Designing Transportation Systems for Active Communities

by José Luis Moscovich

Abstract: Active communities result from the interaction of many environmental, cultural, political and sociological factors. The design of the transportation system is but one of them. A balanced transportation system -- with appropriate levels of investment in transit, bicycle and pedestrian facilities, in addition to auto-oriented facilities – is an indispensable requirement and catalyst for active communities. In the relationship between transportation and land use, the causality arrow is many times stronger going from land use actions to transportation consequences than vice versa. While transit-and pedestrian-supportive land use changes are hard to attain, especially given local control issues and pressure on local jurisdictions to increase their tax base; there are steps that can indeed be taken to increase the quality of transportation projects and services provided to individual communities. This paper provides a general overview of trends and challenges in urban growth and mobility, discusses areas of opportunity and provides some examples of successful application of such steps. The paper includes a cautionary note about the limitations on the effectiveness of these techniques to radically change the built environment, and on the importance of setting goals that are commensurate with the transportation system's ability to deliver performance and with the public sector's ability to deliver transportation projects expeditiously. It suggests that the emerging transportation paradigm, in order to support active communities, may be one where heavy transit investment is concentrated in the core areas that already have appropriate land use densities, carefully sited transit-oriented development is encouraged to absorb the portion of suburban growth it can, and the rest of the growth is given over to the automobile and a hybrid version of transit that behaves more like the automobile than traditional transit. An expanded role is suggested in all three environments for walking and bicycle trips, alone and in combination with transit services.

Transportation System Planning in the Face of Structural Changes

The last four decades have witnessed a veritable explosion in urban motorized mobility the U.S., and in the industrialized world in general. In the U.S. there has been a shift from the metropolitan area with a strong central focus to a much more decentralized pattern. As Downs[1] puts it: "The basic unit of the new city is not the street measured in blocks but the 'growth corridor' stretching 50 to 100 miles. Where the leading metropolises of the early 20th century-New York, London, or Berlin—covered perhaps 100 square miles, the new city routinely encompasses two to three thousand square miles."

Even in Europe, which we in the U.S. tend to regard as a successful paradigm in many respects, there are ample signs that the process of suburbanization and the increasing dependency on the automobile are having a major influence in the shaping and unraveling of communities. In countries like Spain, where economic conditions in the

1960s through 1980's did not allow for the level of public transportation investment achieved in the more prosperous countries, such as Germany, the Netherlands and France, and where planning and community activism lagged behind the northern European countries; there are clear indications that the automobile has gained a significant foothold in shaping current and future urban and suburban development.

For example, the company that runs the Madrid Metro reported in 1997 that despite its extensive system, 136 kilometers in 1998 (56 of which were built in the last four years,) the metro was carrying fewer riders than in 1970 (440 million/yr. vs. 500 million/yr.) when the network was less than half the size. Between 1970 and 1996, the average commute distance in Madrid doubled. Not surprisingly, the proportion of walking trips in the Madrid metropolitan area has dropped from 54% in 1974, to 33% in 1996.[2] These numbers are still a far cry from the nearly non-existent percentages of walking trips in most American metropolitan areas, but the trend is nonetheless disquieting.

Transit's modal share decline is symptomatic of a larger phenomenon. Beck and Immers report that "since 1960 the number of trips by bicycle in Amsterdam has halved every 15 years [from 300,000 to 70,000 in the evening rush hour]. The reasons for this decrease include the enormous rise in the number of people who own a car and the constant increase in the distance between home and workplace."[3]

A growing body of literature, stemming partly from environmental justice concerns, partly from the debate about national and local transportation spending policy, is devoted to the discussion of the societal costs of the automobile and its associated infrastructure. Illich (2000), for example, reports that the typical American male devotes more than 1,500 hours per year to his car: "sitting in it, moving or stalled in traffic, working to pay for it, to pay for gas, to pay for tires and tolls, insurance, traffic tickets and taxes for the construction of roads and parking garages. He devotes four hours per day during which he uses it, or works for it. This doesn't include the time he spends in the hospital because of car accidents, or in court or in the shop. In those 1,500 hours he travels 6,200 miles, which works out to 4.1 miles per hour. This is the same speed reached by human beings in countries that do not have access to motorized transportation. Except the average American devotes one fourth of the entire social time available to the simple purpose of getting from one place to another, while non-motorized societies only devote 3 to 8% to that purpose."[4]

A number of authors have observed that, when environmental, air pollution, energy supply and infrastructure financing concerns are put together, the current paradigm of car-based urban mobility prevalent now in the U.S. and Europe cannot practically be expanded to the rest of the world. This argument is compelling, if nothing else from the perspective of the sheer scale of the change that would be necessary to bring the rest of the world to a level of motorized mobility even remotely close to that of the industrialized countries in the Northern Hemisphere. In fact, more than 40% of the cars in the world are in the U.S.; a third in Europe, and 7% each in Japan and Canada. Yet only 7% of the world's population owns an automobile.[5]

