Highways and the Environment

DAVID R. LEVIN
Special Assistant to Executive Director
Federal Highway Administration
Washington, D.C.

Secretary
Special AASHO Liaison Committee
on Environmental Quality

INTRODUCTION

Realizing the immense impact that highways have on our lives and the communities in which we live, the highway official has long been concerned with the compatibility of highways with their environment. In the early stages of road improvement, the dominant concern was to enable people to move themselves and their goods from one point on the earth's surface to another. But now that our technology has assured this objective, we have reached a stage where the highway must be considered in the context of a total impact upon the social-economic, cultural-environmental fabric, of which it is an essential part. Other criteria, in addition to efficiency, have risen in importance in judging the value of a highway. These include safety, aesthetics, and its effect on the social, physical and cultural environment and ecology, both rural and urban. These elements have become important and widespread public concerns, as they should be.

To give a more precise idea of the attention which state highway departments and the Federal Highway Administration already are giving to environmental factors, I figured out last year we spent approximately 12 percent of total project costs of federal-aid highway improvements for elements that could be associated with the environment. It amounts to millions of dollars.

LEGISLATIVE MANDATES

This new emphasis is very much in evidence in the legislative halls, in the press, in public and private conferences of all sorts, and in new and emerging federal, state and local legislation. At the federal level, Section 14 of the Federal-Aid Highway Act of 1966 directed the secretary of transportation to consult with the secretary of agriculture con-
cerning guidelines for minimizing soil erosion in highway construction activities.

The Federal-Aid Highway Act of 1968 directs us to take account not only of physical, engineering and cost factors, but also of the economic, social, and environmental elements. Additionally, section 138 of that act and 4(f) of the Transportation Act of 1966 as amended declares it to be national policy that special effort be made to preserve the natural beauty of the countryside, public parks, recreation lands, wildlife and waterfowl refuges, and historic sites. Finally, a new act, called the National Environmental Policy Act of 1969, signed by the President, January 1, 1970, enunciates a national policy which will encourage a productive and enjoyable harmony between man and his environment. The act further seeks to promote efforts to prevent, eliminate or minimize damages to the environment and the biosphere.

A council on environmental quality is created by the act, and this council is headed by Russell Train, formerly under secretary of the interior and a conservationist of long standing. The council has recently issued some interim guidelines for all agencies administering direct federal or federally-aided projects as follows: Pursuant to these guidelines, the Department of Transportation has issued its regulations, and the Federal Highway Administration is finalizing its requirements in connection with all federal-aid highway projects. We will be glad to provide any of these materials to those of you who may want them.

This new act is noteworthy for a number of its specific provisions. Among these are two which I would like to mention. One requires that all federal agencies, in connection with all direct federal or federally-assisted programs, now utilize an interdisciplinary approach which will insure the integrated use of natural and social sciences and the environmental design arts in decision-making which may have an impact on man's environment. Additionally, in connection with these same decision-making activities, there must be identified and developed methods and procedures which will make sure that unquantifiable environmental amenities and values be given appropriate consideration, along with the economic and technical considerations. A number of other requirements are also prescribed.

In addition to the foregoing, the newest of the legislative mandates involving the highway activity may be found in the Federal-Aid Highway Act of 1970, signed by the President the last day of 1970. So important are these new provisions, that I shall quote them verbatim, from section 136 of the act:
ECONOMIC, SOCIAL, ENVIRONMENTAL, AND OTHER IMPACT

Sec. 136. (A) Section 109(g) of title 23. United States Code, is amended to read as follows:

"(g) The Secretary shall issue within 30 days after the day of enactment of the Federal-Aid Highway Act of 1970 guidelines for minimizing possible soil erosion from highway construction. Such guidelines shall apply to all proposed projects with respect to which plans, specifications, and estimates are approved by the Secretary after the issuance of such guidelines."

(B) Such section 109 is further amended by adding at the end thereof the following:

"(h) Not later than July 1, 1972, the Secretary, after consultation with appropriate Federal and State officials, shall submit to Congress, and not later than 90 days after such submission, promulgate guidelines designed to assure that possible adverse economic, social, and environmental effects relating to any proposed project on any federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for fast, safe and efficient transportation, public services, and the costs of eliminating or minimizing such adverse effects and the following:

"(1) air, noise, and water pollution;
"(2) destruction or disruption of man-made and natural resources, aesthetic values, community cohesion and the availability of public facilities and services;
"(3) adverse employment effects, and tax and property value losses;
"(4) injurious displacement of people, businesses and farms; and
"(5) disruption of desirable community and regional growth.

Such guidelines shall apply to all proposed projects with respect to which plans, specifications, and estimates are approved by the Secretary after the issuance of such guidelines.

"(i) The Secretary, after consultation with appropriate federal, state, and local officials, shall develop and promulgate standards for highway noise levels compatible with different land uses and after July 1, 1972, shall not approve plans and specifications for any proposed project on any federal-aid system for which location approval has not yet been secured unless he determines that such plans and specifications include adequate measures to implement the appropriate noise level standards.

