

standing distribution patterns and doing highway-freight-oriented strategic and policy studies.

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Intermodal Freight Transfer Facilities in California

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The increase in international trade through California ports is creating transportation problems in the urbanized regions adjacent to these ports. Most intermodal freight transfer facilities are being planned or constructed as part of seaport expansion due to this increase in trade. Although these transfer facilities may alleviate some problems on the transportation system, they may also exacerbate others. Any modal shifts from truck to rail that result from the relocation of transfer facilities in closer proximity to the ports must be viewed in the context of the overall increase in rail traffic. The projected increase in container cargo and coal and grain exports equates to significantly higher volumes of rail traffic through highly urbanized areas. Although modal shifts may benefit highway truck traffic, increases in rail traffic could create severe problems, particularly at grade crossings in the Los Angeles area. The focus of this paper is on the role of the state, specifically the California Department of Transportation, in port access planning. The role of the state is reexamined in the light of increases in international trade through California's ports and the impact of these increases on the transportation systems that provide access to the ports. In addition, proposed intermodal freight transfer facilities are examined to determine if such facilities will have a significant effect on the problems associated with increased port traffic.

Intermodal freight transfer facilities in California play a key role in the efficient transportation of commodities. Most of the major new intermodal transfer facilities are being planned or constructed as a part of seaport expansion. This expansion is due, in large part, to increasing international trade through West Coast ports. The increased activity at the major seaports in California has had, and will continue to have, a significant impact on the transportation systems that provide access to the port complexes.

The focus of this paper is on the role of the state, specifically the California Department of Transportation (Caltrans), in port access planning. The role of the state is reexamined in the light of increases in international trade through California's ports and the impact of these increases on the transportation systems that provide access to the ports. In addition, proposed intermodal freight transfer facilities are examined to determine if such facilities will have a significant effect on the problems associated with increased port traffic.

CALTRANS' ROLE IN PORT ACCESS PLANNING

Caltrans is a multimodal transportation agency concerned with developing and maintaining a balanced,

environmentally sound, and efficient transportation system within the state. This perspective should extend to intermodal freight and port-related transportation facilities and issues.

The rapid growth of international trade through California ports suggests that the Department should expand its capability for port transportation planning. In the past goods movement through California ports has increased at a manageable pace. However, if the anticipated increases in certain commodities occur, port development during the 1980s may result in significant impacts to the highway and other transportation systems in the state. By emphasizing port transportation planning, such impacts may be mitigated and goods movement may be facilitated.

Historically, California has not placed a high degree of state involvement in port activity. Most ports are quasi-public entities, and some are partly funded through taxation. However, unlike certain other states, there is no state authority over port development and operations.

Transportation planning has not been conducted on a port-specific basis. Port access facilities are analyzed on much the same basis as all other departmental projects. The state's role in port transportation planning should be developed on the premise that there are characteristics of port access that require a special planning approach.

Due to the multimodal aspects of port access facilities and the multiplicity of jurisdictions involved along the corridors through which facilities pass, planning and coordination at both the regional and state level is appropriate. However, in the absence of a constituency, much less a mandate, for such a state role, planning activities have been limited. Other priorities place higher claims on available state resources.

As a result, current Department responsibility in port planning focuses primarily on transportation impacts associated with port activity. This responsibility is carried out by (a) actions that implement Department policy, (b) the environmental review process, and (c) policy analysis and recommendation.

Department Policy

The Department recognizes the importance of California's ports to the economy and the need to deal with groundside transportation problems related to their operations. It is Caltrans' policy to encourage and facilitate the efficient movement of goods through California ports in a manner that mitigates port-related impacts. This policy is implemented by the following actions:

1. Port issues are monitored and analyzed in terms of departmental programs, projects, and policies;
2. Measures are developed to reduce congestion on port access roads;
3. The development of intermodal freight transfer facilities are encouraged where appropriate;
4. Means of reducing conflicts between transportation modes in port areas are studied.
5. Means of producing modal shifts in goods movement that benefit the state's transportation system are encouraged;
6. Intermodal projects are recommended for FRA funding when appropriate;
7. Port access studies are conducted under FHWA Highway Planning and Research funding; and
8. Actions are coordinated with ports and other public agencies to facilitate efficient goods movement and reduce transportation conflicts and adverse environmental impacts.

