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Gordon A. Sparks, Arthur T. Bergan, R. J. Smeed,

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Books of Interest

Highways, 2nd ed., C. A. O'Flaherty (Vol. I, *Highways and Traffic*, 390 pages, Vol. II, *Highway Engineering*, 457 pages), Edward Arnold Ltd., London, 1974, $23.75 each.

This two volume book is a revision and expansion of a 1967 publication. Volume One, entitled *Highways and Traffic*, consists of eight chapters that deal with highway planning and traffic engineering.

Volume Two, entitled Highway Engineering, consists of eight chapters which deal with highway location and survey, soils, and pavement materials.

VOLUME ONE: HIGHWAYS AND TRAFFIC

Chapter One: "The Road in Perspective," outlines the major historic factors influencing the development of roads in Britain. The period covered begins with the discovery of the wheel, through the time of the Romans, the Middle ages, and into the twentieth century. The discussion briefly outlines factors influencing road construction programs, construction techniques, administration of roads, and the people associated with road developments (i.e., TRÉSAQUIT, PHILLYIS, METCALF, TELFORD, MACADAM).

Chapter Two: "Highway Legislation, Classification, Finance and Administration," commences with a discussion of the highlights of British legislation that has influenced road construction programs from the beginning of the twentieth century through 1971. A discussion of the British roadway classification systems, methods of financing, and administrative structure is also included.

Chapter Three: "Highway Planning," begins by developing the concept of the interaction between land use, transportation, and economic activity and identifies the need for highway planning. The characteristics of the British highway network are discussed as are highway traffic characteristics including hourly, daily, and seasonal demand patterns, yearly trends, effects of weather, directional distribution, traffic composition, speed, delay, volume studies, and origin destination surveys. The concept of design hour volumes is presented in the context of trip generation, trip distribution, modal split, and traffic assignment.

Chapter Four: "Parking," presents the parking problem by first discussing the interaction between parking, business activity, accessibility, congestion, and accidents. The development of the city center parking plan is discussed as are such technical features as the location of city center off-street parking, peripheral car

parks, techniques for developing the parking plan, and parking layout techniques and patterns.

Chapter Five: "The Economics of Road Improvements," examines the concept that the cheapest road is not the one that costs the least but rather the one that makes the most profitable returns in proportion to the amount invested. Methods to determine the economic justification of particular projects as well as priorities between projects are presented. The discussion includes comments on initial costs, maintenance costs, user benefits, as well as such techniques as present worth, rate of return, and benefit-cost ratio.

Chapter Six: "Geometric Design," includes a discussion of design speed and capacity followed by comments on various design criteria including vertical and horizontal alignment, cross section elements, and interchange design.

Chapter Seven: "Traffic Management," details some of the methods and techniques used in traffic operations including accident statistics, accident studies, traffic signals, speed restrictions, crash barrier design, restriction of turning movements, one way streets, reversible lanes, signing, delineation, and pricing.

Chapter Eight: "Highway Lighting," discusses the justification for lighting as well as the technical concepts and such considerations as visibility, light distribution characteristics, and light location including spacing and height.

VOLUME TWO: HIGHWAY ENGINEERING

Chapter One, "Highway Location, Physical Surveys, Plans and Specifications," briefly outlines the factors affecting the location of a highway, techniques of photogeometric measurement and air photo interpretation, subsurface exploration and methods for calculating earthwork quantities, and the development of the contract package. The chapter covers such a wide range of subjects that each item is dealt with only briefly; however, it does present a good introduction to the overall subject of highway engineering.

Chapter Two, "Surface and Subsurface Moisture Control," summarizes methods for calculating surface run-off and provides details on the control of subsurface moisture by the use of subdrains.

Chapter Three, "Pavement Materials," discusses the use of rock, slag aggregates, bituminious binders, and cement in highway construction. The use of bitumen and tar in road construction is presented as well as recommendations for specifications and tests. Information on new specifications using viscosity is also included. A brief discussion of Portland Cement and High Alumina Cement follows. The use of natural and artificial aggregate as well as classification method is presented followed by a mathematical and graphical method for combining aggregates.

Chapter Four, "Soil Engineering for Highways," briefly covers formation of soil, soil types, soil phases, physical and mineralogical characteristics, soil structure, stability, soil classification (Casagrande and H.R.B.), and methods of testing soils. This chapter provides a good introduction to soil mechanics for a reader without any prior knowledge of the subject.

