

Compilation and Evaluation of Rest Area Issues and Designs

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A research study was conducted to determine the required design for rest areas with particular emphasis on comfort stations. Many sources of information were used: personal visits with Department of Transportation rest area professionals in six states, telephone surveys of officials in twelve other states, visits to other agencies that maintain comfort stations, literature surveys, complaint and commendation letters received from users of Texas rest areas, rest area surveys, visits with legal counsel for the Texas Department of Highways and Public Transportation, and visits to Texas rest areas and interviews of maintenance personnel. A summary of current design criteria is presented for site size, location, spacing, and lighting; building design and layout; interior building design; plumbing fixtures; and operations and maintenance. Recommendations are made for design in these areas. An example design of a rest area is presented.

The initial stimulus for highway roadside rest area development came in the form of a provision of the Federal-Aid Highway Act of 1938, which stated that "the States, with the aid of Federal funds, may include . . . such sanitary and other facilities as may be deemed necessary to provide for the suitable accommodations of the public."

While this act is considered to mark the birth of the highway roadside rest area in the United States, rest area growth did not really begin until passage of the Interstate Highway Act of 1956. However, the major impetus for the construction of highway roadside rest areas was the passage of the Highway Beautification Act of 1965, together with the establishment of the Highway Trust Fund.

Today's rest area user has come to expect more than just a place to rest, and the Texas State Department of Highways and Public Transportation (SDHPT) initiated this research project to determine the rest area design, operations, and maintenance criteria required to serve the needs of the highway traveler. Six reports have been issued (1-6). Two of the reports discuss energy sources and water and wastewater design. These topics are not discussed in this paper because of space limitations.

SOURCE OF INFORMATION

State Surveys

Meetings were held with the professionals involved in the design, operation, and maintenance of highway roadside rest

areas in six states: California, Georgia, Louisiana, Oregon, Texas, and Washington. The meetings provided answers to questions concerning rest area design that were prepared in advance of the meeting. Other topics germane to rest area design, operation, and maintenance were also discussed. Drawings, plans, and specifications for rest areas in each state were provided. These meetings were followed by a tour of several of the rest areas in each of these states. In addition, rest areas were inspected in the state of Mississippi.

Comprehensive telephone surveys were conducted with the professionals involved in the design, maintenance, and operation of highway roadside rest areas in 12 states: Arkansas, Colorado, Florida, Illinois, Minnesota, Nebraska, New Mexico, North Carolina, Oklahoma, and Pennsylvania.

Separate meetings were held with the representatives of three SDHPT districts. District personnel responded to an extensive questionnaire. Each of the meetings was followed by a visit to a district rest area and an interview with the rest area attendant, who responded to another set of prepared questions from a second questionnaire.

Other Agency Surveys

Texas Department of Parks and Wildlife

A meeting and several subsequent discussions were held with the professionals involved in the design, operation, and maintenance of all state park facilities in the Texas Department of Parks and Wildlife. Answers were provided for a detailed list of questions concerning park facilities—primarily comfort stations and related utilities and services.

In addition, an inspection tour of 13 Texas Parks and Wildlife installations was conducted for the purpose of providing a large sample of this agency's handling of problems similar to those encountered in the design, operation, and maintenance of highway roadside rest areas. Most of the parks were relatively remote areas, and there are many similarities involved in the construction and maintenance of these and highway rest area facilities.

U.S. Army Corps of Engineers

An inspection tour of five U.S. Army Corps of Engineers public use areas along the shores of Lake Somerville, near Somerville, Tex., was conducted to view their park facilities and comfort stations. A secondary purpose of this trip was to compare the site-built comfort stations that are being replaced by factory-manufactured restrooms.

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Legal Counsel

Meetings were arranged with both the Texas Attorney General's office and the highway department's legal counsel to discuss critical items of concern regarding rest area design, construction, operation, and maintenance.

Literature Review

An extensive search was conducted to identify all available literature that might be pertinent to the research. Unfortunately, most of the 67 books and papers that might be pertinent were written during the period that marked the major thrust in highway roadside rest area construction, namely, the mid-1960s to the early 1970s, and these do not all reflect the current state of rest area design.

Factory-Manufactured Restrooms

The Restroom Facilities Division of Intex Corporation in Ennis, Tex., was visited to observe the manufacturing process and the finished products for the consideration of alternative comfort station designs and construction techniques. This plant designs and manufactures a line of commercial restrooms that are primarily targeted for park installations.

Review, Compilation, and Summary of Complaint and Commendation Letters

All letters were reviewed from the traveling public regarding highway roadside rest areas that were received by SDHPT between January 1984 and July 1985. The complaints were categorized and summarized, and specific comments were itemized.

Rest Area User Surveys

A rest area interview form was developed after extensive research and discussion, and two field surveys of rest area users were conducted. The surveys not only involved interviewing roadside rest area users, but they also included the collection and compilation of data on such items as:

1. the percentage of highway traffic diverting to the rest area during each hour of the survey period;
2. the number of vehicles diverting to the rest area during each hour of the survey period;
3. average duration of visit by category of those vehicles diverting to the rest area during each hour of the entire 24-hour test period;
4. hourly percentage breakdown by category of those vehicles diverting to the rest area during each hour of the entire 24-hour test period;
5. user responses to questions posed on the rest area interview form;
6. additional comments and suggestions of rest area users; and
7. rest area facilities used.

RESEARCH FINDINGS

The underlying fundamental approach used in the research effort was to determine the guidelines and recommendations of those practicing professionals who have devoted a significant portion of their careers to the design, operation, and maintenance of roadside rest areas.

