Building Light Rail Transit in Existing Rail Corridors—Panacea or Nightmare?

The Los Angeles Experience

EDWARD MCSPEDON

The Los Angeles County Transportation Commission (LACTC) is constructing a 21-mi light rail transit (LRT) line between the cities of Long Beach and Los Angeles. Sixteen miles of the line are being constructed on right-of-way acquired from and shared with the Southern Pacific Transportation Company. The design and construction of this portion of the project have proven to be far more difficult and costly than was ever imagined initially. Among the more challenging aspects have been the need to maintain railroad operations while relocating the freight line and constructing LRT, undertaking an extraordinarily large utility relocation program, acquiring hundreds of real estate parcels in addition to the railroad right-of-way, and dealing with extensive institutional problems related to grade crossings, insurance, license agreements, franchises, and the permitting and approval processes of the political jurisdictions through which the railroad alignment passes. It is important that those planning similar projects gain a full appreciation of LACTC's experiences so that realistic cost estimates can be prepared for the purpose of making accurate comparisons of railroad right-of-way alignments with other alternatives.

THE FIRST SIGNIFICANT DECISION faced by any municipality or authority considering the construction of a new rail transit line (other than how to pay for it, of course) is simply where to put it. In most mature urban areas the available choices are relatively few and generally include the following:

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- On, over, or above existing streets;
- Within existing highway corridors;
- Within existing public or private rights-of-way (ROWs) (parallel to utility lines, rivers, drainage facilities, etc.), or
- Within existing railroad ROWs.

Problems with the first two choices are usually related to the facts that these facilities are already at or near capacity (thus the reason for considering a rail transit line) and that adjacent uses may tend to be environmentally sensitive (residential) and/or extremely expensive to acquire (thriving businesses).

Active power company ROWs with overhead electrical transmission lines will probably not have adequate space because of horizontal and vertical clearance problems, present difficult maintenance access problems, pose potential safety hazards, probably fail to serve major activity centers or bus routes, and probably suffer from adjacent environmental problems similar to those described for highway and street corridors.

Publicly owned waterways probably will pose substantial environmental problems, may not serve major activity centers or bus routes very well, and probably will not accommodate an operationally efficient light rail transit (LRT) track geometry.

Railroad ROWs, however, usually provide a much more favorable set of circumstances when these initial considerations are reviewed. First of all, freight railroad corridors are often underutilized. The freight railroads, which were so integral to the growth and development of our cities, have in a large number of cases lost substantial portions of their market shares to other transportation modes such as trucks. The railroads have often consolidated their services onto their most productive routes and have used techniques such as longer trains, double-stacked cars, and the like to improve their competitiveness. These factors, together with the deindustrialization of our economy, have caused many freight railroads to reduce or even discontinue service along corridors that access urban cores. The railroad ROWs themselves are often still intact, providing an assembly of land that is well suited for LRT operations because the standards for railroad design (loads, maximum grades, degrees of curvature) are much more restrictive than those required for light rail. Additionally, the types of land uses adjacent to existing railroad ROWs are often environmentally compatible with LRT construction and operations. Although these corridors may not be convenient to residential trip origins they often provide a very politically attractive "path of least resistance" to LRT implementation.

Such was the situation faced by Los Angeles County in the planning of the Long Beach-Los Angeles (LB-LA) Light Rail Project. Sixteen miles of the

21-mi route were planned to be constructed within the Southern Pacific Transportation Company (SPTC) Wilmington Branch ROW, from the southern fringe of the Los Angeles central business district (CBD) to the northern portion of the City of Long Beach (see Figure 1). Not only was this an underutilized freight corridor, but it also had served as the route of the last active Pacific Electric Red Car line, which was discontinued in 1961.

The corridor appeared ideally suited for the construction of a new double-track LRT line, and the Los Angeles County Transportation Commission (LACTC) decided to place the 16-mi midcorridor portion of the project there.

COEXISTING WITH RAIL OPERATIONS

Soon after the LB-LA line was authorized for final design and construction, the LACTC came face-to-face with consideration number 1: Someone else owned the ROW. In this case, the entity was the SPTC. To construct an LRT line within the SPTC corridor, LACTC had to purchase a portion of the SPTC ROW that was generally 16 mi long by 60 ft wide. LACTC did so in October 1985 at a cost of $26 million.

At the same time LACTC was also facing consideration number 2: Someone else may be operating in the ROW. In this case not only was SPTC operating freight service within the corridor, but to make room for construction of the two LRT tracks, the SPTC freight tracks would have to be literally picked up and moved over to one side of the ROW, while full freight operations were maintained (currently at a level of 12 freight trains per day). (See Figure 2.)