Chapter Five, "Soil Stabilization," presents a very good introduction to the stabilization of soils primarily by compaction or with the addition of cement, lime, bituminous material, and other chemical stabilizers.

Chapter Six, "Flexible Pavements," presents flexible pavement design procedures from several countries as well as design procedures to overcome such specific problems as frost action and compressible soils. The chapter begins with a discussion of stress analysis by the BOUSSINESQ AND BURMISTER method, which is followed by a detailed discussin of flexible pavement design procedure in Britain (C.B.R.), California (Stabilometer), and Russia (Modified Theoretical Approach).

Chapter Seven, "Bituminous Surfacings," discusses bituminous surfaces on the basis of three groups—close, medium, or open textured aggregates. The chapter is introduced with a discussion of failure criteria and is followed by the theory of bituminous mixes and Marshall Design Procedure. The British practice of surfacing is discussed under the topic headings, rolled asphalt, mastic asphalt, compressed natural rock asphalt, dense tar surfacing, and coated macadams. The discussion on surface treatments includes aggregate and bituminous requirements and specifications.

Chapter Eight, "Rigid Pavements," discusses subgrade and subbase requirements, concrete, stress considerations, reinforcement, joints, thickness design, and construction techniques. Considerable information about concrete pavements has been included in one concise chapter.

O'FLAHERTY has undertaken an ambitious task by attempting to provide a single textbook for civil engineering students specializing in highway engineering. The text could not be considered a comprehensive reference on all the topics that are presented. Such is obviously impossible in a single text. It is a well written, relatively concise introduction to the field of highway engineering. O'Flaherty's style is easy to follow and holds the readers interest. The discussion is well illustrated. A complete set of references has been included at the end of each chapter. Metric units are used throughout the text. The text should be given serious consideration by those interested in an introductory text dealing with highway planning, design, construction, and operation.

GORDON A. SPARKS
ARTHUR T. BERGAN
University of Saskatchewan
Saskatoon, Canada

Compact City: A Plan for a Liveable Urban Environment, George B. Dantzig and Thomas L. Saaty, W. H. Freeman and Company, San Francisco, 1973, 244 pp., cloth cover, $9.00, paper cover, $4.50.

The writer of the review was anxious to read this book as soon as he heard of its existence. He wished to know how two men—distinguished for their contributions to the theoretical side of operational research—would tackle a practical problem.

THE DIAGNOSIS

THE AUTHORS BEGIN by saying that—generally speaking—the interiors of dwellings, shops, work facilities, and schools within cities are becoming more pleasant places in which to live, they then follow countless other writers in blaming the ills of urban communities to a combination of the increased availability and attractions of the motor car and the increased urbanization of the communities. They point to the increased sprawl of urban areas, the long time spent by commuters traveling to work, the deterioration of downtown areas, the human and economic losses caused by traffic congestion, the smog, the tension of driving on high speed crowded freeways, and the problems of finding a parking place. They quote MUMFORD predicting that the entire British Isles will have an ever increasing number of "car owners vainly seeking to escape, at high speed that turns into a crawl, into a countryside that no longer exists. . . . Cities, in turn, will be transformed into extravagant parking lots." Similarly, they quote MORRIS NEIBURGER "I don't believe controls can be devised that will adequately reduce the poison given off by automobiles. . . . All civilization will pass away, not from a sudden cataclysm like a nuclear war, but from gradual suffocation in its own wastes."

The authors believe that "many of the problems connected with urban sprawl could be avoided by total system planning" using, "in particular, operations research, mathematical models, and computers" to "simulate and analyze the total system." "The problems of urban development are too crucial to the future to be left to real estate developers and urban planning authorities who recommend more freeways, multilevel parking facilities, and other patchwork cures." "Society invests in freeways, a self-perpetuating mistake . . . these invite greater urban sprawl, pollution, destruction of the countryside, and appalling death on the highways. They create a suburbia that has the unfortunate side effects of draining the money and the richness of life from the inner city. Suburbia, in turn, fosters long-distance travel to work, with corresponding waste of time at commuting. . . . The consequence of the uncontrolled use of the automobile in a rapidly growing urban area leads eventually to an impossible transportation problem at the urban center."

THE SOLUTION TO THE PROBLEM

"URBAN AREAS" the authors say "should be designed to provide a good life . . . a new start for the disadvantaged, . . . ample sized homes," etc., and they discuss

ways of achieving such goals by describing their conception of a new city characterized by two principles that form the central theme of their book, namely, that cities be designed to make more effective use of vertical space and around the clock use of urban facilities.

