housing code enforcement, increased cost of inner city land, highway construction, and other public improvement programs. According to Kemp, recognizing the difficulties which they will face, many low-income families would prefer not to trade what little they have for the uncertainties and possibilities of higher rent, overcrowding, inaccessibility or locations which are unfamiliar to them. On the other hand, since opportunities for predominantly white higher income groups to find desirable housing which they can afford are much greater, an involuntary or forced move becomes mostly a nuisance. Opposition to displacement by such families reflects their satisfaction with the existing situation and an objection to being inconvenienced, especially by the Government.

However, housing supply alone is an insufficient explanation for the problems specifically associated with right-of-way acquisition through low-income areas. A variety of other difficulties result from the social structure of the populations.

3.2.3 Localism

Marvin Cline's⁸ discussion of the city as a social system touched upon a concept which might be referred to as "localism". He contended that urban regions produce a wide variety of social structures and populations. Even the lowest income areas can generate integral systems of living that supply their residents with personal satisfaction, a sense of neighborhood, identification with a physical region, and a great reluctance to change residence even with the inducement of better housing. Such systems appear to vary according to the economic status of the families and the degree of "urbanism" of the neighborhood (an index based on measures of the fertility of the families, rates of females employed, and the number of families living in single family housing units). For example, lower-income urban groups tend to rely more than other income-groups on their immediate and extended families for informal relationships and prefer to use neighborhood economic, service, and recreational facilities. There is less formal structure in the more urbanized community. Even when contacts are based on formal role structures such as consumer-storekeeper relations, a significantly high proportion of urban residents (particularly lower-income groups) prefer to personalize the relationship. Cline concluded that the lower-income neighborhood can be an extended and complex social network involving geographically localized friends and relatives, many informal groups, and strong attachments to the community.

The phenomenon of localism has surfaced in a number of investigations, perhaps most conspicuously in the Field Studies of Fellman and Brandt.⁹ Their research concentrated on the problems of Brookline-Elm, a community

situated in the path of a projected eight-lane inner belt connecting Boston to neighboring cities. Two relatively distinct groups lived in the Brookline-Elm area. One was an upwardly mobile group, comprised mainly of students, unmarried adults and childless couples with no strong ties to the area. The majority belonged to the second group which consisted largely of married couples with adult children, widows and widowers, divorcees, and people living in three-generational households. The latter residents had strong social and emotional ties to the neighborhood. Many were members of extended families who had close friends within walking distance and who placed a high priority on values such as "neighborliness", mutual help, and upkeep of the home. The respondents who talked with Fellman and Brandt indicated concern about disruption of the neighborhood and the problem of relocating extended families. Interviews conducted with this group in mid-1967 showed that 63 percent were "confused, upset or distraught".

Marc Fried's¹⁰ work on the concept of spatial identity appeared to support the conclusions drawn by Fellman and Brandt. He stated that the sense of spatial identity

...represents a phenomenal or ideational integration of important experiences concerning environmental arrangements and contacts in relation to the individual's conception of his own body in space. It is based on spatial memories, spatial imagery, the spatial framework of current activity, and the implicit spatial components of ideals and aspirations.

In studying the reasons for satisfaction that the majority of slum residents experience, Fried found two major components: a vast, interlocking set of social networks is localized in the residential area, and the physical area has considerable meaning as an extension of home which provides a sense of belonging. Thus, dislocation and the loss of the residential area represent a fragmentation of some of the essential components of the sense of continuity in the working class.

3.2.4 Compensation

Once the route selection is final, the right-of-way must be cleared. Governmental responsibility for assisting in the relocation of displaced people and businesses arises from the principle of eminent domain prescribed in both Federal and state constitutions. The right to acquire property against an owner's will may be exercised only when the property is necessary for public use and just compensation is paid to the owner. Although courts have traditionally defined "just compensation" as the fair market value of the property taken, Congress and some state legislatures have provided certain additional relocation compensation.

Anthony Downs¹¹ listed the necessary requirements for a particular transportation improvement effect to be compensable:

1. **Attributability:** the loss concerned is directly caused by the public project rather than by other economic or social forces.
2. **Significance:** the loss is relatively large either absolutely or in relation to the economic capabilities of affected persons.
3. **Noninherent Riskiness:** the loss cannot be considered an inescapable risk of property ownership.
4. **Identifiability:** the individuals or class of people who suffer the loss can be personally identified.
5. **Measurability:** the magnitude of the loss can be measured or estimated with reasonable accuracy.
6. **Deliverability:** compensation made for the loss by public authorities can be accurately directed at those and only those who suffered that loss.
7. **Net Negative Impact:** the loss is not likely to be offset by benefits resulting from the public improvement.

The Federal Aid Highway Act of 1968¹² requires the assurance of an adequate program of relocation assistance and the availability of relocation housing before approval of any highway project. Under its provisions, all moving expenses will be paid up to \$25,000, with optional payments on a fixed schedule for residential moves and alternative payments for a business which cannot relocate. Further, the Act provides assistance for the cost of replacement housing, up to \$5,000 for owner-occupants and up to \$1,500 for tenants.* Such Federal participation is on a project basis.

Not all losses from displacement are monetary. Downs¹³ listed costs which are not compensated, and the variant nature of such losses is evident: a) disruption of established relationships, b) losses due to the taking of real property, c) costs of seeking and financing alternative housing, d) moving costs, and e) higher operating costs of residing elsewhere.

Because of such losses, various authors have discussed compensation means other than uniform direct payments to individuals. Bruce Yandle,¹⁴ for example, suggested that a market mechanism would most readily provide just compensation to all affected parties; those benefited would pay an amount equal to the value of their benefit, and those damaged would be compensated. Therefore, the alternative which is chosen would yield the greatest collective satisfaction.

* Since 1970, assistance for homeowners is approximately \$15,000 and \$4000 for tenants (Floyd Thiel, personal communication).

Yandle's general method was as follows:

1. Taking the set of feasible routes, interdisciplinary teams would analyze the magnitude of public funds which could be committed to programs in the affected areas.
2. Members of the affected communities would then attend planning sessions to construct hypothetically the areas which would develop as a result of the corridor location.
3. Eventually, several detailed designs would evolve from this process. By examining the total plan, an individual could determine the effect of each proposed corridor on his property and family.
4. Information, maps, development proposals, etc. would be distributed to the public.
5. Each affected citizen would be invited to submit a bid, positive/negative/zero, for each location.
6. The highest total positive bid would indicate the preferred corridor location. Payments would then be made to those property owners along the corridor who had made negative bids and received from individuals who had made positive bids.

Yandle's proposal appeared to have some serious flaws. Charging people to choose how their taxes are utilized is suspect. Any benefits derived from the highway are a product of the original taxation, and any negative impacts should be compensated from the same source. In addition, the method assumes that at least one highway corridor proposed would receive a somewhat positive response and that individuals will honor their bids.

3.2.5 Relocation Assistance

A relocation service is set up to assist those individuals who are displaced. Assistance can be obtained at the Federal, state, and local levels of government. In most cities, either a public housing or urban renewal agency assumes the responsibility to find new homes or new locations for businesses as well as to counsel and advise the displaced during this process.

Christensen and Jackson¹⁵ described the processes of relocation in Baltimore, Maryland. When value appraisals are begun, a survey is made to determine the workload and identify problems. As property is acquired, each displacee is offered individual assistance in finding a new structure which is of sound construction at a price which the family or the businessman can afford. Problems of zoning, special licenses or permits, and financing are also considered. Due to the variety of problems associated with displacement, specialists who work directly with displaced families

are drawn principally from two fields, real estate and social work. Unfortunately, even when the relocation staff members are efficient and concerned, problems may occur. Assistance is often ineffective if a displacee refuses to accept help. Some displacees wait until their own efforts have failed before they request help. Small businesses frequently are so closely oriented to the community that they cannot be moved, and must go out of business. In expressway areas, the Federal Government made no provision for the small businessman until passage of the 1968 Federal-Aid Highway Act, which provides for a specific payment to the businessman who cannot relocate. Finally, the long-standing shortage of replacement housing often overshadows all other problems. A new home cannot be found for everyone if enough housing is not available.

Whether or not the relocation staff or right-of-way personnel are successful, the displacees are not always satisfied with their efforts. According to David Colony,¹⁶ more than a third of the homeowners in his survey expressed dissatisfaction with state employees because they felt that the personnel were not courteous, urged overhasty settlement, or tended to harass tenants. Displacees also complained of feeling a pressure to move. Others commented that their special problems were ignored, or that their primary concern was a lack of information and advice on real estate procedures and legal questions.

3.2.6 Transition

After the displacement process is initiated, the area enters into a transition phase. This process usually has various effects that condemn the area to substandard status, stagnation, and eventual decay. The designated area suffers temporary physical effects, such as vacant lots and boarded-up stores. An increase in a poorer transient population occurs as the more well-to-do move out to relocate. Property owners no longer feel a need to improve their property since the government will eventually buy it. Since home improvement loans are difficult to obtain, the remaining residents can't do much to prevent the decay.

Anthony Downs¹⁷ listed a number of physical and psychological losses imposed upon the remaining households during this transition period. Property owners are unable to sell property at reasonable prices. In addition, the property value declines because of deterioration. If owners do attempt to maintain their property after the value has been determined for acquisition payments, the costs cannot increase the property value. Owners of rental property suffer losses of income because tenants depart before the highway department actually takes the property. There is a general decline of the quality of life during waiting periods.

Another temporary effect of the transitional period is the sharp increase of "nuisance complaints". David Colony¹⁸ found that this increase occurred immediately when acquisition of property began and remained at a high level until after the highway project was completed.

Relocatees have a choice of either vacating the area before it deteriorates or staying slightly longer while searching for relocation housing. The people who do stay in the area may have to contend with vandalism and other associated problems. Past experience in areas subjected to right-of-way procedures has shown the value of coordinating clearing activities. In view of the fact this condition exists for a short period of time, it has not received a great deal of attention in the literature. Possibly, its importance has been overlooked.

3.3 RELOCATION

3.3.1 Choice of Location

David Colony¹⁹ made spot maps of a total of 638 "permanent relocation" addresses of families who had been displaced for a Cleveland highway project in order to demonstrate moving behavior patterns. His maps showed that relocatees tended to choose new residences as close as possible to their old homes. Those who moved more than one mile generally moved to suburbs on the same side of Cleveland.

Colony investigated the decision processes of the relocatees by analyzing the social status of their census tracts of origin and first destination. Each of the 127 census tracts containing one or more relocatees was assigned a socioeconomic rank score in accordance with the following criteria: percentage of white-collar workers, median school years completed, median income, and percentage of nonwhite persons. The probability of moves of the relocatees from one social status space to another was compiled. From the analysis Colony concluded that relocatees tend to move to new areas having a social status equal to or higher than that of their old areas provided they are financially able to do so. Colony also examined the origins and destinations of 507 moves in Toledo which were unrelated to right-of-way acquisition, and thus qualified as a legitimate control group. There was a similarity between relocation and voluntary moves: both reflected the tendency to upgrade the social status of residences.

There were too few nonwhites in Colony's sample to permit a detailed study of the effect of race on the impact of relocation. Surprisingly enough, despite this limitation, it appeared that the experience of having lived in an integrated neighborhood may have fostered a dissatisfaction with either a predominately black or a predominately white neighborhood. Those who moved to the east side of Cleveland selected one or the other in approximately equal proportions, but displayed a marked tendency to move again.

