Infrastructure: Transportation

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Roadway Congestion: Bad And Getting Worse

Traffic congestion is a problem that has long plagued large metropolitan areas around the country. While it is common to think of how long our commute times can sometimes last, congestion costs can be expressed along a number of dimensions. For the 75 urban areas examined by the 2002 Urban Mobility Report[1], the Texas Transportation Institute estimated the total congestion bill for the nation to be $65 billion. This represents roughly 3.6 billion hours of delay and 5.6 billion gallons of fuel spent on congestion.

What is more worrisome is that for the nation overall congestion has been getting worse. The Urban Mobility Report has been released annually since 1982. Between 1982 and 2000, the annual delay per peak road traveler climbed from 16 hours in 1982 to 62 hours in 2000!

In California, congestion is the result of massive increases in vehicle miles traveled on our roadways coupled with minimal investment in new roadway stock. But solving this problem does not necessarily mean we need to build more roads. A better solution lies with deeper consideration of the way we organize our urban areas.

Is California The Worst In The Nation?

Los Angeles, California has the dubious distinction of having the worst traffic congestion in the nation for the 15th year in a row as ranked by the Texas Transportation Institute. Other urban areas in California are not far behind. Table 1 lists the top 10 congested urban areas ranked by the Texas Transportation Institute's Travel Time Index. The index represents a multiplier for calculating how long a given trip would take during peak travel times. Los Angeles tops the list with an index value of 1.9,

Table 1

Travel Time Index, 2000. A trip during peak travel hours will take nearly twice as long in Los Angeles, CA.

Los Angeles, CA	1.90
San Francisco - Oakland, CA	1.59
Chicago, IL - Northwestern, IN	1.47
Washington, DC, MA, VA	1.46
Miami - Hialeah, FL	1.45
Seattle - Everett, WA	1.45
Boston, MA	1.45
Denver, CO	1.42
San Jose, CA	1.42
New York, NY - Northeastern, NJ	1.41

Source: "2002 Urban Mobility Report." Texas Transportation Institute. 3 September 2002. <http://mobility.tamu.edu/ums>.

which means that a 30-minute trip during off-peak free flow hours would take 57 minutes during peak travel times. California is the only state to have multiple entries for the top 10 congested cities. The San Francisco – Oakland urban area ranked 2nd while San Jose ranked 9th. Though they don't make it into the top 10, other urban areas in California also displayed relatively high levels of congestion in 2000. San Diego ranks 15th with an index of 1.37 and the San Bernardino – Riverside urban area squeezes into the top 20 with a rank of 19 and an index of 1.34.

How did California get into such a mess? Is it simply a result of California's mythical car culture; are Californian's in love with their cars? Maybe, but the real explanation lays closer to California's history of extraordinary growth in demand for lane space, lack of investments in roads and a paucity of reasonable alternatives.

More People, More Cars, More Miles Traveled

It is clear that demand for lane space has been growing at an extraordinary pace in California. Chart 1 displays the change in population, number of motor vehicles, vehicle miles traveled and freeway lane miles for California between 1980 and 2000. The values reported are indexed to 1980. All three categories have increased dramatically. California's population increased by 44%, the number of registered motor vehicles increased by 64% and the number of vehicle miles traveled annually on California's freeways increased by 107%. At the same time, freeway lane miles increased by only 17%.

Narrowing the view to urban areas reinforces this view. Chart 2 displays the trade off between intensity of use of freeways and congestion levels. Clearly as the intensity of use of freeways increases so does congestion. Urban freeways in California are some of the most intensively used. Los Angeles is the leader in terms of both congestion and intensity of freeway miles used. However, congestion in Los Angeles is much higher than the predicted average for its intensity of use of freeway lane miles.