The framework for the LACTC's relationship with the railroad was established in June 1985 by a construction and maintenance agreement. The agreement, which was actually a condition of the sale of the ROW, places full responsibility on LACTC for performing the railroad relocation and LRT construction work at no cost to, and with minimal impact on, the operations of the SPTC.

The complications presented by the existence of an operating freight railroad within a very constricted ROW during LRT construction have been numerous and substantial. One of the elements of the construction and maintenance agreement that has had the greatest impact on LRT project cost is that the relocated SPTC is to be on a completely new track and substructure. Hence merely moving the existing track(s) is not sufficient. The design and track materials have to meet railroad standards and are subject to railroad inspection, acceptance, and approval. As might well be expected in a case where the owner (SPTC) does not bear the burden of the construction costs, the railroad has been extremely stringent in the application of its construction

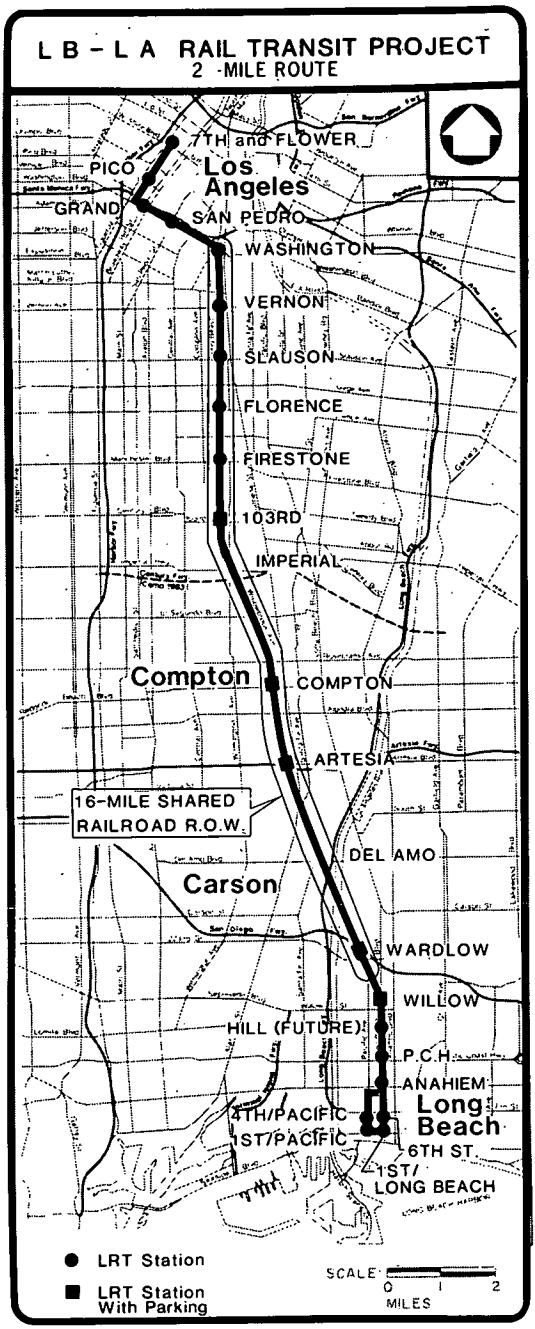


FIGURE 1 Long Beach-Los Angeles LRT route map.

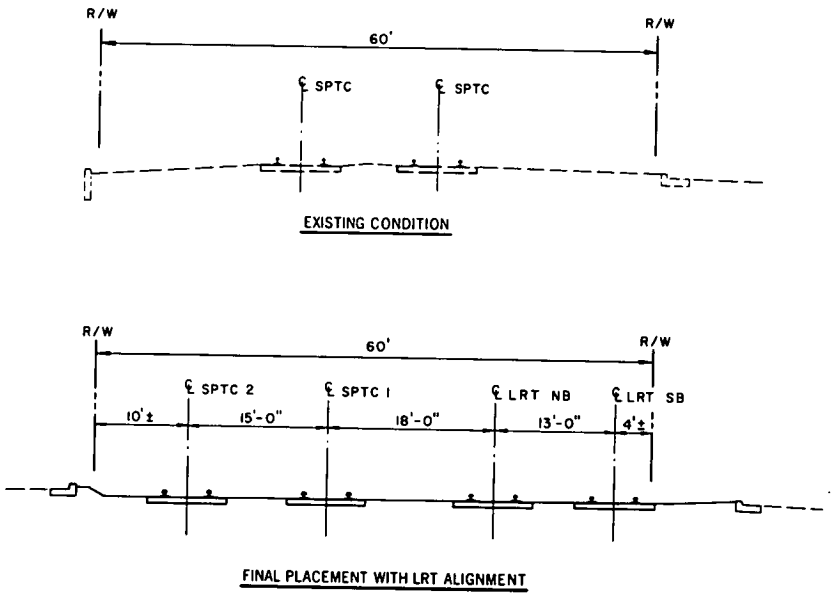


FIGURE 2 Cross section of SPTC right-of-way.

approval authority, resulting in change orders to contracts and pending contractor claims totaling hundreds of thousands of dollars.