Fellman and Brandt,²⁰ whose research with Brookline-Elm residents was mentioned earlier, made some interesting observations about housing. They suggested that construction costs and the current incomes of most residents largely necessitate Federally aided, rent-subsidized, or public replacement housing. Antipathies to public assistance and mass housing must be overcome to adequately serve the needs of the relocatees. Many

of the Brookline-Elm people expressed hostility towards living in large, high-rise apartments. They preferred a place that feels and looks "like a home" with yards and areas where it would not be difficult to supervise children. In addition, many had friends or relatives in public housing projects and were well aware of the problems of faulty construction and maintenance. Fellman and Brandt concluded that even if public housing were built near the old neighborhood, not everyone displaced would move into it. With the current shortage of low-cost housing in many metropolitan areas, it is unlikely that many residents could find replacement housing near their old neighborhood. Relocation in a suburb or in another urban section even two or three miles from the old neighborhood would cause difficulties, particularly for the 50 percent of the population without cars, among these the many women stranded without cars during the day, and the many older residents who cannot drive.

3.3.2 Effects of Relocation

William Adkins and Frank Eichman²¹ studied the effects of relocation upon a sample of 100 home owners displaced for Interstate Highway 20 near Dallas. Interviews were held to obtain the prices of replacement homes, the adequacy of residential compensation, and the effects of displacement by right-of-way on social and economic status. The prices the relocatees received for their original homes were obtained from the files of the Office of the District Right-of-Way Engineer in Dallas.

The major findings of the authors were as follows:

1. Within a few months, 93 owners again owned homes.
2. Displaced owners appreciably upgraded their housing.
3. In acquiring improved housing, owners increased their mortgage indebtedness.
4. The funds received by owners from state payments and sales of retained improvements averaged \$8,523. Immediate dispositions of funds amounted to \$9,297, much of which consisted of down payments for replacement homes.
5. On the whole, owners were adequately compensated for their real estate.

Of the 91 owners who expressed opinions on housing, 20 felt that their new housing was worse than the original, 12 felt it was about the same, and 59 felt it was an improvement. Of the 97 owners who expressed opinions on their financial status, 62 considered that they were worse off after the move, 13 felt that their financial status was improved as a result of the move, and 22 felt that their status was basically unchanged.

Christensen and Jackson²² also researched the financial burden of displacement on owner-occupants for a study done by the Baltimore Urban Renewal and Housing Agency late in 1967. Homes in this study were being acquired in two areas, one black and the other white. The study compared prices received for compensation with the cost of replacement housing. The average replacement cost for housing was \$3,000 above the amount the city had given in compensation. After all relocation costs were added, it was found that the relocatees were paying an average of \$3,500 more for comparable replacement housing than they received for their original homes. Also, the average additional cost was significantly more for blacks (\$4,400) than for whites (\$3,000).

David Colony²³ also studied relocation effects. Of the 285 people he interviewed, 80 percent stated that their monthly housing costs were larger after relocation; the median increase was \$52.50 per month. Relocation seemed to have little effect on employment; only five percent of the relocatees changed jobs as a result of being relocated. Another effect of relocation was the change in the length of time needed to travel to work. Thirty-three percent of the relocatees stated that they spent more time traveling to work, 25 percent spent about the same amount of time and 17 percent spent less time. The remainder were either unemployed, uncertain of their travel-time, or failed to respond. The main change was from tenant to owner status. Fifty percent of the people who were tenants became owners, while only ten percent of the people who were owners became tenants. A few elderly people either entered an institution or moved in with relatives. The relocation experience seemed to provide the incentive for families to buy a house. According to Colony, in this sense the process of being relocated might be a benefit, if and only if the household can afford the improvement without financial hardship.

3.3.3 Reactions to Relocation

Some attention has been directed in the literature toward adjustment once the relocation procedure has been completed. Colony²⁴ investigated the aptitude for adjustment as a function of selected socio-economic variables, and Marc Fried²⁵ studied the impact of relocation on the mental health of the working class.

The previously cited study by Colony was also concerned with the likelihood of the re-establishment of localism. Sixty percent of the surveyed relocatees stated that they had strongly disliked having to move when they had first learned they were to be relocated; in contrast, five percent had been very pleased. After relocation the "very sorry" group was reduced by half while the "very happy" group had tripled with the passage of time.

When asked what features of their old neighborhoods they missed, more than 30 percent of the relocatees replied "nothing", 20 percent missed friends or relatives, and the others mentioned a variety of

neighborhood characteristics. Nearly 40 percent stated that they had nothing in the new neighborhoods that the old ones had not provided.

Colony found that the poor and the elderly were most affected by the severance of social ties that existed in their old neighborhoods. Those households in which the take-home pay of the head of the household was less than \$100 weekly were nearly three times as likely as more affluent households to have made no new friends after being relocated. Families were about six times as likely to have made no new friends if the head of the household was over 60 than households with heads aged 30 or younger. Length of residence at the pre-relocation address was also useful in predicting the impact of relocation on a household. About 60 percent of the relocatees who had resided at their old homes for eleven years or more had strongly disliked having to move when they first learned they were to be relocated. Nearly 40 percent of those families remained very sorry after moving. On the other hand, about 42 percent of the families who had lived at their old addresses for less than a year said they had strongly disliked having to move at first. Less than 50 percent of the latter group was still very sorry about being relocated.

Marc Fried's study was based on the contention that any severe loss can instigate fragmentation of routines, relationships, and expectations, and frequently implies an alteration in the world of physically available objects and spatially oriented action. His analysis involved a comparison of information from interviews administered before relocation with a "depth of grief" index derived from follow-up interviews approximately two years after relocation. Pre-relocation interviews were administered to a randomly selected sample of 473 women from households in the Boston West End area at the time the land was taken by the city. Post-relocation interviews were completed with 92 percent of the women who had been given pre-relocation interviews and with 87 percent of the men from those households in which there was a husband. Primary emphasis was given to the results with the women since pre-relocation information was lacking for the men.

Fried found that some people were overjoyed with the change and many felt no sense of loss. However, of 250 women, 26 percent reported that they still felt sad or depressed two years later, and another 20 percent reported a long period (six months to two years) of sadness or depression. For 316 men, the data showed only a slightly smaller percentage (38 percent) with long-term grief reactions. According to Fried, the true proportion of depressive reactions was undoubtedly higher, since many women and men who reported no feelings of sadness or depression indicated clearly depressive responses to other questions.

One of Fried's primary theses was that the strength of the grief reaction to the loss of the West End neighborhood was largely a function of prior orientations: the greater a person's pre-relocation commitment to the area, the more likely a reaction of marked grief. The data supported his hypothesis. Among those women who had said they liked living in the West End very much during the pre-location interviews, 73 percent

evidenced a severe post-relocation grief reaction; among those who had less extreme, but positive feelings about living in the West End, 53 percent showed a similar order of grief; and among those who were ambivalent or negative about the West End, only 34 percent showed a severe grief reaction. The pre-relocation view of the West End as "home" showed an even stronger relationship to the depth of post-relocation grief. The length of West End residence was also positively correlated with the loss reaction, although it was less important than some of the other factors. Also, the greater the area of the West End which was known, the more likely there was to be a severe grief response. Apparently, the wider an individual's familiarity with the local area, the greater his commitment to the locality.

Fried concluded that the post-relocation experiences of a great many people had borne out their most pessimistic pre-relocation expectations. There were wide variations in the success of post-relocation adjustment and considerable variability in the depth and quality of the loss experience. But the majority exhibited feelings of painful loss, a general depressive tone, a sense of helplessness, occasional expressions of both direct and displaced anger, and tendencies to idealize the lost place.

3.4 SUMMARY AND CONCLUSIONS

3.4.1 Comparability of Results

The majority of the issues discussed here have been researched sporadically. Problems associated with displacing populations are complex. The current generation of highway planners and engineers, under directives to consider psychological and social implications of right-of-way acquisition, have turned to relevant disciplines for assistance. Unfortunately, the development of social indicators is progressing slowly, and responses provided to planners and dutifully included in impact statements are frequently subjective.

Nevertheless, the majority of studies supported some general conclusions:

1. The impact of displacement for right-of-way acquisition is often more pronounced in low-income neighborhoods or in areas which contain large numbers of the poor, elderly, or racial minorities, and highway locations are more likely to be chosen through precisely such neighborhoods.
2. One major factor which probably inhibits the ability to adjust to relocation is the shortage of adequate, desirable, affordable housing which exists in most urban areas.
3. The major impact of displacement is not financial, but social and psychological, due to a sense of "localism" among inhabitants of urban neighborhoods.

Because of the complexity which is inherent in such issues, authors tend to concentrate their efforts on very specialized geographic areas or on a particular step in the process. No studies were found which trace the effects of the process as it evolves.

Difficulties also abound because of discipline orientation. Engineers and planners tend to ignore human factors or to give them cursory mention then exclude them, while social scientists may advocate a particular neighborhood, thereby distorting their scientific detachment. Associated with this is a dichotomy between practical and ideal solutions to the problem under consideration. The models presented have rarely been utilized and are unlikely to be. Proposals are frequently elaborate, but rarely implemented.

Another problem is definitional. Conceptual frameworks which are assumed in the studies are rarely, if ever, defined. Examples include "neighborhood", "social status", "low-income", etc. For expediency an operational definition is occasionally substituted. However, in general, this lack of definition undermines any conclusions and lessens the likelihood of reader comprehension and the ability to verify results.

3.4.2 State-of-the-Art

Relocation research prior to 1964 dealt primarily with urban renewal problems. Those studies specifically related to highway right-of-way acquisition were case studies of the effects of a specific urban highway project emphasizing property replacement experiences of homeowners and businesses. Most investigators concluded that displaced owners were fairly treated under the just compensation concept. The benefits of highway displacement were stressed on the basis that displaced owners often upgraded their residences or properties, hence improving both their own physical circumstances and the community tax base.

Research after 1964 focused on the costs, rather than the benefits, of displacement. Attention was directed toward the socio-psychological and other indirect effects. The impacts on sub-groups of the population and business activities disadvantaged by lack of mobility, power and finances have been explored in continually greater depth and understanding. A considerable number of studies were apparently generated in an effort to direct policy or influence decisions with respect to specific projects.²⁶

Methodological approaches have de-emphasized the traditional cost-benefit analysis to include techniques borrowed from the social sciences. The interdisciplinary team approach to solving problems is widely accepted.

In spite of the slowly increasing volume of research concerning issues related to displacement and relocation some areas remain generally neglected:

- The impact on small businesses

- The transitional period
- Social indicator development
- Practicable means of compensation for indirect impacts
- Interaction between relocation assistance personnel and dislocated individuals, households, and businesses.
- The effect on people left behind

3.4.3 Evaluation

The literature is basically oriented toward various types of categorized impacts, such as financial, social, psychological, etc. This emphasis is perhaps necessitated by the nascent state-of-the-art in this field. Few, if any, attempts have been made to date to assess the total impact upon an individual or group of individuals. Because of the limitations discussed in the prior sections, a composite picture of the total impacts of displacement and relocation occasioned by highway right-of-way acquisition is not available. The possibilities for further research in this area are limited only by interest on the part of concerned individuals.

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4.0 COMMUNITY FACILITIES

4.1 INTRODUCTION

New or improved highways may affect the use of, attitudes toward, and the actual operations of various community facilities such as shopping areas, schools, churches, parks and social organizations. Effects may be beneficial or detrimental. For example, construction of a highway can either provide the opportunity to replace obsolete community facilities or displace vital ones. If possible, it is best to plan the highway in coordination with local objectives so that it can serve as a positive instrument for community development.¹

This chapter treats the relative importance of community facilities and their role in determining route location; discusses specific facilities, such as parks and recreation, schools, religious facilities, shopping, service distribution systems; and attempts to summarize and derive some conclusions from studies concerning facilities in the literature.