At one end of the spectrum then, are those who challenge the current paradigm of ever increasing car-based mobility, positing that achieving this goal is taking up too much of society's resources and negatively affecting too many other worthy societal goals, like the preservation of the environment, the creation of affordable housing and the preservation of communities. According to them, the answer is to return to smaller-scale communities that are more self-sufficient and less dependent on motorized transportation for a number of essential and discretionary trips. This approach is reflected in the initiatives of the new urbanist movement, with its emphasis on the neighborhood as the building block of urban life. This approach faces daunting challenges posed by existing fiscal, tax and housing policy, and by a political structure that makes it very difficult for elected officials to lead constituencies toward fundamental change in any of these policy areas. Those constituencies are now overwhelmingly suburban, and they espouse suburban values. Downs explains that growth-related problems are hard to address due to three key factors related to the fragmentation of control over land use. The first factor is that the problems are regional in scope but control over land use is local. The second is that there are built-in incentives (fiscal/tax policy, etc) for local elected officials and individuals to support parochial views. The third is that the trickle down system of growth and housing, characterized by the outward migration of the wealthier and the concentration of the poor in the inner city and older suburbs, undoubtedly generates environmental injustice. "In a democracy, institutions that directly and significantly benefit a large majority are extremely difficult to change through political action. Politicians are strongly motivated to continue supporting what most of their constituents want. Overcoming the joint effects of these three factors will therefore not be easy; it may not even be possible. Yet unless the effects of fragmented government structures are effectively counteracted, the growth-related problems …cannot be significantly remedied." [6]

At the other end of the spectrum are those who accept the current trends in urban growth and transportation choices as simply reflecting the values of today's society, and its desire for detached single-family homes and unconstrained personal mobility. They continue to look for ways to meet current trends and enable the attainment of those values while moving toward addressing concerns about environmental impacts. The so called intelligent highway systems and more recently the introduction of hybrid cars exemplify this approach: instead of reducing car trips, squeeze more capacity out of the existing freeways; instead of reducing vehicle miles traveled to address energy and pollution issues, improve the fuel consumption performance of the internal combustion engine and clean up its emissions.

For most professionals, the practice of transportation planning and engineering lies somewhere in between these two ends of the spectrum, reflecting the particular values of the communities in which they work.

Transit, Growth, and Transit-Oriented Development

While the philosophical debate over the approach to metropolitan growth continues, transit's ability to retain market share has continued to decline. While the American Public Transit Association reports that transit ridership (in absolute numbers of users) is

at an all-time high, Orski[7] notes that 2000 Census figures now show that over the last 10 years, transit's share of commute trips declined in 39 of the 50 largest metropolitan areas in the US, and increased only slightly in the other 11[8]. Nationwide, the share of commuters taking transit to work in the past decade fell from 5.1 percent to 4.6 percent. Declines registered both in older transit-oriented cities such as Philadelphia and Boston, and in metropolitan areas where rail systems were built relatively recently, like Atlanta and Dallas. Five metropolitan areas had transit shares of
more than a 10 percent in 1990; by 2000, there were only two.

The decline in transit's market share is directly related to the dispersion of land uses in an increasingly suburbanized metropolis. More significantly, it is well understood and accepted that land use decisions have a far greater ability to generate transportation outcomes than vice versa. A 2002 study of San Francisco, Los Angeles and Chicago showed (see Figures 1 and 2) that auto ownership and driving fall sharply (and consistently in all three metro areas) as a function of residential density (households per residential acre).[9] Density does yield transit ridership. Cervero[10] comments that statistical comparisons between different cities and even between different corridors within cities appear to suggest a rule of thumb (with all the appropriate caveats and adjustments for local conditions) that for each additional10 percent in density increase, there is a corresponding 5 to 8 percent increase in transit ridership.

