SOME AESTHETIC CONSIDERATIONS IN LIGHT RAIL DESIGN

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Concern over the visual impacts of LRT remains one of the obstacles to a more general acceptance of the mode. Nor is this concern unjustified; for often, in the past, once a project had been approved, scant attention was paid by transit engineers to the appearance of LRT overhead and trackway. Yet all the fixed elements of LRT, trackway, overhead, and stations, are amenable to visual improvement if some of the principles of visual design, widely used in other fields, are applied. This paper outlines and illustrates some of the concepts that lie behind the installation of visually satisfactory and operationally functional LRT facilities, and suggests that closer coordination is needed between technical specialists and urban designers.

During the past few years increasing attention has been paid to the future potential of the light rail mode. Much technical material has been compiled on light rail vehicles, and on the various design elements that make up LRT systems. Despite this, scant attention has been given so far to the visual aspects of surface electric transit, and to techniques for achieving functional engineering requirements in a visually satisfactory manner. None the less, the achievement of a visually satisfactory design has a major impact on how a community perceives its transit system. Failure to address this issue in the past has led to considerable community concern over the appearance of electric transit, particularly the electrical overhead.

For the past thirty years, it has been commonly held that electric surface transit would gradually fade away, replaced by automobiles, some buses, and perhaps a subway or two, and was not therefore worthy of attention by the urban design profession. There was only one solution to overhead wires -- get rid of them.

Because overhead power supply is used by only about half of the electric transportation mileage in the U.S., it is often not realized that over 95 percent of electrified transportation worldwide depends on overhead electrification (1), a trend that is likely to assert itself in the U.S. as the need for all kinds of electric transportation grows. Thus the need to understand and apply the principals of good visual design is likely to become increasingly relevant, not least in the field of LRT.

This paper is intended to focus on some of the visual problems that confront LRT designers, and to outline some of the design concepts that can lead to a more satisfactory approach to these problems.

Overview

It is widely held that the need for urban transit will continue to grow in the years ahead. At the same time, there is growing concern that unless we can become proficient at planning and constructing less costly and disruptive transit facilities, the role of rail transit in this increasing market will be very largely confined to a few major corridors in the larger cities. One part of this design proficiency must address the visual aspects of system elements in conspicuous or sensitive locations. Unfortunately, the sometimes clumsy approach to the visual aspects of LRT design in the past, compounded with the generally decayed state of those facilities in recent years, has resulted in considerable public resentment towards fixed on-street transit facilities, both for LRT and trolley buses.

Nor is the perception of this issue just a contemporary concern. Even in streetcar times, some cities delayed the introduction of electrification because of their concern over the visual effects of overhead electrification. In more recent times, some communities, in considering their future transit needs have suggested that overhead wires are not "acceptable" as part of any future transit mode. Ironically, the same communities sometimes consider that the so-called "light weight guideways" required for elevated, automated transit do not, for some reason, suffer the same lack of acceptability.

The adoption of such a simplistic response to the design of overhead is scarcely consistent with the effort with which other aspects of transportation analyses are conducted. Nor can it be considered an adequate approach to a design problem that is, in fact, susceptible to a variety of design solutions. While the most obvious, and commonly cited problem is overhead wires, other elements, such as trackway and stations, can also benefit from an integrated approach to their visual and functional aspects. Each of these is discussed in turn.

Overhead Design

Design Requirements

Allegations of "overhead clutter" are commonly leveled at electric transit (Figure 1). It is an impact that is readily identified, less easily quantified, and seldom subjected to a design analysis. One possible approach to this problem is to systematically review the functional elements of an overhead system, decide why it is considered unattractive, and what remedial measures are practical.

For the light rail designer, the basic problem is simply how to suspend an insulted power wire within reach of the pantograph over each track. This is the sole requirement. The other components of overhead (poles, span wires, messenger wires, feeder cables and guys) can be constructed in a variety of ways, each with different costs and visual implications. It is here that the application of visual sensitivity can make the difference between a design that is visually offensive, and one that is visually and functionally satisfactory.