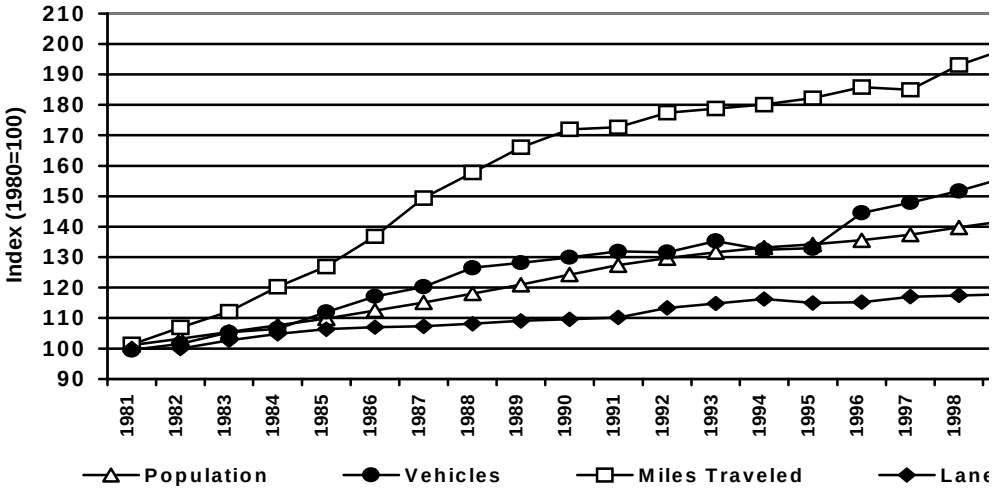
It appears that congestion is not driven so much by people making long-distance trips as it is by there simply being a large number of people competing for lane space. In Chart 3 freeway miles driven per capita is displayed against the per capita stock of freeway lane miles. California is not outstanding with regard to freeway miles driven per capita. Los Angeles is quite average. However, nearly all of the California urban areas displayed sit below average for the per capita stock of freeway lane miles.

Lane Change

Of course the demand for lane space is only one part of the story. An examination of the supply of roadway also helps us to understand why congestion

CHART 1

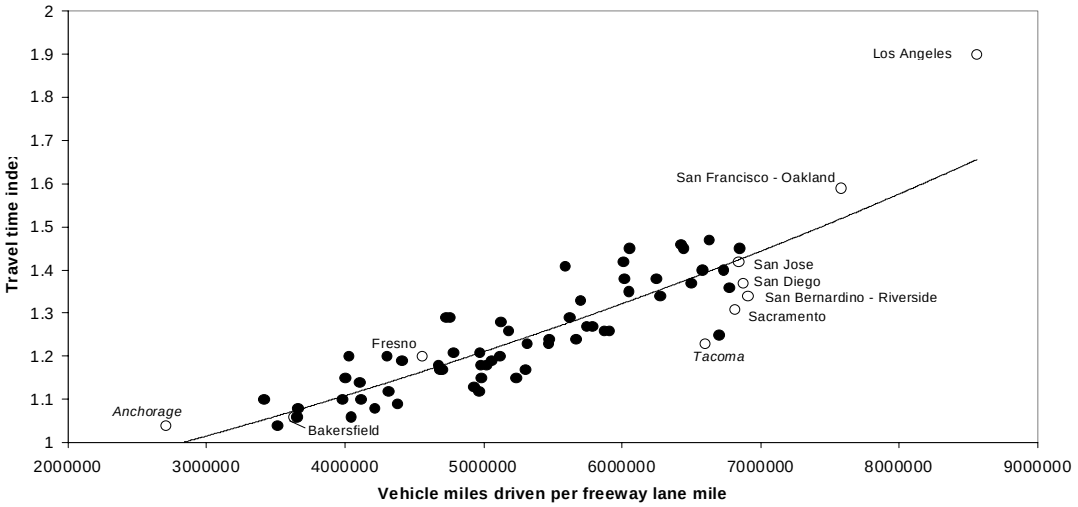
In California, the number of people, motor vehicles and miles traveled on freeways have been increasing, but the stock of freeways has increased at a slower rate than all others.



Source: "Highway Statistics 2000" Federal Highway Administration. 3 September 2002. <http://www.fhwa.dot.gov/ohim/hs00/index.htm>.