"(j) The Secretary, after consultation with the Administrator of the Environmental Protection Agency, shall develop and promulgate guidelines to assure that highways constructed pursuant to this title are consistent with any approved plan for the implementation of any ambient air quality standard for any air quality control region designated pursuant to the Clean Air Act, as amended."
(C) Subsection (b) of section 307 of title 23, United States Code, is amended by adding the following sentence: "The highway research program herein authorized shall also include studies to identify and measure, quantitatively and qualitatively, those factors which relate to economic, social, environmental, and other impacts of highway projects."

The Federal Highway Administration is now putting these new legislative mandates into effect.

Thus, in relation to both highway location and design, on all federal-aid highway systems, it is necessary to recognize the environmental concerns to a greater degree today than ever before.

SOIL EROSION, Siltation, WATER POLLUTION, ETC.

Recent specific actions by FHWA toward the maintenance of water quality and reduction of erosion followed the issuance of Executive Order 11258 in 1965 (revised by Executive Order 11288, 11507 and 11514), which required that specific actions be taken by each department of the federal government to provide leadership in the nationwide effort to improve water quality through prevention, control, and abatement of water pollution. Subsequent to the issuance of the order, division engineers of FHWA discussed the matter with highway department representatives to determine whether the states' practice and procedures would achieve the objectives of the executive order. After consultation with the Federal Water Pollution Control Administration (now the Federal Water Quality Administration) and the Department of Interior, instructional memorandums were issued with guidelines outlining procedures for maintaining water quality and reduction of possible soil erosion occurring during and following highway construction, and for the drainage of storm water from federal-aid and direct federal highway construction projects. Since January 1, 1967, federal-aid plans, specifications, and estimates must contain provisions to keep pollution of all waters by highway construction to a reasonable minimum. Similar requirements were imposed for direct federal projects.

Major emphasis was placed on reduction of erosion and on the control of siltation, although pollution by chemicals, raw sewage, lubrications, fuels, and the like was not ignored. Sample specification language was furnished for consideration by those states whose existing provisions needed improvement. Measures that were suggested included limiting the area of raw, erodable earth exposed at a given time; construction of silt basins; timely planting of erosion control grasses and plants; limitations on fording streams; and reasonable restrictions for bridge and culvert construction. Cooperation with other public agencies having
an interest in this matter was emphasized, as well as consistency with their laws and regulations.

*Guidelines to Minimize Soil Erosion and Water Pollution During Construction*

To assure compliance with the issued guidelines, all states were requested to review their existing construction specifications and incorporate any necessary changes to accomplish the objectives and intent of the guidelines and the President's executive order. Some of the major practices and procedures included in the guidelines to aid in promoting the abatement of water pollution and soil erosion on federal-aid highway construction projects are:

Highway locations are to be selected with due consideration of the problems associated with the basic elements that will greatly reduce erosion during and after construction.

During the construction of a project, the contractor must exercise every reasonable precaution throughout the life of the project to prevent silting of rivers, streams, and impoundments.

Prior to the suspension of construction operations for any appreciable length of time, the contractor shall shape the top of earthwork in such a manner that will permit the runoff of rain water with a minimum of erosion.

Temporary erosion and sediment control measures, such as berms, dikes, etc., deemed necessary by the engineers shall be provided and maintained during construction until permanent drainage facilities and erosion control features are completed and operative.

Frequent fording of live streams with construction equipment will be held to a minimum and, where necessary, temporary bridges or other structures shall be used.

Contractors shall provide adequate sanitation facilities on all construction projects meeting the standards established by state health authorities.

The final condition of borrow or waste pits shall be finished or covered with vegetation in such a manner that it will not be a contributing factor to water pollution.

Excavation and embankment operations will be closely correlated with the seeding and mulching treatment of cut and fill slopes so that their surfaces will not be exposed for an extensive period of time and thereby contribute to soil erosion.

*Controls Must be Used on all Federal Jobs*

These controls, required on all federal-aid and direct federal highway construction projects, are now being included also as directives or special provisions in the majority of state highway specifications. Other steps to control erosion and to prevent water pollution during highway construction may be directed by special provision on some projects, e.g.
seeded slopes as soon as possible as work progresses; step-cutting of slopes to help seeding get started; and constructing brush filter zones at the toes of fill slopes.

A highway built to current standards has few erosion problems after its completion, particularly if good maintenance practices are followed. All highway agencies recognize the potential detrimental effects of erosion within the highway right-of-way and accordingly, give special attention in design to preventive measures where needed. The success of these measures is evidenced by the many miles of highways now serving the traveling public without serious erosion scars.

Good Location, Design, Construction and Maintenance Required

Highways not properly located, designed, constructed, or maintained are at times subject to erosion and may contribute to stream pollution. Serious erosion not only results in unsightly conditions and increased maintenance costs, but sometimes causes safety hazards.

Advice of Various Experts Available

Problems encountered in finding feasible ways to minimize erosion are varied and complex. Several disciplines of science and engineering are required to reach an acceptable solution to most erosion problems. Highway designers, project engineers, and maintenance personnel use the advice of hydrologists, hydraulic engineers, soil engineers, soil scientists, agronomists, landscape architects, and other specialists to minimize erosion problems.

