

UTILITY PROBLEMS IN THE DESIGN AND CONSTRUCTION OF URBAN HIGHWAYS

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•ANYONE who has occasion to cut through the pavement of any city street in any major city will find that others have been there before. Any excavation project in a public way is almost certain to encounter the works of other engineers who were there previously. The excavator will find sewers, electric lines, telephone and telegraph lines, gas pipes, water mains, and a variety of other utilities that may be in use or may be abandoned. Whatever it is, and whether it is currently in use or is a historical relic, the excavator must properly identify the utility and respect its presence. Whatever is already there probably has a right to be there. The burden is on the excavator to plan a project to avoid disrupting the facilities of the utilities that first claimed the subterranean space. Or, if they must be disrupted, the excavator must give proper notice to get them out of the way.

Unlike an iceberg, most of any modern city is above the surface. However, that unseen fraction of the city that is below the surface is vital to everything that goes on above ground. A break anywhere in the underground maze of utilities could immediately spoil the day for millions of people in the skyscrapers. In a dynamic city, something is always being planned and built to improve the quality of life for the people who live and work there or to meet the demands of changing conditions. Every new improvement must plant its footings in the ground with utmost care to avoid stepping on essential facilities that are already there.

The Board of Underground Work of Public Utilities of Chicago was organized in July 1910 for the purpose of coordinating activities of the various organizations involved with subsurface or overhead equipment used in connection with public improvement projects. The board is a self-constituted body with voluntary membership and without statutory powers. The members have sufficient authority, influence, and standing in the organizations they represent to make and meet commitments. The board consists of representatives from the following agencies and companies: Chicago Departments of Public Works, Streets and Sanitation, and Water and Sewers; Illinois Department of Public Works and Buildings; Cook County Department of Highways; Chicago Park District; Sanitary District; Chicago Transit Authority; Commonwealth Edison Company; Illinois Bell Telephone Company; Peoples Gas Light and Coke Company; and Western Union Telegraph Company.

The board employs a full-time secretary and has an office in City Hall. The secretary acts as a clearinghouse, receiving and promulgating notices and information on planned public improvements. The secretary's work is carried on under the active direction of the officers and the executive committee. The executive committee meets frequently as required and prepares schedules for relocation of underground utilities as soon as possible after public improvement contracts are formally awarded. General meetings of all the board members are less frequent and are scheduled as needed to resolve conflicts and plan work schedules for projects involving relocation of a number of utilities. A primary consideration in all deliberations of the board is that of the public convenience. All work involving the subsurface use of the public ways must be planned for minimum delay, overall economy, and the least possible interference with traffic and residential or business locations on the street.

Perhaps the most useful means of explaining the procedures that have been developed by the board would be to follow the steps of a typical case. Figure 1 shows the steps

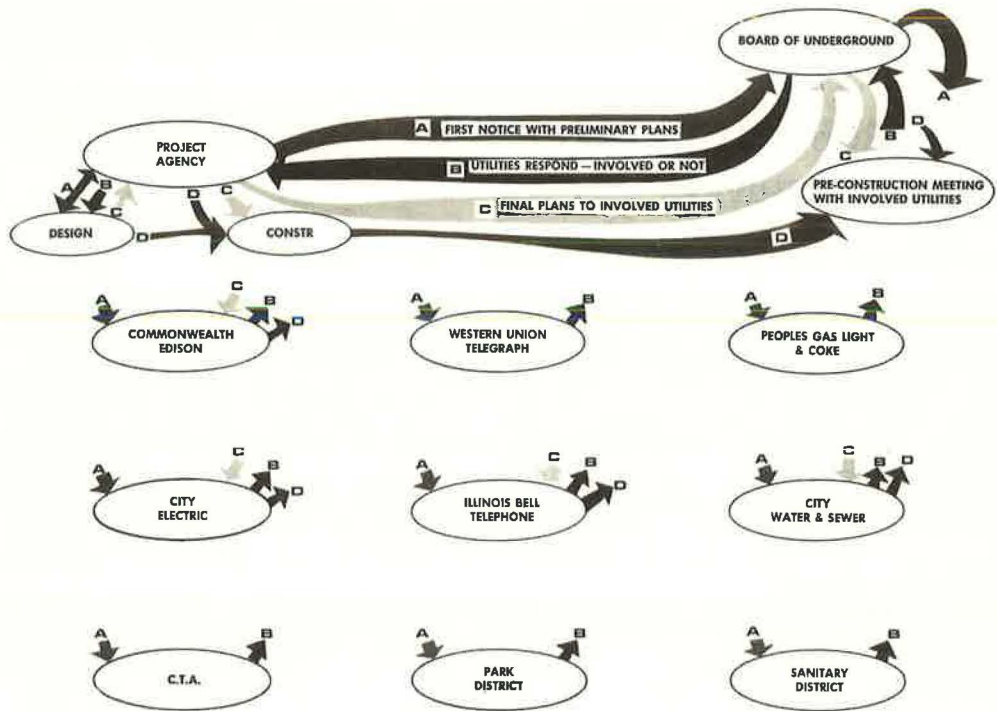


Figure 1. Steps in a typical project.

that are taken in an average project. When a project is adopted, the project agency notifies the board and supplies preliminary plans for distribution by the secretary to all of the member agencies who are asked to report promptly (and the secretary sees that they do) on whether they have any facilities at the site that would be affected by the proposed improvement. The replies and pertinent information from the members are then relayed to the project agency and used in preparing design plans and contract documents. At any point in this stage, informal conferences may be held between the designers and the agencies involved to work out problems. When final plans are completed, copies are sent to the board and relayed to the member agencies. Finally, when construction contracts are awarded, a meeting prior to construction is held at the board at which the member agencies, the construction agency, and the contractor work out detailed work schedules. Conflicts are extremely rare throughout this procedure, and when they do occur they are amicably and efficiently resolved on the spot.

