ASSESSMENT OF THE CURRENT STATE OF THE ART OF ACCOMMODATING UTILITIES IN PUBLIC STREET RIGHTS-OF-WAY IN THE UNITED STATES AND CANADA

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This paper examines the practices and problems related to accommodating utilities in public street rights-of-way, identifies best current practices, indicates areas where further research and improvement are needed, and points the way toward alleviating some of the most widespread and serious problems. The paper is based on information derived from field interviews in 20 metropolitan areas, a comprehensive mail survey of practices in 222 municipalities, traffic delay tests in 16 areas, and a literature search conducted in the course of a research project. Some of the major conclusions and recommendations are as follows: Diffused utility ownership and control arrangements inhibit a total systems approach toward implementing improvements in the broadest possible public interest; local utility coordinating committees can be effective instruments for resolving conflicts; city planning and utilities planning are often carried on as independent efforts, and utility considerations are either ignored or subordinated to other concerns in the planning process; utility location record systems are generally inadequate; municipal inspection programs do not always ensure that pavement is properly restored over utility trenches; workable local utility location standards should be developed, and efforts should be made to develop models for optimum locational solutions; additional studies are needed to resolve controversy over the advisability of joint trenching; additional research is needed to improve utility delivery systems; and the effects of lane closures on traffic may be less than popularly believed.

•THE AMERICAN Public Works Association is conducting a comprehensive and intensive study of utility accommodation practices. In this study an extensive search of pertinent literature has been made, week-long interviews have been conducted among local governmental and utility company officials in 20 metropolitan areas, a comprehensive mail survey has been conducted with responses from 222 municipalities, and field tests have been performed by 16 municipalities to determine the effects of lane closures on traffic. This work will result in the publication of a state-of-the-art report and a manual of recommended practice, which will have the sanction of the American Public Works Association. This report was written during the data analysis phase of this project and represents only the preliminary personal views of the author.

Practices for accommodating utilities in public street rights-of-way vary widely among communities in the United States and Canada. There are, however, a set of organizational arrangements, regulatory and control mechanisms, and problems common to most communities. An examination of these practices and problems can identify best current practices, indicate areas where further research and improvement are needed, and point the way toward alleviating some of the most widespread and serious problems.

A series of utility networks lace all urban communities with webs of cables and pipes that provide essential energy, communication, water, waste disposal, drainage, and other services and commodities that make modern urban life possible. For the most part, these utility networks are superimposed over, and coincident with, the network

of urban roads and streets. Most of the existing electric power, telephone, and other cable-transmitted services are strung overhead on poles located in street rights-of-way and rear-lot easements although there is a noticeable trend toward placing new distribution systems underground and converting existing aerial facilities to underground.

This trend, compounded by continued urbanization of the country, population growth, increased per capita demands for utility services, and the advent of new utility services such as cable TV (and perhaps others such as pneumatic tubes and vacuum waste collection systems), will increase the congestion of subsurface space and the problems attendant to this congestion.

Accidental utility line "dig-ups"—a serious nationwide problem—are but one manifestation of the problem. The crowding of subsurface space, the haphazard location of many older utility lines, and the lack of reliable utility location information complicate the problems of installing and maintaining underground utility systems. The need to protect workmen, pedestrians, vehicles, and neighboring utilities; to minimize traffic delays and inconvenience to abutting properties; to reduce noise; and to prevent other environmental detriments has made utility work in street rights-of-way difficult and costly, and adverse side effects still occur in spite of efforts to minimize them. The number of different types of utilities found in most city streets and the diffuse pattern of utility ownership and management responsibilities make coordination of utility work in street rights-of-way difficult.

Many governmental agencies have developed mechanisms to alleviate these problems and to provide for more efficient and orderly use of space. Some of these approaches appear to be working well. Agencies not now employing these proven practices would do well to adopt them. In other instances, however, the identification of "best" practice is not so clear-cut—only subjective judgments are available to assess the relative costs and benefits. Even when assessible, practices that work well under one set of circumstances may not work so well under others. Not enough is known about the effects of institutional and environmental differences among communities to predict the successful transferability of particular arrangements from community to community. Local adaptations may be necessary to implement identifiable "good" practices. In some areas, no models appear to exist. Better approaches must be conceived. Additional research and development would be useful, particularly to improve product reliability, reduce size, and decrease cost. Following are some observations about the state of the art of utility accommodation practices and what is needed to improve it.

A TOTAL SYSTEMS CONCEPT

In the United States, and to only a slightly lesser extent in Canada, the provision of the array of utility services is characterized by a pattern of diffused ownership. Water and sewage service is usually provided by a publicly owned agency—municipality, special district, or authority—although there are a number of investor-owned water utilities. Electric power, telephone, and natural gas are typically investor-owned utilities although there are a number of municipal and other publicly owned electric and gas utilities. Street lighting and emergency signal systems may be owned and operated either by public agencies or investor-owned companies.