To do this they give designs for circular cities with populations varying from 250,000 to 2,000,000 people. The smaller city would have a base radius of 4,420 feet and would be built on eight platforms, each 30 feet apart in vertical height. The larger city would have double the number of platforms and approximately double the radius. Three storey apartments could be built between each level, various sized lots could be made available on the different levels, and on these one could build offices, plants, stores, schools, apartments, and houses, very much like one would in a conventional city. All levels have a concentric core of 1,500–3,000 feet radius; this would contain offices, factories, warehouses, hospitals, high schools and universities, hotels, convention halls, museums, theaters, sports facilities, parks, fire, police, and administrative agencies.

The main system of roads within the city would consist of radial two-way roads, which radiate from the core edge like the spokes of a wheel accompanied, at different elevations, by 13–26 concentric ring roads. Walkways and bikeways would also be provided and would pass over the roadways. Ramps, escalators, stairs, and elevators would be used to move vertically between levels, but the main mode of transportation from one level to another would be the elevator. A high proportion of personal travel within the town would be by foot, by bicycle, and by elevator.

Starting times for work would be spread evenly, not only over the day but over the week and the year. With this arrangement, the authors claim enormous savings. For example, a restaurant would require only one 24th of the existing number of tables. Because of this spread of working hours and because of the concentrated nature of the ground area of the town, the authors claim that the number of commuters traveling to work at any moment would be between one 300th and one 100th of the number now traveling during the peak periods.

COMMENTS ON THE DIAGNOSIS

THIS REVIEWER BELIEVES it to be a pity that the authors—in their initial diagnosis of the problem—have reproduced the anticar dogma current in some 'advanced' and other circles without giving any reasonable quantitative or qualitative arguments or even references to such arguments. There is much to be said both for and against the use of the car, and rational beings should weigh up the pros and cons.

The Quotation from Mumford

To consider the statements on car use made by the authors and the other people whom they quote, it is convenient to start by examining the amount of road space required to enable complete populations to drive simultaneously. The number of cars per mile of road that a road can carry varies with the speeds at which they travel and with the road layout. It is usually about 25 per 12-ft wide lane if they are traveling at about 60 mph on a rural road or 15 mph on an urban street. The number is greater if they are traveling at lesser speeds, less if they are moving faster. It follows that—under these conditions—each car effectively occupies about 0.000091

sq mi. In Great Britain with 55 million population and, say, two persons per car, they would require 3 percent of the total area, 90,000 sq mi. In the USA, with 220 million population, the proportion of the total area required is 0.06 percent. If the vehicles traveled at even lower speeds even smaller areas of road would be required. And it is difficult to imagine a time when all these cars would be on the road together, even if they ever existed. Other relevant data are that in Britain about 10 percent of the total area is built-up, in the U.S. 3 percent. About 1.5 percent of the area is used for roads in the U.S. considerably less than 1 percent.

Because of these facts, there is no obvious justification for quoting Mumford's statement about a "countryside that no longer exists" because of the car. In Britain, at any rate, there is a widespread feeling that some of the motorways have opened up beautiful views of the countryside that had previously only been seen by a tiny handful of people.

As far as parking areas are concerned, the ground area per head of population in British towns is of the order 2000–8000 sq ft. The total ground area per car when half the population have such vehicles is therefore of the order 4000–16,000 sq ft. Since the plan area of a car is of the order 50–100 sq ft, it really is unrealistic to talk about cities being turned into extravagant parking lots, because 0.3–3 percent of the total area is used for car parking. The position is, of course, worse in downtown areas, but even there the position is often exaggerated. The area per commuter in the downtown area is usually 200–400 sq ft, although less than 100 in the City of London. In U.S. downtown areas, the area per commuter tends to be greater than in British cities, although less in the Wall Street area of New York. Since car commuters travel at an average of about 1.33 per car and since in car parking lots the area per car usually works out at about 230 sq ft, the area required per car commuter is about 173 sq ft. It is clear, therefore, that ground level parking in downtown areas would not be satisfactory if everybody traveled by car, but with parking at, say, five levels, would require about 10 percent of the ground area. This, perhaps justly, would not be acceptable to many people but it would not be turning the city into extravagant parking lots as picturesquely suggested by Mumford; there are, in any case, a number of ways in which this area could be reduced, for example, by parking at more than five levels, increased car occupancies and design of car so that the area required to park a car, say 70 sq ft in plan area, is much nearer to 70 sq ft than the average area for parking now required.