Environmental Review Process

Many port developments are subject to the environmental impact report (EIR) requirements of the California Environmental Quality Act. The Department reviews these port project EIRs. Reviews normally concentrate on the effect that the project will have on state transportation facilities, but the reviews may also include community and other transportation-related impacts. Both the main office and the districts participate in the review and comment process.

Policy Analysis and Recommendation

The Department currently gathers and organizes information relating to ports. Such information is collected from port industry journals and other literature sources. Department personnel also attend port and international trade conferences.

A port inventory document has been developed that lists port characteristics, including capacity, tonnage, commodity types, vessel sizes, channel depths, and related information.

Such information is used in the analysis of port issues and to formulate policy recommendations. The increased interest in port goods movement and its relation to highway and rail facility planning have resulted in a greater emphasis on this aspect of transportation planning. Specific analyses include highway needs for port areas, highway-rail conflicts, international goods movement trends, and port user fee proposals.

The results of these analyses, which are summarized in this paper, suggest that a stronger state role is needed in planning and coordinating port activities.

BACKGROUND: INCREASED WEST COAST PORT ACTIVITY

Although the total volume of international trade through California ports has risen steadily over the past decade, significant increases have been recorded for containerized cargo, coal, and grain.

During the first 6 months of 1980, California's three custom districts (Los Angeles, San Francisco, and San Diego) accounted for 12 percent of the total international trade in the United States and 60 percent of that on the West Coast. The major exports include agricultural products, machinery, electronics, and transportation equipment. Leading imports consist of automobiles, electrical machinery, oil, and natural gas. California's leading trade partners are Japan, Indonesia, Taiwan, South Korea, West Germany, and the United Kingdom.

The Los Angeles Customs District, which includes the ports of Los Angeles and Long Beach, is the third largest district in the United States in terms of value of international trade. In the first half of 1981 it accounted for 62 percent of California's total trade with a value of \$18.7 billion (1).

Containerized Cargo

Containerization of cargo has become an important means of transporting commodities and is virtually supplanting break bulk handling. Containerization is a capital-intensive rather than labor-intensive transport method. Goods are shipped intermodally in 20- or 40-ft metal containers, thereby significantly reducing transfer time, handling costs, pilferage, and damage.

In addition to the efficiencies that make containerization popular, its use is increasing because it is often a more economical and reliable alternative to all-water movement of goods through the Panama Canal. Under this alternative, known as bridge service, containers use vessel and rail or truck modes to move across the United States or to inland U.S. destinations.

The combined effects of container transport efficiency and the bridge service alternative account for the dramatic increase in container movements through U.S. ports. The world fleet of containers rose from approximately 300,000 twenty-foot equivalent units (TEUs) in 1971 to about 3,000,000 in 1981. In 1980, approximately 2,800,000 containers (and trailers) were moved through the U.S. bridge system (2).

Between 1972 and 1980 the number of containers moving on the bridge system through the ports of Los Angeles and Long Beach increased by 1,150 percent. The combined monthly volume of containers through these ports rose from 2,000 TEUs in 1976 to nearly 25,000 TEUs in 1980. The two ports estimate their combined annual volume of bridge traffic will surpass 500,000 TEUs in 1984 and 1,000,000 TEUs in 1990 (3). In the San Francisco Bay area, the Port of Oakland, which specializes in container shipping, reported an annual volume of 734,000 TEUs in 1979. Eighty-five percent of the vessels calling at this port were container ships (4).

Intermodal Container Transfer Facilities

Los Angeles and Long Beach

The ports of Los Angeles and Long Beach have proposed the construction of an intermodal container transfer facility (ICTF) at a location approximately 5 miles from their port terminals. The intermodal container transfer operations are currently conducted at rail yards in downtown Los Angeles, some 20 miles from the terminals. Depending on the specific routes, trucks that provide service between the rail yards and the terminals use portions of various state facilities, including State Routes 1, 5, 7, 10, 47, 91, 110, and 405, in addition to local streets. Many of these highways are already heavily congested during peak travel periods.

Both ports will share in the funding of the project's estimated \$130 million cost. The Southern Pacific Railroad will also participate in the funding and will be the only railroad to use the facility. The Union Pacific and Santa Fe railroads, which also serve the ports, will continue to use their downtown rail yards. Approximately 54 percent of all rail container traffic in the port area is handled by Southern Pacific, and almost 35 percent of all international containers that pass through the ports is bridge traffic. Accordingly, the ICTF will handle about 18 percent of the ports' container traffic. The number of containers handled by the ICTF is projected to be 136,900 TEUs in 1985 and 315,000 TEUs in 1990. The capacity of the ICTF will be increased in three phases to accommodate predicted demand. The first phase is to begin in 1983-1984 and the third phase in 1996.