In addition, although the current Wilmington Branch freight line is largely single tracked, the final design could not preclude the future installation of a second SPTC track, at minimal cost, wherever possible. This has resulted in several costly LRT design features, particularly related to column locations and bent configurations for LRT aerial structures.

Also, LACTC is required to indemnify the railroad against liabilities due to LRT construction, operations, repair, reconstruction, or physical presence by putting in place a $50 million railroad protective liability insurance policy. This policy must remain in effect so long as the two operations continue to share the corridor and must be increased in value to reflect cost of living index changes in future years. LACTC was unable to exert much leverage in the negotiation of these terms, which, unfortunately, are fairly typical of such arrangements in other U.S. cities.

The physical configuration of the SPTC trackage has also added to the cost of the LRT project. Although the Wilmington Branch predominantly parallels the LRT alignment, there are a number of locations where sidings and spurs depart in either direction to access freight customers along the line, and where branch lines cross or depart from the SPTC track. At heavy traffic locations it has been necessary to grade-separate the LRT to avoid crossing

conflicts with the railroad. In total, 2 mi of the 16-mi midcorridor will be on aerial structure, of which 70 percent is due entirely to having to avoid railroad crossing conflicts. At two locations (Slauson Avenue and Cota Crossing) LRT aerial structures also serve to avoid crossing conflicts with other railroads (Santa Fe Railroad and Union Pacific, respectively). The additional design and construction cost of this work is estimated at $20 million.

Because the alignment of the railroad is being shifted, it has meant physical changes to each of the 37 railroad grade crossings in the midcorridor. No matter how minor the change, each requires the concurrence of the affected jurisdictions as well as the approval of the California Public Utilities Commission (CPUC). CPUC regulations require that the crossings be designed to stringent current safety standards and that a complex and lengthy formal application process be followed. The CPUC process often takes a year or longer for each crossing application. Compliance with the CPUC approval process has required that LACTC engage the full-time services of a former railroad official as well as specialized legal counsel, along with staff and engineering consultant resources.

In addition to the required approvals of regulatory agencies for each grade crossing, many of the existing railroad crossings on public streets were constructed and operated under franchise agreements obtained from the street owners. For each modification of these crossings an entire new franchise agreement has had to be drafted with revised legal descriptions and drawings. LACTC must research and prepare these agreements as well as schedule their preparation such that necessary approvals can be obtained consistent with LRT project construction needs.

Lastly, constructing the LRT project in an active rail corridor has imposed the normally anticipated problems and costs, such as contractor inefficiencies, construction site access constraints, railroad flagging requirements, construction of temporary railroad "shooflys," and the required use of railroad construction forces under force account agreements. All of these factors have contributed to increased LRT construction costs and project scheduling difficulties. The cost of relocating and replacing freight railroad facilities is estimated to exceed $40 million.

DEALING WITH OTHER ROW USERS

Perhaps the most greatly underestimated difficulty in the design and construction of the LRT line has come about from consideration number 3: Railroad ROWs are used by other parties as well. In the case of the LB-LA project it sometimes seems as if the LACTC was the last entity on earth to realize the usefulness of the Wilmington Branch corridor. The sheer density of Los Angeles County creates the paradoxical combination of great demand

for utility services and lack of open spaces in which to install them economically. Add this to the fact that the railroad is a for-profit business anxious to maximize returns on its sunk ROW costs by leasing the unused spaces beneath and above it, and the result is an enormous number of utilities within railroad ROWs.

Consider the nature of Los Angeles County, with its vibrant economy, 8 million residents, defense industry (Northrop, Hughes, TRW, Lockheed, etc.), underground oil and natural gas deposits, and one can begin to imagine the number of oil lines, gas lines, cable television conduits, public and private communication lines, and other facilities that have been encountered within the Wilmington Branch ROW. All told, LRT construction has affected the facilities of 22 public utility agencies, 10 private utility companies, and 17 oil producers and refineries over the 16-mi shared railroad ROW. It also has required the relocation, replacement, removal, or protection of 2,300 individual utility lines.