The Quotation from Neiburger

As for the quotation of what Morris Neiburger believes, this is surely irrelevant to a book apparently purporting to treat planning problems on a rational basis. For this purpose, we want evidence, quantitative, meaningful statements about pollution, not beliefs of one person. This is especially true when it is most unlikely that a high proportion of those most qualified to judge agree with Neiburger that the danger from pollution is greater than that from nuclear war, and only a small proportion of those who believe in the extreme danger of pollution would put pollution from motor vehicles exhausts high on their priorities, except in the case of a few areas with specialized atmospheric conditions, such as Los Angeles. The first report of the British Government's Royal Commission on Atmospheric Pollution reached

a different conclusions to Neiburger. It states "we see no cause for alarm"—it gives data showing downward trends in smoke and sulphur dioxide pollution in Britain, and increases in the hours of winter sunshine recorded in Central London. Referring to pollution from road vehicles, it states "there is no firm evidence that in Britain the present level of these pollutants is a hazard to health, even in busy city streets. . . . However, a considerable research and development effort to reduce pollution is taking place. . . . But it would be dangerously complacent to ignore the potential implications of the trend" in numbers of motor vehicles.

Freeways, a Selfperpetuating Mistake

It is true that, by enabling people to live in what they regard as attractive low population density areas, freeways invite a certain amount of urban sprawl, some pollution, and some destruction of the countryside, but these adverse features have to be weighed against their benefits. If such an analysis were made, the results would probably come out against freeways in some circumstances but not in others. There is no justification in the book for the total condemnation made by the authors.

The Uncontrolled Use of the Automobile

There are major difficulties in the "uncontrolled use of the automobile in an urban center," but the statement made is more appropriate to propagandists than to people making scientific assessments. The use of the automobile never is completely uncontrolled. Traffic is it some extent, self regulating. People seem to adjust their use of the motor car in urban areas until congestion reaches a level only slightly better than intolerable, usually about 8–12 mph in downtown areas and faster in suburban areas. In any case, a great deal can be done to reduce the difficulties, especially by opening up intersections, building circumferential roads, increasing car occupancies.[1] The "impossible transportation problem" referred to by the authors would be completely solved in nearly all urban centers by the spread in the times at which journeys take place, suggested for Compact City.

The Appalling Death on the Highways

Any death on the highway or anywhere else can be regarded as appalling. But the use of such words, although, perhaps, desirable when attempting to persuade people to do something about it, tends to substitute emotive feelings for rational thought. It is surely undesirable in a book clearly designed to promote fundamental thought on the way people live. Again, some quantitative thinking would be helpful. Road accidents reduce the expectation of life by about 0.3 percent in Great Britain end about 0.4 percent in the United States, which has a higher rate of motorization. The latter figure means that road accidents reduce the duration of our nonsleeping lives by about 1700 ($= 0.004 \times 71 \times 365 \times 16$) hours per person. If, therefore, the use of motor vehicles enables us to spend an average of more than four [$= 1700 \times 60/(71 \times 365)$] minutes a day doing things that enrich our lives, and which we would not otherwise be able to do, their net effect is to enrich our lives. Since casual observation suggests that car travel enables us to spend a great deal more than four minutes per day in an especially satisfying manner, it appears likely that the net effect of road travel on the effectiveness of human life may therefore be favorable

from this point of view. There are, of course, other very important aspects of the subject, one being that the person who gets killed may have received less than the average benefits from road travel and we do not wish to feel responsible in any way for a death, but the serious consideration that the subject requires is not helped by putting the subject on an emotive plane. In any case, in Britain, and presumably in other countries, the deaths per head of population caused by road accidents were about one-quarter of the present rate before the advent of the motor vehicle: even if we gave up the use of motor vehicles we whould still have a fairly large number of road deaths. Even if we gave up the use of the private car, we should probably not be prepared to give up the commercial vehicle, which is probably essential for the production of the interior of dwellings, etc, of which the authors approve. And even rail, of which the authors apparently approve, is responsible for 300 deaths a year in Britain and three times this number in the U.S.