Ninety-nine out of 100 underground utility relocations are handled in this way as routine business. The hundredth case might require some minor modification of the procedures because of the unusual magnitude or complexity of the project. For instance, Chicago's newly authorized central area subway system will provide the largest scale test of the board's services to date. This \$750-million improvement, financed by formation of a special rapid transit tax district for one-third funding and federal funding for the other two-thirds, is expected to be in construction beginning in mid-1971 for completion late in 1978.

Figure 2 shows the transit project that involves construction of about 10 miles of subway lines in 2 separate but fully coordinated systems. The Distribution System will be a high-level system and, the Loop Subway will be underground, will do away with the unsightly elevated structures that have tortured the eyes and ears of Chicagoans since about 1900, and will contribute greatly to the growth of the city. Figure 2 shows the existing subway systems of the area and the elevated lines that will continue to serve until the new subways take over. Staging of construction is of paramount importance,

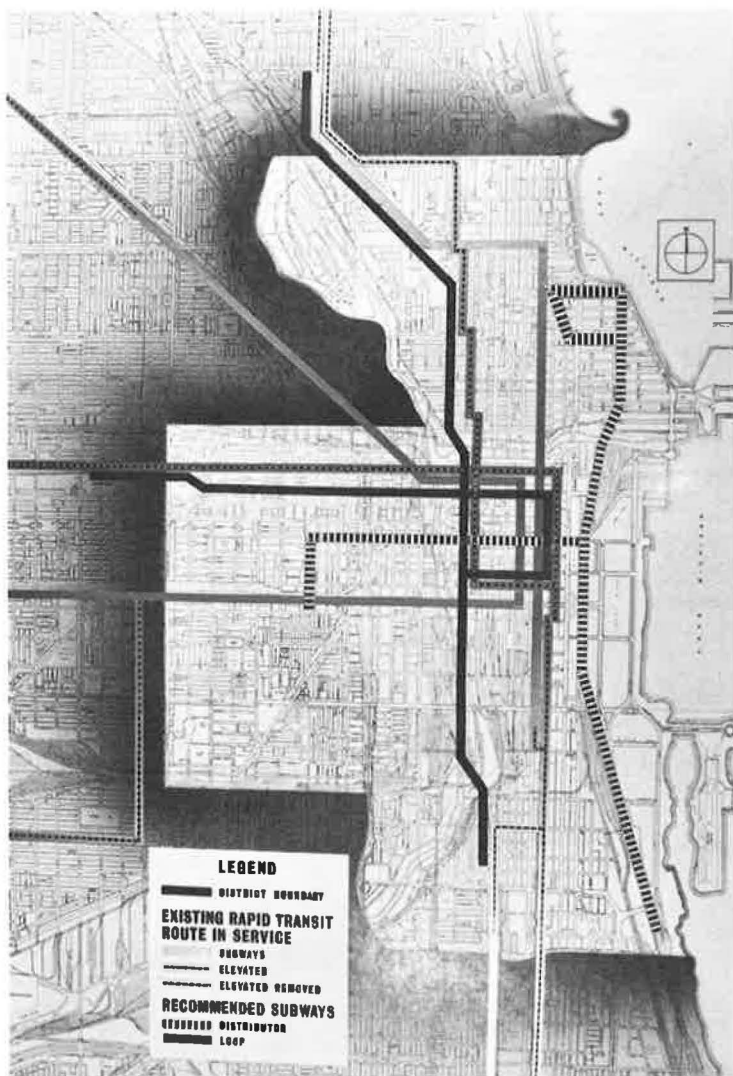


Figure 2. Central area transit project.

and the work must be accomplished without interrupting transit service or underground installations; streets must be kept in at least partial service throughout the project. During stage 1 (Fig. 3), the entire Distributor System will be constructed because all existing rapid transit lines will remain in service. No elevated structures will be removed in this first stage. Construction of the Distributor System will be mainly by the cut-and-cover method.

In the first step of cut-and-cover construction (Fig. 4), soldier piles will be placed as street traffic is carried on the outside lanes only. Excavation will begin in stage 2. Underground utilities will be exposed and supported, and beams will be placed to carry temporary timber decking for traffic. When the timber decking has been placed (stage 3), street traffic will be able to resume on the full width of the street as excavation and utility work goes on underneath. The subway structure and all utility work will be finished in stage 4. The excavation will be backfilled in stage 5, and the street will be repaved.