4.2 RELATIVE IMPORTANCE OF COMMUNITY FACILITIES

The relative importance of various community facilities varies considerably both among and within communities. A study conducted by Gruen Associates for the California Division of Highways² questioned the comparability of effects on community facilities from one community to another. Since each community has unique needs, desires, and social interaction patterns, the ramifications of highway impacts will differ. For example, although one community might view removing a church for the right-of-way of a highway as a slight inconvenience which requires worshippers to use other available churches, a church removal elsewhere might provoke opposition if that church were an essential meeting place and social center. In order to determine the significance of a facility to a community, one must first understand the local community values and objectives.

According to the literature, analysis of neighborhood activity patterns has indicated that some activities are considered more important than others by specific neighborhoods. For example, in a study of West Philadelphia census tracts, McGough³ found that shopping was more locally based than any other activity investigated. Dewey⁴ noted that the facilities most desired within walking distance by the average middle class American family were a food market, elementary school and drug store. Ladd⁵ found that convenience to stores was the most important factor named by families with incomes below \$6,000.

Peterson and Worrall⁶ employed a multimodal scheme in a North Chicago suburb which included rank ordering, paired comparison, and a gaming procedure to analyze individual preferences for accessibility to selected neighborhood facilities. Eight service locations (church, shopping, fire station, emergency hospital, children's park, freeway,

public transportation, and close friends) were manipulated in order to determine the relative values attached to accessibility to each of the facilities. In addition, a sample of 250 residents (a majority of whom had lived in the same neighborhood for six years or more) were asked how much their current housing expenditures would have to be reduced for them to remain equally satisfied with their overall environment if access to a particular facility were decreased. The exercise was relatively unsuccessful in that respondents were unable to relate accessibility and housing cost, and could only judge a situation as being either acceptable or not acceptable. The preference scales used by the authors showed that facilities tended to cluster into groupings by order of importance. The most important group consisted solely of the emergency hospital; the second was composed of shopping facilities, a church, public transportation, a fire station, and a children's park.

Buffington⁷ surveyed Houston residents to determine what types of community facilities accounted for their choice of residential location. In order of preference, the factors which respondents gave for choosing a particular location were: good neighborhood, close to work, old home place, close to schools, close to parents or children, centrally located, convenient access to freeway, close to shopping facilities, close to downtown, and an area of no liquor sales. Buffington's data were quite specific; but the issue of why certain facilities were differentially important to residents was not addressed.

Data from many sources have shown that residents are quite sensitive⁸ to right-of-way acquisitions of community facilities. Phoebe Cottingham showed that some community facilities were valued more highly than others. The number of churches, for example, was a salient issue while public utilities was not. Cottingham also found that, generally speaking, groups actively opposed or supported action only when their own area of interest was involved. Furthermore, she concluded that groups representing a variety of interests tended to be more active in expressing opinions than specialized interest groups. However, communities differ, and their facilities also vary widely, affecting the degree of cohesiveness exhibited by the populace.

A second study by Cottingham⁹ focused on community responses to highway planning in an effort to evaluate the importance of considerations other than direct project costs. She found that attitudes toward free-ways: (1) varied by urban region and (2) were relatively unrelated to anticipated right-of-way impacts on community assets (i.e., properties, dwelling units, schools, parks, public facilities, utilities, churches, and planned subdivisions). She concluded that community value models "...which emphasize counting impacts, such as number of homes, schools, etc. in attempts to develop indexes or numerical evaluations of community values are not measuring community value."¹⁰ In essence, Cottingham said that simple frequency counts of available community facilities are insufficient, and their relative importance to the community must be considered.

4.3 ROUTE LOCATION

Gordon Fielding¹¹ developed a value analysis technique which allows community members, with help from technical advisors, to select from among alternatives the route that will provide the most benefits and fewest detriments to their community. Four categories of community considerations were developed for the value analysis: economic considerations, social considerations, traffic improvement, and design criteria. Included in the list of social considerations provided for individual citizens were the following:

(1) Social Facilities: Certain buildings and areas like schools, churches, community centers, and parks provide centers for community activity. They represent a community value, and the route that is least detrimental to the use of these facilities should be rated highest.

(2) Relocation of Social Facilities: In some instances schools, churches, community centers, and parks must be relocated. Normally freeways avoid these facilities, and highest rating should go to the least disruptive route. However, in some instances relocation or redevelopment through land trading is beneficial to the community. Your score should reflect both the social cost of change and the benefit to be derived from relocation in new facilities.

(3) Public Facilities: The provision of adequate police and fire protection necessitates superior access within the community. Freeways can either enhance this service by improving communication or obstruct it by blocking streets leading from existing or planned facilities. Highest rating should go to the route providing the least detriment-most beneficial service.

(4) Relocation of Public Services: Normally freeways bypass public buildings, and highest rating should be given to the route that is least disruptive. However, if you feel that it would be to the community's benefit to relocate the structure, then you would reflect that in your rating score.¹²

It should be noted that Fielding merely supplied a list of factors to be considered. However, if a value analysis is to be meaningful, guidelines are needed to ensure maximum uniformity in the meaning of values assigned by the participating citizens.

Marshall Kaplan, Gans, and Kahn¹³ conducted research to identify relationships between different types of communities with different social facilities. Once the relationships between communities were established, a model was proposed that would determine available highway corridors. The step-by-step procedure for using the model was divided into three phases; isolation of neighborhood facilities, definition of neighborhood service areas, and evaluation of the vitality of neighborhood activity patterns. The first phase consists of a thorough inventory

of the facilities in each area involved in a highway corridor study. From the inventory, neighborhood facilities are isolated, and techniques are introduced to define the boundaries of local service areas. The result is an "activity zone" within which each community facility has its primary impact. Finally, the study recommended a method of ranking the vitality or strength of each facility. From these considerations a corridor is determined. This model treats the community as a system of social interaction, rather than as a purely spatial object. Changes in the social interaction of people or changes in their activity patterns induced by highway construction thus become an indicator of the social impacts of highways.

The first of the two models for highway route selection discussed above entails direct citizen participation in ranking impacts on community facilities. Rankings for the other model are made by highway planners, based on information gathered from citizens. The question remains as to how citizens communicate their preferences to highway planners, and how highway planners inform citizen groups of the criteria under which the various alternative highway locations are selected.

4.4 SPECIFIC FACILITIES

4.4.1 Parks and Recreation

According to Rex Whitton¹⁴ a park may be considered "as a physical attempt to satisfy a social need, be it open space, a bit of green, an area for active sport and games, or the more passive forms of recreation, such as sitting, walking or general relaxation." Highways are sometimes responsible for the removal of parks, but they can also supply transportation to parks and recreation areas. In fact, there is a strong association between highway travel and recreation; large recreation areas often rely on good highway transportation to bring visitors. At a New York-New Jersey Regional Recreation Conference, one participant (G. E. Spargo) suggested that the tremendous growth of the park system was associated with the expansion of the arterial highway network.¹⁵

There is a need for both local and regional parks. Not everyone can travel to outside recreation areas, therefore a system of neighborhood parks needs to be kept intact. A freeway system can introduce and increase small park facilities; for example, broad rights-of-way can incorporate small internal strip parks. Dennis Neuzil¹⁶ stated that a "network" park system for metropolitan areas has been suggested several times. Such a system would line freeways with strip parks, and join larger parks in the urban area, creating "a web of green open spaces".

Urban planning is not usually completed far enough in advance to encompass a whole city with parks. Some studies have included discussions on how parks were replaced or conserved for citizen use in their area.

For example, Interstate 105 Freeway¹⁷ suggested some methods for developing existing parks; however, local jurisdictions were somewhat reluctant to accept the advice of the interdisciplinary study design team on this issue. According to the study, citizens were concerned about the number of problems involved with adequate policing, supervision, and maintenance of the parks.

Cottingham¹⁸ studied the relationship between parks and freeways, particularly the importance of parks to the general public. She was very concerned about measurement related problems and suggested that the following list be given high priority:

- (1) Nature of the economic good ("park"),
- (2) Units of measurement of park use (e.g., "user days"),
- (3) Prices or valuations on park use,
- (4) Benefits and costs of a park,
- (5) Allocation of park resources for capital, maintenance, opportunity, etc.

Cottingham incorporated these factors in a preliminary model to examine the impacts of freeway locations on neighborhood parks. Her argument was that a park's value is a function of: (a) its type, quality and size; (b) neighborhood area of potential users; and (c) park qualities and neighborhood characteristics which influence the features of the park. The value of the whole park system can be altered by changing the total supply of park land, estimated future demand in user days, or accessibility.

Cottingham located and identified a sample of nine parks which had been affected by freeways. She found that, on the average, 50 percent of the people in a park service area were cut off from the park by the location of the freeway. "In general, the residential areas cut off from a park by the freeway had higher rates of owner-occupancy, higher density per living unit, and lower proportions of the population being non-white."¹⁹

Although the study was based on a limited sample and did not compare data over time, Cottingham's research was one of the better examples of highway impact evaluation encountered in this review. She candidly admitted that "There is considerable variation in the impact of freeway locations on neighborhood parks, varying by both nature of the park and neighborhood external to any freeway effects and the design features of the freeway which allow or impede access to the park."²⁰

In summary, park and recreational facilities are sometimes separated from their user populations by a highway. When they are not, access to the general public is usually increased if transportation facilities are available. Unfortunately, better access sometimes promotes overuse of parks and recreational areas which, in turn, precipitates environmental degradation.

4.4.2 Schools

Education has been significantly influenced by highway construction and improvements. The number of rural one-room schools has decreased during the past 40 years from about 190,000 to 25,000.²¹ Schools have become larger, the number of pupils being bused has increased, the distance traveled by the buses has increased, and the unit cost of transportation per pupil has decreased. Wilbur Smith and Associates²² have suggested some additional highway induced benefits: (1) increased percentage in school enrollment of the total school age population, (2) percent increase of average daily school attendance, (3) consolidation of schools and school districts, and (4) the possibility of commuting to college, evening adult education and extension courses.

The special concern in this review is a new highway's impact on the continued existence of schools and the areas from which they draw their students. Such impacts would include severance of attendance areas, detrimental reduction of pupil population (displaced by right-of-way acquisition) and increases in ambient noise levels.

When the highway divides a school district, alternative courses of action are available to school administrators, according to Gruen Associates.²³ One alternative is to provide adequate bridges or undercrossings so that pedestrians and/or vehicles can reach the school. The other alternatives are to rearrange the boundaries of the school district, close the school, build a new one, or redistribute students among other schools in the area. The Gruen study reported that officials of the Lynwood, California school district recommended closing the Lynwood school, redistributing its pupils, and converting the facility into needed district administration offices.

The authors also reported on several studies which examined freeway related noise at various schools along the highway corridor. Projected freeway-generated noise levels ranged from 48 to 71 dBA, but the majority of schools were expected to experience levels of 55 to 61 dBA. Abatement of such high noise levels would be desirable.

Noise reduction for schools can be accomplished in several ways. The design of the highway can be changed, walls or barriers provided, or windows kept closed to lessen the amount of noise. Although providing the money to air-condition buildings can help eliminate one of the major negative impacts which highways have on schools, this solution has to be balanced against energy expenditure.