Figure 1

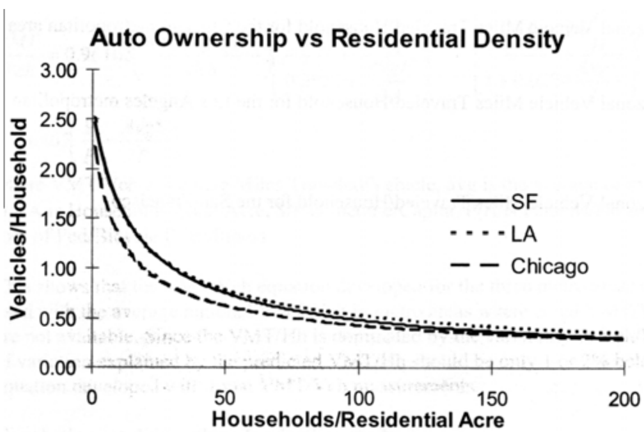
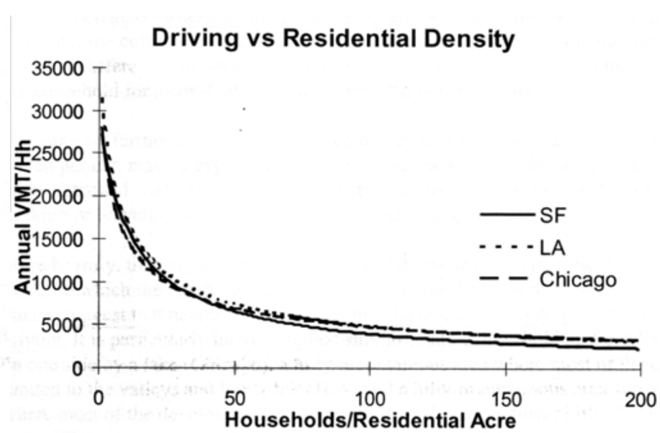


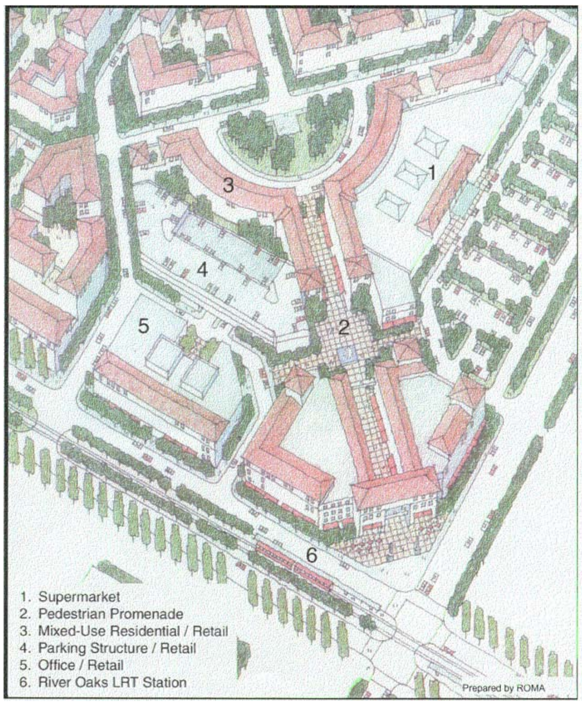
Figure 2



Source: Transportation Planning and Technology, Vol. 25 (1), March 2002, Figures 4 and 5.

Against this backdrop, a number of attempts have been made to come up with a new model to reconcile transit service and suburban living. Most prominent among them is the concept of Transit-Oriented Development (TOD), as proposed by Calthorpe and Fulton.[11] In their view, the concept of suburban transit is not an oxymoron. They propose a hierarchical system where pedestrian and bicycle trips bring people to local bus routes, which in turn feed into fast trunkline transit routes or rail lines with dedicated right of way, which can help ensure that transit travel times are competitive. They also propose that a number of trips currently taken by automobile will be replaced by walking or bicycle trips within the more compact new neighborhoods developed around transit service nodes. In addition, a number of other related principles are part of the transit oriented development concept. They include: mixed land uses; a diversity of housing types and prices; building designs and layouts and street layouts that promote walking; and diversity of uses in a relatively compact area.

Spurred by the need to qualify for increasingly competitive federal funds, which require demonstration of likely minimum ridership levels, in many suburban communities, like in San Jose, California, transit oriented development policies have followed decisions to invest in light rail transit lines.



Tasman Light Rail Project. Transit Oriented Development in San Jose, California. Source: Santa Clara Valley Transportation Authority.

When one considers that the current suburban settlement pattern in the U.S. has been under development for at least 6 decades, it appears that it is too early to evaluate the success of new urbanist attempts on a broad scale. So far, it is clear that building density around transit stops is a sound concept in terms of increasing transit ridership. Cervero[12] points out, along these lines, that there isn't a linear relationship between density increases and transit ridership. In his own words: high-rise Hong Kong-like densities are not necessary to support decent-quality transit services."

But critics are already reporting that, although new urbanist suburbs appear to be increasing transit ridership, they are not having a visible effect in reducing suburban driving, apparently due mostly to the fact that the vast majority of the trip destinations (stores, services, schools, doctors offices) remain dispersed, and the amount and concentration of services around new urbanist neighborhoods is just not sufficient (or at least not yet) to satisfy the needs of a sophisticated and highly mobile consumer market.

Downs[13] provides a critical analysis of transit oriented developments, concluding that they should "be viewed as building blocks that could be used to handle some significant part of the growth". He also notes, however, that "the feasibility of applying them on a large scale is weakened by the high cost of building the rapid transit links among them."