Design Treatments

The development of satisfactory overhead design treatments requires a basic understanding of how overhead wires are perceived. Some streets, particularly arterial streets where LRT is likely to be constructed, are already subject to a jumble of utility poles, wires, billboards, and signs that create an unsatisfactory visual environment. Setting is therefore one important element in overhead design, and provides an indicator as to the appropriate level of investment in visual design. In many situations, the combination of LRT overhead in a coordinated approach to other street furniture can result in an overall visual improvement.

The first and basic concept governing visually effective overhead design is that wires are conspicuous only in silhouette. Where wire silhouette is masked by vegetation or by buildings, it becomes at the least inconspicuous, and often even invisible.

Where overhead silhouette cannot be hidden, then its mass must be minimized, and its shape made as regular and geometrically pleasing as possible. This is the second concept.

These two concepts provide a basis for a systematic approach to the visual design of overhead based on:

1) Minimizing hardware in the sky.
2) Management of the wire silhouette.

Hardware Minimization. The techniques to achieve this objective are relatively straightforward. Where possible, a single contact wire should be used rather than a double wire catenary in sensitive or conspicuous areas. Feeder cables should be underground. Usually center poles with bracket arms are less conspicuous than side poles with span wires, particularly if integrated with street lighting. The general use of pantographs on new LRT installations already minimizes the need for secondary hardware such as pulloffs on curves, or overhead switches. Figures 2 and 3 illustrate two approaches to the same problem.

Engineers are usually under pressure to minimize cost, and in the absence of effective community or environmental control, may be tempted to allow wires and poles to proliferate as needed with little thought for appearance. The adoption of a comprehensive systems approach to the installation of street facilities can do much to avoid the installation of separate poles or wires for street lighting, traffic signs, signals and utilities.

Management of Wire Silhouette. The techniques for managing wire silhouette are less obvious and are worthy of discussion in more detail. Three approaches can be used:

- Landscaping.
- Decoration
- Geometry

Landscaping. The landscaping approach is already widely applied. It consists basically of using trees or buildings either to hide or to provide an alternative silhouette to the overhead from common viewpoints. Figure 4 illustrates how both buildings and trees can interrupt the wire silhouette for an observer's normal viewpoint, so that it becomes an inconspicuous element of the street scene. Notice that wire silhouette can be interrupted from in front of or from behind with equal effect (Figure 5).

The observer's viewpoint is critical to silhouette management. Overhead is almost always conspicuous to auto occupants or pedestrians on the trackway, and can be screened from this viewpoint only with landscaping directly overhead (Figure 6). With the increasing tendency to segregate transit from autos, this problem occurs less frequently.

Decoration. The second approach is to apply decoration. This was widely used on the earliest street car installations, particularly in Europe where ornate cast iron poles and bracket arms were often seen. In the first decade of this century, the use of wrought iron scroll work, ornate finials and pole bases became a highly developed art form (Figure 7). Later examples were often somewhat less ornate, and some remain in use as light poles to this day, though the wires they once supported are gone.

The decorative approach need not necessarily be ornate. A common variation has been the use of curved bracket arms, providing both a pleasing and functional design (Figure 8). Similar designs are often used in the U.S. for street lights.

Geometry. With the geometric approach, the designer's objective is not to hide the wires but rather to create a pleasing, or at least inoffensive pattern through the use of clean, simple and functional design. The geometric approach is largely a modern concept and has been applied with considerable success on a number of recent installations. Geometric design is particularly effective with centerpole overhead, since this permits elimination of all wires but the contact wires themselves. Often, but not always the centerpoles are integrated with the street lighting for the adjoining highway, if any. The bracket arms may be cantilevered, hinged, or supported by stays or props. Bracket arm selection depends in part upon the method of wire tensioning used, and whether expansion compensation is to be included. In the last few years, a number of effective geometric designs have been installed, both in Europe, and, in 1977, in San Francisco (Figures 9 and 3). One attraction of the geometric approach is that it need cost little more than a design developed without aesthetic consideration.

The design and installation of electric transit overhead often provides an opportunity for simultaneous removal of utility wires and coordination with street lighting. While it may sound self-defeating to place utilities underground at the same time that electric transit overhead is installed, the visual impact of this treatment can be very effective due to the reduction in the amount of aerial hardware, and the geometric coordination of what remains. The cost of such projects should not be borne solely by the transit operator. Two recent examples include the rewiring of the San Francisco LRT overhead, which includes overhead utility removal, and the extension of the Seattle trolley bus system, which similarly incorporates the removal of all other unnecessary utility and lighting poles by way of visual "compensation."

