be considered carefully and should carry much weight when decisions regarding the nature and extent of stage construction proposals are to be made. A good stage-construction plan might produce relief quickly where needed most and result in a substantial measure of the desired improvement in traffic conditions being realized and enjoyed several years in advance of what would otherwise be possible. Also, a good plan for stage construction could provide a preview of things to come which might help materially with financing, rights-of-way acquisition or other problems. On the other hand, however, a bad plan could add to the distress on city streets and even endanger the entire proposal by presenting an unfavorable picture of the effects of expressway construction in an urban area.

The effect on city streets of stage construction of expressways will depend on the particular physical, economic and social conditions and traffic problems existing in the urban areas to be entered or traversed as well as on the nature and extent of each stage construction proposal. For this reason, no set rules for evaluating the effects of stage construction can be determined with the idea that they may be applied to all proposals which may be advanced. Each case will require intensive study, particularly of the capacities of existing streets (and their intersections), the loads on them, the probable effect of the proposal on those capacities and loads, and the potential advantages (or disadvantages) in service to traffic which will remain on or be diverted to each street (temporarily or permanently) as well as to that accommodated on the expressway.

One of the major problems encountered in planning urban expressway construction is that of providing for the collection and distribution of traffic by means of the connecting street network. This problem may be intensified when an expressway is constructed by stages. To assure that a stage construction plan is both worthwhile and workable, a complete analysis of traffic flows and travel habits seems essential. As a minimum, it is believed that answers to the following questions should be determined:

1. Which streets will be benefited by the stage construction proposal and to what extent?
2. Which streets will be required to carry heavier loads than at present and are they capable of doing so?
3. Will interchanges to be built as part of the stage construction plan have adequate capacities?
4 If it is planned to defer grade separations, what will be the effect on the expressway and city streets? Will they function with reasonable efficiency or will barriers be created at heavy cross-traffic streets which might nullify all other advantages?
5. If a project is to be constructed by sections, will a particular section, when completed, be effective in providing traffic relief in the area in which it is built? What will be the operational behavior at its end points and can controls be established which will permit traffic to traverse the remainder of the route with reasonable ease until the entire improvement is completed?

Once these questions and others suggested by them are answered, it will be possible to formulate a sound and efficient stage construction plan rather than be compelled to go ahead on a hit-or-miss basis set up mostly with an eye on available funds.

To summarize, it is recognized that stage construction may be necessary. If so, however, the plan to be followed should be based on comprehensive and comparative studies which will insure it is the best that can be devised, that it will better, not worsen, traffic conditions, and that no unworkable situations or traffic bottle-necks will be created by the temporarily curtailed construction program. Also, stage construction should be a last resort rather than the first "out" when funds are scarce.

PARKING AND TERMINAL FACILITIES

Parking and terminal facilities in urban areas include (a) curb spaces along the existing street system; (b) offstreet facilities such as public and private parking lots and garages; (c) parking facilities within commercial

buildings for autos and trucks, ranging from recessed street level truck tailboard spaces within building lines, to large areas below or above street floors, connected by ramps or elevators; and (d) such specialized terminals as union bus and truck terminals.

Vehicles that now utilize offstreet parking and terminal facilities arrive there for the most part via existing street systems. Even where urban controlled access expressways are available only portions of vehicle volumes that use offstreet parking and terminal facilities arrive via expressways.

As more urban expressways are constructed and expressway tributary areas grow, increasing proportions of vehicles parking at individual parking and terminal facilities will arrive or depart via expressways. New parking and terminal facilities will then tend to be located as close to expressways as possible in order to reduce vehicle travel on existing street systems to a minimum. This growing intimacy between expressways and large individual parking and terminal facilities is bound to create serious traffic problems. Engineers must consequently provide flexible expressway designs that will relieve inevitable traffic pressures as they arise, since some types of expansions cannot be completely envisaged when expressways are being planned.

It is a commonly accepted fact that a controlled access expressway lane can handle from 5 to 10 times the traffic of a city street lane. Or, in other words one expressway lane can deliver enough traffic to keep 5 to 10 street lanes busy absorbing the traffic, if the traffic can be absorbed. Query: What happens if the rate of difussion on the street system in the vicinity of the expressway is slowed down by the rate at which cars can be parked at large concentrated off-street parking and terminal facilities? Answer: Chronic traffic backups on the expressway, when rush hour traffic is arriving in town.

Conversely, several large individual off-street parking and terminal facilities located in a local area in the vicinity of an expressway entrance ramp may in a peak period deliver to the expressway entrance ramp a flood of traffic far in excess of its ability to absorb it. In this case, there would be chronic traffic congestion on the city street systems, in peak periods when traffic was leaving town.