LACTC has entered into 60 cooperative agreements with government jurisdictions, private and public utilities, and pipeline and railroad companies to define roles, responsibilities, and procedures for handling project impacts. Each utility within the ROW currently operates under terms of a license agreement with SPTC. These agreements generally indemnify the railroad against any possible detrimental effects from the existence or operation of each line and spell out terms of financial responsibilities of the utility companies to the railroad for the use of the ROW.

Each and every change in the location, configuration, or encasement of each and every utility affected by LACTC's construction has required preparation of a completely new license agreement for execution by the utility company and the railroad. Not only has this proved to be burdensome in and of itself, but the terms of these revised license agreements have often turned out to be contentious issues, particularly when increased lengths of encroachment have resulted in increased annual assessments by the railroad. In addition, LACTC has had to develop and negotiate similar indemnification agreements with each utility for easements beneath its own portion of the ROW.

Perhaps the most substantial difficulty related to utility relocations is that much of the design and construction work must, by regulation, be performed by the individual utility companies themselves. This has meant that the most complex and time-critical project coordination effort has been largely entrusted to dozens of third parties over whom LACTC has no direct control. Billing rates, man hours, and schedules are often a matter of faith considering the fact that many of the utilities are regulated monopolies. The identification of utility conflicts, the development of design solutions, and the safe and efficient relocation of the affected facilities have been combined to form one

of the most challenging and frustrating aspects of the LRT construction project (see Figure 3).

COPING WITH RELATED IMPROVEMENT PROJECTS

Consideration number 4 is something that became more and more evident as the engineering and design efforts proceeded into the final phases. It can be summarily described as follows: "Lurking behind any neglected and underutilized railroad corridor are an infinite number of painstakingly conceived, but as yet unfunded, improvement projects." The 16-mi midcorridor passes through four cities and through unincorporated portions of Los Angeles County (see Figure 4). During design development necessary impacts to the facilities of each jurisdiction, as well as to the facilities of the SPTC and the Department of Transportation (Caltrans), were identified. In case after case the impacts of the project on these facilities have required substantial and extensive modifications that, at a minimum, require bringing the facilities up to modern-day design standards no matter how neglected or substandard they might have been. Some of the more significant examples of this phenomenon include railroad grade crossings, grade-separated crossings, and municipal improvements.

Railroad Grade Crossings

Each of the 37 SPTC grade crossings in the midcorridor has had to be modified to reflect changes in the track alignment and, in many cases, the addition of LRT tracks to the crossing. Through design reviews with the local jurisdictions it was found that many of these crossings had long been scheduled for widening. The municipalities dictated either that the widenings occur as part of the LRT project or, at minimum, that the reconstructed crossings be configured to facilitate future street widenings. This has meant longer gate arms, additional warning devices, and dedicated ROWs for future streets and sidewalks at additional project cost.

Another typical situation involves cross-street profile modifications at crossings. Throughout the midcorridor, SPTC's grade crossings often create severe "humps" in intersections. In many instances these crossing humps are 3 ft or more above adjacent street elevations with substandard vertical transitions. Naturally, with the extensive grade crossing reconstruction work involved in the LRT project, the local jurisdictions have required LACTC to eliminate these humps to improve sight distances and speeds for crossing traffic. The lowering of the railroad profile needed to accomplish this has