Although pertinent information obtained from other agencies was considered where applicable together with the literature review and surveys, the major thrust of the research concentrated on the practices and recommendations from the states. By using this approach, it was possible to learn what not to do, as well as what should be done in the design, operation, and maintenance of highway roadside rest areas.

Spacing Criteria

The research sought to determine the highway roadside rest area spacing criteria used by each state, both currently and when the program was initially established. In addition, state officials were asked if they were satisfied with the current criteria and, if not, what criteria they would recommend.

Virtually all states used the criteria of 30 miles apart or 30 minutes' driving time between rest areas as their spacing goal at the initiation of the program. (The 30-mi or 30-minute criterion is synonymous with the 60 MPH speed limit that was prevalent in most states at the time.) Only five of the states surveyed actually achieved this goal by July 1986. One-hour driving time between rest areas or 50 to 60 mi apart is the current spacing criterion for the majority of states.

Overall Design Criteria

All of the states surveyed, except four, are using a formula developed by the Oregon Department of Transportation that starts with the average daily traffic. Although all the states surveyed use a format similar to this, there are some rather minor variances in the factors used. For example, some states assume that the ratio of males to total restroom facility users is 0.5, whereas others use a factor of 0.4 for design purposes.

Several states reported realistic results using the factors developed by the state of Oregon as compared with results of all follow-up surveys. This is the only specific design procedure mentioned with any degree of regularity.

Site Size and Selection Criteria

Site

Although the size of rest area sites inspected varied from 3 to more than 80 acres, the majority fell into the 20- to 30-acre range. Most states dedicate rather spacious sites and devote considerable effort in designing and maintaining the landscaping. Large varieties of trees and other plantings are carefully placed. In most instances it is obvious that the states are trying to make their rest areas "show places" in an effort to create a favorable impression on the traveling public.

The site selected should facilitate an attractive layout of all buildings, picnic shelters, and other facilities without convey-

ing a feeling of "crowding." In other words, there should be some open areas between structures, which themselves should not be crowded together. The site should not be long and narrow like an airport runway. The ideal site would have equal side dimensions and permit the use of divided parking to separate small and large vehicles, which is the practice in nearly all states.

Site Selection

In addition to the need to find a spacious site, there are other important considerations involved. Some of these include

- Source and quality of water supply;
- Availability of electric power;
- Annual rainfall data for evaporative lagoons;
- Soil classification or percolation test for septic systems with leach fields;
- Proximity to commercial sewage treatment facilities for direct connection;
- Level and proximity of aquifer for on-site sewage treatment facilities;
- Proximity to major metropolitan areas (all states interviewed would not build a rest area near a major metropolitan area because of the vandalism problem);
- Presence of a buffer zone between the rest area and any nearby community; and
- Availability of emergency services such as firefighting and rescue from nearby communities.

Lighting

Most of the states place more emphasis on the importance of illumination of rest areas than perhaps any other area of engineering, with the possible exception of restroom ventilation. While some states use three different types of lighting (high-pressure sodium for parking and roadway areas, metal halide on building exteriors, and fluorescent in building interiors), two different forms are more predominantly used: fluorescent inside buildings and metal halide (typically mercury vapor) at all exterior locations. Several of the states indicated a plan to replace all parking area and roadway metal halide fixtures with high-pressure sodium fixtures.

The main point made by all states is that it is important that all building interiors are well lighted with no dark corners, and that the path from the farthest parking space to the restroom facilities is not just well lighted but very brightly lighted. Lighting is one of the main security measures against unwanted attacks and molestations of the traveling public.

Building Design and Layout

Several features were found to be in common use by most states. Some of these are listed below:

1. A mechanical room containing pipe chases, furnace, and vent stacks is located between the men's and women's restroom facilities. Several rest areas inspected use this room to facilitate back-bolting mirrors and plumbing fixtures through the wall to make removal more difficult for vandals.

2. Both natural and mechanical ventilation in restrooms is necessary to eliminate noxious odors.

3. All states but one provide entrance doors on restroom facilities. Most of the doors are made of heavy metal and, in some cases, have plastic overlays to eliminate denting and scratching of the metal with the subsequent unsightly rusting problems.

4. All but two of the states visited provided dual restroom facilities to minimize the inconvenience to the traveling public when either the men's or women's restrooms was out of service for cleaning or maintenance. Of those states surveyed by telephone, all but six had dual facilities, whereas three of these accomplished nearly the same goal by employing both male and female attendants at every rest area to allow both facilities to remain partially open during cleaning. Most of the states provided separate structures, but one accomplished the same goal by providing two pull-down overhead doors to subdivide each restroom during cleaning or maintenance.

One of the states visited said that consideration was given to providing dual facilities, but that their rest area spacing is such that it was not deemed necessary. This is the only state that actually has an average spacing of 30 mi. This state also has designed some Interstate highway roadside rest areas so that traffic that exits the interstate and turns into the rest area has access to two restroom facilities in either direction.

5. Natural lighting in the form of clerestories and skylights is used extensively by most states even in existing construction, but it is planned for even a higher degree of use in all new construction.

Plumbing Fixtures and Accessories

Some of the more consistent recommendations for plumbing fixtures and accessories are

- Wall-hung toilets and urinals with concealed mounting attachment bolts;
- Flush valves mounted behind permanent construction; and
- Electric hand dryers rather than paper towel dispensers (several of the states stressed the fire hazard when paper towels are used).