4.4.3 Religious Facilities

A number of studies have listed churches and other religious facilities as impact areas to be considered by planners, but few authors have actually examined the effect of highway construction on church activities. One exception, Thiel,²⁴ discussed trends in church attendance and related them to highway changes. He noted that church membership

has grown mostly in suburban areas. In fact, although 70 percent of a sample of suburban churches had expanded in membership size, urban churches had not experienced a similar growth, and many appeared to be declining in membership. The author concluded that people seem to be traveling farther to attend larger churches, presumably because highways and highway access have improved.

Highways have been beneficial to churches in other ways. Thiel sees an advantage to building a church next to a freeway; it literally is "going on display". Non-user impacts related to religion are closely tied to the individual community. Church activities naturally correspond to population movements; if a highway changes the population of a community in one way or another, it will also alter church activity patterns. To be more specific, changes in neighborhood characteristics may have a profound effect on church membership and community support. Hence, a church building need not be removed to be affected by a freeway.

4.4.4 Shopping

The impacts of freeways on shopping and shopping centers are mostly economic in nature. A number of studies have examined the levels of business activities before and after a highway was built. Most of the studies to date have emphasized the complexity of the highway's effect on local entrepreneurs. William Garrison²⁵ stated that just as business establishments may or may not have been located optimally prior to highway construction, the same may hold true after the highway is completed. These "mays" and "may nots" are certainly a function of the kind of business (a strategic location for a gasoline service station would presumably be different from that for a general store), and the kind of location (frontage road versus downtown location, for example). He terms this portion of the business environment as the location aspect. Another aspect is the site of the business establishment. Changes in highway facilities may affect the amount of available parking, the ease with which the establishment can be seen from the highway, the ease of access from the new roadway, etc. These effects vary with the type of business (for example, a drive-in would differ from a tea garden in sensitivity to noise) and by the type of highway design features.

The adequacy of shopping centers clearly influences whether people go outside their immediate district to purchase needed items or services. The importance of neighborhood shopping areas which cater to the specific needs of residents was reported by Marshall Kaplan, Gans, and Kahn.²⁶ In addition to stocking general merchandise, many shops carried ethnic specialties not available in other parts of town.

The importance of shopping centers generally depends on the mobility of the community residents. Thus, the degree to which the highway has a positive or negative influence on shopping activities may be closely related to such factors as dependency of local residents on walking to and from stores, mass transit, or private automobiles.

4.4.5 Service Distribution Systems

The majority of the literature concerned with service distribution systems such as fire and police protection, health and postal services, and public utilities primarily emphasizes benefits purporting to accrue from developments in the road network since the beginning of the automobile era. Two major summary studies exist: Floyd Thiel's work concentrated on the value of the availability of efficient highways while Wilbur Smith and Associates stressed the contributions of highways as well as some negative features. Both studies are somewhat outdated, having been written in the early 1960's.

Thiel²⁷ claimed that the efficiency of many services has been increased by improved mobility. Fire fighting organizations rely on highway transportation to obtain mutual aid in case of severe emergencies, and police protection has been enhanced by the introduction of mobile units. Medical personnel formerly used highways for home care, but partly due to road improvements and the increase in automobiles, patients now visit the doctors' offices. The increased efficiency from this change was alluded to in an American Medical Association study cited by Thiel which indicated that in one rural county in Illinois, sixteen physicians in 1950 provided more service for more people than 42 had done in 1920. Improved highway transportation appears to be at least partially responsible for the trend to longer rural postal delivery routes, fewer post offices, and an increase in the portion of mail delivered by highway. Such changes have markedly affected productivity; the average length of rural delivery mail routes increased from 27 miles in 1920 to 56 miles by 1959. Though the number of post offices has declined, the volume of mail increased substantially; the percentage increase in mail volume has been approximately twice that of the population.

The second major study, by Wilbur Smith and Associates²⁸ assumed that roads would not exist if the benefits did not exceed the costs. Relatively detailed lists of impacts resulting from highway improvements (expressed in terms of percentage increases) were given for education, police and fire protection, health services, libraries, and other selected public services. Under library services, for example, the authors discussed such highway-induced changes as increases in circulation, the institution of bookmobiles and branch libraries, and increased access to main libraries due to reduced travel time and improved accessibility. It should be noted, however, that exogenous factors which may also have accounted for part of the increase were mentioned, but apparently ignored in reaching conclusions. For example, the education of a larger proportion of the population has also contributed to increased library circulation.

Several other studies have specifically investigated the benefits which utilities have received through the use of streets and highways as locations for these service facilities. James Lemly²⁹ determined the value of benefits to utility companies by calculating the cost of alternative rights-of-way in rural and urban areas of Georgia,

Wisconsin, Colorado, and Texas. Lemly concluded that utilities, public and private, benefit from lower costs as a result of privileges to use street and highway rights-of-way.

In another study, Nelson *et al.*³⁰ collected data in Utah relative to the use of public rights-of-way by each utility in the state, determined the advantages which accrued to the utilities from such usage, and evaluated them in terms of monetary cost savings. They found that approximately 92 percent of the lines of all water and sewer systems, 77.5 percent of natural gas company lines, 52 percent of all telephone lines, and 41 percent of electric power lines are on public streets and highways. Nelson *et al.* called attention to three categories of costs associated with utility usage of highway rights-of-way: effects on vehicle operation, effects on construction and maintenance costs of the highway system, and the aesthetic effect of utility poles. Among the benefits they discussed were the economic desirability of multiple use of scarce land resources, lower rates to the consumer, and lower maintenance and construction costs to the utility companies.

4.5 SUMMARY AND CONCLUSION

The majority of articles in the highway literature did not deal solely with community facilities, but only touched upon them briefly. No one appears to have done an in-depth study of the impact of highways on community facilities, or to have studied any one type of facility in detail.

Some basic problems are manifested by the literature: (1) few of the studies attempted to show that an impact specifically related to a highway had really occurred; (2) "neighborhood" or "community" was rarely defined; (3) authors seldom attempted to obtain empirical data from citizens (few questionnaires or other methods to obtain opinions were designed); and (4) frequently, impacts on community facilities were only listed without any attempt at quantification.

Despite these limitations, several conclusions can be drawn from the few studies which did consider community facilities. People tend to react negatively to the disruption and inconvenience caused by highway construction. They don't want freeways disrupting local facilities, but they do want freeways available for their use; thus they want the highway built in someone else's community rather than their own. A typical example is quoted by Gruen Associates:³¹ "We feel that the present route will burden our district with unnecessary financial losses, a split of school attendance areas, dirt, noise and other nuisances detrimental to the educational program." The neighborhood school emerges as the facility that communities seem most anxious to preserve.

The adequacy of community facilities is affected by the strength of neighborhood activity patterns. Where facilities are located outside the community, the impact of highways on neighborhood activity patterns

is not great, and access to these facilities is often improved. The impact is greatest where facilities are located in the community and depend on pedestrian traffic. Because communities are unique with respect to the value attached to various facilities, they must be considered individually when planning highway route locations.

Community facilities have sometimes suffered as a result of highway construction. Anthony Downs³² suggested that they lose patronage if highway displacement removes customers, or become overcrowded if highway displacement removes alternative sources of supply (such as the loss of a local school). Community facilities are also adversely affected if access to them is hindered or if access to other sources is improved. Few of the studies reviewed here have attempted to measure the scope and magnitude of disbenefits accruing to specific community facilities as a result of highway construction.

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5.0 AESTHETICS

5.1 INTRODUCTION

Aesthetics, when applied to highway issues, is usually discussed as a practical rather than a philosophical issue. Patricia Moser,¹ in a summation for the Highway Needs Report in 1972, suggested that:

...an aesthetically pleasing road would be one which the majority of the community considered attractive, or which (if nothing better could be managed) did not offend a significant number of people. It is quite possible that the majority opinion of a road's aesthetic quality could change over the road's lifetime.

At least for the present, aesthetic standards are basically subjective. Groups of people may or may not agree on transitory norms; highway engineers may or may not correctly divine such norms and interpret them adequately in construction. Charges are frequently leveled at highway officials for ignoring aesthetics in favor of least-cost methods. However, in the past several years interest, at least in the literature, has become continually more pronounced.

This chapter will treat aesthetic issues involved in highway construction. The discussion will be limited to visual factors in order not to overlap with Chapter Six on Noise, although this limitation is arbitrary. The remainder of this chapter is ordered as follows. Section 5.2 discusses the various components included in the general category of aesthetics and 5.3 places these components in the perspective of their importance to the public. Sections 5.4 and 5.5, respectively, discuss proposed means to enhance the aesthetic qualities of highways, and suggest techniques for incorporating aesthetic considerations into highway planning. Section 5.6 briefly evaluates the literature on these topics.

5.2 AESTHETIC CATEGORIES

In general, there is little agreement in highway studies as to specific elements which should be included as aesthetic considerations. The category is a conglomerate, frequently consisting of factors which are not readily included elsewhere. However, there is wide agreement that aesthetic considerations vary according to viewpoint.

5.2.1 Factor Lists

The traditional factor list of aesthetic impacts, suggested by the Federal Highway Administration² as relevant to the location/design process, includes visual quality, city image, perception sequence, and rhythm.

Marvin Manheim³ expanded the FHWA list and developed the following taxonomy:

1. View of the Facility: lighting (dark scary areas, cold light, monotony); location (obstruction of sunlight, change of air currents, visual barrier); architectural quality (image-ability, dimensional balance, beauty, orientation, psychological barrier).
2. View from the Facility: location (perception sequence); design (rhythm, signs).
3. Natural Beauty: open spaces; greenery; park system; boulevards or gardens; lakes; wildlife habitats.

As actually used in impact studies, the contents of the aesthetic category vary extensively. For example, an evaluation of four alternative highway routes in Ogden, Utah⁴ was partially based on an aesthetic rating scale which consisted of the following factors:

- Contributing to total city green (open) space,
- Effective city entrance,
- Neighborhood regeneration,
- Neighborhood aesthetics,
- Visual impact to motorists.

5.2.2 Viewpoint

An individual's assessment of the aesthetic quality of a highway is based on his physical viewpoint as well as his subjective values. Value judgments may differ, not only among individuals, but in the opinion of a single individual as his relationship to the highway changes. The viewpoints a person may experience are traditionally categorized in the following manner:⁵

- The View from the Road,
- The View of the Road,
- The View by the Road.

From the perspective of the highway user, the highway appears and disappears at the threshold of visibility. The driver takes the highway's continuity for granted, seldom noticing how the freeway is designed and of what materials it is constructed, or viewing details in the neighborhoods through which he passes. Rather, he is exposed to a series of panoramic impressions.

As seen by a pedestrian, the expressway is a massive monolith, dominating the urban "streetscape". Usually monochromatic, it is largely devoid of texture and undistinguished or confusing in terms of aesthetic expression. The highway often assumes the character of sculpture which can be viewed from all sides and from above and below. In general, the freeway presents a better appearance from a distance.

The view of the road from adjoining or nearby property varies according to the particular type of land use. To occupants of an office building or high-rise luxury apartment building, the view of the nearby highway may be interesting or even stimulating. To those in more modest housing, the freeway might constitute a source of continuous noise. From this reference point, the freeway often constitutes a barrier, frustrating both physical and visual attempts to interact with other parts of the city. Although this barrier may be useful as an element separating incompatible urban areas, it is likely to be overly imposing to the individual. If it is an elevated freeway, its height, mass and the dark space underneath can appear threatening. If it is depressed or at grade, the huge open area created by it can become a "no-man's land", inaccessible on foot, a corridor of alien territory which will not support human life.