San Francisco Bay Area

The need for improved intermodal facilities is becoming apparent in the San Francisco Bay area. This need has been analyzed by the Metropolitan Transportation Commission and the Bay Conservation and Development Commission and is addressed in their seaport plan.

The majority of future terminal developments planned for Bay area ports will serve container cargoes. Approximately 14 new container berths are planned for Bay area ports during the 1980s. Currently 25 percent of the region's nonlocal container cargo is moved by rail. Most of these intermodal shipments require truck transfers of containers between port terminals and rail yards. Several of the planned Bay area development proposals are designed to improve rail access to container terminals and reduce truck transfer distances.

Coal and Grain Movements

Although there is substantial disagreement among forecasters regarding future export levels, coal and grain shipments from West Coast ports are expected to increase significantly. Historically, coal shipments from western U.S. ports have been minimal, but demand by Pacific Rim nations may soon produce substantial coal export tonnages as these nations shift from oil to coal for certain uses and seek to diversify their energy sources.

In southern California the ports of Los Angeles and Long Beach are expanding their existing facilities and proposing new ones. In northern California the ports of Richmond, Redwood City, Sacramento, and Stockton also are studying new coal export terminal projects. A total of 19 West Coast port areas are being analyzed as potential coal terminals (5). Although many ports have plans for coal export facilities, it is expected that foreign demand will warrant only 2 or 3 major West Coast facilities.

Export levels of grain from West Coast ports are projected to rise during the 1980s, although these levels are not expected to increase as rapidly as coal. Exports of U.S. grain rose by 150 percent between 1970 and 1979. Although year-to-year export levels vary because of changes in harvest volumes, exchange rates, and other variables, they are expected to increase steadily over the long term. Currently, no California port has proposed construction of a major new grain export facility (6).

Rising levels of coal and grain exports from California will generate increased rail traffic through the urbanized regions adjacent to the ports. When added to the increased container rail traffic from development of intermodal facilities

near port terminals, the combined effect may be significant. Many of the transportation impacts associated with greater port activity will be rail rather than truck related.

IMPACTS OF INCREASED PORT ACTIVITY IN THE LOS ANGELES REGION

The forecasted increases in international trade, especially that related to containerized cargo, coal, and grain, will have significant impacts on the transportation systems that provide access to California ports. In addition to these transportation impacts, higher levels of port activity will also result in environmental, economic, and energy impacts to port regions.

The Los Angeles region adjacent to the major ports of Los Angeles and Long Beach was chosen to illustrate the impacts that increased international trade through these ports will have on the transportation systems in this highly urbanized region. The implementation of plans to construct an ICTF provides the opportunity to evaluate the transportation, environmental, economic, and energy impacts of such a facility.

The increase in port activity will affect the transportation network in the region around the ports of Los Angeles and Long Beach. These effects will be somewhat more complicated than those on many other regions because of the interrelated nature of the multimodal port access network.

Highway Impacts

A significant percentage of all goods moving through the ports of Los Angeles and Long Beach are transported by nonhighway modes. Liquid petroleum products, which constitute approximately 50 percent of the ports' cargo tonnage, are transported primarily by pipeline. Many bulk goods, including the growth commodities (coal and grain), are delivered by rail directly to terminals. In addition, the proposed ICTF will reduce container truck transport to some degree. Nevertheless, the truck mode remains an important factor in port freight movement.

The proposed ICTF will result in a 90 percent reduction in container truck miles traveled for approximately 18 percent of the container trucks moving through the ports of Los Angeles and Long Beach. Virtually all trucks that serve the ICTF will use the Terminal Island Freeway (SR-47). If non-ICTF traffic levels on this highway remain unchanged, total traffic on the facility will increase.

Container truck traffic on port access highways is expected to increase even if the ICTF is constructed. As indicated previously, the state facilities subject to increased container traffic include State Routes 1, 5, 7, 10, 47, 91, 101, 110, and 405. Many of these highways are already heavily congested during peak travel periods.