What is becoming increasingly clear, from the evidence collected over the last 20 years of construction of new rail systems in the U.S., is that building new rail transit lines will not, in and of itself, generate new transit ridership. With the exception of grade-separated, high-frequency lines in high density (typically urban core) locations with plenty of connectivity to very frequent bus feeders, fixed-route transit as we know it has a hard time competing with the door-to-door convenience of the automobile.

Weber[14] observes that the auto-highway system has proven to be remarkably sustainable; while transit, by comparison, seems to have become unsustainable. He proposes that the way to make transit more competitive is to make it more like cars, and conversely, that the way to reduce some of the undesired features of cars is to make them more like transit. He points to the ongoing development of new techniques to clean up emissions, as well as to computer technology improvements that are bringing the concept of personal rapid transit (i.e., car-like transit) closer to the realm of feasibility.

While personal rapid transit may not yet be ready for prime time, transit systems everywhere in the U.S. are attempting to address the issue of competitiveness with the private automobile, particularly as regards travel time and convenience. Where density or transit ridership conditions are not quite sufficient to justify light rail levels of investment (i.e., almost everywhere in the U.S.) there is the option of bus rapid transit (BRT.) BRT can help to speed up surface transit operations considerably; particularly when the right kind of equipment is deployed (e.g.: low-floor, articulated vehicles with multiple doors, combined with proof-of-payment). While operating speeds cannot match those of the private automobile, a well-designed BRT network can offer a respectable level of transit service and connectivity. When combined with appropriate parking charges at key destinations, BRT services can constitute a viable choice for certain trips.

It is also interesting to note the success of specific transit programs which attempt to provide the user a measure of control over his or her own time and travel choices. One such program provides electronic signs that display wait and arrival time information, in real time, at bus stops, and on board buses. Given the unpredictability of operating conditions in heavily congested urban corridors, these devices, supported by global positioning technology, can compensate for the unreliability of schedules by at least providing transit riders with the information necessary to make a choice as to whether to wait or find another way to travel. Similarly, in heavily utilized bus routes, a proof of payment system-essentially an honor system combined with random inspections and heavy fines- provides a way for transit riders to board through any door, avoid the long lines and bypass the gauntlet at the front of the bus, past the bottleneck created by the farebox.

Given the prevalent settlement pattern, the success of transit in the U.S. appears to be conditioned heavily upon other necessary components, including transit oriented development, and the supply and pricing of parking. While investment in rail has occurred in a number of metropolitan areas over the past three decades, parking and pricing issues have typically not been addressed; which begins to explain why transit has not been successful in retaining market share in all cases.

The foregoing discussion suggests that the emerging transportation paradigm may be one where heavy transit investment is concentrated in the core areas that already have appropriate land use densities, carefully sited transit-oriented development is encouraged to absorb a portion of suburban growth, and the rest of the growth is given over to the automobile and a hybrid version of transit that behaves more like the automobile than traditional transit. Such a paradigm would for the most part reinforce the creation and maintenance of active communities.

Transportation and Community

One of the challenges facing transportation planners today, is the way in which the concept of community is influencing decisions about larger transportation policy issues. Two typical examples are growth limits and traffic calming. Both are relatively recent developments in urban planning. Both stem from increased public awareness of and generalized displeasure with the byproducts of growth in an increasingly auto-dependent society: sprawl, encroachment on open space, congestion, decreased pedestrian safety. Both are characterized by intense community activism and involvement. And both are part of a trend toward balkanization of urban areas, where self-defined *communities* close themselves in, in an effort to exclude the perceived threats from outsiders, be they cut-through drivers, or refugees fleeing the real estate wars in more expensive parts of the region.

This concept of community conspires against the creation and sustainability of active communities in the real sense of the word. Here again, Downs[15] has a compelling perspective: “True, there must be some practical geographic limit to how broadly *community* is defined for purposes of creating public policies. But the definition appropriate for evaluating the desirability of growth-related policies in a metropolitan area is the entire area.“ He makes the case that central cities and the suburbs are kept together by vital economic links. People living and working in the suburbs and only occasionally visiting the city to shop and play, are inclined to think, mistakenly, that their communities can function independently of the center city and of other suburbs. This geographically limited perspective of *community*, though compelling because of its simplicity, often leads to actions such as opposing increases in residential densities. Such actions, although taken with the intent of *protecting* the community from congestion or parking shortages, often undermine the implementation of policies that can help alleviate suburban mobility problems, and instead end up reinforcing auto dependency.