Most of these were consistently observed during the rest area inspection tours. On the other hand, there were significant inconsistencies in the recommendations for other items such as stainless steel vs. glazed mirrors, water saver toilets, and waste receptacle design.

All state rest areas observed used vitreous china plumbing fixtures; however, representatives surveyed by telephone from two of the twelve states indicated that some rest areas had stainless steel plumbing fixtures.

Interior Building Specifications

Since the design of rest areas is a dynamic, ongoing activity, the interior design of the restroom facilities is affected perhaps more than most aspects of highway roadside rest area design. Not only are there significant variations in interior design

among the states, but there are variations in the interior design of rest areas within a state.

Because of this variation, this summary will cover only those consensus aspects of current interior design.

1. All states use some form of ceramic tile in current construction.
2. Most states use a ceramic tile wallcovering for the interior walls and toilet partitions. One state is using structural glazed tile. Stainless steel toilet partitions generally are considered to be the only preferred alternative.
3. All states except one use full-height toilet partitions and doors in both men's and women's restrooms.
4. Although they are considered the most vandal resistant, the use of stainless steel toilet partition doors was observed in less than half of the rest area installations.
5. Electrical receptacles (110-volt outlets) are normally provided in both the men's and women's restrooms as a convenience to the traveling public.

Rest Area Operation and Maintenance

The organization and management control of highway roadside rest area operations and maintenance varies widely among the states; however, there were certain areas of similarity.

1. Although most states consider the ideal rest area custodial coverage to be 24 hours per day, 7 days per week, the general consensus is that the minimum coverage provided should be 12 hours per day, 7 days per week; however, coverage of 16 hours per day, 7 days per week is even more desirable. The majority of the states surveyed provided a coverage equal to or in excess of this minimum criteria.

It was generally felt that rest area attendants must be present on all 7 days of the week to maintain a satisfactory level of cleanliness and to keep all equipment in satisfactory working order. A lower level of coverage is insufficient to attain this level and ultimately will result in vandalism from public dismay over either the state of cleanliness or malfunctioning equipment.

2. Some states require attendants to wear an identifying uniform. It is felt that this improves the overall level of custodian dress, improves the public's perception of the custodian, and adds to the general feeling of security in the form of an identifiable presence.
3. Custodial personnel are typically responsible for building and ground cleanliness and maintenance. In a small rest area, they are sometimes responsible for grass cutting, but in very large rest areas, the highway maintenance crews handle the mowing of the grass.
4. Most states handle rest area custodial duties with state employees. Two states use contractors at a few selected locations. A number of other states indicated they had tried contractors but received poor results and subsequently abandoned this approach. It seems that there was continual bickering over who was supposed to do what. Those states researched via the telephone generally were positive about the use of contract personnel for rest area maintenance.

5. Routine maintenance is typically handled by the custodian or other maintenance specialists within the highway district. Repairs such as rewinding a burnt-out motor are always handled by outside firms.

6. Most states steam clean the restroom facilities two or more times per year, and one state includes built-in steam cleaning equipment in the construction of all rest areas.

7. All states prohibit overnight parking in rest areas. Although all admit that this rule is not rigidly enforced (most of them report having to enforce it on a few occasions), they do not really have a problem with "squatters."

Although state highway roadside rest area operation and maintenance organizations differ substantially, there is general agreement that the overall management and control of rest area performance would be considerably enhanced if the design, construction, operation, and maintenance were the responsibility of one midlevel manager in the state highway department. One state reported that although this centralized level of authority had not been totally achieved, the state compensated for it by forming a headquarters design review team that periodically inspects rest areas, roadways, drainage, lighting, and various other services and files a report for any remedial action required. This state seemed to feel that this approach is effective and that any discrepancies noted are typically acted upon immediately by the district engineer.

Special Services

Special services provided at state rest areas vary from only pay telephones to a complete array of vending machines for snacks, soft drinks, newspapers, and maps. Some states place rest areas in conjunction with, adjacent to, or near recreational areas and places of historical or geological interest. In some cases, these areas of interest are explained by "displays" at the rest area, and sometimes this is in conjunction with a viewing area.

Heavily used recreational areas nearby should provide separate parking or the rest area parking spaces will be monopolized by the recreational users to the detriment of the rest area parking needs of the traveling public. One state passed a bill that charged an annual fee of \$10 for the use of state-constructed parking lots near recreational areas, and success was reported with the program. Two states have for sometime awarded permission to various charitable organizations for disbursing free coffee to the traveling public, and they heavily endorse providing this service.

Most states provide (as a minimum) some type of traveler information service concerning local areas of interest. One state constructs and maintains rather complete traveler information gazebos similar to those found at major airports, at selected rest areas, and advertising space is sold to the business community.

Recreational Vehicle Dump Stations

Most states are experiencing operational problems with recreational vehicle (RV) dump stations. Several states have begun separating RV dump station sewage treatment facilities from restroom sewage treatment facilities.

The primary problem appears to be the heavy use of formaldehyde in RV sewage holding tank cleaning solutions. The chemical "shocks" the sewage treatment system with a heavier concentration than it can handle. This problem primarily manifests itself near the end of a weekend in certain rest areas

during which large numbers of travelers stop to dump their tanks. All states interviewed would like to see RV dump stations eliminated at highway roadside rest areas, and one state has initiated a program to eliminate all of them within 5 years.

One state is required by law to provide RV dump stations at all highway roadside rest areas in the state, but the legislature passed a bill charging all licensed RV owners \$1.00 per year. According to those responsible for rest area design, construction, operation, and maintenance, this fee has proved adequate to pay for all these services for RV dump stations with separate sewage treatment facilities.