Despite the ICTF, approximately 82 percent of port containers will still be transported on highways, including those that connect the ports with the downtown rail yards. Because the total number of container TEUs through both ports is predicted to increase from 1.2 million in 1982 to 3.1 million in 1990, highway impacts could be significant. In addition, should non-ICTF trucks be restricted from using the section of SR-47 between the ports and the ICTF, they would then travel on segments of SR-7 and SR-110. In any case, the annual number of non-ICTF-routed container TEUs moved on port access highways is expected to increase by 133 percent, from 1.2 million in 1981 to 2.8 million by 1990. Considering the existing traffic levels on some portions of these highways, especially SR-7 and SR-405,

peak-hour traffic problems in this region may well be exacerbated by future container truck traffic alone.

In addition to container traffic, other truck movements through the ports of Los Angeles and Long Beach may well increase during the 1980s. Total volumes may vary yearly, but long-term average increases in both commodity and port support trucks are expected.

Rail Impacts

Increased movements of coal and grain plus the operation of the ICTF will generate substantial rail impacts to the transportation network around the ports. Highway-rail conflicts at highway grade crossings are one important impact; mass transit, environmental, and energy impacts also need to be considered.

Highway-Rail Crossing Impacts

The transportation network around the port region contains numerous crossings of rail lines and roadways. Between the port terminals and its downtown rail yard, Southern Pacific's San Pedro line encounters 90 crossings, 82 of which are at-grade; between the rail yard and the site of the proposed ICTF, the San Pedro line has 78 crossings, 70 of which are at-grade. The Union Pacific's line contains 78 crossings between its rail yard and the port terminals, with 60 of them at-grade. The Santa Fe line contains 110 crossings between its downtown yard and the terminals, 94 of which are at-grade. Except for the San Pedro line crossing at SR-1, all state facilities are grade separated.

The specific types of protective devices vary among the at-grade crossings. Gate devices, which provide physical barriers for vehicular traffic, are installed on 100 of the 236 crossings. The Santa Fe line has 81 gated crossings (86 percent) on its at-grade facilities. Union Pacific has 14 (23 percent) gated crossings, and Southern Pacific has 6 (7 percent). All other at-grade crossings are protected only by visual and audible signals such as swinging signs (wig wags), flashing lights, signs, or combinations of these devices.

Highway traffic volumes vary widely on facilities with at-grade crossings. Six highways have average daily traffic (ADT) volumes of more than 30,000; 22 have daily volumes between 20,000 and 30,000; and 39 have volumes between 10,000 and 20,000. The at-grade crossing on SR-1 has an average daily volume of 35,000 vehicles. Rail volume varies also, but accurate counts are not readily available (7).

The large number of grade crossings indicates that increased rail movements, especially long slow coal trains, may result in longer traffic delays, greater use of state highways with grade-separated crossings, more problems with emergency vehicle response times, and greater accident potentials.

The California Public Utility Commission (PUC) establishes grade-separation project priority. The priority criteria emphasize safety over other factors, such as emergency vehicle needs and facilitation of traffic flows. Because grade-separation funding averages about \$15 million annually, and projects often cost \$4 and \$5 million, few structures can be constructed.

Traffic Delays

Coal unit trains are usually composed of approximately 100 cars. When moving at 20 mph, traffic will be subjected to a 3.25-min delay at each nonseparated grade crossing. During this period au-

tomobiles and trucks may back up to such an extent that additional traffic problems, such as blocked intersections, could develop. If such delays become routine, traffic on local facilities may shift to state highways that are grade separated and thus add to peak-hour congestion.

Emergency Vehicles

Additional rail movements through urban regions will increase the number of delays encountered by emergency vehicles. Emergency vehicle delays at rail crossings could mean increased loss of life due to longer response times. Emergency response organizations may be required to develop duplicate facilities in order to avoid the grade-crossing problem.

Accident Potential

On a nationwide basis the accident rate at rail crossings has declined over the past two decades. This has been attributed to improved protection due to gates and other devices and from motorist education programs. The Southern Pacific and Union Pacific main lines that lead to the port terminals have a much lower percentage of gate-protection devices than the Santa Fe line. The large number of nongated crossings on the two lines, which are expected to carry containers and coal in large volumes, is a potential safety issue.

Mass Transit Project Impacts

Increased freight rail traffic in the region around the ports of Los Angeles and Long Beach may complicate development of a proposed Los Angeles to Long Beach light rail transit project. One proposal for a light rail system between these cities recommends use of Southern Pacific's Wilmington and East Long Beach branch lines. Increased port rail activity may require grade-separation structures where the lines used for light rail cross other main port freight rail lines. Grade-separation structures will add significantly to the construction and maintenance costs of the light rail project and may also affect the completion date.