National Guidelines Must be General Because of Variable Regional Conditions

Erosion control guidelines encompass all phases of highway engineering to realize economical and effective control of erosion that might occur. National guidelines for the control of erosion must necessarily be of a general nature because of the wide variation in climate, topography, geology, and soils encountered in different parts of the country. For example, erosion control must be given careful attention in the design of a highway traversing an area of rough topography, erodible soils, high and constant wind velocities, and heavy precipitation. A high degree of erosion control is required in a watershed that is the collecting area for a public water supply or a recreational facility.

Erosion Control by Geometric Design

Erosion is controlled to a considerable degree by geometric design as well as by drainage and landscape development. It is minimized by
the use of flat side slopes rounded and blended with the natural terrain; drainage channels designed with due regard for depth, width, slopes, alignment, and protective treatment; facilities for ground water interception; protective devices, such as dikes and berms; and protective ground covers and plantings.

*Manual for Erosion Control During Construction*

Complete explanation of measures taken to minimize erosion related to highways is found in Guidelines for Minimizing Possible Soil Erosion From Highway Construction, a report presented to Congress in 1967 and distributed to state highway departments by Instructional Memorandum 20-6-67.

**NOISE ABATEMENT**

There are other environmental elements, of course, other than soil erosion, siltation, and water pollution which we have been discussing up until this point. One such additional element with which the highway contractor will need to be concerned is construction equipment noise.*

Noise is unwanted sound. There is a comfort zone of noise just as there is in terms of temperature and humidity. Too much noise is objectionable, and sometimes even injurious to the human ear and nervous system. Most Americans are appreciative of the mobility which the highway of modern design makes possible, but we are becoming increasingly aware of the noise which some of these vehicles generate, including heavy construction equipment. Noise control and noise abatement requirements are generally a function of the nature of the construction site, lengths of projects, and types of mechanization units.

*Manual for Design Against Noise*

The Federal Highway Administration is currently considering new measures to abate noise from highway construction and operation. A study recently completed by a consultant for the Highway Research Board and funded by federal highway planning and research money and titled, “Highway Noise—A Design Guide for Highway Engineers” will provide basic techniques for engineers to predict noise levels of proposed highway projects, suggest acceptable noise levels, and offer

---

various ameliorative measures which can be taken to control noise, e.g., installing acoustical barriers, elevating or depressing the roadway, and providing different road surface conditions.

**Construction Equipment Noise and Traffic Noise**

With respect to highway construction equipment specifically, the use of advanced types of mufflers and resonators, scheduling of construction operations during designated hours of the day or night, and a sensitivity to even restricting operations to certain days of the week, all will assist in the solution of the noise problem on highway construction equipment.

You will recall that the Federal-Aid Highway Act of 1970, recently enacted, contains some new and important emphasis on highway noise. Incidentally, this is not limited to highway construction noise, but would also apply to noise generated on highways, especially by trucks on sharp, steep grades, or by the stop-and-go movements at traffic controlled intersections.

**Noise Measurements for Problem Areas**

In certain types of situations, the highway official might want to take noise measurements, especially where noise is suspected of becoming a problem. He will want to evaluate the data he so obtains, together with all the other data he assembles at the location and even at the design stages. In other circumstances, space or distance is a good insulator. In still other situations, certain types of landscaping of appropriate design and depth can be effective noise barriers. Finally, the types and proximity of land uses adjacent to freeways need to be identified and perhaps controlled in the public interest, so that the highway and the adjacent land uses are compatible.

**AIR POLLUTION**

*Vehicles and Air Pollution*

The Air Quality Act of 1967 authorized the Department of Health, Education and Welfare to regulate pollution emissions from new motor vehicles. In that year motor vehicles were responsible for causing 72 percent of the carbon monoxide and 49 percent of hydrocarbons in the nation's atmosphere. As a result of HEW-imposed standards there has been a downtrend in these two pollutants since 1967. However, the engine modifications used to control carbon monoxide and hydrocarbons have increased the emission of nitrogen oxides, the only other significant pollutant from internal combustion engines.
Construction Activities and Air Pollution

Air pollution resulting from highway construction activity is also an element of this problem. Specific measures recently undertaken by FHWA to combat air pollution during construction include recommendations that state highway departments require, where applicable, nonburning techniques for the disposal of brush and timber removed by highway projects in urban areas, and recommendations that dust collection systems be used on hot-mix asphalt plants and other types of plants used primarily for highway construction. All but six states now require such dust collection systems.

State Specifications

An increasing number of states are including air pollution requirements in their specifications, and references are being made to health departments or other responsible pollution-studying agencies regarding requirements.

Drilling Dust Control Study

Our records indicate that one state (New Hampshire) has initiated an experimental project along Project No. I-93-3(48)90 (approved June 3, 1969) concerning rock drilling dust control. This project involves a cost and efficiency study of controlled versus uncontrolled rock drilling involving respirable dust. The New Hampshire Department of Health and Welfare, Bureau of Occupational Health, is collaborating with the New Hampshire Department of Public Works and Highways in conducting this survey. The intent is to obtain information concerning possible health hazards and also air pollution data.