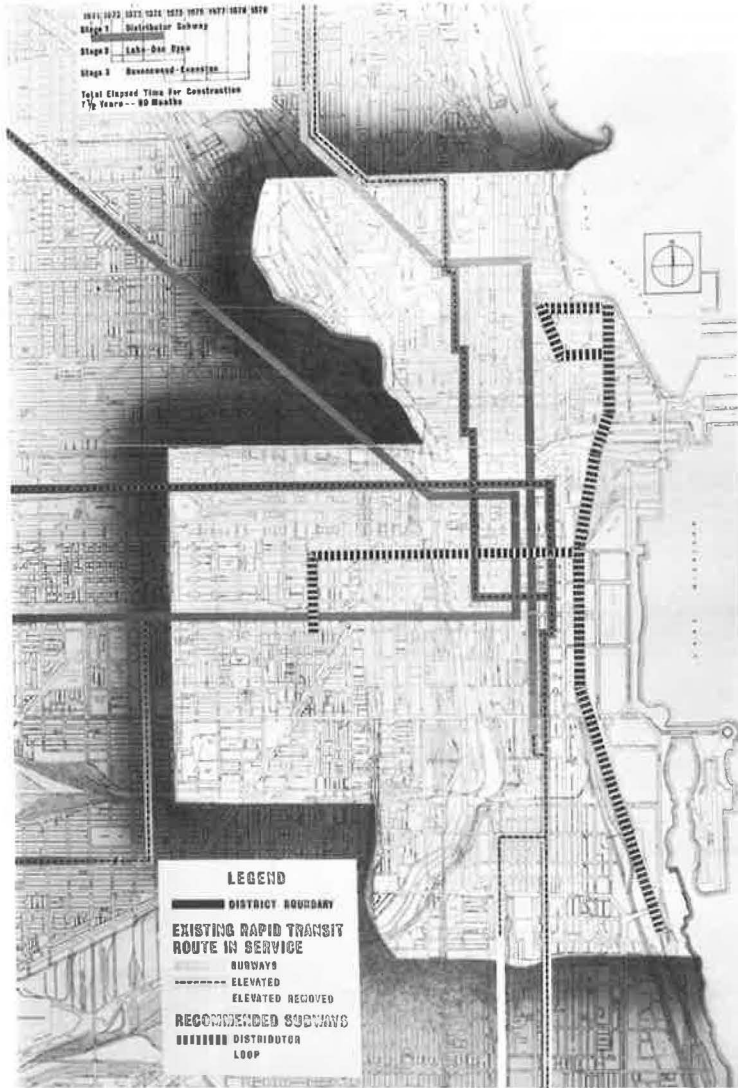


Figure 3. Stage 1 of central area transit project.

This cut-and-cover construction method has some complications. For example, the Distributor System is a shallow system that is extremely shallow at some points. At the Monroe Street Station where it crosses over and provides a transfer point with the existing Dearborn Street Subway, there will be only about 8 ft of cover above the Distributor System tubes, and all of the underground utilities must be accommodated in this cramped space. Obviously, there is no room above the tube for a fare-collection mezzanine level, so in the central area these must be built to the sides in the right-of-way of cross streets, and this will involve relocation of underground utilities there too.

In such cramped quarters, it would be difficult for each of the utility companies involved to carry out its own relocation work—the problems of scheduling so many different types of work with the precise timing needed would be almost too much. Therefore, it is probable that the construction contracts in cases of this sort will specify that the utility work be carried out by the prime contractor under supervision of engineers of the utility companies involved. That is one of the procedural departures from the normal routine described previously.

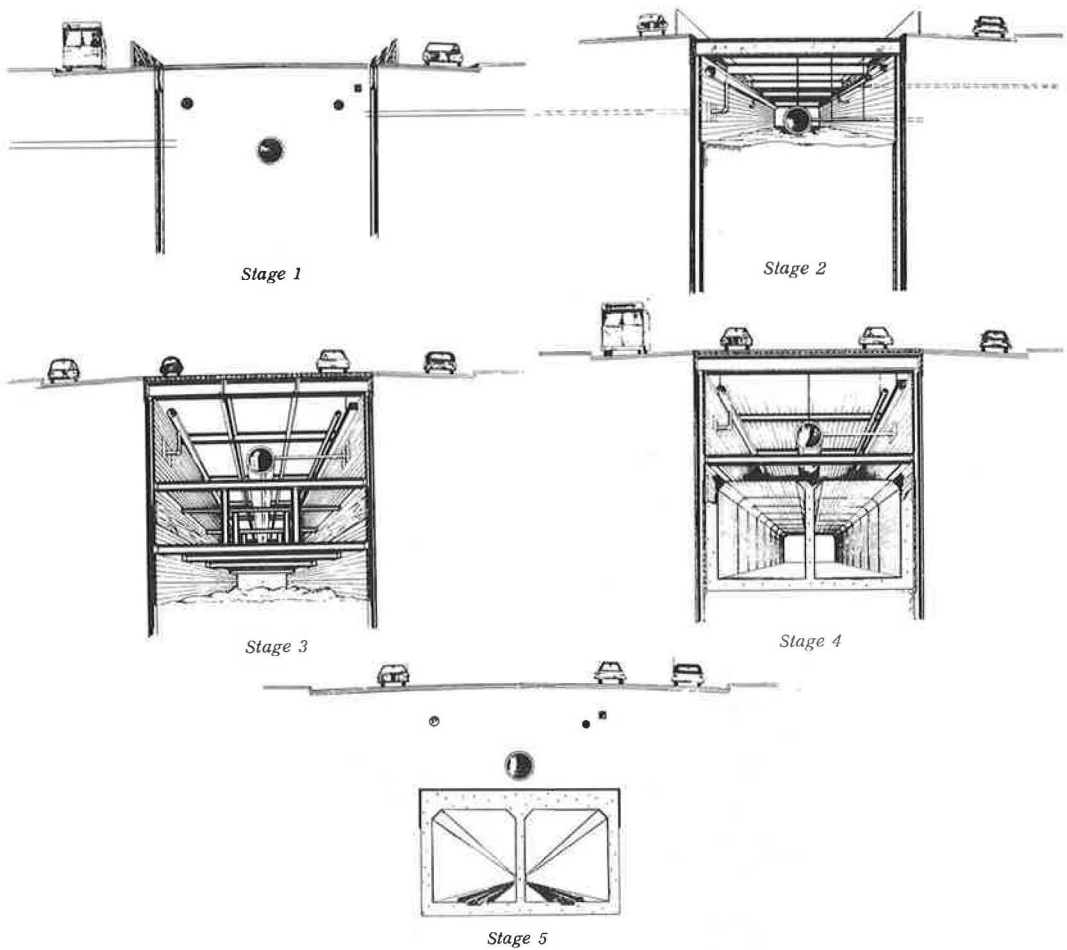


Figure 4. Stages of cut-and-cover construction.

