Design of Off-Street Parking Facilities

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INTRODUCTION

The decision whether a parking garage will be attractive, profitable and will operate efficiently, or whether it will be unsatisfactory to the point of being an unprofitable venture, often is made when the parking facility is in the design stage. This is particularly true of parking garages of the self-parking type.

On behalf of the Building Planning Service of the National Association of Building Owners and Managers, Hudson Moore, Jr. of Denver is quoted: "A parking garage is like a fine watch. If it is designed properly and all of the gears are correctly tooled, it will work beautifully. But if one of those gears is out of line, if one specification is off, it is going to give you a bad time, literally."

Experience, several years ago in developing the basic design criteria for the Fountain Square Parking Garage in Cincinnati, Ohio, confirmed this important guide line. The Fountain Square project was to be a 1200 car underground garage to be developed as a public improvement. It was carried all the way into actual structural design. However, the project unfortunately became the focal point of an extremely bitter political controversy which resulted in its indefinite postponement, and construction even yet has not been started in that City.

The firm was already operating five parking facilities with capital investment of $5,500,000. A team of architects and engineers visited approximately 40 additional garages in eight cities. Since that time, the author inspected many more garages so that the total number on which this paper is based covers approximately 100 parking facilities.

PARKING GARAGE DESIGN FEATURES

It was found that the features built into a parking structure in connection with its original design, often establish the rigid limitations of the facility for its life. These include original cost, operating cost,

efficiency of operation, ease of maintenance, safety and ease with which the public is able to use the facility.

The most frequent flaws, which we found in this study, consisted of bad dimensions, poor drainage design, over-design of some features, inadequate directional signing, and poor location and poor design of various fixtures with respect to public use.

Bad column spacing often results in inefficient operation. For example, bays which are approximately 27 ft. by 27 ft., or some lesser dimension, center to center of columns, often result in the parking of a lesser number of cars than was originally contemplated by the designer. Frequently it is found that a design which was originally conceived for 90 deg. parking must be converted to 45 to 70 deg. angle parking and one-way operation simply because the bay size or the location of columns is such that it is not possible to operate efficiently otherwise. While such angle parking and one-way operation is satisfactory from the customer viewpoint, it reduces the number of parking spaces available and thus either reduces the potential income of the garage or forces the operators to charge a higher rate than was originally intended. We found that in the design of a garage intended for self-parking, in which 90 deg. parking is anticipated, a bay dimension of 28 ft. by 30 ft. or 30 ft. by 30 ft. provides the best overall efficiency in space usage.

Virtually all of these problems of column spacing can be avoided with clear span construction which consists of bays 60 ft. to 65 ft. in width for 90 deg. angle parking or slightly narrower for one-way circulation and angle parking. A garage of this type may be constructed using precast tee beams and a post-tensioned slab. The latter provides a trouble-free type floor which properly designed, eliminates many operating problems. This construction was used in the Perry Street and Ripley Street garages in Davenport Iowa by De Leuw, Cather. This type of construction not only provides a very efficient and attractive garage but it is found to be somewhat lower in cost than many of the conventional designs. The resulting building is an attractive, extremely rigid and efficient design.

Most of this discussion deals with the garages of the self-parking type. Much tighter design of course is possible with garages of the attendant parking type. However, with current trends in the cost of labor a designer would be giving the best advice to his client by advising the development of a site with design capable of being operated as a self-parking facility even though attendant parking might be contemplated in its initial years.

Garages of the mechanical type have a wide variety of design but are suitable only for extremely tight locations in the center of a city

and at locations where continuous turnover is anticipated. Because of their operating characteristics, mechanical garages do not operate satisfactorily in periods of extremely heavy peak in and out traffic.

Design of parking lots follows the same general principles as garage lay-outs but of course is much simpler because of the absence of walls and columns and also because it is relatively easy to correct mistakes in parking lot lay-out if improved design is found necessary.

In developing the circulation plan of a self-parking garage, one-way operation usually is desirable but not always obtainable because of the dimensions of the site. One-way plans, particularly those involving sloping floor style, often require the development of an express "down" ramp for exit from the upper floors of the facility. While this is an efficient way to handle exiting vehicles, it generally tends to add to the cost.

Spiral ramp design is a critical element in the design of garages. Generally drivers can negotiate a spiral much easier if the turn is toward the left rather than toward the right, because of the better view in left hand drive cars. Spiral ramps should be at least 15 ft. wide, curb to curb. Outside radius of 75 ft. is a practical minimum for self-parking garages. Tight spiral ramps discourage use of self-parking garages.

DESIGN ERRORS OBSERVED

In all of the buildings which we have inspected the most prevalent error which has occurred in design is that of proper attention to floor drainage. At least two thirds of the garages we inspected were inadequate in this respect. Flat slab design results in a tendency to create puddles of water, either from the direct rain or snow, or from snow and ice which may be carried in on the vehicle and later dropped on the floor. The best solution to this problem is proper slope on the floors themselves. We find that a slope of 2 percent into drains of adequate size avoids nearly all of the drainage problems.

A serious pedestrian hazard may be created by too fine a finish on concrete floors where pedestrians may be passing. Drops of oil and grease adds to the hazard. Rather than trowel finish, it is found that a wood float or broom finish is best in pedestrian areas. However, too deep a roughness resulting from broom finish may add to maintenance problems by the collection of dust in these indentations.

Many of the buildings inspected were over-designed with respect to ventilation and fire protection. Eight changes of air per hour in peak periods is adequate for even the most critical underground garage. Four changes per hour is adequate most of the day. One garage in which

the capacity of the ventilating equipment had been used only once and it created such a heavy wind at the exit it had to be partially shut off.

It was also found that building codes require the over-design of fire protection equipment in many cases. It appears that a great deal of the potential fire hazard in garages exists only if gasoline sales and car service are to be carried on. A self-parking garage of the open deck type is a relatively safe structure and is readily accessible in case fire should occur in a vehicle parked somewhere in the facility. One garage in which a wet system sprinkler had been installed with the result that winter heat was required to avoid freezing of the pipes. This added operating cost for heating, and in addition it complicated maintenance because of melting of snow and ice as it fell from the cars in the heated garage.

Many self-parking garages are under-designed with respect to directional signing but some are grossly over-designed with respect to lighting. This applies particularly in parking areas where it appears that adequate lighting of the aisles is sufficient because there is enough spill into the parking areas so that no lighting units whatsoever are needed over the parking bays.

Few of the garages inspected have adequate directional signs to guide the public. Internally illuminated fixtures are by far the most efficient and satisfactory for garage use. This type of sign can be built so that it is not vulnerable to breakage due to the whip of car antennas; also this type of sign gives good readability with a minimum of glare.

CONCLUSION

Parking garage design is very largely a matter of applying sound principles and some imagination to the problem involved in a particular site. If a free standing structure is anticipated (with no building above or with no over-burden of earth for park purposes such as occasionally occurs in the design of underground garages) there probably is no sound reason for going to any other design than the open-span construction using precast beams and post-tensioned slab. The older type of design using closely spaced columns is of course necessary if a heavy load is to be supported above the structure.