Conflicts of interest among these viewpoints often exist. In such instances, it is generally agreed that the group most affected should be given priority. For example, an expressway in a scenic corridor should favor the user, while a freeway in a built-up section of the city might favor residential neighbors. Since highways can be overwhelming at close range, the view by the road must be given priority if the living space of people in cities is to be respected. Frequently, if the view by the road is made pleasing the views from and of the road will be also.

To date, the majority of aesthetic studies have been user oriented, concerned with the view from the road. However, for the purposes of this report, the discussion will be limited to non-user aspects, that is, the views of the road and by the road.

5.3 RELATIVE IMPORTANCE

With the myriad problems confronting highway planners, it is difficult to attain perfection of design. There is a tendency to ignore problems which are not emphasized by opposition groups and which are thus less likely to create conflict. Therefore, it is interesting to note the relative importance of aesthetics to the public and highway officials. Two major studies have investigated priorities concerning highway issues, with similar results.

Martin Wachs⁶ attempted to isolate perceptions of the relative returns to be gained from investments in various types of transportation improvements. He asked each individual in a sample of private citizens to theoretically allocate one hundred dollars among several types of transportation improvements. He found that extremely low importance was assigned to the beautification of transportation facilities.

Another group of questions included in his survey determined what effects the respondents felt that a freeway built through their neighborhood might have. Fifty percent of the citizens felt that a freeway within five blocks of their residences would not make their communities unsightly or unattractive, thirty-three percent stated that such a freeway would make their neighborhoods unsightly, and the remaining seventeen percent expressed

no opinion. The respondents who felt that a highway would make their communities unsightly could be discriminated from the others by their higher levels of education, longer periods of residence at current addresses, lower mean car ownership, and higher representation in white collar and professional jobs.

Wachs also asked his sample to rank broad, general criteria which could be applied to problems in the selection of rights-of-way for new freeways. The suggestions for freeway location which involved providing pleasant scenery for the driver and harmony with surrounding scenery received the lowest rankings. Thus, Wachs found that the respondents generally attached low levels of importance to scenic and aesthetic considerations.

In another study, J. B. Mason and C. T. Moore⁷ studied the importance of various highway criteria as perceived by two population sets: first, public officials as compared to private citizens; second, school administrators as compared to highway engineers. For both sets the results were obtained by forced choice rankings. The following conclusions relevant to aesthetics were drawn:

1. Private citizens ranked "retardation of urban blight" as much more important and desirable than did public officials. The lowest ranked items by both of these groups were "improved public lighting system along highways", and "reduction of unpleasant visual effects".

2. The school administrators strongly emphasized the importance of aesthetic values in the planning process and were in agreement as to specified ways of implementing such values. The highway engineers either were not very interested in aesthetic features and factors of landscape beautification relating to roadway planning, or else perceived this element to be beyond planning parameters.

In view of the almost universal low level of importance assigned to aesthetics, the lack of solid research in this field is not surprising. Nevertheless, as various other problems are resolved and the order of precedence shifts, aesthetics will probably receive more attention. The public is not disinterested in the issue, but the relative importance is obscured by more immediate problems.

Highway officials are cognizant of this situation. In a Highway Research Board Special Report,⁸ the authors suggested:

Visual amenities are important in the measure of highway values by the public. This is valid reason why the concern with the civic beauty should occupy the highway planner from the start, without waiting for the emergence of an "anti-ugly" opposition.

5.4 BEAUTY VS. BEAUTIFICATION

The beauty of a highway is an inherent characteristic of its location and design; beautification is cosmetic treatment. Beautification may soften the unpleasantness of an unattractive highway or enhance the appearance of an attractive one, but it cannot by itself make a highway aesthetically pleasing.⁹

Since aesthetic qualities are subjectively imposed by the viewer, criteria for improving aesthetic quality which have been suggested by various authors must be viewed as statements of individual preferences.

5.4.1 Beauty

The most extensive set of standards for highway design was developed at Washington State University.¹⁰ The first set of standards dealt with basic route location:

- Conformity with regional and city planning,
- Relationship with the pattern of the landscape and the city,
- Avoidance of "Sacred Areas",
- Avoidance of areas where the highway will harm people by its noise and large scale,
- Location to avoid generating undesirable activities and changes.

The second set of standards dealt with design decisions which should take place at the time when the route is selected:

- The continuity of the "ribbon" of road,
- The integration of the ribbon in the city structure,
- The scale relationship of freeway and its surroundings,
- The problem of noise,
- The problem of the freeway as a barrier,
- The freeway as an element of change in a community,
- Standards for landscape design.

Although the range of suggestions was too broad to examine thoroughly here, a few samples will serve to illustrate the general format. The following are examples of route location standards:

- Locate and design the freeway so that future urban changes will not cause adverse visual complications.
- Locate the freeway in a proper relationship to the configuration of the base terrain.
- Do not locate a freeway where it will encourage commercial strip development beside it.

Design decision standards included items such as the following:

- Design the freeway so that it relates well in scale to the urban areas it crosses.
- Fence-in freeways in a way which is visually satisfying.
- Use the building of the freeway as an opportunity for the elimination of excessive urban accessories.

The majority of suggestions by other authors appeared to be derived from the Washington State standards.

5.4.2 Cosmetics

Although good appearance is a functional quality of the basic structural design and not easily achieved after the structure has been completed, "cosmetic treatments" may be necessary as a last resort. A basic strategy may be to screen as much of the structure from view as possible either by planting and landscaping, or by constructing buildings or screenwalls.

The general principles of the most frequent application of cosmetic treatment were described in The Art and Science of Roadside Development.¹¹ The roadside, the area between the shoulders and the right-of-way limits, may be improved by saving and protecting existing trees and other desirable growth on the right-of-way from destruction. Plantings appropriate to the local area may be used to screen headlight glare and to provide a visual screen and partial sound barrier between the highway and adjacent urban development. The authors suggested that appropriate planting can partially dispel opposition to the location of urban freeways.

Brinton and Bloom¹² examined the effect of highway landscape development on nearby property. Data were developed by: (a) establishing a series of objectively measurable physical disturbance factors created by the highway such as noise, odor, headlight glare, and vibration; (b) evaluating the property-value differentials caused by various levels and degrees of the physical disturbance factors; (c) evaluating the effectiveness of various degrees of landscape development in abating the physical disturbances; and (d) conducting approximately 800 interviews with owners of property adjacent to highways.

The authors concluded that the presence or absence of landscaping on the right-of-way of a limited-access highway does not affect the value of adjacent properties. However, people living next to such highways indicated that they would accept the presence of the highway more readily if it were concealed from view by landscaping. Attitudes relating to disturbance factors held by people living next to a highway, even in the same geographic location, varied greatly.

5.5 MEASUREMENT TECHNIQUES

According to Patricia Moser,¹³ the ideal would be to measure aesthetic quality in a way which would allow direct calculation of the extra expenditures needed to achieve given levels. Unfortunately, no such method appears to exist at the present time. The predominant contemporary techniques emphasize the use of rating scales or the measurement of individual factors.

5.5.1 Rating Scales

The Washington State Desirability Scale¹⁴ is a technique for rating the relative desirability of various highway routes. A proposed route is given a numerical rating for each of a set of aesthetic considerations and from these ratings a single desirability index for appearance is computed. Weighting factors are assigned to reflect the goals and objectives of any specific route by knowledgeable people involved. The appearance considerations are then combined with similarly derived sociological and economic scales to provide a desirability rating scale for the entire route.

As described, the method appeared to have a number of serious flaws. For example, the three proposed rating scales were scored differently. Therefore, it was necessary to rework one scale in order to make it compatible with the other two. Also, little rationale was given for assigning a particular numerical rating to any item on the scale. The explanation for its final usefulness was vague.

In a study done in Ogden, Utah,¹⁵ another scale was developed. Aesthetic ratings were assigned to four specified alternate routes on a scale ranging from +10 to -10. Again, very little justification was given for the appropriateness of specific numerical values. The meager discussion hinged on other factors, such as safety, property values, and neighborhood disruption. No methodology for obtaining the composite scores was described, although such scores were given.

5.5.2 Measurement of Individual Factors

Bor and Roberts¹⁶ described methods for measuring visual intrusion. They differentiated between intrusion and change of view, defined as whether the highway occupies more or less than 50 percent of the visual field, respectively. A full-field camera was used to photograph an operational highway (or the void created if it was depressed). For predictive situations, the highway was superimposed on the photograph. Diagrams containing the calibrated field of view were then superimposed, and the number of obliterated rectangles read off to obtain a rating for the degree of intrusion/change of view. The authors attempted to correlate intrusion measurements with social response, with limited success. Lower income groups were generally disinterested in visual intrusion, other income groups showed concern either on aesthetic or property depreciation grounds.

Brinton and Bloom¹⁷ developed a method for measuring traffic visibility by utilizing the technique of experienced observation. A trained observer viewed the highway from the back of the selected home, while a photograph was taken of the scene. Later, the projection of the photograph was superimposed on a specially prepared screen grid, the ratio of unobscured grids to total number of grids was determined, and the percent traffic visibility was obtained by multiplying the ratio by 100.

5.6 SUMMARY AND CONCLUSIONS

Empirical studies concerning aesthetics were virtually non-existent in the reviewed highway literature. The majority of available non-user studies asserted that aesthetics should be taken into consideration as a highway impact, then the authors ignored the issue in their research. The rudimentary state-of-the-art in this area is influenced by two major factors: lack of expressed public interest, and the subjective nature of the problem area. Hopefully, as other more controversial problems are solved, priority will be given to further research on aesthetic issues.

This general situation was aptly summarized by Peterson:¹⁸

Things that are physically discordant, relative to their objectives, are neither good art work nor good engineering. To the extent that highways are aesthetically and functionally ugly, they are in discord with the objectives they are intended to serve. The cost of these discords should be evaluated if possible and compared with the costs of harmony. Thus, complete value analysis has not been accomplished until performance has been evaluated relative to all significant fundamental goals.

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6.0 NOISE

6.1 INTRODUCTION

Noise has become of considerable significance in modern life, particularly in and around urban areas, where approximately 80 percent of the Nation's people live.¹ The ambient level of urban noise continues to increase although, according to Rubin,² there is considerable controversy over the rate of increase. Bolt, Beranek and Newman³ estimated that construction noise alone affects approximately 30 million people each year, yet transportation was recently identified as the prime cause of increased noise.⁴ This gradual change in increased noise levels usually goes unnoticed. Given the extraordinary human capacity for adjustment,⁵ noise may be partially responsible for adverse effects on those exposed to it without the cause being positively recognized.

6.1.1 Highway Noise Sources

The noise emanating from a highway is a composite derived from the moving stream of many different types of vehicles. Noise level depends on many factors; the most obvious being the number, type, speed, and condition of vehicles using a given road. Generally speaking,⁶ vehicles generate engine-exhaust and tire-roadway interaction noise. Noise generated by an automobile increases with speed while the noise generated by a truck remains relatively constant.

Road traffic may be free flowing or congested.⁷ Vehicles in a free flowing stream move at relatively constant speeds with little interaction between them. Congested traffic is characterized by stop-and-go movement and considerable interaction. Particularly irritating congestion noises are due to acceleration, gear changes, braking, and horns. Although congestion does not significantly increase the average level of free flowing traffic noise, it does increase the number and magnitude of noise peaks, which are most apparent near the road.

The topography and character of the surrounding land and intervening structures may delimit noise propagation by absorption or deflection. Weather and/or seasonal conditions may also modulate perceived noise levels, although it is not clear if this is due to changes in noise propagation or simply to changes in human activity levels.⁸

6.1.2 Noise Measurement

Noise is not a single sound, but a discordant and often meaningless mixture of many sounds differing in frequency, intensity, and duration. In terms of physics, it has been described as broad-band energy without periodicity;⁹ or, in psychological terms, as unwanted sound.¹⁰ The latter definition implies that noise may be physiologically arousing and harmful, subjectively annoying, or disruptive of performance.