CHART 2

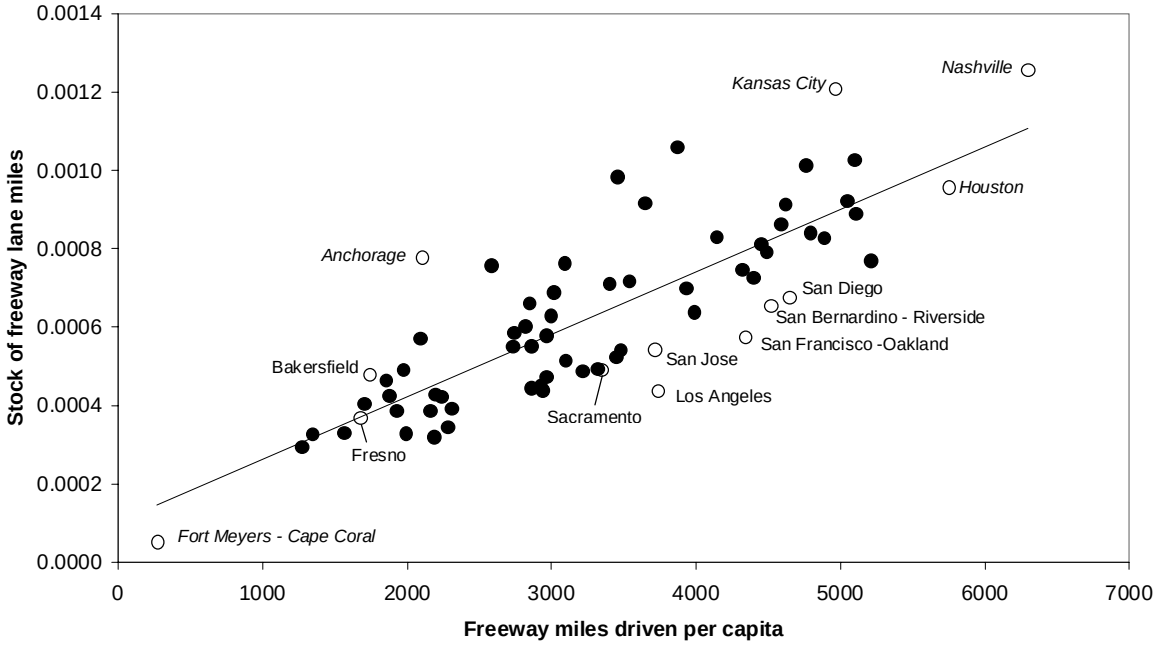
Congestion is caused by too much driving and too few freeway lane miles.



Sources: "Highway Statistics 2000" Federal Highway Administration. 3 September 2002. <http://www.fhwa.dot.gov/ohim/hs00/index.htm>.
"2002 Urban Mobility Report." Texas Transportation Institute. 3 September 2002. <http://mobility.tamu.edu/ums>.

CHART 3

Stock Of Freeway Lane Miles Per Capita vs Freeway Miles Driven Per Capita: 2000



Source: "Highway Statistics 2000" Federal Highway Administration. 3 September 2002. <http://www.fhwa.dot.gov/ohim/hs00/index.htm>.

has increased in California. Given that freeway segments typically offer the highest speed limits giving drivers the opportunity to cross large distances in short periods of time, it is reasonable to assume that additions to the stock of freeway miles would give drivers a greater opportunity to complete their trips in a relatively short period of time. Between 1980 and 2000 California added 3,273 highway miles to its stock of freeways, however this represents only a 17% increase over 20 years. Clearly the stock of high-speed road way has not been increasing as fast as demand.

An examination of finance data for roadways suggests a similar story. Capital outlay spending refers to dollars spent on improvements in public roads. This could include such things as land acquisition, construction, resurfacing, rehabilitation, and service facilities such as guard rails, fencing, signs, and signals. California spent nearly 5 billion dollars on capital outlay from all levels of government in 1999. However, as a proportion of total disbursements from all levels of government for all roadways, California ranks 43rd having spent only 43.1% on capital outlay. Table 2 compares spending on freeways in California with the top 10 states in spending on capital outlay for freeways.

Data from the Texas Transportation Institute's 2002 Urban Mobility Report provides a snapshot of the dearth of needed lane capacity in urban areas. In order to simply maintain current congestion levels, Los Angeles would need to add 118 lane miles

TABLE 2

As a proportion of total spending on roadways from all levels of government, California does not spend as much as other states for capital outlay.