Alternatives

Numerous attempts have been made over the years to devise an alternative to overhead power supply on city streets. In the past, both the surface contact stud system, and the conduit system have been used to power street cars operating on streets and in mixed traffic (2). The surface contact stud system consisted of a row of studs placed between the rails, energized as the rail vehicles passed over them. Power was collected by means of a ski-like skid placed beneath the car. Historically, this system was conspicuous by its unsuccessful performance, including failure to operate, and conversely the tendency to occasionally electrocute other highway users. The conduit system worked rather better, and was used extensively in Washington, D.C., New York, Paris and London. Overhead could be eliminated, but only by incurring considerably higher installation and maintenance costs, and diminished reliability. The widespread practice, in more recent times, of salting highways in winter would make any new in-pavement electrification even less feasible.

The possibility still remains that a major research effort might be able to advance one or both of these technologies to a viable state although it is certain that 1) the cost would still be far higher than the overhead system, and that 2) the sole benefit, visual, can already be attained through a lesser investment in landscaping or geometric treatments.

Trackway Design

The appearance of LRT overhead is not the only visual issue. Trackway appearance can also have considerable visual impact, mainly through two design elements, type of surfacing, and fencing.

Where the trackway is part of the street pavement, a variety of paving techniques can be applied. Some properties seek to minimize the difference between the trackway and the rest of the street by completing the track paving in an identical material. Generally asphalt concrete is used, but Portland Cement Concrete is also suitable. Alternatively, the trackway may be paved in a contrasting material, a technique particularly useful when an exclusive transit lane is planned. In locations such as pedestrian mall, ornate paving may be applicable, such as the black and white checkerboard paving used in Zurich, or perhaps rounded cobblestones which can also serve to discourage pedestrians from walking in the trackway except at designated crosswalks, (which would be smoothly paved).

Where the trackway does not need to be paved a variety of treatments are possible. A number of systems have segments of track set in lawn. Such track can be found in many European cities and in New Orleans. To minimize maintenance, a strong, well drained trackbed is required, and wooden ties should not be used. Figures 10 and 5 show lawn covered track under construction, and completed, respectively.

The use of low shrubs along the trackway is another commonly used technique to soften the otherwise arid expanse of street and tracks. Generally no additional space is required for such treatment, since the shrubs can grow within the LRT clearance space (Figure 11).

A common and visually conspicuous design element is the use of fencing on median trackage. Fencing may be located either outside the tracks, or between them. A common design error has been the location of fencing outside the tracks when fencing between the tracks would have provided adequate protection (Figure 12). To evaluate the appropriate design, it is necessary to understand the function of fencing in a light rail median. The primary purpose in an urban situation is not to exclude people from the trackway, but rather to prevent unexpected and random crossing at all locations. This purpose can be achieved by a center fence just as well as by a side fence, while a center fence requires less space and offers considerable potential for visual relief (Figure 13). In either case, the fence need not be more than four feet high, since a fence of this height is sufficient to prevent jaywalking. Moreover, the fence should be raised above the ground to prevent the collection of wind blown debris and other litter. Chain link fencing should be avoided.

As with overhead design, where the median is of minimum width, the geometric concept, of tidy, regular patterns can provide an effective design approach to trackway appearance. Where more space is available, other design options become possible. Where sufficient space exists for landscaping outside the tracks, then a fence can be integrated into the landscaping.

An important consideration in trackway landscaping is to preserve the best possible line of sight at all critical locations. This is achieved primarily by the avoidance of "middle height" landscaping. Thus, landscaping should consist either of ground cover and small shrubs, or of trees, or both (Figure 14), but never bushes which can conceal a potentially hazardous situation.

Station Design Elements

The design of an LRT station in a street environment can also benefit from consideration of its visual elements. For instance if the trackway is paved in the station area, the collection of debris is minimized, and uneven surfaces that may trip pedestrians are largely avoided. A common problem at LRT stations is the tendency of pedestrians to walk behind a stationary LRV into the path of one going in the opposite direction. This problem can be solved by placing a barrier between the tracks. Since all that is needed is to prevent carelessness, an absolute barrier is not needed, and indeed is visually undesirable. Many systems use an ornamental post and chain fence for this purpose (Figure 15).