Twelve different types of utility services are provided in most urban areas. In a recent APWA survey, the following percentages of respondents indicated the presence of the named utility in their communities.

Utility	Percentage
Water	99+
Sanitary sewers	96
Storm sewers	97
Gas	98
Electric power	99+
Telephone	99+
Telegraph	67
Cable TV	51
Street lighting	97

Utility	Percentage
Traffic signal cable	92
Police signal cable	53
Fire signal cable	69
Combined sewers	41
Steam lines	18
Chilled water	6
Other	5

Typically, 1 municipal department, 2 other governmental agencies, and 4 investor-owned companies provide utility service in a municipality although the total number of different utility agencies reported in one community runs as high as 27.

A number of different agencies and municipal departments are involved in the utility regulatory, planning, or control process. Typically, a state public utilities commission or a public services commission regulates utility rates and may prescribe certain practices such as undergrounding. The state legislature or city councils or both may grant utility franchises and impose certain restrictions. A local planning commission may establish subdivision regulations and zoning districts that affect utilities. The public works department or city engineer may regulate street openings. The traffic engineering or police departments may regulate lane closings and traffic protection measures. A state agency may prescribe safe work practices. A state highway department may regulate utility work in state rights-of-way passing through municipalities.

Each of these regulatory agencies, and each utility service agency (investor-owned or public), has its own clientele to serve, its own interests to protect, and its own limited perspective on the problem of utility accommodation. One wants to maximize the return on investment, one wants to minimize rates, one wants to protect workmen, one wants to reduce traffic congestion, one wants to prevent damage to the pavement, one wants to beautify the community, and so on. Measures designed to optimize one of these objectives often conflict with others. Each resolution of a problem ultimately has an effect—real, but not measured—on a variety of groups: the utility company and its customers, the municipality and the taxpayer, the motorists, the abutting property owner or resident, and a number of other affected groups.

Under present diffused ownership and control arrangements, there is no incentive (and plenty of disincentives) to look at total systems costs—the sum total of the effects of accommodation practices on all affected parties. Consequently, the net total effect of existing practices is unknown; neither is it known whether proposed changes will have a net beneficial or negative effect.

There are immense theoretical and practical problems to be overcome both in determining total system costs and in applying this concept to real-world situations. Where to draw the boundaries of the system, i.e., what costs to include, and how to measure or recognize certain environmental and social effects are both problems. Minimum total system cost solutions, which result in the redistribution of immediate costs and benefits among affected parties, may be difficult to implement because of the political and economic power of the affected groups. In spite of these difficulties, it seems advisable to develop mechanisms for providing a broader perspective on the problems, for evaluating trade-offs, for resolving conflicts, and for implementing solutions in terms of the broadest possible public interest.

UTILITY PLANNING AND COORDINATION

Utility coordinating committees, composed of representatives of investor-owned utility companies, governmental utility agencies, regulatory bodies, and other interested groups, have been formed in a number of communities in the United States and Canada to coordinate their plans and programs for their mutual benefit. The composition, structure, legal status, authority, activities, and effectiveness of these organizations vary from place to place. In most cases, these committees are organized on an informal basis, meet on call as an occasion arises, and have no powers, responsibilities, or continuing programs except to serve as a focal point for the exchange of information and the resolution of problems through the mutual consent of the participants.

In a minority of cases, the committees are formally organized with officers and by-laws, meet on a regularly scheduled basis, employ a staff, have an operating budget (financed from assessments levied on participating agencies), have authority to recommend decisions to some higher authority (in a very small number of cases, to make binding decisions), and carry out some on-going programs that may include centralized record keeping, public information campaigns, "1-call" and "locate-and-stake" programs, the development of utility location guidelines or standards, and the coordination of plans and programs of the participating agencies.

These voluntary utility coordinating committees clearly perform a useful service and should be formed where they do not exist. (Forty-six percent of the communities in the United States and Canada have no utility coordinating committee, either formal or informal.) Although the structure and programs of these committees should reflect local needs and circumstances, the successful groups tend to be organized on a formal basis with adequate staff and fiscal resources.

Although utility coordinating committees can be effective coordinating instruments and may be able to focus attention on various planning problems, in most cases they do not have the authority to determine certain public policies and plans that directly bear on the utility-accommodation process. In too many cases overall city planning and utility planning are carried on as independent efforts. City plans are developed—and changed—often with little regard for the effects of those decisions on the utility networks. Rezonings and unplanned high-density developments can have major impacts on the utility system, requiring the installation of miles of new trunk facilities and the attendant street openings and traffic disruptions. Vacating existing street or alley rights-of-way can eliminate necessary access to utilities in those rights-of-way. The granting of building encroachments into the subsurface space within rights-of-way can preempt an alignment needed for utility purposes.