Only one state reported any incidents of deliberate dumping of toxic wastes into rest area RV dump stations.

Joint-Use Rest Areas

Several states are actively pursuing the concept in which a highway rest area is built in conjunction with commercial enterprises; these enterprises then become responsible for the operation and maintenance of rest area facilities, as well as the financing of all or part of the rest area construction costs. In some states not presently considering this concept the subject had been discussed among members of the state rest area management team and may be considered sometime in the future. In general, the idea seems a plausible way to reduce state rest area construction, operation, and maintenance costs. Since current federal legislation prohibits commercial enterprises on highway rights-of-way, the realization of this concept would require a change in legislation or providing the facilities off the system, perhaps at an interchange.

Rest Area Vandalism

Upon the initiation of this project, rest area vandalism was thought to be a major problem, with more questions pursued on this subject among states than any other subject. Two factors under discussion among the other states deserve special mention:

1. Virtually all states report (*I*) that the major reason for excessive vandalism in rest areas near large metropolitan areas is not only because of their ready availability to large population segments but also because of the typically large homosexual communities in large cities. Without providing for 24-hour-a-day security in these rest areas, it is virtually impossible to eliminate this problem. For this reason, coupled with the fact that similar commercial and public facilities are available nearby, consideration should be given to closing all rest areas adjacent to (within 50 to 60 mi of) metropolitan areas.

2. A buffer zone between the rest area and any nearby community is essential and should not be violated during the life of the rest area to prevent problems with nearby residents.

Vandal-resistant design and vandalism problems are addressed in many of the design criteria. These recommendations came forward only in response to specific design problems. However, when the more general question, "Do you have a major problem with vandalism?" was asked, the

respondents said no, and in all but one state this was verified by the fact that vandal-related repairs represented less than 2 percent of the total annual rest area operations and maintenance budget. In some instances, vandal-related repair costs were less than 1 percent of the total annual rest area operation and maintenance budget.

Most of the states accept all or part of the blame for vandalism. Numerous times, the following statement was made: "If we do a good job in design, construction, and maintenance of all rest area facilities, we would not have a vandalism problem, except for those rather rare instances when a habitual vandal enters the premises intent only on destruction" (*I*, p. 9). One state even offered a further clarification by stating, "If we install all the required facilities and if the equipment does what it is supposed to do the way it is supposed to do it, we will not have a vandalism problem" (*I*, p. 9).

This summary of state rest area official responses to the vandalism issue is essentially the unanimous opinion of all states visited and surveyed by telephone, except for one state. Vandalism takes many forms, some of which are reported elsewhere (*2*).

REST AREA GUIDELINES AND RECOMMENDATIONS

Specific recommendations and guidelines for the design, operation, and maintenance of highway roadside rest areas were developed after a detailed review of all drawings, plans, specifications, photographs, interview reports, and other materials, together with detailed discussions among SDHPT representatives and others involved in this project. One of the best sources of information was the experience and practice of other states. Texas, however, has unique requirements, and the recommendations made in this report attempt to recognize these needs.

Site

1. Use the ideal rest area spacing, usually 50 to 60 mi. No site should be closer than 50 to 60 mi from a major metropolitan area.

2. Base overall design guidelines for determining the number of users on current procedures recognized by many states, supplemented by data and experience in Texas.

3. Use the ideal site size, 20 to 30 acres, with 10 acres considered the absolute minimum. The site should be relatively square and should facilitate an attractive layout of all buildings, picnic shelters, and other facilities, with sufficient open spaces to prevent a feeling of crowding.

4. Use divided parking areas to provide separate parking areas for small vehicles (e.g., automobiles and pickup trucks) and for large vehicles, (e.g., all other trucks, buses, and RVs).

Lighting

1. Provide a high level of illumination in the parking areas, on the walkways to the restrooms, on the buildings around

the outside of the building in the immediate vicinity, and inside the building. High-pressure metal vapor lighting is recommended in all locations, not only because of its effectiveness, but because of its superior bulb life and low maintenance cost. An acceptable alternative would be fluorescent fixtures with vandal-resistant covers in the men's and women's restrooms, or a combination of both.

2. Provide strong natural lighting using skylights and clerestories.

Site and Ancillary Facilities

1. Use concrete picnic tables and benches set on concrete pads.

2. Provide picnic shelters, charcoal boxes, and waste receptacles at all table locations.

3. Use concrete trash receptacles outside and inside the building.

4. Provide utility sink, drinking fountain, and outdoor water spigot in conjunction with the restroom building.

5. Construct a separate gazebo-type structure for use as an information-communication center. Install telephones and provide for an informational display complete with a state highway map and description of nearby points of interest.

Restroom Building Design and Layout

1. Construct essentially square or rectangular restroom building units with no recessed or hidden corners, and with a mechanical room between the men's and women's restrooms. Design men's and women's restrooms with vaulted (cathedral) ceilings to allow natural light into the rooms.

2. Construct dual men's and women's restroom units.

3. Provide an effective flow-through (low ingress-high egress) natural ventilation system supplemented with mechanical exhaust fans.