Stage 1 of the construction, the building of the Distributor System will take about 42 months. Stage 2, construction of the west and south sections of the Loop Subway (Fig. 5), will also take 42 months and will begin about 1 year after the start of stage 1. Figure 5 shows all existing elevated lines and subways that will remain in service during this stage, together with the new Distributor System that will begin operation when completed. Some of the old elevated structures will be removed after completion of stage 2.

Because it will be at a deeper level, some sections of the Loop Subway will be constructed in a tunnel by using several types of mining such as the bench method or the shield method (Fig. 6). It is likely that machine mining (not shown) will also be used. Tunnel construction, of course, avoids much utility relocation work by simply going under the existing installations, but other complications of tunnel construction are caused by bascule bridges (Fig. 7) that have foundation piers going to bedrock and make a tight squeeze for the tunnel builders.

The existing elevated loop will remain in service during construction of the new Loop Subway. This presents some special problems that can be met only by cut-and-cover construction. Along Wabash Avenue during stage 2 construction, it will be necessary to sink soldier piles along both sides of the street (Fig. 8). Then it will be necessary to excavate to expose the footings of the elevated structure and install cross beams to support the temporary timber decking for the street, with trusses to take the load of the elevated structure while the concrete footings are taken out and construction goes

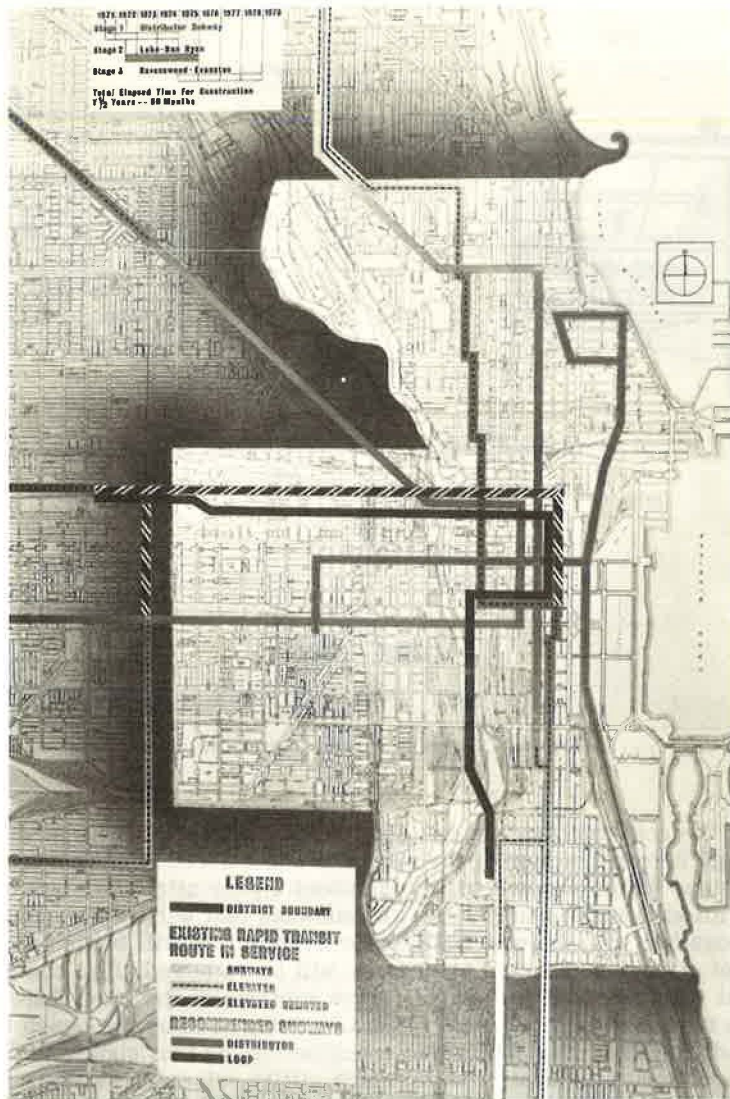
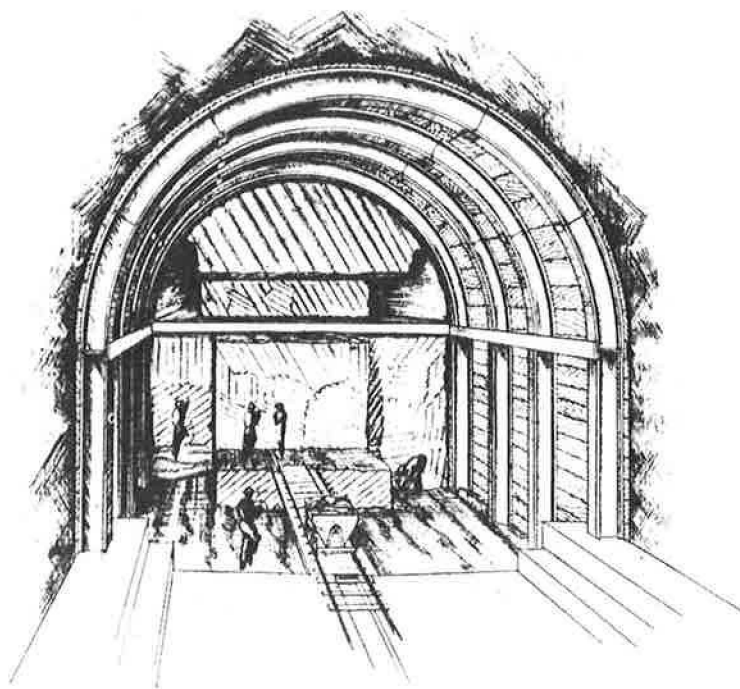
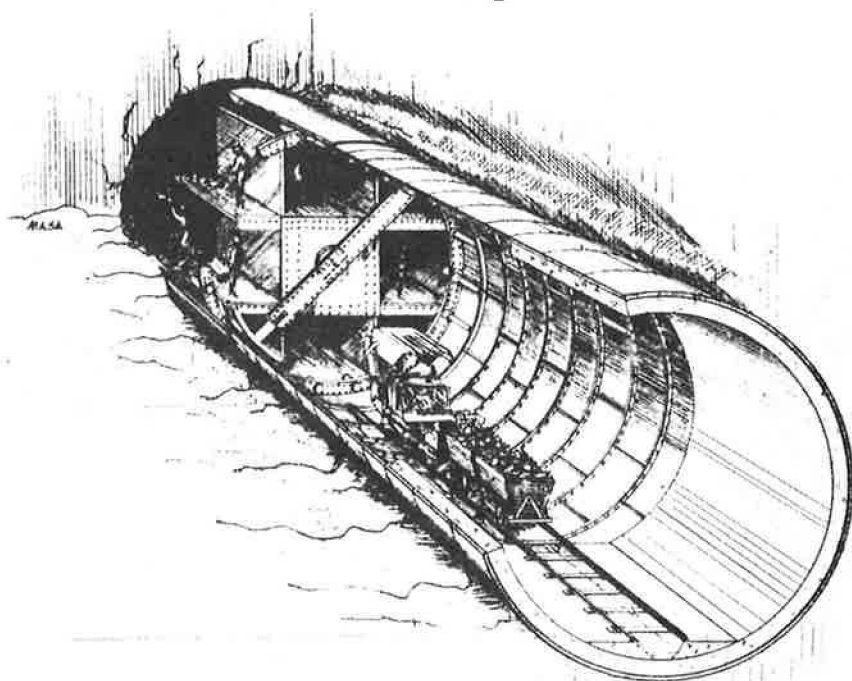