Approximate locations and spacing of entrance and exit ramps are usually determined by origins and destinations of vehicles in zones tributary to proposed expressways. More precise locations of interchanges can be determined by giving special consideration to individual existing and potential off-street parking and terminal facilities that would contribute substantial portions of traffic to interchanges. Such off-street parking facilities would also indicate the design types of entrance and exit ramps required. Some of these types are described under Design of Interchanges. For example, concentrations of parking facilities in a local area would require that some interchanges be provided with more than merely an accelerating or decelerating lane. Some interchanges might require adjoining service streets that could function as reservoirs, like plazas of vehicular bridges and tunnels. It must be borne in mind that while interchanges proper may have the capacities to deliver to the expressway all the peak period traffic of the surrounding off-street parking facilities at any given point, the expressway itself would have only the margin of its available unabsorbed capacity at that point to absorb the traffic delivered to it by a particular individual entrance ramp.

Consequently, in the design of expressways in the vicinity of interchanges, particularly where there are or are likely to be concentrations of off-street parking and terminal facilities, stretches of expressways may have to be widened to provide extra lanes in the vicinity of the interchanges. These stretches of widened expressways would permit of properly absorbing peak traffic. They would also permit the storage of moving vehicles as the street systems in the vicinities diffuse and the offstreet parking and terminal facilities absorb peak expressway traffic delivered by the local interchanges.

In the selection of locations, determinations of the number of interchanges,

and the provision of extra widths of expressways proper, in given local areas, the essential desideratum is to maintain a proper balance in the capacities of (a) the expressway proper; (b) its local interchanges; (c) the local traffic light controlled street system in the vicinity of interchanges; and (d) the capacities of local offstreet parking and terminal facilities.

1. Auto Parking Terminals.

It may generally be said that, today existing lots and garages in urban areas ave very largely located without much relationship to where they are actually needed. Many garages are former stables. A few have been built at locations where land is cheap but at much greater than convenient walking distances from major urban destinations. Existing lots have been located wherever land is available, usually in blighted areas at the fringes of business districts, pending redevelopment of the areas. Consequently most existing garages and lots are no criteria for the locations of off-street parking and terminal facilities.

There are, however, certain existing parking facilities which would require particular attention in connection with the design of proposed urban expressways. They are the concentrations of parking in connection with places of public assembly, such as, large ballparks and stadia. Designs of expressway interchanges in their vicinities require special treatment, if chronic traffic congestion is to be avoided.

With regard to future offstreet parking facilities, current thinking appears to favor municipally financed lots and garages. Where large public parks or wide boulevards are available, these are being suggested for underground municipal parking facilities. In some cities like Pittsburgh, for example, comprehensive plans have been prepared for a system of municipally financed and operated garages; those near the shopping areas for short time parkers and toward the fringes of the business district for long time parkers. It is felt that these plans for large municipal parking and terminal facilities will eventually materialize then designs for interchanges in their vicinities should be flexible enough to be constructed or enlarged if and when, traffic to and from them develops.

It is believed that, gradually, municipalities will adopt zoning ordinances requiring new commercial building to provide offstreet parking and truck berths. As a result of this trend, offstreet parking facilities will once more become less concentrated, more diffused. This gradual diffusion of offstreet parking facilities should improve traffic conditions around expressway interchanges by spreading peak traffic loads by the travel time required between nearest and farthest parking areas tributary to individual expressway interchanges.

2. Bus Terminals.

Interurban and intercity buses usually enter cities from several directions via city streets. Large buses travelling along narrow city streets congest these streets out of all proportion to the number of buses entering the city. Where the number of such buses are substantial municipalities out of self protection will eventually require that these buses use a union bus terminal. A union bus terminal would be so located as to be convenient to downtown offices, shopping areas, theaters and hotels, and as close to urban expressways as possible, in order to utilize city streets to a minimum. Where municipalities are contemplating requiring union bus terminals expressway interchanges should be designed to give easy access to and from bus terminals.

For example, the Port Authority's Union Bus Terminal in mid-Manhattan will be provided with special ramps connecting the terminal with the north and south tubes of the Lincoln Tunnel. These ramps will keep 80 percent of the 2,500 bus trips into the Bus Terminal entirely off city streets in the vicinity of the terminal. The sketch of the Port Authority Union Bus Terminal shows the ramp connections with the Lincoln Tunnel.