Air Curtains for Brush Burning

A St. Louis area contractor, Millstone Construction, Inc. and Millstone Associates, Inc., has devised a practical and efficient means of burning trees and brush from clearing operations on Project I-IG-44-4(42) in St. Louis County, Missouri.* The project consists of building approximately 2.8 miles of Interstate Route 44 in the St. Louis suburb of Webster Groves. Due to local air pollution controls and fire regulations, the problem was presented of how to dispose of trees and brush from clearing operations. The contractor obtained the plans of a port-

able air curtain destructor and constructed one for use on this project to see if satisfactory results could be obtained. The results proved to be successful in the urban area because of the greatly reduced emission of smoke and unburned particles into the air.

Because of the lack of adequate oxygen, only partial combustion results from open burning. As a result, air is polluted with unburned hydrocarbons, smoke, or odors. The air curtain destructor establishes a curtain of high velocity air above the fire burning in a pit. The air curtain is delivered by nozzles inclined approximately 30 degrees below the horizontal. As the air curtain strikes the far side of the pit and deflects downward and horizontally into the fire, higher temperatures result to insure complete combustion. Particles in the air above the burning material are picked up by the air curtain and returned to the burning pit, and only the gaseous products of combustion pass through the curtain of high velocity air.

The portable air curtain destructor was built by the contractor at an estimated cost of $10,000. If the materials and equipment are available, it can be assembled in one week by two men.

By burning trees and brush in the air curtain destructor, the contractor has realized a substantial savings over the cost of removing the material and hauling it to a land-fill area.

Besides cutting down on air pollution, the air curtain destructor has proven to speed up the burning operation to an extent that the contractor would consider using the destructor in areas where air pollution controls are not needed.

I know that many of you will want to further investigate the possibilities of this new device to get rid of excess timber and brush.

*Recent Paper on Air Pollution*

Incidentally, an excellent and recent paper on the control of air pollution in connection with highway construction was presented at the WASHO meeting this month at Anchorage, Alaska, by Leno Menghini, construction engineer, with the Wyoming Highway Department, entitled "Control of Air Pollutants on Contracts."

**RODENT CONTROL**

Rodent control is another environmental element with which the highway official is concerned. Perhaps you did not know it, but there are approximately 100,000,000 rats in the United States, most of them in the urban areas of the nation. Each rat is estimated to do approximately $10 damage each year. This means that one billion dollars an-
nually goes down the drain, thanks to the rat. Obviously, the highway official could not, by any stretch of the imagination, be responsible for the entire rodent control problem, but he is striving valiantly, to deal with the problem effectively in connection with the rights-of-way which he acquires each year for highway purposes. Federal-aid reimbursement for these expenditures is authorized. The highway contractor is sometimes concerned with this problem, where some houses or other structures remain and he has the responsibility, under his contract, of demolishing them. It is in this connection that he will want to become increasingly aware of the rodent control problem and will want to deal effectively with it.

OTHER ENVIRONMENTAL CONCERNS

Tree Preservation

In addition to the important foregoing elements which I have mentioned, there are several other environmental concerns which involve the highway construction operation. One of these involves the conservation and preservation of trees, and all of you are familiar with this element. From some points of view, this could be a design matter rather than a construction one, but it is obviously involved in the construction operation.

Clean Construction Operations

Another consideration to be aware of is general cleanliness of the construction operation, especially in urban areas. Overloading of trucks should obviously be watched carefully, and this could involve the creation of excessive amounts of dust and other pollutants.

Safe Passage in Construction Areas

The creation and maintenance of safe passageways into and through construction areas or adjacent to them is still another factor to be dealt with in construction operations. Additionally, the construction operation itself needs to be executed with the expected precision, so that charges of carelessness of operation cannot be made; incidentally, damage suits increasingly are being mounted on this basis, in part at least.

Neighbors Considered

Finally, the whole construction operation needs to be undertaken in a manner so as not to annoy or alienate neighbors. This can be an important environmental and social consideration, of the utmost importance today.
**Improve Scenic and Recreational Areas**

In addition to these measures taken to protect the environment, other actions may be taken when the opportunity is available to improve the scenic and recreational aspects of the area traversed by a highway project. An outstanding example of this practice is the conversion of borrow pits, from which roadbed material had been taken, to form a chain of 50 lakes bordering Interstate 80 in Nebraska. Boating, fishing, and swimming are now available where no lakes existed before the construction of the highway. Similar lakes and ponds have been created along many other interstate routes for recreational purposes. Highway construction professionals have contributed significantly to this very worthwhile development.

**Salvage of Archeological Remains**

One other protective program warrants mention here. The Federal-Aid Highway Act of 1956 (Sec. 305, 23 U.S.C.) authorized the use of federal-aid funds for the salvage of archeological and paleontological remains uncovered during highway construction. Under Policy and Procedure Memorandum 20-7, “Archeological and Paleontological Salvage,” and subsequent instructional and circular memorandums, are encouraged to work closely with appropriate authorities to avoid, if possible, or to preserve threatened remains that appear to be of paleontological or archeological value. Federal funds may be used for any archeological surveys that may be judged necessary, for excavation of discovered remains, and for measures necessary to preserve the remains.