Figure 5. Stage 2 of central area transit project.

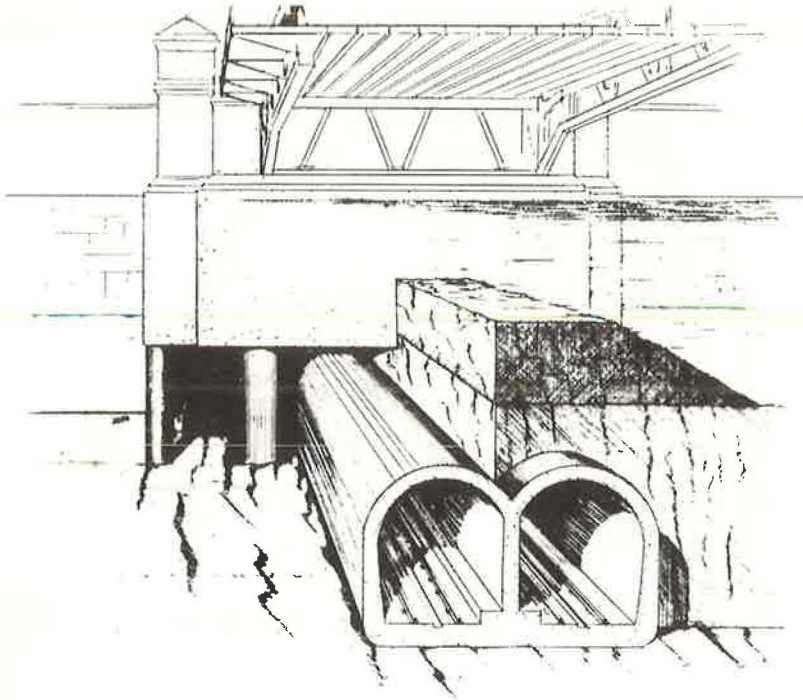


Tunnel Section - Bench Mining Method



Tunnel Section - Shield Method

Figure 6. Bench mining and shield methods.



Monroe Street River Crossing

Figure 7. Tunnel river crossing under bridge.

on below. The diagonals and vertical struts between the upper and lower chords of the trusses will somewhat complicate the work of supporting the underground utilities. Here again, the cramped space and multiplicity of work in progress may make it advisable to specify that much of the utility work be done by the prime contractors.

Stage 2 construction of the Loop Subway will include the South Connection to the existing Dan Ryan Line in the median of the Franklin Street Connector, an expressway extension that will be under construction at the same time as the subway. Although the exact alignment has not been worked out, Figure 9 shows the plan of underground utilities that will have to be dealt with where the expressway and subway join. The highway lanes will be in box structures under Harrison Street, with the subway tubes in tunnels, one above the other. Figure 9 also shows the profile at this location; and, if it resembles a 3-dimensional nightmare, it is! Almost every type of underground utility will be involved, and the Board of Underground Work already is working with the utility companies on the basis of preliminary plans so that construction design and contract documents can be prepared quickly when we receive final approval.