The narrow definition of *community* appears to be a result of people’s natural tendency to look for a simple model that can explain their problems and help them find solutions. As such, this is a rather universal phenomenon, and not one exclusive to the suburbs. In the city of San Francisco, for example, which is blessed with an extraordinary level of community awareness and participation in every aspect of civic life, we are being deluged with requests for traffic calming projects in neighborhoods throughout the city. The Long Range Transportation Plan, currently being developed by the San Francisco County Transportation Authority, has already clocked in traffic calming requests worth several hundred million dollars. In the vast majority of cases, the requests cover small areas, typically a few blocks, and are not coordinated with adjacent *communities*. Invariably, the proposed solutions simply force the traffic to adjacent streets. Invariably, given the highly mixed land use pattern in the city—a feature that accounts largely for the livability of our streets—every street is partly a residential street; with the consequence that there is practically no situation where a traffic calming project can be undertaken to benefit a *community* without noticeable impact on another nearby *community*. The answer to this dilemma is, of course, to regard the *whole city* of San Francisco as a community, and to consider each traffic-calming request in that context. While such an approach is a far cry from the simplistic definitions of community discussed above, and it requires a much more serious amount of effort in order to design solutions that truly work, at least for large sectors of the city, the reward we reap is the preservation and enhancement of the entire city as an active community of 750,000 people, with the fantastic potential that such a scale entails for walking, transit and bicycle trips, and for the continued improvement of livability (and property values) for everyone.

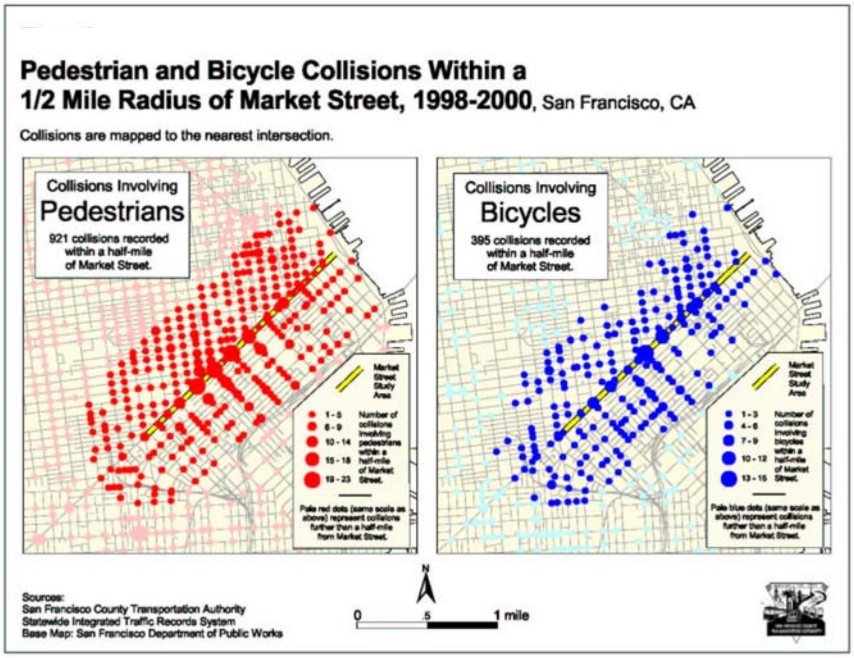
Traffic Calming as a Technique to Promote Active Communities

Continued metropolitan growth and the trend away from public transportation are contributing to ever increasing levels of traffic congestion along major thoroughfares. This results in increased levels of commute traffic cutting through neighborhoods. The phenomenon is particularly strong in older, grid network neighborhoods, or in those that have street patterns that connect to the arterial system at multiple points, as contrasted with the more limited access provided by meandering local collectors in more recent suburban subdivisions.

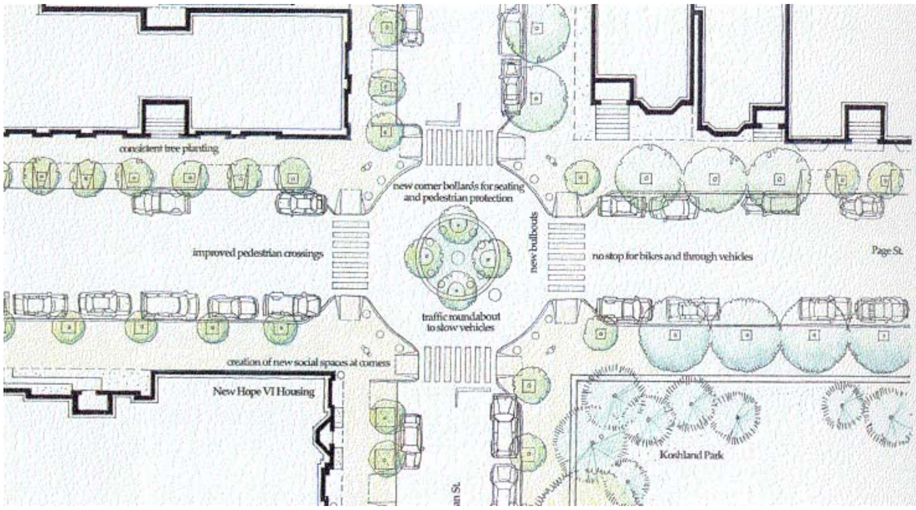
As discussed above, as traffic congestion increases requests for implementation of traffic calming measures are becoming more and more frequent. The challenge in responding to these requests is to be able to do it in a context, rather than simply to satisfy the specific request or to address just the specific condition. Traffic calming should not be allowed to become a sort of retaliatory technique, pitting neighbors against outsiders or commuters. It should instead be structured as part of a comprehensive approach to transportation planning; as a necessary component of a well-balanced transportation system. In fact, a well-balanced transportation system requires less traffic calming, because the users are more aware of each other’s needs, and the users do not define themselves as *only* drivers or *only* bikers. Instead, they can at given times take on any one of those roles, depending on the nature of their travel needs. A well-balanced transportation system can help to achieve a less polarized community, where all transportation needs are understood to be reasonable.