To protect passenger platforms from both vehicular intrusion, and from traffic wash in wet or snowy weather, barriers may be needed at the back of a platform. Such barriers, and the backs of passenger waiting shelters present a conflict between the design goals of comfort, safety, and appearance. Where additional right of way can be acquired, the space between the platform back and traffic lane can be increased, lessening the need for a splash wall, and additionally, permitting landscaping. Other alternatives might include diverting some traffic to parallel streets, thereby lessening the combined traffic and transit impacts, or the acceptance of the barrier, and its mitigation by the use of textured or decorative treatments.

Summary

Historically, there has been a tendency for engineers, once engaged on a project, to place a low priority on visual quality. This attitude has led to considerable community resentment in the past, and apprehension over future surface electric transit installations. Nevertheless, a number of relatively simple design techniques exist and are being used in a few locations that go a long way toward addressing these concerns. These techniques deserve to be more widely known and more generally applied. While this paper has covered only some aspects of this problem, hopefully it will stimulate both thought and discussion, and lead to a more positive approach to this problem on future installations.

References

1. Railway Directory & Yearbook, 1976. Compiled from Official Sources, and published by IPC Transport Press, London, 1975, 734 pp.
2. C. E. Baddeley and E. R. Oakley. Current Collection of Tramway and Trolleybus Systems. Published by the authors. Hartley, Kent, 1975, 112 pp.

Figure 1. Overhead Clutter. A mix of overhead feeder cables, utilities, and wires for LRT and Trolley buses.

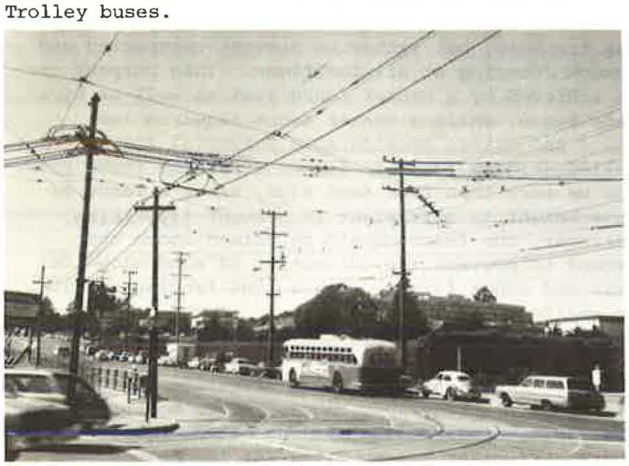

Figure 2. Uncoordinated, side pole design, with independent street lighting--Stuttgart.

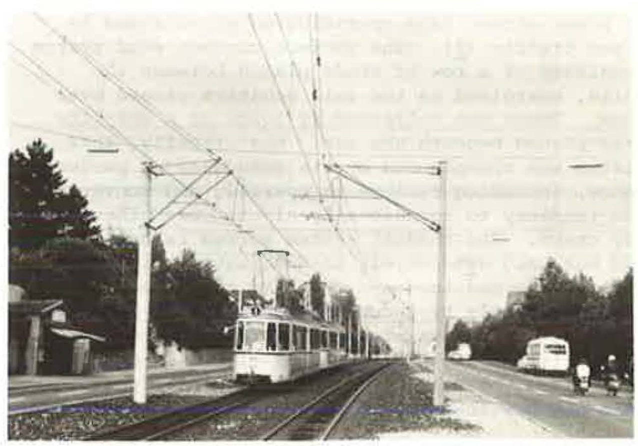

Figure 3. Coordinated, Center pole design--San Francisco.

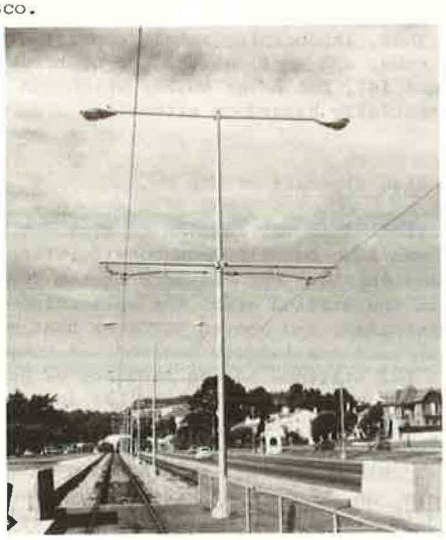

Figure 4. Limits of LRT overhead silhouette due to landscaping and buildings on a transit mall.