Stage 3 (Fig. 10) of the subway project will begin about 1 year before completion of stage 2 and will require about 4 years of work. The Franklin Street leg of the Loop and the North Connection will be constructed in this stage, and then the last of the old elevated structures will be removed in the central area of the city.

Throughout this major project, the Board of Underground Work will play an important role in clearing the way. The system has worked well for Chicago since 1910, and I am confident that it will continue to work well in the years ahead when we will be engaged in projects of unprecedented magnitude. If the methods developed by the Board of Underground Work of Public Utilities of Chicago seem simple and straightforward, I would observe that this is the principal virtue of the system. Its effectiveness depends on the sense of common cause shared by the participating members. The key is common purpose, common sense, goodwill, and confidence in the future of our city.

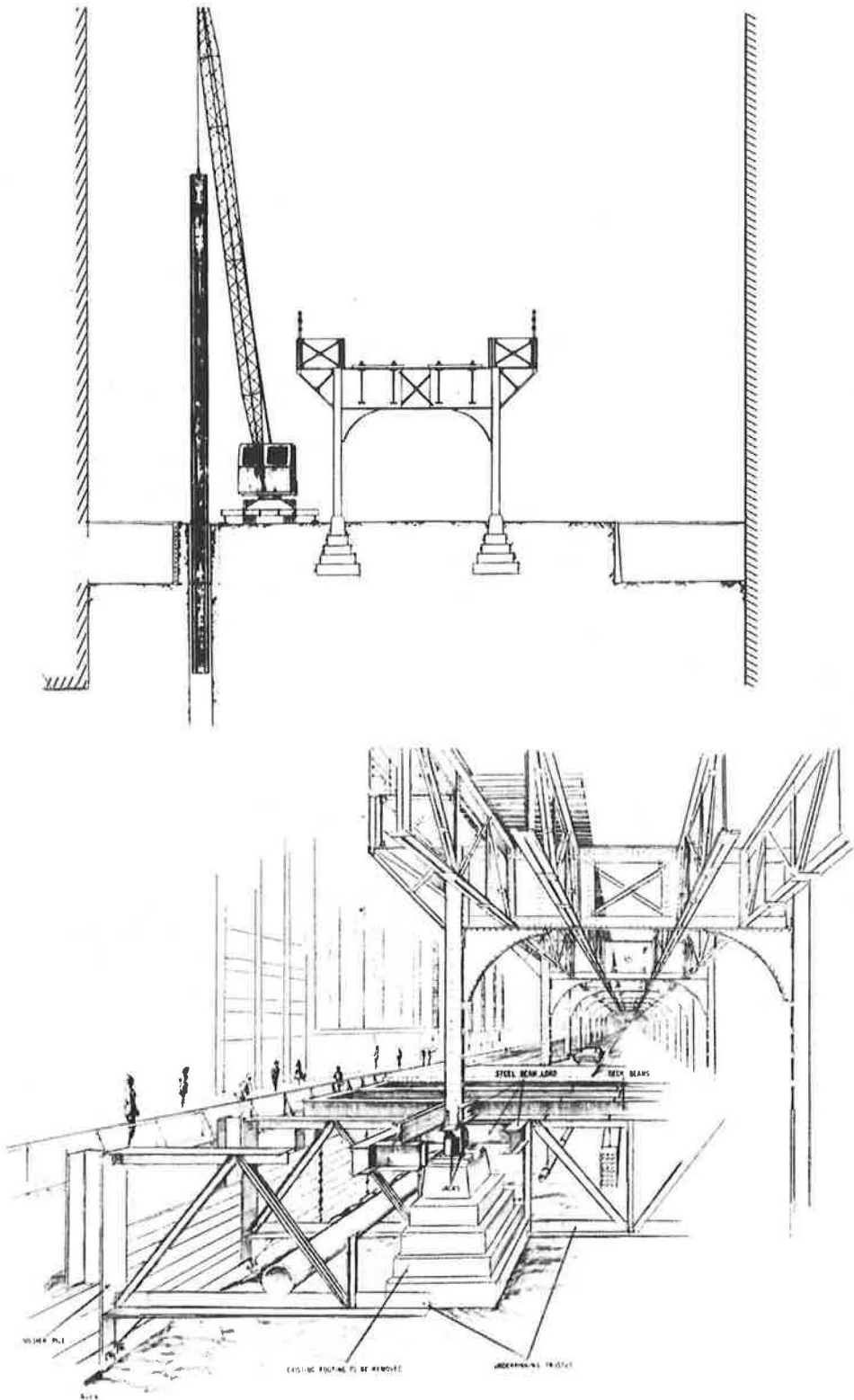


Figure 8. Placing soldier piles and underpinning elevated structure on Wabash Avenue.