4. Provide solid core laminated plastic clad exterior doors in steel frames on all restroom entrances.

5. Provide a central forced air heating-cooling system to condition restroom units.

Plumbing Fixtures

1. Use wall-hung vitreous china toilets and urinals "back-bolted" through the walls.

2. Use push-button operated flush valves, with the valves mounted behind permanent construction.

3. Use vitreous china lavatories in conjunction with spring-loaded faucets.

4. Provide central liquid soap dispensing, with a translucent tank to permit monitoring the fluid level.

5. Use anti-theft-type toilet tissue holders (two per stall).

6. Use a compressed air hand dryer (without heating coils) in each restroom.

7. Provide a stainless steel sanitary napkin disposal unit in each toilet stall in the women's restroom.

8. Provide a toilet seat cover dispensing unit in every toilet stall in the rest area.

9. Use heavy-duty glazed mirrors back-bolted through the wall in each restroom.

Interior Building Design and Specification

1. In all restrooms, use full-height toilet partitions suspended 12 to 15 in. above the floor to permit easier floor cleaning.

2. Use stainless steel-clad toilet partition panels and doors on all toilet partitions.

3. Use ceramic tile on the floors in all restrooms.

4. Use ceramic tile on all building walls in all restrooms to a height of 7 ft, 2 in.

5. Provide one or more 10-volt electrical outlets in all restrooms.

Operations and Maintenance

1. Wash down all rest area restrooms with either a portable steam cleaning nozzle or high-pressure hot (160°+ F) water spray containing strong cleaning chemicals. This type of cleaning should occur at least quarterly and more often if there are odors or visible accumulations of dirt or other residues that cannot be removed by normal cleaning means. The permanent installation of steam or hot water cleaning equipment is not recommended because (a) the system is expensive (about \$10,000 per building) and (b) the portable systems can be used to clean the interior as well as the exterior, including sidewalks and picnic tables.

2. Establish custodial presence 24 hours per day 7 days per week; in most cases a minimum of 16 hours per day, 7 days per week, should be provided. The attendants should be provided with uniforms. Wearing uniforms should be mandatory while attendants are on duty.

Example Design

An example site plan is shown in Figure 1. Separate parking areas, restroom facilities, information kiosk, and picnic facilities are shown. Future restrooms are shown by dashed lines on the right. Figures 2 through 5 show the comfort station design. Each comfort station, which includes two men's and two women's restrooms, will serve 500,000 people per year. The facilities have well-defined entrances and exits, an escape route in each unit, and a central maintenance and equipment room between units. A roof with a wide overhang covers the units. Ceramic tile is used on the walls and floors; stainless steel partitions are suspended to provide for easier cleaning.

CONCLUSIONS

Rest areas are an important aspect of the Interstate highway system. The design of rest areas involves many aspects: location, spacing, site, buildings, mechanical equipment, plumbing, water and wastewater, energy sources, conservation, and lighting. This paper summarizes the results of a survey and makes recommendations for the design of rest areas.

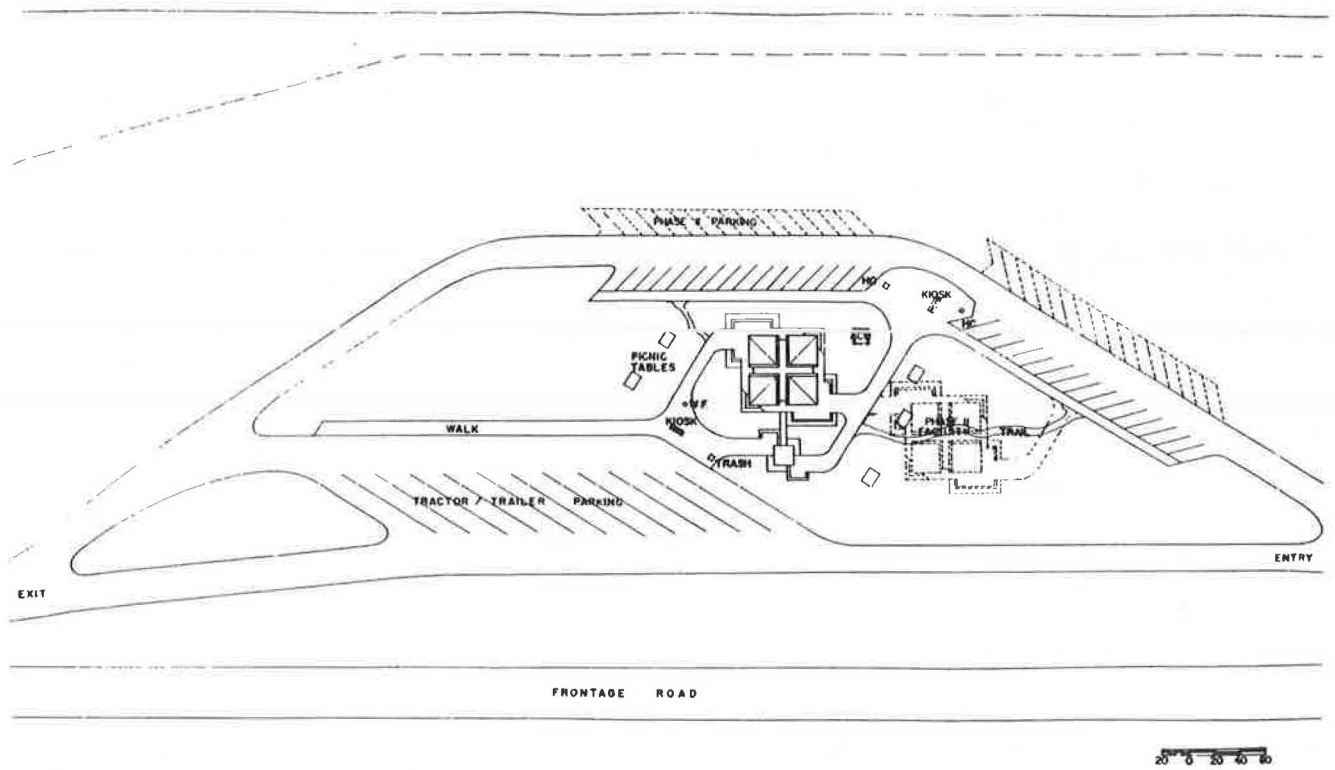


FIGURE 1 Rest area site plan.