Thoroughfare plans are developed primarily to meet transportation needs; little attention is given to utility space requirements. Right-of-way widths are set to accommodate traffic and parking lanes, sidewalks, and planting strips. Utilities must then fit into available space as best they can. Little thought is given either to providing adequate space for utilities or to organizing space utilization in a manner that will minimize conflicts in using that right-of-way for both transportation and utility purposes.

When highway grades, alignments, or widths are changed, utilities are usually required to relocate at their own expense. Too little thought is given to planning for this eventuality. Many municipalities do not have long-range capital improvement plans for streets and municipal utilities and do not adequately coordinate development plans to avoid the cutting of new pavement for utility work. When acquiring additional right-of-way for street improvements, most municipalities do not obtain extra right-of-way that is needed for either municipal or investor-owned utilities.

In practice, utility considerations are practically ignored in the planning process, and utility rights in public rights-of-way are definitely subordinated to other interests. The result is not in the public interest. Better understanding needs to be developed of the interrelations between city and utility planning. Utility concerns should be better represented in the planning process, better capital improvement planning should be undertaken, and additional efforts should be made to communicate and coordinate decisions and plans with affected parties.

RECORD SYSTEMS

The comprehensiveness, accuracy, currency, and accessibility of utility location maps and records vary from municipality to municipality and from utility to utility. There are some excellent record-keeping systems, but most are deficient in one or more respects. Common deficiencies include failure to record as-built conditions (field changes are often made from planned alignments and not noted), out-of-date records (locations may be referenced to original features such as curbs that may subsequently have been relocated), delays in updating maps (months of field notes may be backlogged), errors in field measurement or in plan dimensioning, incomplete records (no records exist for many older systems), and failure to show service connections.

Generally each utility is responsible for keeping records of the location of its own facilities. Central repositories of information on the location of all utilities in public street rights-of-way are uncommon, and most of these are incomplete.

The vast majority (99 percent) of municipal location records exist in the form of engineering drawings or utilities maps. Microfilm records are kept by about 23 percent of the municipalities, and only 1 percent of all municipalities use computerized records. Five percent of all municipalities use a geocoding coordinate system for storing utility data.

Improvements are clearly needed in utility record-keeping systems and procedures. Greater care and effort should be devoted to gathering and recording utility location information; available technology for information storage, processing, and retrieval should be more widely utilized; and mechanisms should be developed and implemented for facilitating the compilation of all utility location information in a particular area either through centralized record-keeping arrangements or through the use of modern telecommunication links to the individually maintained record systems of all utility agencies.

FIELD LOCATION AND SUBSTRUCTURE DAMAGE PREVENTION

Most utilities are actively engaged in substructure damage prevention programs. Eighty-seven percent have a "call-before-you-dig" program, although in only 35 percent of the communities is there a central telephone number to reach all utilities. Almost all (95 to 98 percent) of the water, sewer, gas, telephone, and power utilities provide a field service to locate buried facilities. However, a sizable portion (30 to 50 percent) of these programs depend entirely on records to mark the location of buried utilities (as indicated previously, record systems are not always reliable). Instruments are used about 50 to 60 percent of the time, and in only about 13 to 15 percent of the cases are the lines actually uncovered by test digging.

Additional efforts are needed in this area. Call-before-you-dig and locate-and-stake programs should be installed in all areas; more intensive public and contractor education programs should be undertaken; convenient 1-call systems should be developed to encourage public cooperation; less reliance should be placed on records to locate underground utilities, and more use should be made of instruments and hand digging to verify locations; and better instruments should be developed, particularly for locating nonmetallic conduits.

PERMIT AND INSPECTION PROGRAMS

In almost all communities the use of street rights-of-way for utility purposes is regulated by the municipality. Permits are normally required to cut street pavement except in emergencies. Fees are normally charged for each permit, and performance or surety bonds are normally required from private contractors and frequently required from utility companies. Municipal departments are often exempt from these permitting requirements.

Permits normally regulate or specify the extent and method of work (open cutting is prohibited under certain circumstances), hours of work, signing and barricading, vehicular and pedestrian safety measures, protection of other utility facilities, backfilling, pavement restoration, cleanup, and others.

Although permit requirements are often very stringent, field inspection is often less than adequate to enforce these requirements. Backfilling, compaction, and pavement restoration are most likely to be less than adequately controlled as evidenced by the number of settled utility trenches that exist in most communities.

Generally, municipal permit systems for utility work in street rights-of-way work fairly well. Improvements are needed in the areas of simplifying administrative procedures and making it more convenient for the permittee to obtain a permit; subjecting municipal departments to the same necessary and reasonable procedures and standards required of other utility agencies and contractors; and providing better field inspection, particularly for backfilling and pavement restoration.