The next sections highlight some techniques and implementation approaches where traffic calming is having positive results on pedestrian safety and intersection safety.

Pedestrian Safety: In San Francisco, for example, the Department of Parking and Traffic has set up a system to prioritize traffic calming requests based on the type of situations they attempt to address. The system aims to increase pedestrian safety at crosswalks, for instance giving priority to the striping of zebra or “ladder” crosswalks at intersections that are in the vicinity of schools. It also distinguishes between mostly residential streets, arterial streets and commercial streets with transit service. San Francisco is an interesting example because the city has a veritable sampler of different situations: from the high density of downtown, with very high intensity of pedestrian use; to the SOMA area, with a high proportion of seniors and a number of conflict points where the city grid meets the freeway system; to relatively low-density neighborhoods resembling old suburbs, including neighborhood-serving commercial uses and bus and rail transit service.



The City has also undertaken some area-wide traffic calming studies, to assess the viability of solutions in the larger context, while maintaining a good level of cross-town accessibility. Even in a transit-first city like San Francisco, the performance of main arterials is of concern to all, including the communities requesting traffic calming projects. Specific traffic calming treatments implemented in different cases have included raised crosswalks, pedestrian-activated flashing pavement markers at crosswalks, zebra crosswalks, roundabouts and traffic circles and sidewalk bulbouts. The Transportation Authority also initiated a red light camera project, to discourage traffic light violations at key intersections where right turns were creating significant conflicts with pedestrians, including fatalities.



Proposed treatment of an intersection, with roundabout and corner plazas
Source: Market and Octavia Neighborhood Plan. San Francisco, CA

The significance and effectiveness of areawide implementation of traffic calming measures to increase pedestrian safety should not be underestimated. Cervero[16] reports that Berlin's areawide traffic-calming measures have been credited with removing traffic out of residential neighborhoods and onto commercial streets and reducing citywide accidents involving pedestrians by 43 percent.

Intersection Safety - Roundabouts: Modern roundabouts, a form of traffic circle, are an excellent example of a low-tech intersection-based traffic calming solution that has yet to reach a level of widespread acceptance by the professional transportation planning and traffic engineering community, even though is has been in common use in other countries for decades.

In a recent article, Butch, Metzer and Owens[17] provide an excellent in-depth analysis to dispel common myths about these wonderfully useful contraptions. Modern roundabouts are smaller in diameter than traditional traffic circles. The smaller diameter, and other related design standards, like carefully established entry angles, flared approaches and yield-controlled entries, result in low speeds and safer operating conditions. In fact, they point to studies that have determined that modern roundabouts reduce crashes by 40 to 60 percent compared to intersections that are signal controlled. Furthermore, they typically reduce injury crashes by 35 to 80 percent. Fatal crashes and very serious, disabling accidents are virtually eliminated. These results apply both in the US and abroad.

Even more startling are the results of traffic handling capacity and cost evaluations of roundabouts. The example comes from the 2001 Northwestern Connector study in suburban Detroit. The study showed that in a comparison of upgraded traffic signals versus roundabouts at fourteen intersections, the roundabouts would cut total annual delay 50 percent, and peak hour delays by about 70 percent.

As far as other operating issues, it has been posited that roundabouts feed steady streams of traffic into streets, making it more difficult for neighbors to get out of their driveways. This is not really the case, given that vehicles that enter the roundabout have multiple exit choices. Even though the traffic gaps that this creates downstream are smaller than those produced by traffic signals, roundabouts tend to keep traffic moving at lower speeds, which results in a generally safer operating conditions downstream as well. Although this does not always apply in older cities, where street right of way is typically a given and cannot be expanded, in suburban locations it is common for signal upgrade projects to include the redesign of the intersection to include turn lanes, or additional turn lanes if the intersection already had some. When these costs are factored in, the capital costs of roundabouts can actually be quite competitive with signal upgrades, and signals also require more ongoing maintenance expenses.