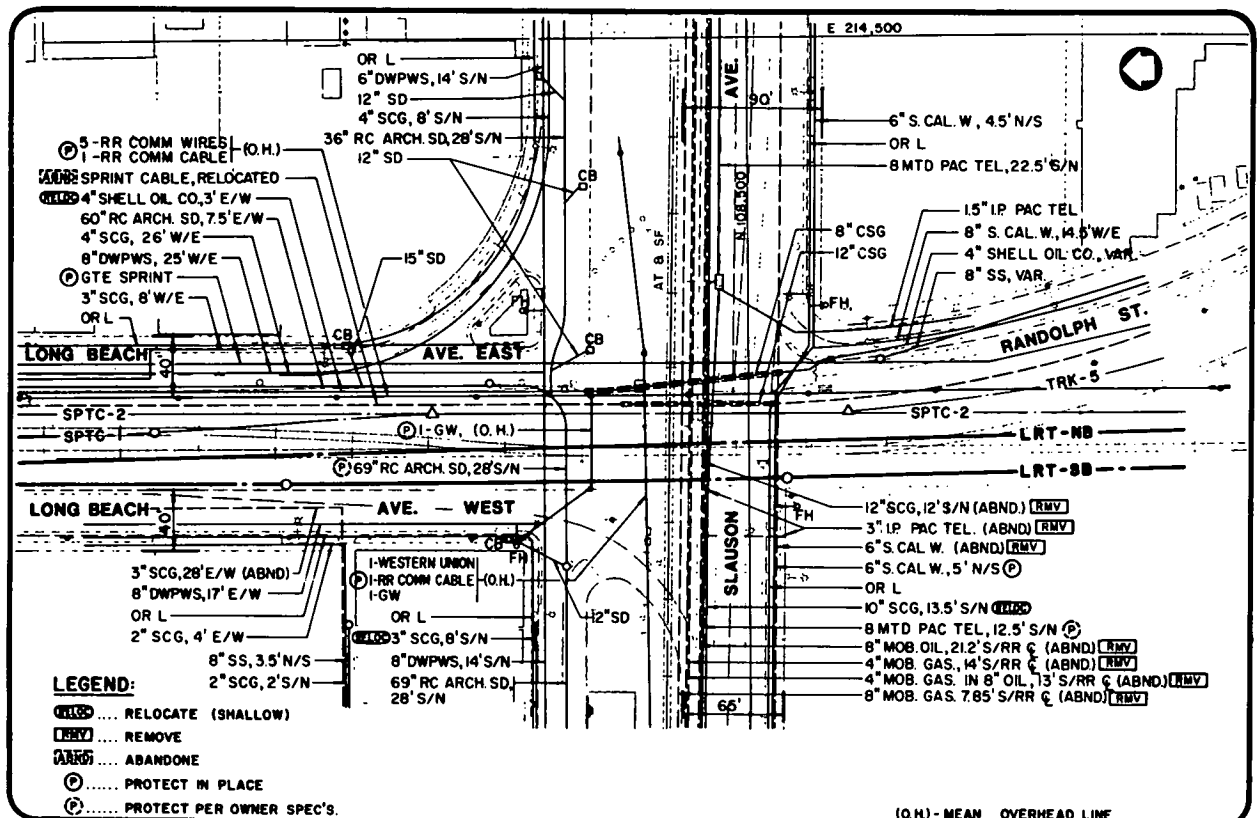


FIGURE 3 Cluttered utility relocation plan shows complexity of effort.

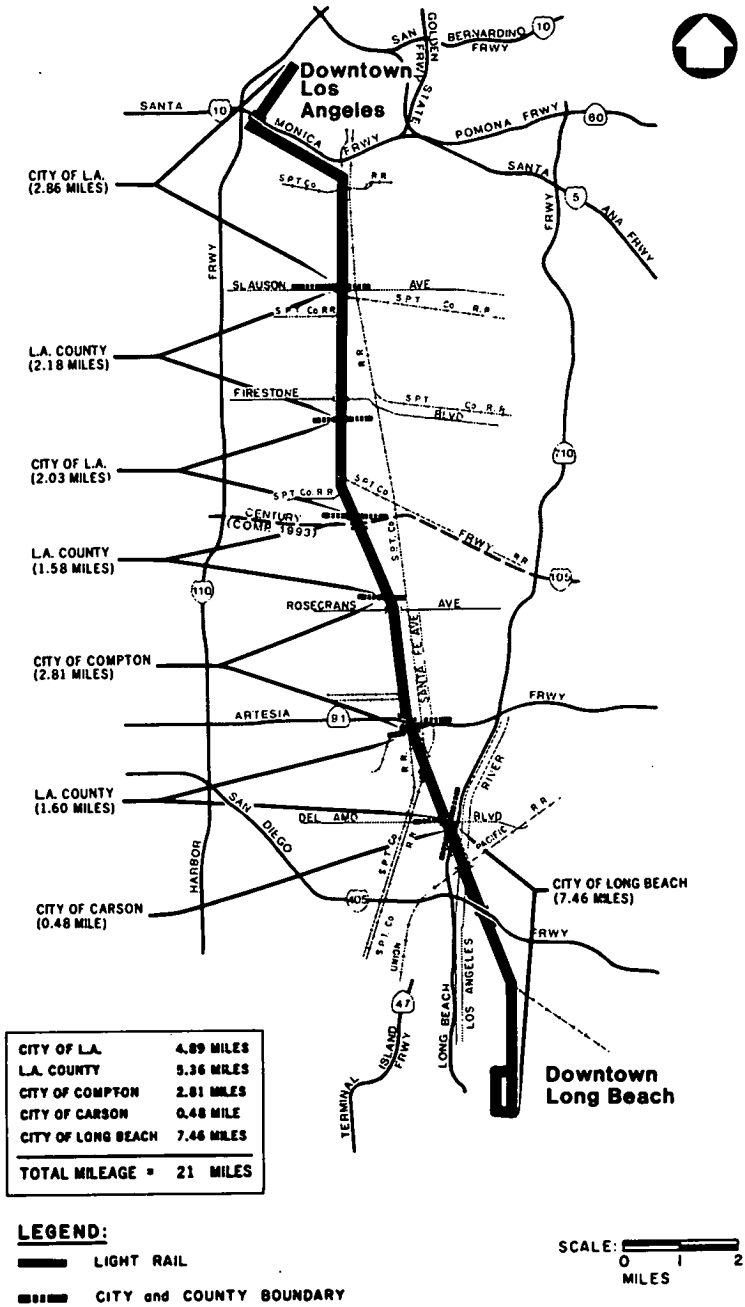


FIGURE 4 Route map showing multiple jurisdictions involved (with mileage per jurisdiction).