Physiologically, sound may be defined¹¹ as the sensation resulting from the stimulation of the organs of hearing by vibrations transmitted through the air. Implicit in this definition are three elements: 1) a source of disturbance causing the vibrations; 2) a path through which the vibrations can be transmitted; and 3) a mechanism for receiving the vibrations. The particular type of vibration that constitutes sound is actually represented by fluctuations in the air pressure above and below the average atmospheric pressure. The physical term "sound pressure" is used to describe the amplitude of the pressure fluctuations; the term "loudness" is a subjective expression of sound level. Similarly, the physical term "frequency" gauges the rapidity of the fluctuations, while "pitch" or "tone" is the subjective measure.

Sound pressure or loudness is the standard measurement in highway noise studies.¹² Since the range of amplitudes encountered in the everyday environment is so great, a logarithmic scale, called the decibel (dB) scale, is used to measure sound pressure. The softest sound that can be heard corresponds roughly to zero decibels. The human ear responds to intensities ranging approximately from 0 to 140 decibels. The noise from automobiles typically falls in the 70 to 80 dB range, city buses about 90 dB and painful sound at 130 dB or more.

Sound frequencies are measured in hertz (Hz, cycles per second). Although for human hearing the frequencies of importance are those between 20 and 20,000 Hz, most researchers now use a modified "A" scale,¹³ which concentrates on frequencies in the 800 to 3000 Hertz range. Because the majority of all perceived noise falls within these limits, the reliability of the data is increased. Reasonably accurate and simple noise meters based on the dBA scale may be used to take noise readings directly at a site.

A 1963 London survey¹⁴ indicated that typical background noise levels on heavily traveled arterial roads ranged from 68 to 80 dBA during the day and 50 to 68 dBA during the night. Other recorded daytime values were 63 to 75 dBA on major roads with heavy traffic, 60 to 70 dBA on main residential roads, and 51 to 65 dBA on residential roads carrying only local traffic. In Great Britain¹⁵ the standards for maximum acceptable outside noise levels generally fall between 65 and 70 dBA, although it is recognized that the standard should be elevated or reduced depending on environmental circumstances.

6.2 PHYSIOLOGICAL RESPONSE

Severe exposure to very high intensity sound can result in permanent physical or structural damage to the ear and subsequent hearing loss, particularly in the higher frequency ranges. The adaptive capacity of man to short term exposures to severe noise appears extensive, however. That is, if the noise is not of sufficient power to damage the ear, hearing acuity will rebound rapidly. However, whether complete adaptation occurs over the long term to continuous, semi-continuous, or intermittent exposure to sound or noise of some severity remains a serious,

unanswered question. Many investigations now hypothesize that such adaptation is incomplete and that lengthy noise exposure at appreciable, but unspecified, levels will eventually result in adverse and irreversible effects.¹⁶

The prevailing suspicion¹⁷ is that the effects of noise are cumulative and, as a result, both the level and duration of any exposure to noise must be carefully examined in determining possible effects. The specific effects that noise has been shown to have on man include an increase in muscular tension, sweating, metabolic changes, reduced gastrointestinal activity, nausea, headaches, tinnitus, drowsiness, respiratory irregularities and emotional disturbances. Sufferers from diseases such as heart trouble, asthma, ulcers, and gastrointestinal spasms are particularly vulnerable.

Actual behavior indicative of noise susceptibility¹⁸ may include acting directly to alleviate or escape from the problem, such as moving from a noise ridden area. More abstractly, a lowered tolerance toward stimuli from the overall outside environment may result. In other words, heightened irritability due to noise susceptibility may generalize to other less intrusive components of the outside world which otherwise might be comfortably disregarded.

One interesting explanation for man's sensitivity to noise,¹⁹ particularly in the city, is that he is subject to the same territorial imperatives as the lower animals. Although sometimes suppressed by sanctions within a society, this need becomes apparent when man finds himself resisting an invasion of his personal space or territory. Yet noise respects no such boundaries.²⁰ Since the individual may be bombarded by this pervasive stimulus wherever he goes, either escape or defense may be impossible.

Obviously, noise can prevent sleep or awaken a sleeper. It is not as obvious that noise can reduce the effectiveness of a night's sleep without rousing the sleeper. Noise interrupts the deep sleep stage, resulting in a less beneficial stage of sleep.²¹ Because sleep is a more or less "unconscious" state, and because learning and most other adaptation requires some kind of conscious activity, it is also difficult for the sleeper to adapt to the disruptive effects of sound.²²

6.3 PERFORMANCE

Task interference due to noise is another important consideration. The results of field studies on the topic vary nearly to the point of contradiction, and the vast majority are not concerned with traffic noise. Only two major studies specifically treated the effects of highway noise on task performance.

6.3.1 Ward and Suedfeld

Ward and Suedfeld²³ evaluated some potential effects of the proposed extension of a major highway near a university campus, with the expected increased level of ambient traffic sound as the major independent variable. The study was conducted in two major parts.

1. Classroom Behavior Data. Data were obtained during the course of three days in an experimental condition with traffic noise being broadcast via loud-speakers outside a large classroom and dormitory building, and during three days in a control condition in the same classes. Two kinds of data were obtained; first, from questionnaires filled out by students attending classes in the building, and second, from rating forms completed by trained observers sitting in on classes.
2. Field Experiment. Paid student volunteers were divided into three groups and assigned to dormitory quarters for one week. One group was designated as a control; the other two were assigned in pairs of individuals to high and low-level traffic broadcast sound rooms. The students completed a packet consisting of variations of memory, story integration, and affective state tests three times daily. Group discussions and cognitive games were also conducted.

The major innovation in the study was the inclusion of measures of social interaction. Induced sound significantly affected performance in group discussion, with the high noise level group spending more time in discussion, making more statements per unit of time, expressing disagreement rather than agreement, showing tension and asking other people for opinions more often, and being more forgiving of their opponents' breaches of cooperative precedents in the games. In the classroom, high sound levels led to less classroom participation and less attention to classroom proceedings, with trends away from discussion and toward lecturing.

Emotional reactions to the sound itself were uniformly, strongly, and sometimes violently negative. Subjects reported being annoyed by the noise both in class and in the dormitory, and that it led to less enjoyment of class and less desire to participate in the study. Spontaneous comments, threats, and actual attempts to disrupt and sabotage broadcasting equipment supported these data.

On the more traditional measures, the effects were much less dramatic. Brief tests of cognitive performance showed no reliable effects of induced sound; sound did not raise general arousal level either as measured by heart rate or as inferrable from improvements on simple cognitive tasks and decrements on complex ones.

The authors concluded that more research is needed in this area, suggesting the inclusion of personality measures and a greater variety of physiological dependent variables, the use of more types of cognitive tests, the extension of experimental sessions to several weeks, and the collection of data from more representative samples of impacted populations.

6.3.2 Glass, Cohen, and Singer

An interesting departure from traditional research methods was reported by Glass, Cohen, and Singer.²⁴ Elementary school children who lived in an apartment building abutting a Manhattan expressway were employed as subjects. The authors noted that expressway generated noise was "moderately loud" on the first floor, but diminished measurably with each succeeding floor. They hypothesized that noise exposure would have adverse effects and that the effects would be more serious for children living on lower floors where expressway noise was loudest.

Floor level was found to correlate significantly with auditory discrimination in children who had lived in the same apartment for four years or more, but not for shorter periods. The same relationship was found between floor level and scores in reading achievement (word knowledge, reading comprehension, etc.). It should be noted that the results were not affected when the authors controlled for socio-economic status and education level of the parents. Thus, they concluded that noise intensity and length of exposure were important factors in the subjects' ability to discriminate between sounds and in reading achievement:

The research reported here suggests there are four factors of importance in determining the effects of noise on behavior: intensity, duration, predictability, and controllability. The clangor found in modern cities is frequently intense, unpredictable, and largely uncontrollable. Our evidence warns that decreased tolerance for frustration, loss of efficiency, deficits in auditory discrimination, and lowered reading achievement may be the price for living in modern cities.²⁵

6.3.3 Related Studies

Another study by Glass and Singer,²⁶ which did not deal specifically with highway noise, is nevertheless of interest. Their paper described the results of approximately two dozen laboratory and field experiments, conducted over a five-year period, which systematically explored the behavioral consequences of noise exposure. An audio tape consisting of a melange of indistinguishable sounds was prepared and played back at intensities up to 108 dBA to serve as the stimulus.

The most reliable result was that people adapted to the noise. When noise was presented in intermittent bursts over a 24-minute session, few disruptive effects were shown after the first few trials. People did not adapt to noise under at least two particular circumstances:

1. If a person was in a state of cognitive overload, that is, working on more than one task and straining his ability to cope with nonstressful stimuli, the addition of noise produced performance decrements.
2. If a person was working on a vigilance task which required constant monitoring or attention, the presence of high-intensity noise was disruptive.

The finding that noise had minimal effects upon task performance does not imply that it has no adverse effects; to the contrary, the research suggested that noise impairs subsequent routine functioning. Whether or not adaptation took place, noise had disruptive aftereffects which were demonstrated on a variety of performance measures. The ability of people to find errors when proofreading, to continue working on difficult graphic puzzles, and to work efficiently on a competitive-response task were all adversely affected by having been previously exposed to noisy conditions.

These aftereffects were not only a function of the physical intensity of noise, but also depended upon the social and cognitive context in which noise occurred. Two cognitive factors -- predictability and controllability -- had a particularly powerful impact on noise aftereffects. Exposure to unpredictable noise, in contrast to predictable noise, was followed by greater impairment of task performance and lowered tolerance for post-noise frustrations. In tests of perceived controllability, i.e., the individual's belief that he can escape or avoid aversive sound, subjects who were given a switch with which to terminate noise showed minimal aftereffects compared to other subjects exposed to the same noise without a switch. This reduction in aftereffects occurred even though the switch was in fact not used; merely perceiving control over noise was sufficient to ameliorate its aversive impact.

One other direct consequence of noise is a possible increase in the accident rate which might result from the masking of auditory alarms.²⁷ Since danger signals often take this form, it can be reasonably expected that some of these signals will be drowned out in environments typical of heavy industry operations, construction activities, and mid-city traffic during shopping and commuting hours.

Research on noise has often been of high quality, but the results have been less than clear-cut. In some instances beneficial effects have been reported as, for example, when noise masks distracting sounds, stimulates the individual to remain alert on an otherwise boring task,

or arouses a sleep-deprived subject to perform better than under quiet conditions.²⁸ A recent summary of conclusions drawn from research on noise and human task performance is contained in the following excerpt from Kryter.²⁹

...Other than as a damaging agent to the ear and as a masker of auditory information noise will not harm the organism or interfere with mental or motor performance. Man should be able, according to this concept, to adapt physiologically to his noise environment, with only transitory interference effects of physiological and mental and motor behavior activities during this period of adaptation.

Perhaps the obvious conclusion is that more research, both field and laboratory controlled experiments, is necessary to resolve these issues.

6.4 ANNOYANCE

Annoyance has been defined as "a feeling of displeasure associated with any agent or condition believed to affect adversely an individual or a group...".³⁰ According to a NASA study,³¹ community reactions to noise may be classified as: 1) annoyance, 2) complaint, and 3) protest. Some people will react at very low exposures to the stimulus; some will not react at even very high exposures; the majority will respond at an intermediate level.