Source: APA

Roundabouts also provide a low tech design answer to a challenge that is often intractable: aggressive behavior by drivers -- a definite early trigger of the traffic calming revolution. No matter how aggressive, drivers have to slow down when operating in a tight diameter circle, head-on collisions are virtually impossible, and broadside collisions are drastically reduced. Questions remain about the handling of bicycles in roundabouts. The practice in the U.K. and elsewhere in Europe is to design the pedestrian crossings so that they can also accommodate bicycles. Mixing bicycles into the traffic stream at a roundabout is generally not recommended.

Like anything else in the transportation engineer’s armamentarium, modern roundabouts have their science and their practice, and in order to ensure their success professionals must avail themselves of the right tools to plan and design them properly. The experts recommend roundabout software based on empirical regression equations, rather than on gap acceptance theory. Two such programs are Rodel and ARCADY. Geometry plays a critical role in ensuring proper level of service at a roundabout, particularly for multiple lane roundabouts at busy intersections.

The Role of Pedestrian and Bicycle Trips in Active Communities

Pedestrian trips are an essential component of an active community. In addition to its obvious impact on commercial activity, the presence of pedestrians is a very critical factor in promoting a sense of safety in any neighborhood.

To be sure, there are steps that can and must be taken, beyond merely improving safety and protecting pedestrians against potential conflicts with the automobile, in order to create further incentives for people to walk. San Francisco has, for example, invested in sidewalk widenings and pedestrian signage in downtown, as a way to ensure that high pedestrian volumes are accommodated and encouraged. In an effort to recognize the importance of a safe, clean and inviting pedestrian environment, the

Authority includes street tree planting and maintenance as an eligible expense for reimbursement from the local transportation sales tax.

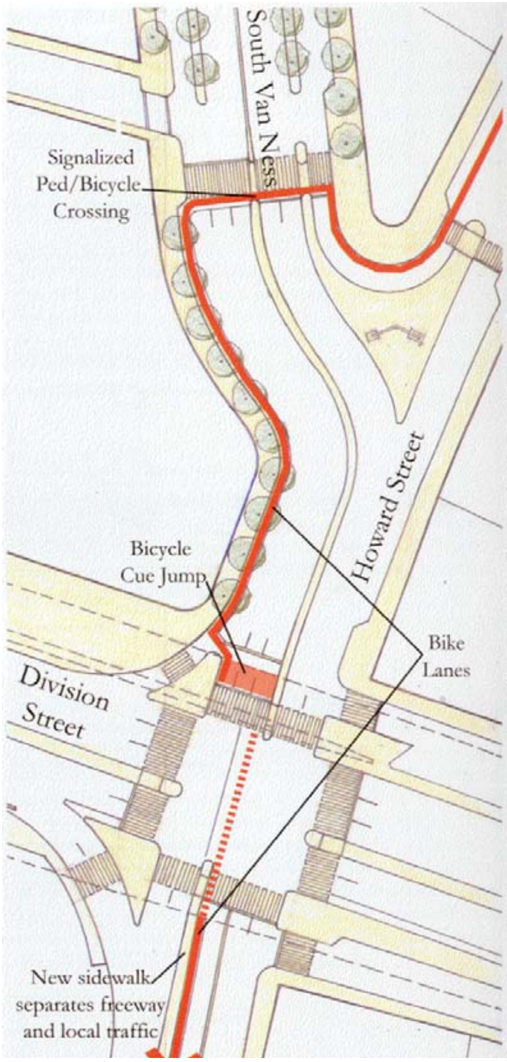
One important recent addition to traffic calming measures in San Francisco has been the installation of pedestrian countdown signals. Strictly speaking not a traffic calming technique, since they affect pedestrian rather than driver behavior, these devices display the number of seconds left before the light changes, enabling pedestrians to make informed choices, based on their own perceptions of risk and on their own assessment of physical ability, about whether to cross or to wait for the next cycle. The countdowns, which are a simple and relatively inexpensive addition to existing pedestrian signals, are tremendously popular because they eliminate uncertainty and restore to the pedestrian a measure of control over the situation. Not surprisingly, the program has been an unmitigated success.

A related technology-based approach is a technique known as “leading pedestrian interval signal phase.” It consists of allowing pedestrians at an intersection a few seconds to start crossing before turning vehicles are allowed to proceed. The technique was originally tested at several intersections in St. Petersburgh[18], Florida, and it has resulted in a noticeable reduction in auto-pedestrian conflicts.

Pedestrian and bicycle trips can also play a significant role as connectors to transit, not only in dense downtown areas, but also in a variety of suburban settings, provided that at least minimum accommodations are made for their safety and convenience. In suburban settings the internet can provide web-based real-time bus schedule information. Bicyclists and pedestrians can use this information to time their access trips to transit. In many communities, buses are now being outfitted with bicycle racks, to further enhance the complementary nature of these two travel modes.