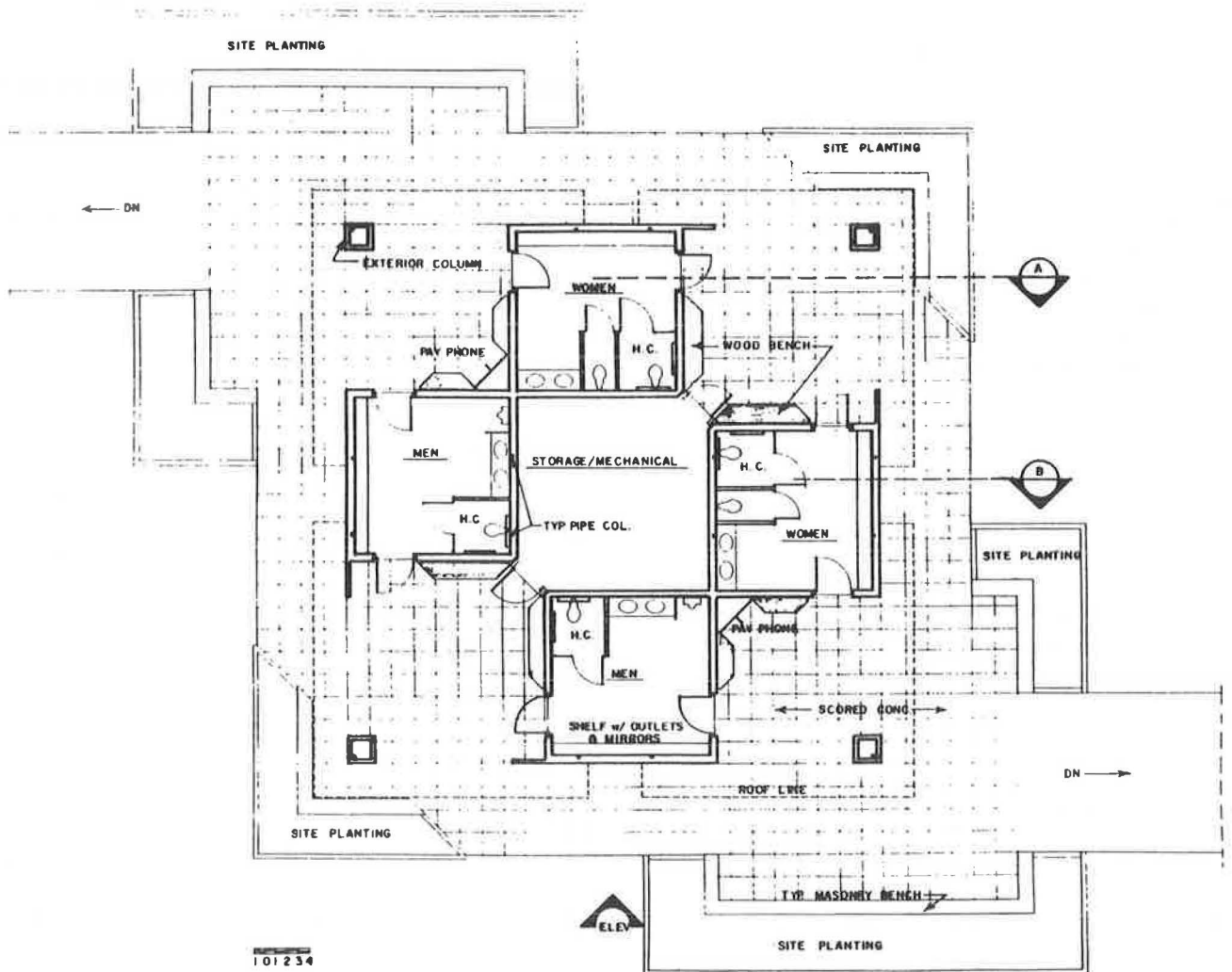


FIGURE 2 Rest area floor plan.