been accompanied by extensive related modifications and upgrades to streets, curbs, gutters, and sidewalks for hundreds of feet in either direction at each affected crossing.

Additionally, CPUC regulations require that each of these reconstructed crossings be designed and equipped with state-of-the-art railroad crossing protection. In many cases this has meant upgrading from as little as two wig-wag warning devices to full railroad gates, flashing pedestrian warning devices, and cantilever signal bridges in both crossing directions.

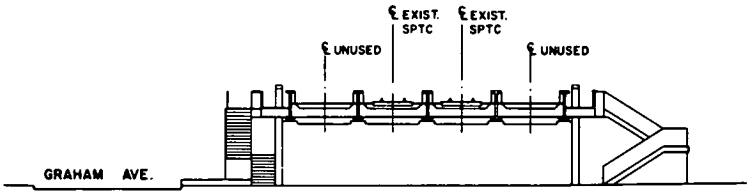
Grade-Separated Crossings

Even in situations where the railroad crossings are already grade separated, unanticipated and often costly problems have been encountered. A case in point is the Firestone Bridge, which is a four-bay SPTC structure crossing Firestone Boulevard (see Figure 5). LACTC's original plans were to utilize one of the four bridge bays for an LRT track and to build a single-track LRT structure adjacent to the railroad bridge. Two of the existing bays would carry the SPTC tracks, and the fourth bay would serve as a buffer between the two rail facilities. Detailed engineering, however, identified a number of problems with this approach and resulted in a costly sequence of events.

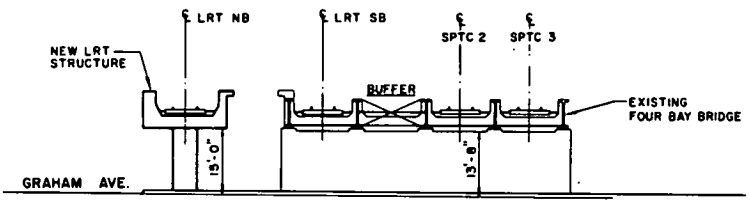
Because of the proximity of the center-platform LRT station to the bridge, the LRT track center had to be spread to approach the station. This made the use of the outboard (closest) SPTC track for LRT infeasible. Use of the next SPTC track over (the bay originally designated a buffer between LRT and SPTC) would violate CPUC regulations related to horizontal clearances between LRT and railroad. The only viable solution therefore would be to demolish half of the SPTC bridge and to construct a second single-track LRT structure, leaving one-half of the bridge intact for two operating SPTC tracks.

But the existing bridge does not meet current seismic design standards. Any significant modification to the facility (such as demolishing half of it) requires that it be brought up to standards. Nor is the bridge's design capacity adequate to carry the heavy freight loads that the railroad currently handles. SPTC has been restricted to operating only one train at a time across the bridge under a "slow order." The railroad, not surprisingly, requested that the portion of the bridge to remain intact be reinforced to increase its load-carrying capacity.

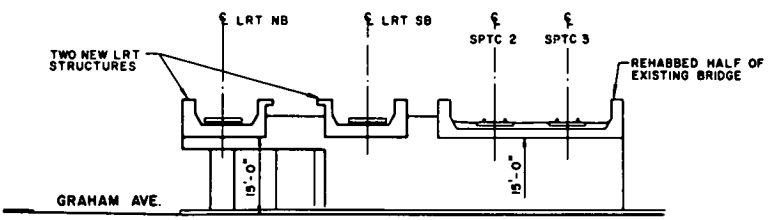
Further complicating the situation, the street over which the bridge passes, Firestone Boulevard, is a California state highway. At the point at which it crosses the highway the bridge creates a bottleneck because of its short center span length and the resultant column location on each side of the road. Caltrans therefore requested that the remaining SPTC half of the bridge be lengthened and that the column locations be moved to permit widening of