**HIGHWAY RELOCATION ASSISTANCE FOR THOSE DISPLACED**

A final environmental factor is highway relocation assistance. If highways of modern design are to be provided where they are needed the most, they obviously will be displacing some existing homes, businesses, and farms. Highway location techniques seek to minimize such displacement, but it is impossible to avoid all displacements.

A maximum of compensation and relocation assistance is now available under the Federal-Aid Highway Act of 1968, the new Federal-Aid Highway Act of 1970, and the brand new Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, signed by the President January 2, 1971. This latter act is applicable to all direct federal and all federally-assisted public works projects. That would include highways, urban renewal, post offices, Corps of Engineer projects, GSA acquisition activities, all federal buildings, and a host of other programs.
Under this act, liberal moving costs can be paid to the displaces, in addition to the fair market value of all properties taken, special additives and incidental payments. For home owners, a replacement housing payment of up to $15,000 can now be made, in addition to the fair market value of the home, under certain conditions. An additive payment also can be made to the tenant who is displaced, of up to $4,000, which will assist him in attaining replacement-decent, safe, and sanitary housing. Businesses are dealt with liberally, too.

JOINT DEVELOPMENT OF TRANSPORTATION CORRIDORS

The final subject I want to briefly discuss is joint development which the highway official is fostering increasingly, as he moves into the decade of the 1970’s.

Definition

Joint development of transportation corridors involves the planning, designing and construction of public and private facilities of all kinds, in combination with each other so that the resulting benefits are greater than if each individual work were provided separately. It can involve either urban or rural communities. The transportation facilities can be provided either before, during or after the other public or private accommodations are in place. A maximum of flexibility is contemplated.

Constraints

But there are some constraints. Joint development presumes that the transportation corridor is provided as part of a total environment and functional whole, must be reconciled with social, economic, and environmental concerns. The public or private uses proposed as part of the joint development package must be uses that are compatible with each other, with the transportation corridor uses, and with the community or area uses that are proximate to the joint development corridor.

Unlimited Opportunities for Communities

This unprecedented joint development program offers communities unlimited opportunities to preserve and enhance the environment, to stabilize the tax base, to provide the occasion for the timely provision of many other public and private uses, while still meeting their transportation needs.

750 Joint Development Projects to Date

Throughout the nation about 750 joint development or multiple use projects have been identified to date, most of which are associated
with federal-aid highway projects. The variety of uses includes a post office in Sacramento, California; a fire station in Orleans Parish, Louisiana; the Labor Department Building, in Washington, D.C.; a runway over I-70 at the Stapleton Airport in Denver, Colorado; rail transit facilities in Chicago, Illinois, and Boston, Massachusetts; marinas and wharf areas in such places as Sioux City, Iowa; Louisville, Kentucky; and Wheeling, West Virginia; a housing development over the Inner Leg in Washington, D.C., and many parks and recreation areas from Medford, Massachusetts and Wilmington, Delaware to Salem, Oregon.

In the following pages is a summary of various types of joint development and multiple land use projects initiated in the past few years.

As of September 1, 1969, the state highway organizations reported a total of 725 projects or program activities involving the joint development concept. Of this total, the following comparison has been developed.

Character of Community:  
Urban—539  
Rural—168  
(State-wide)—18

Implementation:  
Proposed—270  
Underway—139  
Complete—316

Highway Classification  
(by funds):  
Interstate—514  
Primary—75  
Urban—65  
Other—45 (includes FA secondary, toll roads, parkways, APD program, direct federal construction)  
Planning and Research—26

The following variety of applications that have been realized or considered in furtherance of joint development as a tool of compatible environmental design in the highway program:

1. Recreation, Open Space, Parks: 266 projects. These include such activities as mini-parks, a battleship memorial, camping facilities, boat launching sites, a scenic railroad, historic preservation, underpasses and overpasses for wildlife conservation areas and the recreational use of the reclaimed gravel pits.

2. Parking: 233 projects. Included in this figure are temporary as well as permanent facilities.
3. General Use of Airspace: 66 projects. These projects include facilities designed to allow retention of existing land use activities, maintain existing land use access or allow continuation of activities through the provision of new access corridors across highway right-of-way.

4. Other Federal, State and Local Public Uses: 55 projects. These activities include urban renewal, a museum, medical facilities, U.S. post office, city owned garage, U.S. Army, U.S. Navy, U.S. Coast Guard, war memorial, airport, helistop, courthouse, water works, civil defense, power substation, police use, libraries, a fire station and radio transmission towers.

5. Retail, Commercial: 44 projects. Included are a convention center, stores, banks, offices, motel service units and light industry.

6. Studies: 46 projects. Research, multiple use feasibility studies, joint development planning, design concept team projects and general transportation studies that promote multiple use.

7. Storage, Loading, Warehousing: 36 projects.


11. Education: 12 projects. In addition to school facilities themselves, student walkways and a sound barrier are included.

12. Agriculture and Stock: 6 projects. This figure excludes the majority of land service structures included as a normal part of highway design.

13. Utilities: 3 projects. This figure also excludes the multitude of cases where the accommodation of utilities within or adjacent to highway rights-of-way are encouraged.

The State of Indiana has several joint developments too. One that is perhaps typical is the Fairland Recreation Club which has been developed on a reclaimed gravel pit adjacent to Interstate 74.