3. Union Truck Terminals.

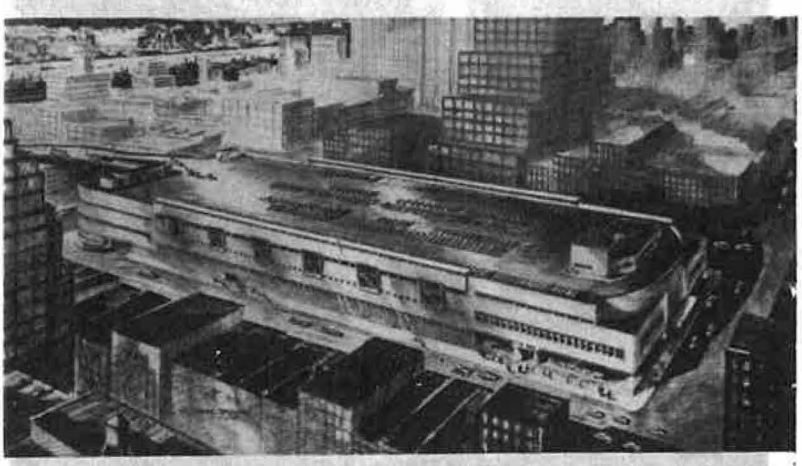

Figure 11. Sketch of Proposed Union Bus Terminal.

Figure 12. Sketch of Approaches to Terminal.

Into and out of most cities long haul, over-the-road tractor-trailer combinations haul freight daily. Individual company truck terminals are usually scattered throughout the city. Many of these trucks and trailers meander about on the narrow streets of cities picking up and delivering small lots of freight. Whether moving or parking on narrow streets, these oversized vehicles congest streets out of all proportion to the numbers of tractor-trailer combinations in relation to other traffic. Consequently where this type of traffic is growing, municipalities will eventually demand that over-the-road truck operators operate out of union truck terminals served by smaller trucks that would perform pickups and deliveries of feright within the cities. In such instances, large tractor-trailer combinations would arrive via expressways and proceed to the Union Truck terminal which would be located close to expressways and thus use city streets to a minimum.

Where it is anticipated that a union truck terminal will be constructed close to an expressway that will be open to commercial vehicles, interchanges in the vicinity of the terminal should receive particular attention. The terminal should be made convenient to both incoming and outgoing vehicles. There

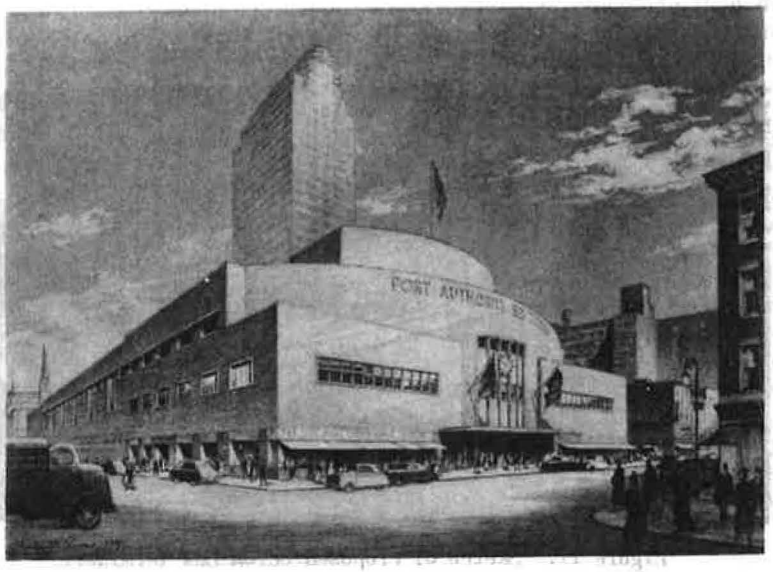

Figure 13.