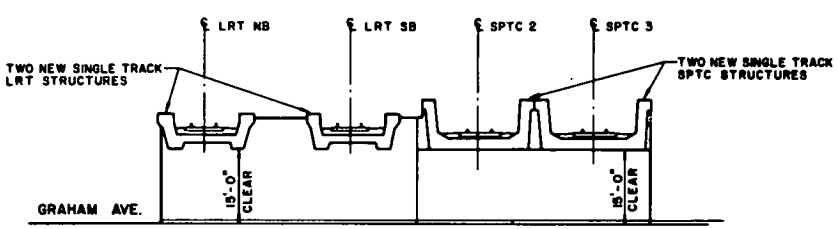
EXISTING BRIDGE CONDITION



ORIGINAL BRIDGE DESIGN



CONCEPTUAL BRIDGE DESIGN



FINAL BRIDGE DESIGN

FIGURE 5 Firestone Bridge design and redesign stages.

Firestone Boulevard. The vertical clearance of the bridge over the highway is noncompliant with CPUC regulations and with current highway standards (13 ft 8 in. versus the 15 ft required) and needs to be increased. This can be done either by raising the bridge (a severe problem because it would change the SPTC track elevation and require extensive railroad alignment and grade changes for thousands of feet in either direction) or by lowering the street (also a severe problem because it would create a flood-prone area that would require extensive drainage improvements, including a pumping station).

The net result of all of these factors has been that what started out as an apparent opportunity to reduce project costs by utilizing an existing grade-separated crossing structure has led ultimately to a decision to demolish the entire four-track railroad bridge and to construct a new double-tracked SPTC structure as well as two new single-tracked LRT aerial structures—all to current design standards. This is the most cost-effective solution to all of the problems identified.

Although LACTC will obtain financial participation from SPTC for the increased capacity "betterment" and from Caltrans for the highway width improvement, LACTC will still realize on the order of $4 million to $5 million in additional project costs for this facility, nearly twice the initial estimate for the work.

Municipal Improvements

In terms of municipal improvements, the list is endless and, for the most part, not atypical of the kind of situation faced on all projects of this type. Included are such things as upgrades of adjacent streets and sidewalks, installation of new street lighting, computerized traffic signals and signage, addition of landscaping, construction of new fences and retaining walls, construction of new street crossings across the ROW, and closure of certain existing crossings, to name but a few.

One municipal improvement that is definitely not typical of the kinds of situations faced on projects of this type but that is an example of what can happen is known as MC-5. MC-5 (for midcorridor alignment alternative number 5) is a project element that involves the complete removal of the SPTC trackage from a 4-mi stretch of the Wilmington Branch in the City of Compton and the construction of replacement trackage in a parallel freight corridor (the San Pedro Branch) further to the east, together with connector tracks between the two corridors. The City of Compton was vehemently opposed to the LB-LA project largely because the Wilmington freight corridor cuts through the heart of the city, causing noise, vibration, and traffic congestion. Adding LRT trains to the same corridor was viewed by the city as a change that would exacerbate an already unacceptable situation.

The city decided to employ every available legal and political means to stop the LRT construction until and unless a solution could be found to the existing freight train problems. Although LACTC eventually prevailed on the legal front, the MC-5 project had gained enough political momentum during the several years that it was debated that LACTC ultimately agreed to implement it. This project element, which is not physically necessary for LRT construction or operations, will cost $67 million, of which LACTC will contribute $57 million and the City of Compton, $10 million. (A substantial portion of the city's $10 million consists of a long-term, zero-interest loan from LACTC.)

BUYING ADDITIONAL PROPERTY

The last major factor faced by LACTC is consideration number 5: No matter how perfect the ROW may look, it's probably not big enough. In this instance the project's statistics speak for themselves. In addition to purchasing the 16-mi SPTC ROW, LACTC has had to effect more than 250 other property acquisitions. Included are 43 additional parcels required for auxiliary LRT facilities outside the ROW, such as traction power substations, maintenance facilities, and park-and-ride lots.

Perhaps the most interesting and significant real estate statistic, however, is acquisitions that have had to be made for street modification purposes (typically widenings). An excellent example occurs at Vernon Street, which crosses the ROW at grade and which is the location of an LRT passenger station. Here, the track centers widen to facilitate access to the center-platform station (see Figure 6). The widened track centers result in an encroachment onto Long Beach Boulevard West, which parallels the LRT tracks. Traffic studies showed the need for additional queueing capacity on this street to handle pent-up turning movement demand across the tracks that will result from the increased gate-down time caused by the relatively short LRT headways.

The combination of increased LRT ROW needs, resultant street narrowing, and increased traffic queueing requirements has created the need to acquire portions of several real estate parcels for street improvements as well as the need to relocate three businesses and a church. In addition LACTC has had to acquire a parcel at this location for a traction power substation because there is no room for such a facility within the ROW.