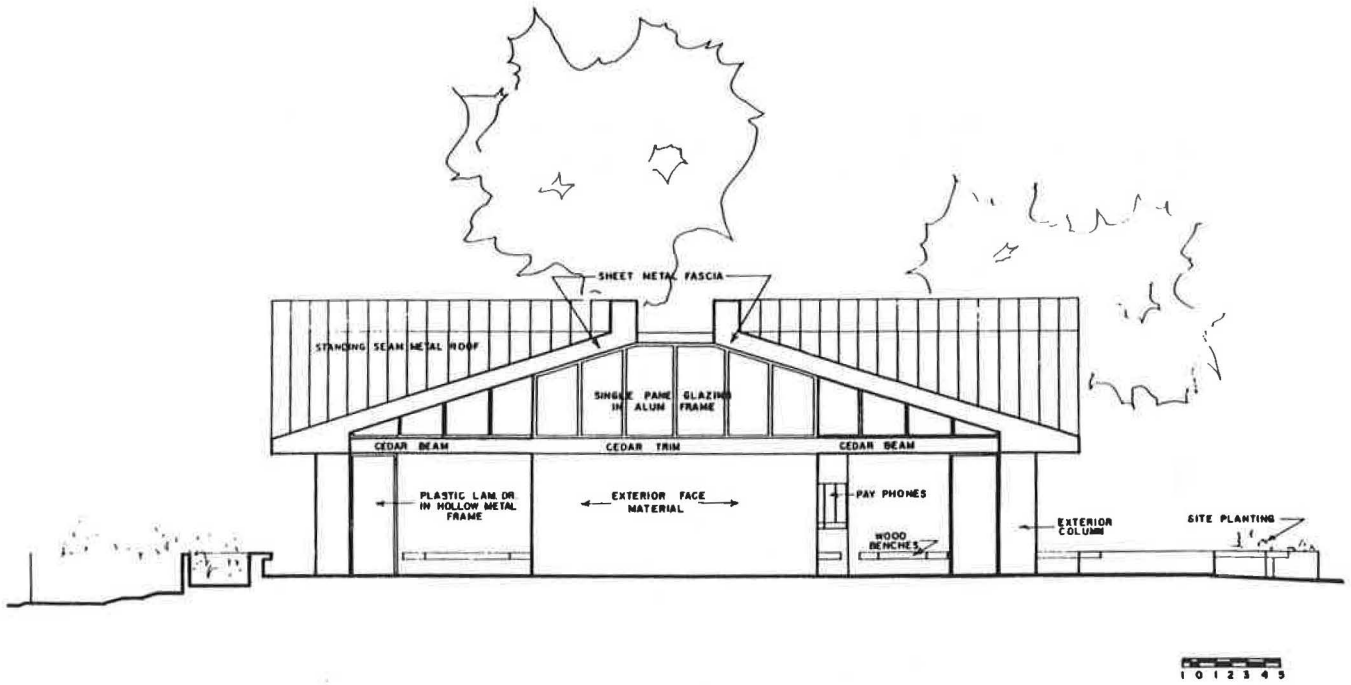


FIGURE 3 Comfort station elevation.

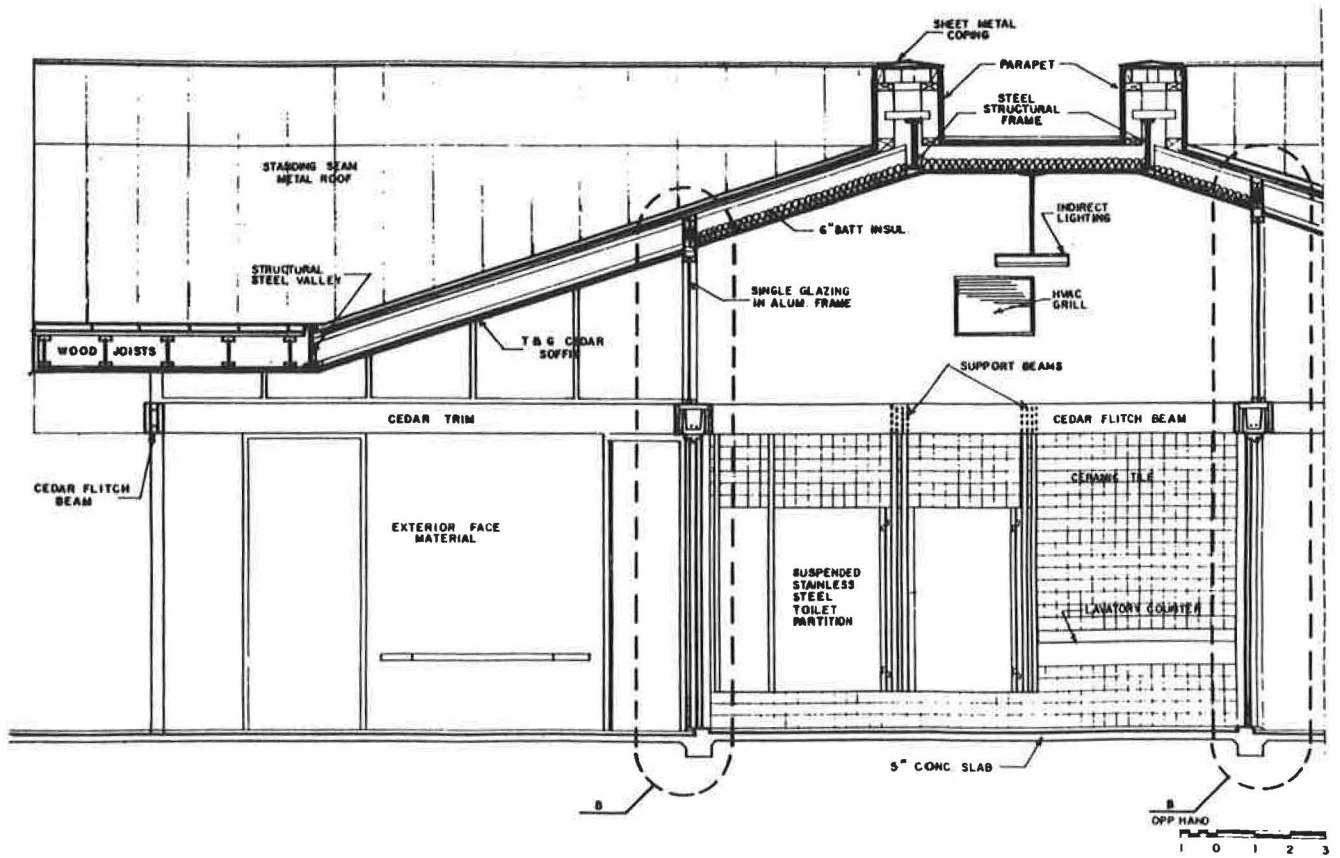


FIGURE 4 Comfort station building, section A.