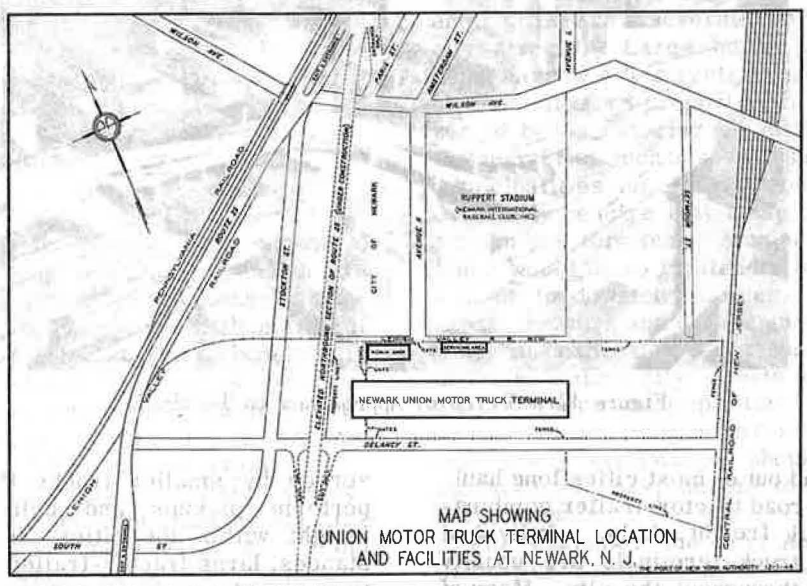

Figure 14.

should be a minimum use of city streets by such trucks. The streets which they use, however, should have the capacity to absorb all trucks delivered by the expressway in peak periods; interchanges should be designed to pass peak traffic; and the expressway should be able to absorb all trucks delivered thereto by the interchanges.

The Port Authority is constructing two Union Truck Terminals, one in New York City in Lower Manhattan, the other in Newark, New Jersey. The truck terminal in Manhattan is within three blocks of the Holland Tunnel via which crossing most of the over-the-road trucks will arrive at the terminal. The Newark Terminal is located near New

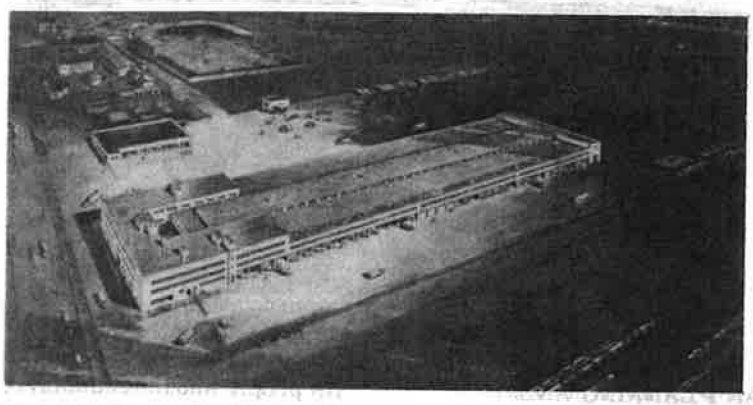

Figure 15.

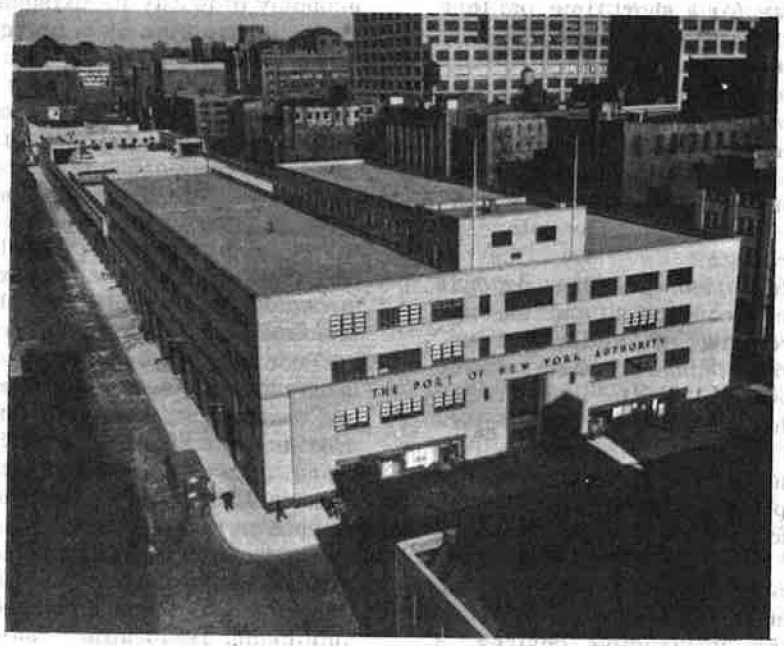

Figure 16. Union Motor Truck Terminal.

Jersey Route 25, the major express route via which most of the over-the-road trucks will arrive at this terminal. Both truck terminals are located within close proximity of express routes like the Holland Tunnel and N. J. Routes 25 and 100.

The Manhattan entrance and exit of the Holland Tunnel are convenient to the lower Manhattan Union Truck Terminal. Trucks will use city streets to a minimum to reach this terminal. The interchanges of the New Jersey routes will be designed to give easy access to the Newark Truck Terminal. There also trucks will use the streets in the vicinity to a minimum.