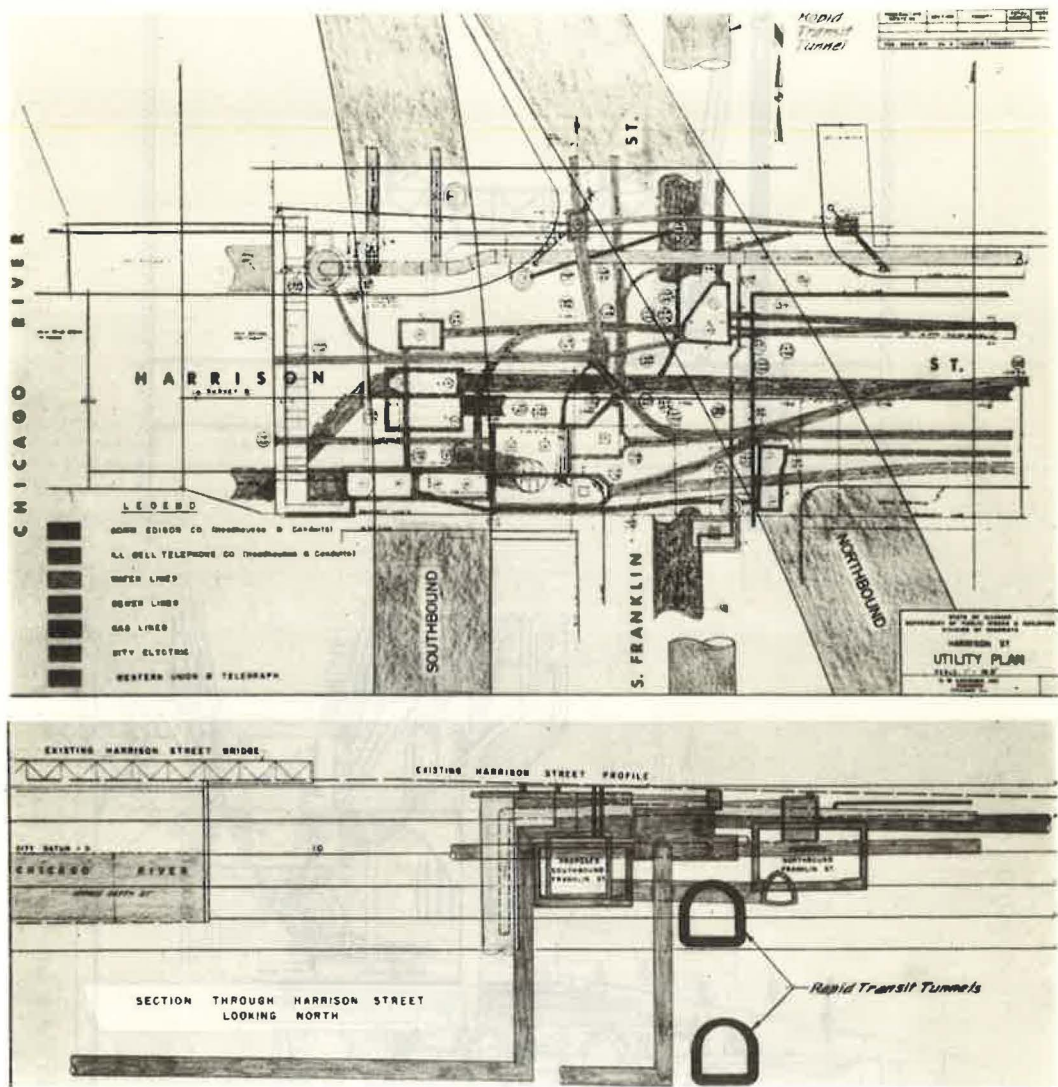


Figure 9. Underground utilities at Harrison and Franklin Streets—plan and profile.

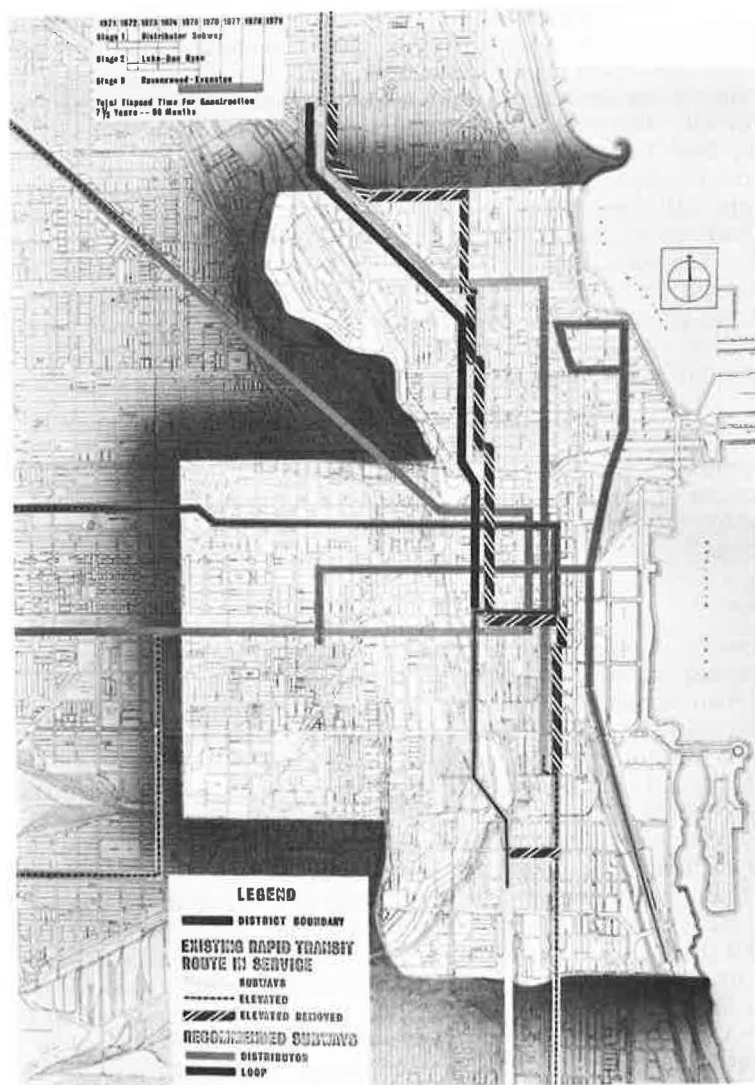


Figure 10. Stage 3 of central area transit project.