Joint Development Ideas

The present policies of the Federal Highway Administration offer positive encouragement to the establishment of joint development projects. As Figure 1 indicates conceptually, within a block-wide area, we are now encouraging compatible public and private uses of all kinds, within and adjacent to the highway right-of-way. Please note how close
to the highway pavement itself are the residential or other structures. Moreover, the highway "tunnel" itself is on elevated structure, which is quite different from past practice which involved earth fill. Obviously, the structure is more expensive, but has other advantages such as providing surface vehicular and pedestrian accessibility, and more air and light.

Figure 2 provides another possible joint use, namely, a small business plaza under a highway structure. Incidentally, such joint uses must be compatible with the neighborhood and the general area traversed by the highway. It could add thousands of additional dollars to the local property tax base, and in part at least, compensate for the diminution in tax base resulting from the acquisition of the property for highway right-of-way purposes.

Still another possibility is conceptualized in Figure 3. The transportation corridor is multi-modal, and the immediately adjacent structure is a passenger terminal. In the vicinity, but farther removed are other compatible uses, such as office buildings, residential uses, etc. Here again, note the easy accessibility facilitated by the liberal use of structure.
Figure 4 indicates the use of the transportation corridor as a use "separator". Residential uses might be placed in the highrises on the far side of the corridor, with its swimming pools and other accommodations. And note the swimming pool extended under the highway structure. This may not be the best swimming pool in the world, but it does add to the capacity of these kinds of recreation accommodations and are generally helpful. On the other side of the corridor could be one- and two-story business uses, each with ample vehicular and pedestrian accessibility, landscaping, and other amenities.

The use of airspace is suggested in Figure 5. The areas adjacent to the transportation corridor are utilized, as well as the space above it. Note the variety of potential uses, the blending of the entire area into an environmental whole presumably. Incidentally, the type of uses to which the airspace is dedicated is important, in relation to its proximity to the transportation corridor, while it is reasonable to expect that the air pollution which is in part caused by motor vehicle emissions will soon be substantially abated; until that comes to pass, it may be necessary to restrict airspace uses to those which are not sensitive to air pollution. Noise pollution is probably subject to the same
constraints. So that use compatibility is an important consideration in the use of airspace above and below and along side of transportation corridors.

A school in close proximity to a transportation corridor is depicted in Figure 6. Note that the playground accommodations could be in an area immediately under or along side of the highway structures, thus making maximum use of space that otherwise would lay fallow. The landscaping adds to the amenities and may also provide some kind of barrier between the school use and the highway corridor. Many examples of the practical application of this kind of use already exist in the nation, especially in the large urban areas.

A new dimension of urban drama may be facilitated by the kind of joint development suggested in Figure 7. Residential uses, in close proximity to the transportation corridor, may involve medium or even low-cost housing, made possible in part, at least by the lower cost of the land which may actually be within the highway right-of-way or close to it. Here again, it is presumed that the transportation corridor and its adjacent public or private land uses are reconciled, environ-
mentally, each with the other, so that a minimum of adverse environmental impact results.

The economics of joint development is indicated in Figure 8. It is this element which, in the end, will make the program a success. Of a block-width of 350 or 400 feet on the average city block in the United States, a highway of modern design could physically require from 20 to 40 percent of its area. From studies of typical urban freeway projects, we may well pay up to 90 percent of the cost of the entire block-wide width, for this up-to-40 percent transportation-tunnel. Accordingly, if the state highway department or the city or some other public or private state or local agency were to acquire the entire city block, it could sell back to the state highway department what is required for a highway corridor, at the usual cost which I have just indicated. This would mean that the holding agency could then control the remaining 60 percent or more of the physical area of the block for just 10 percent of the cost. This low land cost, presumably below the market, could call into being marginal or even submarginal public or private uses, a very interesting situation indeed!
There are many present applications of the joint development concept involving transportation corridors, the extent of which I have previously summarized for you. I would like to illustrate some of these on-the-ground, real-life situations. Figure 9 is the University of Alabama Medical Center located in airspace over a city arterial in Birmingham. It contains hospital facilities including an operating room, which normally is a very sensitive kind of hospital use, requiring a minimum of vibration, pollution, etc. This Center is operating very effectively. Incidentally, proximity to a Veterans Hospital right next door was an important factor in providing this airspace structure, as well as the fact that it is part of the university complex. It probably could have been built cheaper farther out, but it obviously would not enjoy its present advantages which I have just suggested.

As Figure 10 depicts, a public park of considerable sophistication is being planned on either side of Central Avenue, the main business street
of Phoenix, under an elevated portion of the proposed Papago Freeway. The consultant's design involves a light and unobtrusive structure 100 feet high, which would constitute a sculptural feature in the park. More than 23 different joint development projects are under consideration on this project, and there is ample opportunity provided for just this type of development because of the relatively high structures involved. A large hospital, for example, located adjacent to the proposed right-of-way, has indicated a desire to use five or six blocks of such right-of-way for much needed expansion of their facilities, including a nurses' home, storage buildings, a central heating plant, etc.