The authors claim that "About 500 lives would be saved from death on highways . . . each year in Compact City as compared to a present-day city, assuming both have 2,000,000 inhabitants." They presumably deduce this result from the fact that the U.S., with rather more than 200 million people, have about 50,000 deaths a year due to road accidents. But such a calculation is wrong, probably by a factor of at least three. As a result of the lower speed of travel, fatal accident rates in cities are much less than in rural areas. Published figures[2] of fatalities in U.S. cities show that the average number of fatalities in 1972 was 127 per million population, about half the figure assumed by the authors. In addition, many of the fatalities in a city do not involve private motor vehicles, and these would presumably still occur. In addition, even Compact City would have some private vehicles. One can argue even further. There is good evidence[3, 4, 5] that people driving low mileages per year have more accidents per mile travelled than people driving high mileages per year. A given percentage reduction in car miles travelled would not therefore produce an equal percentage reduction in traffic accidents.

Sprawl

It is true that cars, even more than trains and buses, enable sprawl to occur, but there are other ways of reducing sprawl—if there is sufficient public desire to do so—than abolishing the use of cars, just as there are other ways of preventing some types of headache than by cutting off people's heads. In Britain, for example, planning laws are by no means completely effective, but they seem to be much more so than in the United States.

The Avoidance of Urban Sprawl by Total System Planning

There is no doubt that the formulation of policies for dealing with those aspects of urban sprawl that need to be limited, could be assisted by the appropriate use of appropriate mathematical techniques. However, the view that decision making should be by these techniques instead of by urban planning authorities raises quite fundamental questions. Would such decision making produce better decisions? Would it be publicly acceptable? Since the decisions would depend on the assumptions made, the new decision making process would presumably replace the urban authorities by the technicians who decide on what assumptions should be made.

These decisions would sometimes be very undesirable, just as decisions by urban authorities frequently are nowadays. The fundamental difficulty is that decisions are usually good for some members of the public but not for others. The resolution of such difficulties can hardly be left to 'total system planning,' although such planning might well help in the analysis of difficulties.

Quotation from Jane Jacobs

The authors have also quoted JANE JACOBS in a statement that runs counter to a large part of their diagnosis. They quote "American downtowns are not declining mysteriously because they are anachronisms, nor because their users have been drained away by automobiles. They are being witlessly murdered, in good part by deliberate policies of sorting out leisure uses from work uses, under the misapprehension that this is orderly city planning."

This review, written primarily for a transport journal, is mainly concerned with the transport aspects of Compact City, but, in view of the above quotation, the opinion of Jane Jacobs on the authors' proposals would be of especial interest.

COMMENTS ON THE SOLUTION

THE AUTHORS HAVE carried out an interesting—and perhaps useful—calculation and shown that, provided the conditions are found to be tolerable to human beings, it would be possible to build a town of up to about two million people, in which a large part of personal travel would be by foot and elevator. They do this—using the same surface area per head of population as in many a normal town, about 4,000 sq ft, but by the use of 32 platforms vertically above one another, thus reducing the horizontal distance traveled by a factor of about $6(\sqrt{32} = 5.7)$, and the need for road space for travel is further reduced by a factor between, say, 5 and 20 by spreading the journeys evenly in time, although the actual reduction could not be nearly as great as this because of the necessity for roads to be at least, say, 22 feet wide. The authors have been bold in their thinking and taken the possibility of spreading working and sleeping hours to the limit. The authors discuss some of the difficulties, but the reviewer found this part of the book considerably less than adequate. After all, an appreciable proportion of the benefits of Compact City over existing ones could be gained by the rearrangement of working and leisure hours in existing cities, but, despite major attempts to achieve a modicum of such arrangements by the authorities in many cities, only a little progress has been made. Again, the psychological difficulties many people would experience caused by the artificiality of the environment, the absence of natural sunlight and fresh air, the difficulties of making arrangements to meet one's family, one's friends, and one's business acquaintances, the fire risk, the risks—however small—that the power supply might fail for a period —all tend to make one hesitate to support the building of Compact City. However, there might well be places suffering from extremes of temperature where it is very desirable to build a major city. In these places it might well be worthwhile building a city on the lines suggested and finding out what difficulties arise. If this should ever be done, the authors' preliminary thinking on the technical arrangements of numbers of platforms, means of personal and freight transport, water supply, air conditioning, etc., will be of value to those responsible for planning. However,

in the opinion of this reviewer, the ideal place in which to live is a village with satisfactory telephone and radio broadcasting systems and access to a good library. This is very different from Compact City.

R. J. SMEED
University College
London

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