PAVEMENT RESTORATION

About 36 percent of the municipalities surveyed performed pavement restoration work with their own forces. Nevertheless, almost all permit the utility company or its contractor to backfill the trench, make the temporary pavement restoration, and maintain the temporary pavement. Municipalities that have chosen this method maintain that it works well for them, although restoration by municipal forces is no guarantee of superior work. Other cities, which have good pavement restoration standards and adequate inspection, report satisfaction with the restoration work performed by utility companies or their contractors. Each municipality must judge the adequacy of its own procedures, identify the cause of any deficiencies, and apply its own remedies. One improvement that might prove of general benefit, however, is in the area of backfill materials. Some cities have experimented with "unshrinkable" fills (a weak soil-cement mixture) and mixtures of crushed pavement and excavated spoil with good results.

UTILITY LOCATION STANDARDS

A number of communities have developed guidelines to standardize the location of utilities in street rights-of-way and to use scarce space more efficiently. These standard locations vary from community to community, and clear-cut patterns are not easily discernible. Each local standard appears to be a product of a number of organizational, technical, traditional, environmental, and other considerations unique to that community so that transferability to other areas is indeterminate. There is little documentation to indicate why, or by what process, the final determinations were made. The rationale for supporting particular locational preferences is weak in many cases.

Although there undoubtedly is no one best arrangement for all circumstances, there probably is one best arrangement for each particular set of circumstances. To formulate a model by which optimum locational arrangements can be developed for each set of circumstances may be useful. This, however, is a most complex undertaking because of the difficulty in identifying all the relevant constraints, requirements, and variables; the difficulty in identifying and measuring the effects of various locational alternatives on total system costs or some other indicator of overall system effectiveness; and the lack of uniform data on utility installation and maintenance costs, among others.

The potential benefits of this approach, however, would seem to warrant the pursuit of this model. If "optimum" utility arrangements cannot be identified, "workable" arrangements that provide for some regularity and predictability in utility locations within a community would be of considerable benefit and should be developed.

JOINT-USE FACILITIES

The joint use of utility poles by 2 or more utilities is widely practiced to cut costs and minimize street clutter. Joint trenching, however, is not so widespread. It is common practice in only 22 percent of municipalities surveyed, and an exceptional practice in 37 percent of these municipalities. It is not practiced at all in 41 percent of the municipalities. The most common joint trench combinations place water and sewer lines in the same trench and electric and telephone lines in the same trench in various combinations with telegraph, cable TV, and other signal cables.

There is much controversy over whether joint trenching is advantageous or detrimental from a cost, safety, and compatibility standpoint. It is encouraged in some places and discouraged in others, and there is no clear-cut consensus. Additional studies are needed to resolve this question.

EFFECTS OF LANE CLOSURES ON TRAFFIC

The opinion is widely held that lane closures for utility work in street rights-of-way have a major impact on traffic and create congestion, delay, increased travel costs, and environmental pollution.

A number of measures, such as limiting the amount of street to be closed at one time or restricting the hours of work to off-peak hours, have been devised to minimize these problems and are widely used. These measures, which significantly increase the cost of performing utility work in street rights-of-way, have been developed in response to public pressures and are assumed to be justified. However, studies have not determined the costs of such lane closures and the costs of such palliative measures or compared the two.

Some field testing performed by a number of municipalities on city streets for the American Public Works Association supports the conclusion that controlled lane closures on the majority of municipal streets during off-peak hours have a minimal effect on traffic. Additional testing is required to determine the effects of severe lane closures on streets operating at or near capacity. Such testing would provide valuable information for developing optimum regulations and procedures for traffic controls at work sites and should be undertaken.

MATERIALS AND PROCEDURES

During the years, a number of improvements have been made in pipe, joints, cable, and other materials used in utility installations. Such improvements, which increase reliability and extend the useful life of facilities, can pay dividends in reduced maintenance and other costs during the life of these installations. Continued product improvements should, of course, be encouraged. However, more economic studies that use a total systems cost approach should be performed to determine to what extent higher first costs for improved products can be justified over the long term. Once determined, these analyses should guide engineering practice.

Technological innovations such as the telephone "wave-guide" transmission system, which greatly increases the number of messages that can be sent through a limited space, could produce dramatic improvements in the utilities field. Procedural innovations, such as direct burial of cable, could also be useful. The delivery systems of many utilities, however, remain essentially unchanged from earlier technological eras. More research is needed, and should be undertaken, to improve these delivery systems.

CONCLUSION

This paper has sought to analyze the current state of the art of accommodating utilities in street rights-of-way, to identify best known practices, and to indicate ways in which improvements might be made. A more extensive analysis of the state of the art and a manual of recommended practice are available from the American Public Works Association.