Top 10	*Capital Outlay Proportion*	*Rank*
Utah	74.85%	1
Nevada	63.69%	2
Wyoming	63.21%	3
Arizona	62.59%	4
Georgia	60.78%	5
New Mexico	60.13%	6
Mississippi	59.66%	7
Massachusetts	59.41%	8
Florida	59.15%	9
Kentucky	59.06%	10
California	43.21%	43

Source: "Highway Statistics 2000" Federal Highway Administration. 3 September 2002. <http://www.fhwa.dot.gov/ohim/hs00/index.htm>.

annually. San Diego would need to add 113 while San Francisco - Oakland, San Jose, Riverside-San Bernardino and Sacramento would need to add 92, 53, 42 and 32 lane miles respectively.

Congestion Relief

Clearly the supply of roadways across California has not kept up with the demand for lane space. The result has been increased congestion, possibly leading to California to be known as the most congested state in the union. The question is, then, what can be done to relieve congestion? The State has essentially two options - work at the extensive margin to increase the stock of roadways, or target the intensive margin to find ways to use our roadways more efficiently.

Addressing the problem of congestion at the extensive margin is certainly one of many possibilities. This would simply mean building more roads. However, it is incredibly difficult for a variety of reasons to sustain a road-building program that keeps pace with increases in demand. It seems to be generally accepted wisdom that metropolitan areas will not be able to build their way out of congestion. The 2002 Urban Mobility Report[2] examines those cities that were able to sustain long-term road building programs to keep pace with congestion. Over the 1982 - 2000 history of the report, only 5 metropolitan areas have exhibited periods of 5 years or more during which they were able to maintain road building programs and keep pace with increasing travel growth. These areas include Houston TX, Tampa FL, Jacksonville FL, Richmond VA, Bakersfield CA, and Fort Meyers.

Battles over politics and environment can delay or even prevent road-building programs. Concerns over the endangered California gnatcather (a small songbird) brought construction of the San Joaquin toll road to a screeching halt. Construction was put on hold as environmentalists, local politicians, and state biologists debated differing interpretations of the federal Endangered Species Act[3].

Working at the intensive margin to find ways to use roadways more efficiently is the other alternative. At the intensive margin, adding new stock gives way to improving the efficiency of use of existing resources. Possibilities for using roadways more efficiently include regularizing congestion, building high occupancy vehicle (HOV) lanes and congestion pricing.

Perhaps the easiest way to ease the difficulties caused by congestion is to make it predictable. With knowledge of when freeways become congested, where they are congested, the typical time it takes to make a trip, and confidence that congestion will

reappear in consistent fashion, commuters and freight movers can plan trips accordingly. Commuters can leave a little earlier or a little later to avoid peak hours on the freeway. Freight haulers can alter travel times and travel routes to insure that goods arrive on-time. Strategies such as rapid accident response systems, freeway condition signage, timed on-ramps and smooth interchanges can help to reduce the irregularity of congestion and make travel predictable. Simply speaking knowledge is power.

HOV lanes are another alternative. The HOV concept is rather simple - dedicate a lane of highway to high occupancy vehicles to encourage carpooling. Ideally this would remove cars from the road (or at least slow the growth in the number of cars sharing the freeway) and reduce or slow the growth in the amount of automobile emissions entering the air. To date, California has dedicated 1,060 lane miles of highways to HOV lanes. Nearly 70% of those lane miles are in southern California. The remaining 30% are in the Sacramento – San Francisco Bay area. LA County alone accounts for 36% (383 miles) of HOV lanes in the state. Combined, the LA County segments represent the largest HOV lane system in the country.

Unfortunately, according to the independent Legislative Analysts Office report titled "HOV Lanes in California: Are they Achieving Their Goals?" the performance of HOV lanes is unclear. Although HOV lanes have been in practice in California since the 1970s, data collection regarding their performance has been poor. While Caltrans requires each of its 12 districts to submit annual reports on the performance of their HOV lanes, many have failed to meet the requirement.

Despite the paucity of data, in their 2000 report the LAO estimate that on average the HOV lanes are only operating at two-thirds of capacity. Further, 24% of the lanes fail to meet the minimum vehicle throughput standard, which is 800 vehicles per hour during peak hours.