CONCLUSION

Obviously, based on the LACTC's experiences to date on this particular project, the use of existing railroad ROW can hardly be considered a panacea.

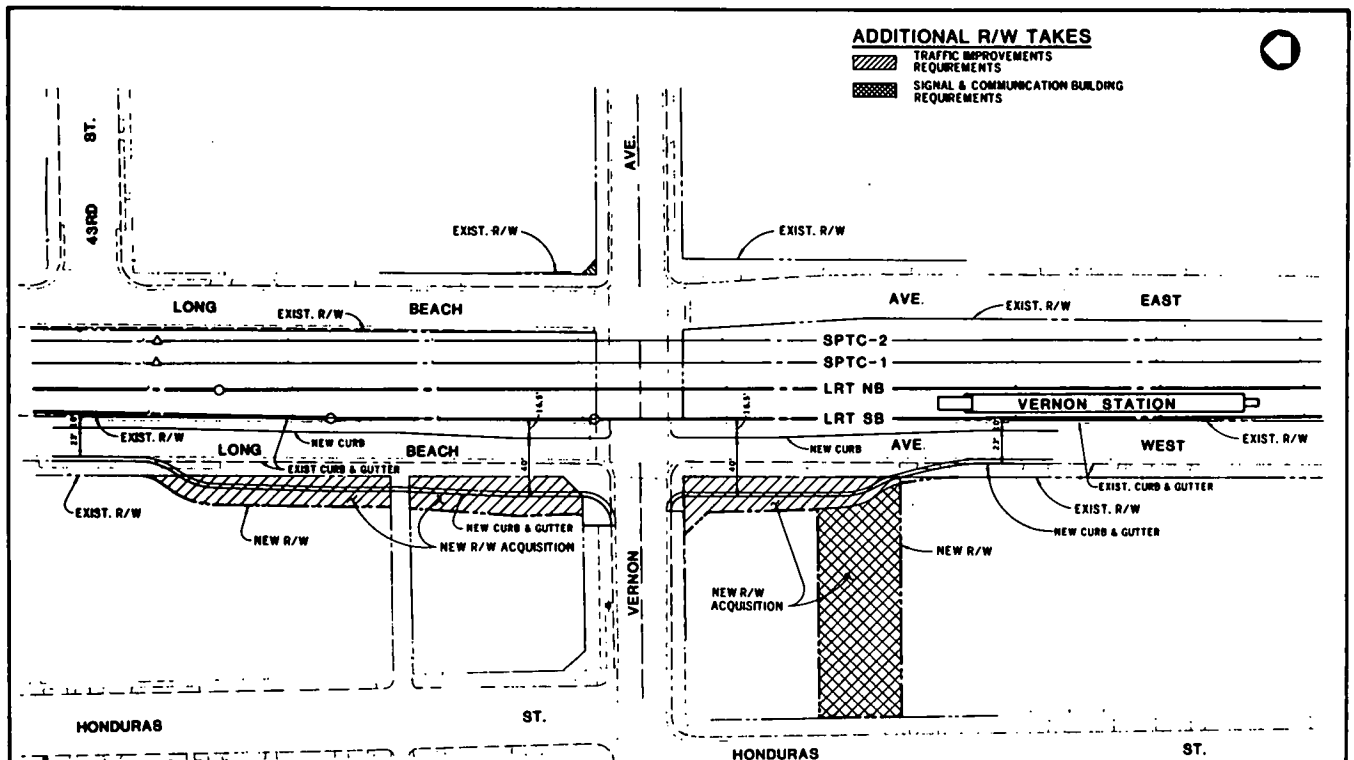


FIGURE 6 Vernon Station area plan.

Although probably not a nightmare either, it has certainly been more like the latter than the former. However, in a situation that requires the construction of a new rail transit facility in a mature, densely developed urban area with the objective of minimizing construction costs through maximum use of at-grade construction, the use of existing railroad corridors will always be high on the list of least-undesirable alternatives.

The important lesson to be learned is that the use of such corridors will probably be much more costly, time-consuming, and complex than might be presumed initially. Any railroad ROW alignment candidate should be closely examined, therefore, in the light of the five considerations presented herein:

1. Someone else owns the ROW;
2. Someone else may be operating in the ROW;
3. Railroad ROWs are used by other parties as well;
4. Lurking behind any neglected and underutilized railroad corridor are an infinite number of painstakingly conceived, but as yet unfunded, improvement projects; and
5. No matter how perfect the ROW may look, it's probably not big enough.

Only when these considerations have been carefully explored can realistic budgets and schedules be developed to facilitate an accurate comparison of railroad ROWs to other alignment alternatives.