The restaurant conceptualized in Figure 11 has been proposed and approved for joint development in conjunction with Interstate 80 in Sacramento. It will provide a spectacular combination of multiple uses within the highway right-of-way and obviously will add a substantial sum to the local property tax rolls. Finally, it will also provide a visual landmark for motorists, tourists, the local citizenry, and others, and provide an interesting point of focus for most everybody.
A highway maintenance station is pictured in Figure 12, located under the Interstate 10 and Interstate 405 Interchange in Los Angeles. Convenient access to two major highways is thus provided for a necessary facility. Its architectural and landscape design are handsome, whether viewed from the highway or from the adjacent neighborhood areas. Use of the right-of-way for this purpose eliminates the necessity for taking additional land elsewhere, permitting it to remain on the tax rolls, and also cutting down on added costs for motorists and the public.

The area under Interstate 10 near Main Street in Santa Monica, illustrated in Figure 13, provides parking and storage for a local automobile dealer. This project illustrates the adaptability of a smooth soffited structure to lighting installation.

A good example of an intermodal joint development project is provided in Figure 14 involving a Stapelton Airport runway extension over Interstate 70 in Denver. So far at least, the facility is functioning well.
Even such sensitive uses as public libraries have already established themselves in airspace over public highways. Here, in Figure 15, is the existing Hartford Public Library over the Whitehead Highway. I have been in it, and it has all the quietude and lack of vibration and noise which one expects in a facility of this kind.

Here, in Figure 16, are several playground and recreation facilities in actual operation, in the areas under Interstate 95 in Wilmington, for use by the adjacent community. The facilities include a portable swimming pool, basketball, shuffleboard, benches, swings, and other active play equipment. Parking facilities are also available in the area.

The District of Columbia has an increasing number of joint development projects, completed or underway or being planned. Among these is part of the Forrestal Building complex which bridges the 10th Street Mall, indicated in Figure 17. This large federal office building provides a gateway to the new L'Enfant Plaza area. It is a handsome and noteworthy use of urban airspace.
Another joint development project currently under construction, illustrated in Figure 18, involves a cut-and-cover section of Interstate 95, the Inner Leg Freeway, between the New York and Massachusetts Avenues. Almost twice the number of housing units displaced by this right-of-way section will be provided, and at costs and rentals within the range of the displacees. In addition, playgrounds, town houses, parking accommodations, and recreation areas are to be provided, and a little pre-existing church has been retained and preserved.

The new expansive Labor Department Building is being constructed over Interstate 95 within a few blocks of the nation's Capitol. The layout is indicated in Figure 19. Ventilation equipment for the adjacent tunnel will be housed in the new building, and has been artfully and functionally designed right into the structure. The freeway will be shielded from view from nearby historic areas.

Off-street surface parking is probably one of the most frequent understructure joint development uses that has been authorized on federal-aid highways, as this one, shown in Figure 20, along America to Washington Streets in Orlando, under Interstate 4. The parking areas
are controlled by the municipality and have functioned well for over eight years now. Such parking areas need to be designed for orderly parking; should be appropriately landscaped, and need generally to be planned and maintained so that they are an asset to the community, both from a functional and aesthetic point of view.

Essential local government services, such as police stations, fire departments, welfare service centers, and the like can be provided under highway structures, where these are appropriate. The rendition shown in Figure 21 illustrates a proposed U. S. Post Office substation and related parking area at Pawaa Station under a highway structure between Piikoi and Pensacola Streets in Honolulu.

Chicago too has many illustrations of joint development in connection with highway improvement. The one shown in Figure 22 is a good illustration of mass transit in the median of an expressway; this one is on Interstate 90. Because it is a joint development project, the costs were lower through the concurrent right-of-way acquisition and construction involving grading, lighting, drainage, common structures for cross roads, etc.
Figure 23 highlights the Halstead Street Interchange in Chicago, bringing together Interstate 94, Dan Ryan Expressway (to the right), Interstate 94, Kennedy Expressway, (to the left), and Interstate 90, the Eisenhower Expressway (from the foreground). The Eisenhower Expressway passes through the Post Office Building (in the background) and connects to the Chicago Loop area just beyond. The opening in the Post Office Building was provided at the time that structure was first built, in the 1930’s, though it had to be enlarged when the Eisenhower was built to its present capacity.

An essential use, stockyards are located under U. S. 20 in Sioux City, as indicated in Figure 24. Included are unloading facilities for incoming and outgoing livestock. The area is lighted for nighttime operation.

Even structures over water provide some joint development potential. As Figure 25 illustrates, the area beneath Interstate 65, Riverside Drive in Louisville serves as an access and parking area for U. S. Coast Guard facilities which are moored on the River.
Figure 26 pictures a structure built in the airspace over Fayette Street in Baltimore, part of the Charles Center as a downtown renewal project that includes office buildings, theaters, high-rise apartment buildings, hotels, stores, restaurants, and underground parking accommodations. Also provided within the Fayette Street right-of-way is a bus lane with sheltered loading areas, the entrance and exits ramps of an underground parking garage and landscaped channelization.

The “Gateway Center,” indicated in Figure 27, is currently under construction over the Massachusetts Turnpike in Newton. The Turnpike Authority has been actively encouraging the concept of air rights and joint development.