INFORMAL DISCUSSION

Robert G. Bartlett

It is obvious that Chicago has both private and public types of utilities. William Gelbach, what do you think of the prime contractor doing the multiple-purpose utility relocations and the related implications involved with coordination on the job?

William Gelbach

The idea from the standpoint of the overall construction is certainly appealing. However, the persons who are not involved in heavily unionized areas probably could not see the problem that could occur in Philadelphia. For example, there would be no problem for the prime contractor when such things as sewer work and water work would be involved. However, the electrical work, especially the electrical work handled by the Bell Telephone Company, could create a fiasco. The jurisdiction of labor problems has become a national problem. For example, there are problems between the operating engineers and the electrician. Throughout the nation today electricians want to run the bulldozers and the cranes where they are to put the cables in the trench. The operating engineers say, "No, we are going to run the machines; we will let you put the cable in the trench." The idea is wonderful and it would certainly help in the phasing of the construction if the contractor could control such operations. It would be cheaper and certainly faster. If we did so in our area, however, and had to relocate a utility other than water and sewer, we would have a fiasco.

Robert G. Bartlett

Marshall Suloway, what sort of problems do you encounter in Chicago with regard to the jurisdiction of labor problems in this type of utility relocation? Do you have the problem in which the private utility companies do not want the public agency to handle their relocations?

Marshall Suloway

It is, of course, a more simple problem when dealing with water and sewer lines than it is when dealing with electrical or telegraph cables. It is a problem but certainly not an insurmountable problem. The union problems in Chicago are the same as those in Philadelphia. I think that we are very fortunate in Chicago to have good cooperation. In addition, the top political leadership in Chicago has caused, if I may use that word, a good relationship between management and labor. If we are in a trench, we feel that at least we should put in the most disruptive thing and that is the duct work, whether or not it is put in by members of the electrician's union manning the rigs (they do this normally for the contractor anyway). Illinois Bell will probably elect to have them pull a cable. The main thing is building the manholes and getting the ducts in. Maybe we can go one step further, and I think we can. The prime contractor will put the duct work and the cable in, and then probably Illinois Bell will want to go into the manholes and do the splicing. This is no problem to the contractor coordinating the job. I think it is essential that the telephone company do the splicing because there are millions and millions of splices to be taken care of in a central area. Some construction for the public utilities has been accomplished in the past by the prime contractor. This is the first major job in which I feel confident that we will have the full cooperation of the utilities to permit the prime contractor to do the heavy work such as the ducts, manholes, and vaults.

Robert G. Bartlett

That is a very good point. I think it should be emphasized that a city must have responsible political leadership. Too often, political decisions deter the proper implementation of necessary programs. When there is a mature political process, many things can be accomplished because the coordination of the various agencies—private sector, labor, management—can then be achieved because there is proper leadership.

John McCue, do you have similar problems in Miami Beach dealing with utilities of the type that Marshall Suloway has just discussed, or do you have a different problem?

John McCue

I think the utility problems are universal. One question that I have related not to what to do to relocate utilities because of new construction but to what to do to find the utilities in the first place.

Marshall Suloway

This is a problem we have all experienced. One thing that an engineer knows when he goes in the utility space is that the utility is where it is supposed to be. On a job such as this, of course, the whole street is being torn up, and we are always lucky to find the utility. I must admit that the utility map of Chicago has been kept up to date extremely well. For example, suppose an engineer must relocate a gas main, and while underground he can see the telephone company's lines alongside the trench. If the old maps and old construction drawings have placed the lines in the wrong place, correct maps are done on the spot to replace the old ones. This is another board function—to alert everyone involved about the location of all the utilities.

Douglas B. Fugate

This question is related not to the relocation of utilities but to financing a subway system. We are planning a system in Washington, D. C.; financing has become a terrific problem. Have you any idea how much the Chicago system is going to cost and who is going to pay for it?

Marshall Suloway

Our latest estimate is \$750 million, and it is to be financed one-third by local funds and two-thirds by federal funds. The local funding is through a tax district. This was decided by referendum in the state of Illinois and passed at the last legislature. We now have the vehicle to get the local funds.

William Gelbach

The Board of Underground Work is the best thing I have heard of in a long while for keeping records of the locations of utilities and maintaining the proper plans to know where the utilities are located. Unfortunately, contractors often find the utilities where they should not be found and we hit a water line or a telephone cable. If a situation exists such that the plans are current and accurate, it would certainly save many people from many problems.

Robert G. Bartlett

This would be particularly true of an urban area in which dense utility distributions exist. Is the secretary of the Board of Underground Work paid by the city?

Marshall Suloway

I cannot answer that question. I do not believe so, but I am not sure.

Robert G. Bartlett

Regardless of who pays for it, the city obviously gives its blessing and backing, and this makes it operate. All the utility companies, both public and private, and the city agencies are involved so that there is a clearinghouse.

Marshall Suloway

Another important function of the board is coordination. At the beginning of the year when the state highway department issues its annual program, everybody gets a copy of

it. They also get the city's capital improvement program and the park district's program. In addition, the utility companies distribute their annual improvement programs. At the beginning of the year or near the end of the year, the Board of Underground Work will be informed by the gas company, for example, that it is going to install a gas main in one street and another gas main in another street. A list of the proposed additions is provided with the proposed time schedule. An electric company will do the same thing, and so will the other agencies. The programs are submitted early enough so that, if we can see a year ahead of time that we are going to have a sewer project in a location coinciding with a project of another utility, they will be scheduled for the same time. Why tear up the street twice? All utilities and agencies alert each other not only at the start of a project but also well enough ahead of time so that everyone is cognizant of what the other is doing.