Many studies attempting to measure annoyance by complaint activity consistently show that the complaint level is not an accurate reflection of the magnitude of the community reaction. Most complainers are highly annoyed, but those persons highly annoyed do not always complain. Such factors as occupation, educational level, and property investment distinguish complainers from those equally annoyed and equally exposed to noise, but who take no action.

6.4.1 Colony

Colony³² investigated the effects of the Detroit-Toledo Expressway on nearby residents. In this study, Colony plotted maximum perceived noise level contours which were based on actual measurements of sound pressure levels. Home interviews were also collected from 138 families who lived within 1200 feet of a depressed section of the freeway. An analysis of the data showed that: (a) while most of the residents were aware of the noise, generally speaking, it was not considered disturbing -- only a few persons had taken any action to reduce noise through insulation or other means, and no one had lodged a complaint; (b) sound pressure levels of 81-85 dBA were found in homes contiguous to the right-of-way line (at this level 75 percent of those interviewed found the noise level annoying or objectionable, 50 percent experienced disturbance, 37 percent rated the disturbance very severe, and 63 percent stated they

would not buy or rent that close to a freeway again); (c) awareness of traffic noise correlated with length of residency. Surprisingly, however, Colony found no correlation between distance from the freeway and degree of disturbance despite the fact that sound pressure levels decrease with distance.

6.4.2 Griffiths and Langdon

The extreme variability in tolerance for noise has been reported in several investigations. In the study by Buffington et al.,³³ interviewers were sometimes dismayed by noise levels which made communication difficult; yet noise was seldom mentioned as a problem by respondents. Griffiths and Langdon³⁴ sampled twelve neighborhoods in London on the basis of traffic volume and compared survey responses with tape recorded sound levels. The researchers found that demographic variables generally did not discriminate major differences in level of dissatisfaction. Nor was there any apparent relationship between sound level measures and preferences for distance from the road. However, consistent with other findings, those individuals who had lived at a particular residence for longer than six months were more likely to be dissatisfied than those who had been there for a shorter duration. Persons dissatisfied with traffic noise also preferred living farther from the road. The most common complaints about noise had to do with loss of sleep (e.g., respondents reported having their sleep interrupted and great difficulty in getting children to fall asleep in the summer) and disrupted communication, which frequently meant that windows had to be closed. In essence, the London survey supported the notion that not only do people have different thresholds at which loudness becomes annoying, but degree of annoyance also varies with different types of noise and sudden changes in noise level.

6.4.3 McKenna

A study of aircraft noise by McKenna³⁵ is worthy of note, primarily because of the conclusion that socio-psychological factors account for most of the variance in noise annoyance. The author defined "annoyance" as a general subjective response to noise while a "complaint" was considered to be a formal, public reaction. McKenna's results indicated that: (a) there was a small group of people annoyed at lowest levels of noise exposure; (b) the largest proportion of annoyed people were not found at the highest decibel levels of noise exposure, but at several levels below that; (c) annoyance was dependent on recent experience, i.e., exposure to noise within the last two to three weeks; and (d) the more things a person disliked about his overall living conditions, the more likely he was to be annoyed by aircraft noise (conversely, some individuals who were subjected to the highest levels of noise exposure could think of nothing in their immediate environment that was displeasing). Complainants comprised a small percentage of those annoyed by aircraft noise and were also likely to be found in all strata of noise exposure levels. Of additional interest was the finding that although variables such as occupational level, education, value of home, organizational membership

and political activity were not highly correlated with degree of annoyance, they were directly related to complaints. Those most likely to complain were representatives of the articulate, politically active middle class.

6.4.4 Galloway, Clark, and Kerrick

Galloway, Clark, and Kerrick³⁶ interviewed 300 residents living within sight of a Los Angeles freeway. In one area, comprised mainly of upper socio-economic residents, 70 percent of those interviewed expressed annoyance at low levels of freeway noise. In contrast, only 50 percent of those living in the area of greatest noise exposure, where the recorded level was approximately four times as great as the first, reported annoyance. Factors such as landscaping, visual dominance, and distance to the freeway did not correlate strongly with freeway noise annoyance. The analysis did reveal, however, that residents judged their living situation on the basis of four considerations: convenience, attractiveness, traffic volume, and intrusion (which includes vibration and odor as well as noise). The authors concluded that annoyance due to noise is a function of the total situation, including existing attitudes toward freeways.

6.4.5 Brinton and Bloom

Brinton and Bloom³⁷ investigated the effect of highway landscape development on nearby property. Some of their more important findings included the following:

1. When sound levels reached 68 dBA, more people living next to expressways were annoyed by the noise than those who were not.
2. Average sound levels were not significantly related to the degree of disturbance reported by a homeowner nor his attitude toward locating next to a highway again.
3. Truck noise was determined to be the most serious and objectionable feature of living next to an expressway. Other factors such as odor, vibration, and light were disliked, but not with the same intensity.
4. Expressway noise created problems for residents of high-rise apartments (turnover was high and rent concessions were made to tenants living in units next to the highway).
5. Property value change was not related to quantity of landscaping, but planting used to shield the highway seemed to encourage the highway's acceptance.

6. People in less expensive homes next to a limited access expressway were more likely to accept highway-related disturbances than residents of more expensive homes.

6.4.6 Arvidsson

A study conducted in Sweden by Arvidsson et al.³⁸ reported findings strikingly similar to the results of noise research in this country. Residents of two city districts (described as "noisy" and "quiet") were divided into "annoyed" and "not annoyed" groups on the basis of interviews. Sixty percent of the respondents were annoyed in the noisy district; 31 percent in the quiet district. A relationship was found between degree of annoyance and age (annoyance appeared to increase with age) and between annoyance and dissatisfaction with the area. Approximately half of the respondents considered traffic noise to be the area's worst nuisance.

6.4.7 Gamble, Sauerlender, and Langley

One of the few systematic efforts to measure the impact of highway generated pollutants on property values was reported by Gamble, Sauerlender, and Langley.³⁹ Data were collected in 1971 and 1972 on four urban highway communities: Rosedale, Maryland; Towson, Maryland; North Springfield, Virginia, and Bogota, New Jersey. Measurements were taken on the quantity and dispersion of air and noise pollutants, property values, household characteristics, and the volume, speed, and mix of highway traffic. In addition, over 1,100 families were interviewed in the four communities. The results indicated that, while engaging in outdoor activities, people considered noise to be the most annoying feature of the highway; noise and dust annoyed respondents equally when they were indoors. An analysis of all four communities showed that 58 percent of the abutting property owners were annoyed by highway disturbances in contrast to only 12 percent of those living at greater distances. Surprisingly, odors were not a source of annoyance in any of the study areas. Some additional noteworthy findings were that: (a) except for residential properties located near interchanges, "the adverse environmental effects of a limited access highway lower the value of properties near the highway as compared to properties more distant from the highway;" and (b) the difference between highway related noise and ambient noise levels is more important than the actual magnitude of traffic noise emanating from the road.

The studies cited above provide only a brief view of the literature on annoyance; nevertheless, they do suggest the idiosyncratic nature of human response to highway related sounds. The data suggest that actual sound levels do not correlate highly with reported disturbance; other factors such as age, length of residence, socio-economic status, and attitudes toward one's immediate environment (and toward highways in general) appear to account for most of the variance. There is also

evidence indicating that the type of noise, and the difference between ambient noise levels and that produced by freeway traffic, are sometimes more important than absolute noise levels.

6.5 CONCLUSION

This chapter has explored the major causes and effects of highway traffic noise. Research on this topic is currently incomplete, and any conclusions must be regarded as tentative.

Jonsson et al.⁴⁰ described some of the methodological problems of studies of community response to noise. They stated that alternate definitions which have been used in survey investigations for "annoyance" have often resulted in differently phrased questions. Consequently, individuals have been classified as annoyed on different bases. In the majority of cases, the assessment has been based on the individuals' reports on their reactions to noise. Therefore, respondents not only have to try to describe their own experiences, but also to evaluate them. Investigations showed that many more individuals claimed to be disturbed when the study's purpose was not disguised, when direct annoyance questions were used instead of general annoyance questions, and when the questions were structured rather than open. What type of questionnaire gives the "true" value is difficult to determine.

A more general criticism of the demographic deficiencies of many of the works reviewed concerns the over-emphasis on the opinions, activities, and needs of home-owners. Although more transient and perhaps less concerned about property values, renters must also bear the effects of highway noise and should be more equitably represented. Similarly, women are seriously neglected in many of the surveys although they spend considerably more time at home each weekday than male respondents.

Despite these problems, some preliminary insight may be derived from consensus among researchers:

1. Although the adaptive capacity of man to noise is extensive, there are strong indications that long term exposure may seriously affect health and task performance and contribute to the stress of urban living.
2. There are four major variables of importance in determining the effects of noise on behavior; intensity, duration, predictability, and controllability.
3. Actual sound levels do not correlate highly with reported disturbance; other factors such as individual sensitivity, socio-economic status, length of residence, and attitudes toward highways in general appear to account for most of the variance.

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7.0 OBSERVATIONS ON THE DESIGN AND CONTENT OF HIGHWAY IMPACT RESEARCH

7.1 INTRODUCTION

The preceding chapters in this volume synthesized research findings on the social effects of new and improved highways. This chapter is written from a slightly different perspective, being concerned primarily with (1) the adequacy of research methodology as reported in the highway literature and (2) areas of potential importance to highway planners where gaps in information appears to exist. The objective here (as in most other critical reviews) is to bring important issues to the attention of researchers who may wish to conduct similar investigations and, perhaps more importantly, to decision makers who desire to implement research findings.

The sections which follow identify several basic problems related to highway research methodology and, where possible, suggest some tentative solutions. Among the topics discussed are the dearth of information on research design, sample selection, and other procedural questions; fragmentation of research on social effects; and the need for comprehensive longitudinal studies of highway impacts. The final section also includes a brief discussion of social impacts which did not receive sufficient treatment in the literature covered by this review.

7.2 A CRITIQUE OF THE METHODOLOGY USED IN HIGHWAY IMPACT RESEARCH

7.2.1 Missing Data

In order to evaluate properly the various methods and procedures contained in the literature on highway impact assessment, it was useful to engage in a form of role playing. Specifically, we attempted to view the published research from the perspective of a highway planner who requires certain categories of information for effective decision making. There was, of course, an implicit assumption that sufficient data would be included to permit an evaluation. To our dismay such was not the case. Out of the original pool of 300 titles, less than half were considered germane based on the criteria outlined in Chapter 1.0. Furthermore, only 64 (not counting five reports which summarized other published data) were empirical studies, the remainder falling into categories such as major theoretical works or "think pieces", modeling efforts, and simulations. Many of the non-empirical articles and technical reports suggested hypotheses to be tested and contributed valuable insights with respect to areas in need of research; nevertheless, in the absence of supporting data, they were of little value for estimating the magnitude of highway impact.

A simple but useful index of the value of published research is the amount of attention given to the reporting of methodology. A tally of the 64 empirical studies revealed the following:

- 91 percent reported where the research was conducted;
- 70 percent reported who funded or supported the research;
- 67 percent reported the size of the sample while an equal number (but not necessarily the same studies) reported one or more sample characteristics in addition to size;
- 53 percent reported when (approximate dates) the data were collected;
- 52 percent reported the use of statistics (other than percentages);
- 30 percent of the total studies (or 58 percent of those using statistics) reported the level of significance or confidence levels which were employed;
- 27 percent reported the use of before-after measures with respect to completion of highway construction;
- 20 percent reported data on possible sample attrition (e.g., refusal of respondents to participate, unusable answers, failure to ask questions of all sample members, etc.);
- 16 percent reported the use of control groups;
- 10 percent reported for whom the research was intended, or who the ultimate beneficiary might be (e.g., planners, designers, etc.).