Congestion pricing of freeway use is yet another option. The basic idea behind congestion pricing is to charge variable prices for the use of freeways. Prices would vary in direct proportion to the level of congestion. In short, turn freeways into toll roads. In California, Assembly Bill 680 (1989) authorized the state to enter into agreements with private agencies to develop four toll road systems around the state, including routes 91 and 57 in Orange County, route 125 in San Diego county, and a mid-state toll way between routes 680 and 4 in Alameda and Contra Costa counties. Despite some confusion over financing and ownership the Orange County toll roads have proven to be profitable. Mixed high occupancy vehicles and toll vehicle (HOT) lanes on I-15 in San Diego have also been successful[4].

Unfortunately the ability of toll roads and pricing to relieve California's congestion problems over the long term is unclear. It is possible that we could expand congestion pricing to include all freeways, however the result might be that demand for roadway travel shifts from freeways to surface streets for those people that don't want to pay a price for freeways. In effect, free travel on surface routes would compete with priced freeway routes. The result being that we don't remove people from cars, rather we might simply shift their choice of route. The 2002 Urban Mobility Report shows that in some urban areas, congested freeways slow to the pace of surface streets (30-40 mph). Under such conditions, it is easy to see surface streets as a viable substitute. What California needs to introduce is an alternative mode of transportation that can effectively compete with the automobile in terms of time, price and connectivity. An obvious alternative is mass transit.

Where Is The 'Mass' In Mass Transit?

Currently 215 different transit agencies serve the public in California. Unfortunately, combined

TABLE 3

Transit systems in California metropolitan areas are not used as intensively as those in other regions.

Rank	Urban Areas*	Population	Passenger Miles (millions)	Passenger Miles / Person
	US FTA Totals	*282124631*	*45100.2*	159.9
1	New York, NY--Northeastern NJ	16,044,012	17,590.60	1096.4
2	San Francisco--Oakland, CA	3,629,516	2,254.30	621.1
3	Washington, DC--MD--VA	3,363,031	1,997.10	593.8
4	Boston, MA	2,775,370	1,614.50	581.7
5	Chicago, IL--Northwestern IN	6,792,087	3,701.30	544.9
6	Honolulu, HI	632,603	318.9	504.1
7	Seattle, WA	1,744,086	751.7	431.0
8	Philadelphia, PA--NJ	4,222,211	1,797.80	425.8
9	Atlanta, GA	2,157,806	803.3	372.3
10	New Haven--Meriden, CT	451,486	164.5	364.4
California Urban Areas				
16	San Jose	1453019	340.8	234.5
17	San Diego	2348417	555.4	236.5
20	Los Angeles	11402946	2453.0	215.1
33	Stockton	262046	39.1	149.2
39	Sacramento	1097005	146.3	133.4
49	Riverside - San Bernardino	1170196	129.1	110.3
53	Fresno	453388	43.0	94.8
55	Bakersfield	302605	27.3	90.2
79	Modesto	230609	13.5	58.5

**Based on 129 urbanized areas and transit systems that accept federal aid dollars.*
Source: "2000 National Transit Summaries and Trends." Federal Transit Administration. 17 September 2002. < http://www.fta.dot.gov/ntl/database.html>

summary transit data for all 215 agencies is not readily available. However, the Federal Transit Administration (FTA) does provide data for federally assisted transit agencies in 129 urbanized areas across the country in their annual report.

Ridership data from the 2001 FTA Annual report for the top 10 urban areas compared to the US Total and California urban areas are displayed in Table 3. The San Francisco – Oakland urban area is the only one in California to make it into the top 10, with 621 passenger miles traveled per person. This is well above the national total of 159.9 miles, but it is also over 50% lower than the number one ranked New York – Northeastern New Jersey metropolitan area. Los Angeles, California's largest urbanized area in terms of population, has a ridership level of 215 passenger miles per person. While this is above the national average of 160, it is roughly 80% lower than the New York – Northeastern New Jersey urban area. Five other urban areas in California have ridership levels below the national average.

Of course the low ridership levels do not reveal whether this is a supply or a demand issue. Is it the case that the transit options offered in California are not efficient or effective, or is it simply that people living in California love their cars? Regardless, it is clear that mass transit in its current configuration does not serve as a reasonable substitute for the automobile. This is clearly reflected in a recent report by the California Governor's Commission on Building for the 21st century. According to the Commission "existing mass transit systems fail to provide an alternative that matches the performance of auto travel for most trips." The report paints a rather bleak picture, suggesting that currently "transportation modes are not well connected on an interregional level and fail to provide viable, efficient point-to-point personal and freight movement options[5]."