The immense Cobo Hall, a convention and exhibition facility with rooftop parking was built simultaneously with and over the John C. Lodge Expressway in downtown Detroit. As illustrated in Figure 28, it is an excellent example of joint development. Maximum use of very expensive urban land is thus achieved, use linkage of all sorts are strengthened, and the Detroit River waterfront is enhanced. A very important traffic generator is placed in functional proximity to the highway, so that the vehicle in motion and the vehicle at rest becomes part
of an overall service to the consumer of highway transportation—a most significant concept to recognize. Interestingly enough, the peak hour usage of Cobo Hall is quite different from that of downtown Detroit. Off the picture to the left, the Expressway passes beneath the loading platforms of the C & O Railroad.

The joint development project illustrated in Figure 29 represents three levels of occupancy, in the Twin City metropolitan area. The lowest level on the ground, with access to the Mississippi River, is dedicated to warehousing for the Minneapolis Port Authority. The second level carries U. S. 12 over the Mississippi River. The top level is a pedestrian walk-way between the east and west banks of the University of Minnesota. The entire walk-way is illuminated, and the center portion of it is closed for the convenience of users during inclement weather. The walk-way is accessible to ground-level parking lots and structures at both ends of the facility.

With increasing frequency, highway corridors are becoming multimodal transportation corridors. As indicated in Figure 30, the joint use of highway rights-of-way by the Bi-State Development Agency for the "stacking" of public service buses during non-rush periods of usage
is made possible under Interstate 70 in St. Louis. This 51,000 square-foot area has been leased since 1959 for an indefinite period, subject to a 30-day cancellation clause. The lease provides for a rental of $442 monthly, with the lessee providing the maintenance of the area involved.

New York, where this talented Society is meeting this week, has as many applications of joint development as any state in the nation. Here, for example, in Figure 31, is an elaborate park and playground facility under and near the approach roadways of Interstate 278, near the Verrazano-Narrows Bridge.

The highway improvement program contributes to the preservation of environmental quality in a variety of ways. One of them shown in Figure 32, is exemplified on this section of the Southern Tier Expressway, Route 17, near Oswego, New York, where the opposing roadways were separate and so located as to preserve a huge area of wetlands in the wide median. The area thus retains the natural environment for ducks, birds and other forms of wildlife. A gravel walk and gate have been constructed by the State Transportation Department so that conservationists and bird watchers can have easy access to the area.
Figure 33 shows Interstate 95 crossing New York City, spanning Manhattan with a 12-lane depressed freeway, linking the George Washington Bridge (top left corner) with the Alexander Hamilton Bridge (bottom center). In the lower center of the picture are the interchange ramps connecting Interstate 95 with the local street system, Harlem River Drive, and the Washington Bridge (bottom right corner). The airspace over Interstate 95 now contains four 32-story apartment structures for 960 middle-income families (center left), many of which were displaced by the highway improvements involved. A bi-state bus terminal (above and left of buildings) was also provided for the New York Port Authority, over a subway terminal which is below the highway’s surface.

Wisconsin, too, has more than its share of joint development projects. Here, in Figure 34, is a complex Civic Center Plaza in Mil-
waukee with terraces, walkways, pool, fountain and landscape plantings, located above a 3-level underground parking garage. Freeway ramp connections have also been placed under the building complex. All elements of the joint development undertaking function well.

Another application of multiple-use planning and construction is the new Milwaukee County Court House Annex, over U.S. 141 shown in Figure 35. It provides parking accommodations and much-needed, additional administrative office capacity for the Court House.

Finance Elements of Joint Development

I want to comment finally upon some of the finance elements of joint development. In connection with any joint development undertaking, the question will be asked very early in its planning consideration: “Who is going to pay for what?” It is probable that joint development will involve a different allocation of costs from that normally encountered in the separate elements of such a project.

Cost differentials will arise when structure is used rather than earth fills; the Federal Highway Administration already is encouraging the former in the urban areas where appropriate, and will participate in the extra costs involved. Incremental costs will result because of the grading and drainage items, necessitated by joint development projects; additional span lengths; development of mini-parks, play and recreation areas; benches; paving; lighting; false ceilings under structures; public parking accommodations; foundation supports; and many others.

Suffice to say here that each particular joint development project, at this time, will need to be evaluated on its own merits. Fixed cost
limits cannot now be set except one of “reasonableness.” The Federal Highway Administration will bend over backwards, one might say, to facilitate a joint development project, in connection with sharing-of-cost considerations. But it would be unrealistic to expect the highway official to pay the entire cost of the non-highway oriented uses. We do expect that the other associates in a joint development venture will be willing to contribute a fair or reasonable share of the costs involved.

Cooperation Required

It must be quite apparent by now that the highway official and the highway engineer want to be entirely responsive to the tenor of the times, with new and bold solutions to our emerging problems. It is our earnest belief that the joint development concept can materially assist the nation in these directions. There obviously must be effective dialogue between the highway official, the engineers, the planners, the architects, the landscape architects and other disciplines and interests that have a legitimate concern with the subject matter of the nation’s cities and their transportation goals. I sincerely invite the help and cooperation of all of you in the application of the joint development idea where it will make good sense to do so.