It should be noted that these figures relate only to procedures which were reported; they indicate little about scientific rigor or the appropriateness of research methodology.

Why were data on methods and procedures treated so casually? Part of the problem seemed to be that a preponderance of the literature on highway impact research was in the form of brief articles published in journals intended for a non-technical audience. While this format served a useful purpose by acquainting the readership with current work in the field, crucial data were frequently omitted for lack of journal space or other editorial considerations. This situation was further complicated by the occasional absence of references to original studies or to source material on which the journal articles were based. Thus, an interested but skeptical highway planner would be forced to write for supporting data which might no longer exist or which the investigators were loathe to relinquish.

Although there were references in earlier chapters to methodological shortcomings, it seems appropriate to again emphasize one of our major conclusions -- even those studies which provided relatively complete information on research methodology were frequently biased, improperly designed, and often failed to take into account alternative explanations for obtained results. Moreover, rarely were study limitations brought to the reader's attention. If nothing else, the problems encountered with such studies raise even greater doubts about the validity of research reports which leave methodology to the imagination. In sum, caveat emptor remains sound advice for decision-makers.

The solution to the problem of missing data is by no means simple, but several steps might be taken to improve the situation. First, tighter editorial standards are needed for journal submissions. For example, a clear distinction ought to be made between theoretical work and "armchair studies" on the one hand, and empirical research on the other. A manuscript for publication in the latter category should include sufficient information on method and procedures to demonstrate technical merit. This is hardly a new idea; most reputable scientific journals in other fields adhere to stringent requirements. A second step (lacking radical changes in standards) would be to insure full reference to the source document somewhere in the bibliography of any abridgment of larger studies. At the very least some information on where to obtain copies of questionnaires or similar items would be helpful.

Basically, of course, the problem is one of scientific rigor, not of adequate methodological information, although such information is required to judge rigor. Considering the vast sums spent on research related to the social and environmental effects of highways, the situation is rather dismal. This report has pointed to only a handful of investigations which appear to be solid research efforts; the issue need not be raised again.

7.2.2 Fragmentation of Research

A second problem encountered in the review was fragmentation of highway impact research. In their definitive treatment of the literature, Horwood, Zellner, and Ludwig¹ observed:

Because highway consequence studies have been conducted for so many reasons and under so many unique circumstances, their criticism and evaluation must clearly keep in mind the circumstances under which they were commissioned, the cost limitations imposed on them, and where they fit in the entire hierarchy of studies. By far the greatest number of the existing studies of highway consequences has been made for public relations purposes, particularly to ease the development of highways and highway changes in regard to counteracting adverse sentiment.

Although a decade has passed since the publication of their critique, many of the problems identified by Horwood and his associates have not been resolved. Lack of coordination between and within sponsoring

agencies has sometimes led to overlap and duplication of research efforts. Perhaps most visible is the proliferation of studies concerned with community participation and the development of planning techniques stressing public involvement. As noted in Chapter 2.0, the failure to validate these techniques on appropriate population sub-groups seems to be a more serious problem than lack of techniques.

Needless duplication of literature reviews on the social impact of highways is also readily apparent. A 1971 study by Winfrey and Zellner,² and two 1972 efforts (Literature References on Techniques for the Evaluation of Factors Relevant to Decision Making on Highway Locations³ and Economic and Social Effects of Highways⁴) immediately preceded the effort reported herein.

In 1974, the previously mentioned Economic and Social Effects of Highways was updated and published as Social and Economic Effects of Highways.⁵ Additional studies, which were being conducted by private contractors concurrently with the present investigation, were also scheduled to contain extensive literature reviews covering the social impact of highways. Of course, some new material is introduced with each fresh survey of the field, but a few additional references hardly compensate for the cost of so much repetition and redundancy.

It would add little to this discussion to state that tighter coordination among agencies funding studies on the social impact of transportation projects is a solution to the problem of research duplication. A more positive approach might be to search for better means of disseminating information (e.g., research findings, the scope of ongoing studies, and the need for proposed projects), not only within the Federal Government, but to appropriate offices at the state and local level as well. For example, at the time this document was being written, several similar studies on social impact assessment were underway. Of these, some were being supported by the Federal Government, others with state funding; yet there was little mutual awareness of these undertakings. Perhaps some combination of regionally sponsored workshops and clearinghouses would stimulate more effective communication, reduce duplication, and, of most importance, provide state transportation planners with timely, state-of-the-art information on social impact assessment.

7.2.3 The Need for Longitudinal Studies

There are numerous factors which combine to make highway impact research a difficult task. Highways differ widely in terms of size (two-lane, four-lane, six-lane divided, etc.), design features (elevated, on-grade, depressed; noise shielding, landscaping, etc.), function (bypass, circumferential, radial, etc.), location (urban, suburban, rural), and many other well known characteristics. Highways take years to complete even under ideal conditions; and during that period many changes occur in the areas through which they pass. Sometimes the changes are highway-related, and sometimes not. It is also worth observing that the difficulties associated with the delineation of comparable control areas have frequently

dictated their omission from highway impact investigations. Moreover, even in those instances where control settings are available, the additional cost has sometimes been prohibitive. As a result, research findings are frequently confounded by exogenous factors. Of course, time constraints and personnel shortages are often limiting factors, particularly in the conduct of in-house studies.

Despite these difficulties, a strong argument can be made for more longitudinal studies of highway impact (few could be found in the literature). Specifically, such studies ought to include the collection of adequate baseline data at selected intervals prior to the start of construction, measurement of social phenomena which might be affected during the construction phase, and follow-up procedures to determine how people's lifestyles have been altered after the highway is completed. Unfortunately, without longitudinal analyses, the validity of highway impact assessment will continue to be suspect in most instances.

The lack of longitudinal studies has also contributed to some serious gaps in information in the highway impact research literature. Some of these topics have been touched upon in previous chapters, and need not be repeated; however, there are questions of considerable interest to highway planners about which we know very little. A representative, but by no means complete list is suggested below:

1. Pre-construction Phase

- a. When is a locality really a neighborhood in the sense that true social bonds exist between people; and when is it merely a loose-knit collection of people? Do geographic reference points or physical boundaries which have sometimes been used to delineate neighborhoods coincide with a "community" of interests?
- b. What sort of communities do residents want? What are the special transportation needs of the disadvantaged?
- c. What changes begin to occur in localities once the decision is made to build a highway? To what extent is quality of life downgraded for residents whose homes are designated for removal (e.g., unavailability of home improvement loans; failure of landlords to make repairs; general deterioration of the neighborhood)? To what extent are urban freeway projects responsible for the abandonment of buildings which may become havens for drug addicts and spawn other types of crime in the inner-city?

2. Construction Phase

- a. What percentage of jobs related to highway construction accrue to workers residing in the affected community? What percentage go to outsiders?

- b. How do patterns of social interaction change as a result of highway construction? To what extent is the use of community facilities such as shopping centers, libraries, churches, parks, etc. affected? How do people cope with the noise, dust, and odors associated with highway construction?
- c. To what extent is the delivery of local government services (fire, police, emergency medical, trash collection, etc.) affected during highway construction? What is the impact of highway construction on pedestrian access and safety?

3. Post-construction Phase

- a. What changes in social interaction patterns occur as the result of a new highway? Is community cohesion enhanced or disrupted? Do old friendships wither as a result of relocation? What effect does a new highway have on those residents who are left behind (not relocated)?
- b. What are the immediate, short-term effects of a highway project? What are the long-term effects of highways on land use patterns and population characteristics? How long are impacts felt and how can adverse effects be mitigated?
- c. How do dislocated businesses prosper after relocation? Do new businesses replace dislocated stores in inner-city areas; and how is accessibility affected?
- d. Is the safety of school children enhanced or jeopardized by highway improvements? Does the completed project provide proper access to new job opportunities for urban residents? How are the transportation needs of the handicapped affected? Which population groups have serious, long-term problems adjusting to displacement and relocation; and does this process hasten morbidity in the elderly?

These are but a few of the issues which deserve attention through longitudinal study. Hopefully, one of the positive consequences of fervent environmental activism will be a firm commitment from decision makers to seek valid, comprehensive data on the social impacts of new and improved highways.

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FEDERALLY COORDINATED PROGRAM (FCP) OF HIGHWAY RESEARCH AND DEVELOPMENT

The Offices of Research and Development (R&D) of the Federal Highway Administration (FHWA) are responsible for a broad program of staff and contract research and development and a Federal-aid program, conducted by or through the State highway transportation agencies, that includes the Highway Planning and Research (HP&R) program and the National Cooperative Highway Research Program (NCHRP) managed by the Transportation Research Board. The FCP is a carefully selected group of projects that uses research and development resources to obtain timely solutions to urgent national highway engineering problems.*

The diagonal double stripe on the cover of this report represents a highway and is color-coded to identify the FCP category that the report falls under. A red stripe is used for category 1, dark blue for category 2, light blue for category 3, brown for category 4, gray for category 5, green for categories 6 and 7, and an orange stripe identifies category 0.

FCP Category Descriptions

1. Improved Highway Design and Operation for Safety

Safety R&D addresses problems associated with the responsibilities of the FHWA under the Highway Safety Act and includes investigation of appropriate design standards, roadside hardware, signing, and physical and scientific data for the formulation of improved safety regulations.

2. Reduction of Traffic Congestion, and Improved Operational Efficiency

Traffic R&D is concerned with increasing the operational efficiency of existing highways by advancing technology, by improving designs for existing as well as new facilities, and by balancing the demand-capacity relationship through traffic management techniques such as bus and carpool preferential treatment, motorist information, and rerouting of traffic.

3. Environmental Considerations in Highway Design, Location, Construction, and Operation

Environmental R&D is directed toward identifying and evaluating highway elements that affect

the quality of the human environment. The goals are reduction of adverse highway and traffic impacts, and protection and enhancement of the environment.

4. Improved Materials Utilization and Durability

Materials R&D is concerned with expanding the knowledge and technology of materials properties, using available natural materials, improving structural foundation materials, recycling highway materials, converting industrial wastes into useful highway products, developing extender or substitute materials for those in short supply, and developing more rapid and reliable testing procedures. The goals are lower highway construction costs and extended maintenance-free operation.

5. Improved Design to Reduce Costs, Extend Life Expectancy, and Insure Structural Safety

Structural R&D is concerned with furthering the latest technological advances in structural and hydraulic designs, fabrication processes, and construction techniques to provide safe, efficient highways at reasonable costs.

6. Improved Technology for Highway Construction

This category is concerned with the research, development, and implementation of highway construction technology to increase productivity, reduce energy consumption, conserve dwindling resources, and reduce costs while improving the quality and methods of construction.

7. Improved Technology for Highway Maintenance

This category addresses problems in preserving the Nation's highways and includes activities in physical maintenance, traffic services, management, and equipment. The goal is to maximize operational efficiency and safety to the traveling public while conserving resources.

0. Other New Studies

This category, not included in the seven-volume official statement of the FCP, is concerned with HP&R and NCHRP studies not specifically related to FCP projects. These studies involve R&D support of other FHWA program office research.

* The complete seven-volume official statement of the FCP is available from the National Technical Information Service, Springfield, Va. 22161. Single copies of the introductory volume are available without charge from Program Analysis (HRD-3), Offices of Research and Development, Federal Highway Administration, Washington, D.C. 20590.

B/BS
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