In part this failure may be a result of the fact that the regions of California have followed a pattern of dispersed land use that make the implementation of any mass transit system difficult. Los Angeles as well as other urban regions in California exhibit dispersed land use patterns that have no single main center. They are textbook examples of the multi - nucleic model of urban development first outlined in the 1940's[6]. Whereas cities that developed before the advent of automobile exhibited a pattern of development focused on a distinct urban center (known generically as the central business district), modern cities develop following a more dispersed pattern with multiple centers or 'nuclei'. Centers could be industrial, service or retail oriented. The Los Angeles-Long Beach-Santa Ana and San Francisco-Oakland-San Jose conurbations are typical examples of the multi-nucleic city. The result of this pattern is that people travel in all directions for all sorts of reasons.

Such a pattern of development causes great difficulty for the implementation of mass transit system. How does one plan a system around myriad different possible commute trips? What places should it connect? Can a mass transit system match the flexibility of an automobile in terms of connecting different places? There are also political questions to consider. Should a transit system be built around a concept of social equity that insures everyone has access to all parts of the city, or should the system be designed to connect those central places that seem to draw commuters during peak hours? It would seem that the answers to these questions would demand very different combinations of travel routes and connection times. Of course the problem of answering these questions is exacerbated by the continuing sprawl of the urban areas.

Looking Inward Towards the Future

The problem of congestion is a tough nut to crack. Automobiles offer extraordinary independence and flexibility for the individual. However too many people are now competing for lane space on California's freeways. Given that continued road-

building programs are difficult to implement we need to look towards the intensive margin to guide us in using our roadways more efficiently. Congestion pricing may help bring supply and demand into balance. Competition among alternative modes would be even more helpful. Unfortunately, it seems there is no good alternative to the automobile for matching travel patterns in dispersed multi-nucleic urban regions. Thus solving the problem of congestion is about much more than just building roads or applying prices. It is fundamentally a question about land use patterns.

It seems unlikely that congestion will be reduced as wave after wave of new suburbs are appended to urban areas and commuters increase their tolerance for long distances and long periods of time in the car. It is time to stop looking outward towards new development and start looking inward towards redevelopment.

In her August 4, 2000 op-ed piece in the LA Times titled "It's Time for LA to Grow Up", Gloria Ohland argued that it is time for LA to change its land use patterns. It's time to stop the sprawl and think about how to use existing land intensively. It's time to think about multi-family high-rise buildings rather than single-family sprawl. However, simply layering more people onto an already dispersed multi-centered urban area may not make travel any easier. Were it that we had clear concentrations of industrial, residential and commercial centers, we might be able sort out transportation patterns with less difficulty, but, given the current layout of California's urban areas, development at the intensive margin will require a careful examination of the juxtaposition of places as well as their intensity of use. Thus, we need to re-evaluate our zoning with regard to both their patterns and density. Bringing homes closer to places of work and providing alternative and competitive forms of transportation are certainly in order.

Endnotes

[1] "2002 Urban Mobility Report." Texas Transportation Institute. 17 September 2002. <http://mobility.tamu.edu/ums/>.

[2] "2002 Urban Mobility Report." Texas Transportation Institute. 17 September 2002. <http://mobility.tamu.edu/ums/>.

[3] Fulton, William. The Reluctant Metropolis. Baltimore: Johns Hopkins University Press, 2001.

[4] Hill, Elizabeth. "HOV Lanes In California: Are They Achieving Their Goals?" California Legislative Analyst's Office. 17 September 2002 <http://www.lao.ca.gov/lao_menu_products.asp>.

[5] "Invest for California: Strategic Planning for California's Future Prosperity and Quality of Life." California Governor's Commission on Building for the 21st Century. 17 September 2002. <http://www.bth.ca.gov/invest4ca/>

[6] Harris, C.D. and Ullman, E.L. 1945: The nature of cities. *Annals of the American Academy of Political and Social Science* 242: 7-17.