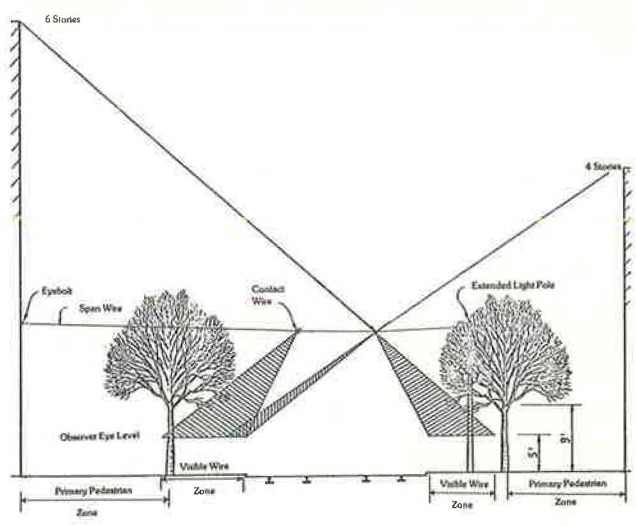

Figure 5. Background Screening. Note that an observer in the street or sidewalk could not see the overhead silhouette--Basle.

Figure 6. Large trees can block LRT overhead silhouette from any viewpoint--Dusseldorf.

Figure 7. Decorative overhead support poles.

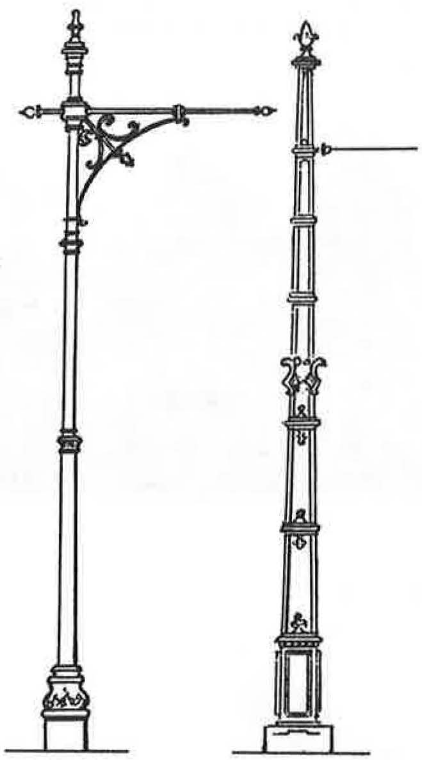

Figure 8. Curved bracket arms--Karlsruhe.

Figure 9. New Overhead. Geometric design--Braunschweig.

Figure 10. Track in lawn under construction--Linz.

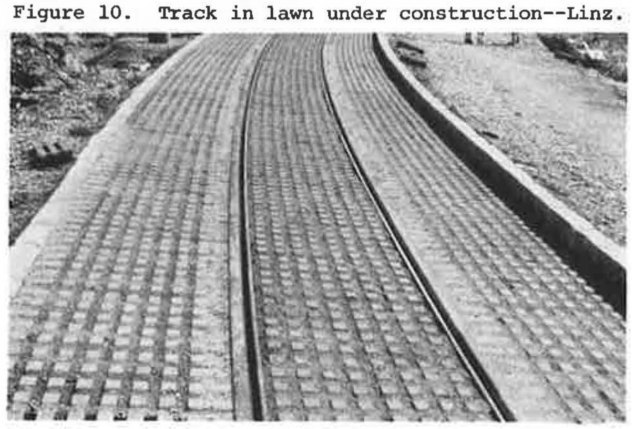

Figure 11. Low shrubs as a track screen--Munich.

Figure 12. Side fencing where center fencing could suffice.

Figure 13. Center fencing--Boston.

Figure 14. High and low landscaping at a pedestrian crossing approach--The Hague.

Figure 15. Post and Chain center fence--Mannheim.