Environmental Impacts

Noise

Rail movements generate noise impacts that affect local communities. The impacts vary with distance, train lengths, speeds, frequencies, and time of day. Unit trains that move coal, grain, and containers to the ports will travel at relatively slow speeds (15-25 mph) and contain between 50 and 100 cars. If train movements are scheduled at night to minimize traffic impacts, noise impacts would probably be more severe. Long, frequent trains traveling at high speeds during the night would have the most severe noise impacts. Some noise impacts are unavoidable. For instance, the California PUC requires that train whistles be blown before each at-grade crossing. Noise impacts may be mitigated by routing train traffic along the lines that pass through fewer residential areas.

Air Quality

The higher volumes of coal and grain movements to the ports of Los Angeles and Long Beach will result in increased train-related air emissions, and the increase in container movements will result in higher levels of truck-related air emissions. Al-

though operation of the ICTF should mitigate air quality impacts to some degree, rail-related emissions will increase. However, the net effect should be a reduction of certain pollutants (8).

Energy Consumption

The increased transportation of coal and other commodities to the ports of Los Angeles and Long Beach will result in higher levels of petroleum fuel consumption. However, operation of the ICTF may reduce fuel use associated with container traffic. Locating an intermodal transfer facility closer to port terminals will take advantage of the greater fuel efficiency of the rail mode. The ICTF will reduce truck mileage by about 19,500 miles/day. It is estimated that the facility will be responsible for an overall reduction of 79 percent in truck fuel consumed in the movement of containers between the ports and the Southern Pacific's trains.

Economic Impacts

Locating the container transfer facility closer to port terminals will reduce truck transfer costs in addition to highway maintenance expenditures. It is estimated that the ICTF will reduce truck transfer costs from the current \$110 to only \$35/container.

SUMMARY AND CONCLUSIONS

Increased goods movement through California ports will affect the transportation facilities that provide access to these ports. Many of the transportation impacts associated with the increased goods movement will be rail rather than highway related, but highway facilities will be subjected to higher volumes of truck traffic due to increased container and general freight movements, and more serious highway-rail conflicts will develop.

The landside transportation and environmental impacts associated with higher levels of activity at the ports of Los Angeles and Long Beach may be significant because they will affect highly urbanized areas and a complex and congested transportation network. Highway impacts include greater congestion, pavement damage, maintenance costs, safety problems, and facility improvement requirements. Rail impacts include additional delay and accident problems at grade crossings. Future mass transit projects may also be affected by increased port activity. Environmental problems include air quality deterioration, increased energy consumption, increased noise, and other community impacts.

The authority of the state and the Department over port activity is limited. There is no state agency that has overall responsibility for port development or operations. The Department's role is also limited, even though state facilities are directly affected by port activity.

The expected increases in goods movement through California ports and the concomitant transportation and other impacts will require a greater emphasis on port transportation planning by the Department. Port transportation planning can be improved by conceptually focusing on port areas as trip generators, developing port expertise, improving coordination between the Department and local entities (including the ports), and supporting measures that facilitate the efficient movement of goods through the ports.

Intermodal transfer facilities may alleviate some of the problems caused by an increase in container

traffic through California ports by promoting a modal shift in the vicinity of the port. However, the benefits of this modal shift must be viewed in relation to the cumulative impacts of increases in container, coal, and grain rail traffic. The potential for major transportation impacts at grade crossings resulting from this increased rail traffic warrants particular concern.

Federal, state, local, and private-sector funding for improved safety measures at these crossings is extremely limited, and the commitment of these resources is constrained by other priorities. Both the public and private sectors are not prepared and, to a certain extent, are precluded from making improvements until such time as safety or delay problems at grade crossings become an immediate and critical public or political issue.

Increased port activity may therefore lead to a reconsideration of the roles that public and private agencies play in the planning and development of port access facilities. Existing organizational and funding arrangements may not be adequate under conditions of unprecedented levels of goods movement through highly urbanized port regions. However, if transportation planning is responsive to the changing situation in port regions, the benefits of international trade and modal shifts can be realized, and adverse transportation and other impacts can be mitigated.

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The contents of this paper reflect our views, and we are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of Caltrans, the State of California, or FHWA. This paper does not constitute a standard, specification, or regulation.

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