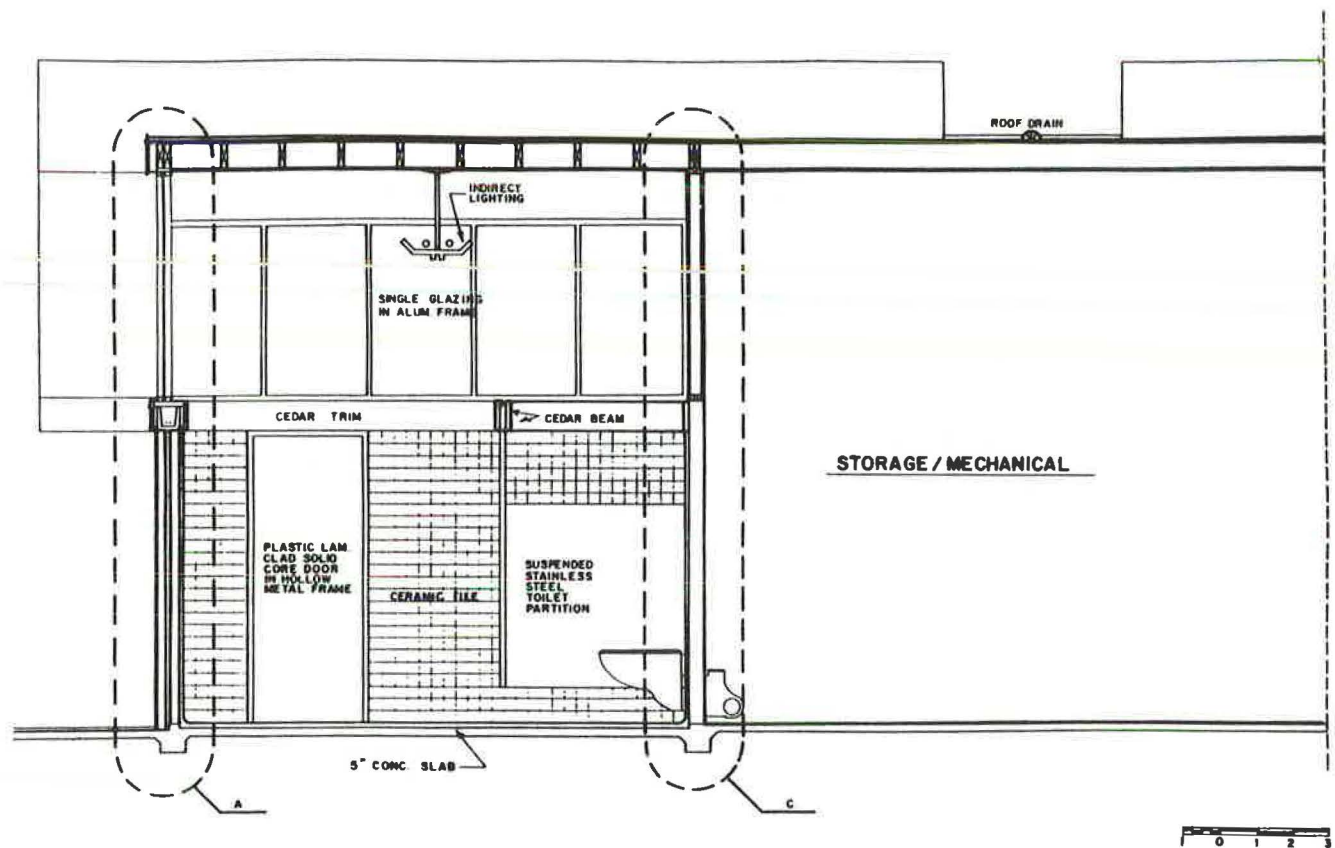


FIGURE 5 Comfort station building, section B.

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REFERENCES

1. W. T. Straughan, D. W. Fowler, and K. Perry. *Investigation of Rest Area Requirements*. Research Report 442-1, Vol. 1. Center for Transportation Research, The University of Texas, Austin, November 1987.
2. W. T. Straughan, D. W. Fowler, and K. Perry. *Investigation of Rest Area Requirements, Appendix: Pertinent Rest Area Literature*. Research Report 442-1, Vol. 2. Center for Transportation Research, The University of Texas, Austin, November 1987.
3. B. A. Rock and G. C. Vliet. *Evaluation of Energy Sources for Roadside Rest Areas*. Research Report 442-2. Center for Transportation Research, The University of Texas, Austin, December 1986.

portation Research, The University of Texas, Austin, December 1986.

4. C. W. Scharfe and J. F. Malina, Jr. *Water and Wastewater Systems at Highway Rest Areas*. Research Report 442-3. Center for Transportation Research, The University of Texas, Austin, March 1987.
5. W. T. Straughan, B. A. Rock, C. W. Scharfe, D. W. Fowler, J. F. Malina, Jr., K. W. Perry, and G. C. Vliet. *Design Recommendations for Rest Areas*. Research Report 442-4. Center for Transportation Research, The University of Texas, Austin, November 1987.
6. K. W. Perry, D. W. Fowler, C. W. Scharfe, J. F. Malina, Jr., and G. C. Vliet. *Design Manual for Rest Area Comfort Stations*. Research Report 442-5F. Center for Transportation Research, The University of Texas, Austin, November 1987.

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