Three main challenges remain to the implementation of bicycle programs: lack of accurate bicycle trip demand data; use of level of service measures and standards that do not favor the implementation of bike lanes; and scarcity of funding at all levels. The lack of bicycle trip demand information is a significant problem in most cases, since it makes it more difficult to make a case for the cost effectiveness of proposed bicycle projects, like bike lanes, particularly when the project requires the taking of a traffic lane. The same goes for level of service measures.

A number of factors remain to be addressed in order to maximize the contribution o bicycles to the creation and improvement of active communities. Improving safety, for example, could have a major effect on increasing the number of trips by bicycle. While the collection and reporting of bicycle accident data needs to improve (it is widely believed that many bicycle accidents, for instance, go unreported), it is known that bicyclists committed one or more traffic errors in 66 percent of fatal bicycle accidents.[19]



Integration of a Bicycle Lane Into a Complex Intersection Through the Use of a Cue Jump.
Source: Market and Octavia Neighborhood Plan. San Francisco Planning Department.

Changes in bicyclist behavior, and better training, can bring about a considerable improvement (an estimated 50 percent reduction!) in these statistics. This is not a trivial issue: the accident fatality rate per mile for a responsible adult bicyclist who wears a helmet and follows traffic rules is reported to be up to twice that of non-Interstate automobile occupants.[20]

Security and convenience undoubtedly play a role in encouraging the use of bicycles as a mode of transportation. Secure bicycle parking is a major issue. It has been reported that every year 40 percent of all bicycles in the Amsterdam metropolitan area are stolen. This translates into about 256,000 bicycles annually.[21] In San Francisco, we have recently opened secure bicycle storage and repair facilities at key regional transit stations, to encourage security conscious patrons to commute by bicycle.

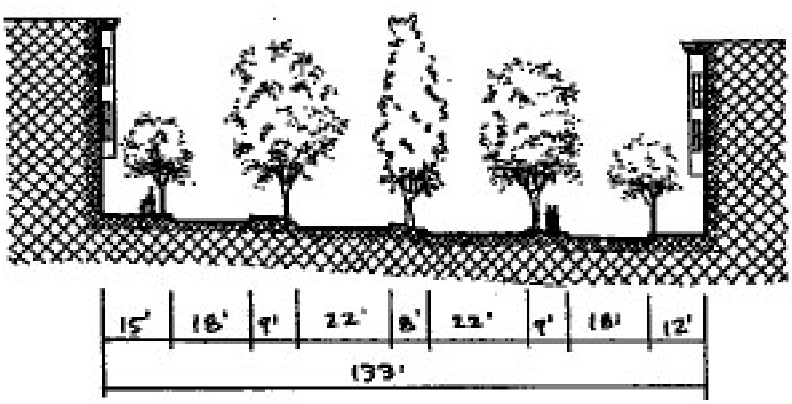
Integration of the bicycle into active communities means that we must also address factors that contribute to the social acceptance of bicycling as just another form of transportation, rather than as a radical quasi-political statement. People typically do not care how someone gets to a business meeting, as long as he or she is on time. Increasingly, however, people are forced to reckon with the inescapable fact that someone biked in, particularly in hot or humid weather or in hilly areas. While social acceptance of bicycling (and the sweating associated with it) are clearly on the rise, as we have observed in San Francisco, providing showers for bicycle commuters is a very effective way to level the playing field for those who may otherwise choose to forego this healthy and cost effective form of transportation. It is an investment akin to providing bicycle racks on a bus, intended to encourage better integration of the transportation system and to foster active communities. This is definitely not a utopian proposition, especially in light of the number of people that such facilities can serve, and considering that the capital cost of providing a parking space for a single automobile in an urban setting is typically in the range of $20,000 to $30,000 per space.

It is more cost-effective to take bicycles into account when designing new or renovated roadway facilities, but this is obviously not always feasible. In San Francisco, the demolition of the Central Freeway and its replacement with a boulevard are providing that very kind of an opportunity (see illustration). The City of Toronto has been a leader in the implementation of bicycle facilities. About 30 miles of bike lanes have been implemented in central Toronto[22]. In addition, the city has put in place a successful mix of programs aimed at encouraging biking. A number of Toronto's 4-lane arterials were converted to 2 traffic lanes plus bike lanes and parking (see illustration.) Remarkably, traffic volumes on those arterials remained practically unchanged, while bicycle volumes increased significantly. The Toronto experience shows that it is possible, at least for roads carrying under 20,000 average weekday vehicles, to reduce the number of traffic lanes in order to accommodate bicycles, and that, when carefully planned, this can be accomplished without deleterious effects on the functioning of the roadway system.

Context-Sensitive Vehicular Facility Design to Nurture Active Communities

An important step toward the development of a transportation system that complements urban form and nurtures active communities is the realization that it is possible to handle large amounts of traffic adequately in urban settings without resorting to freeway-standard vehicular facility design. The replacement of the Central Freeway in San Francisco offers a prime example.

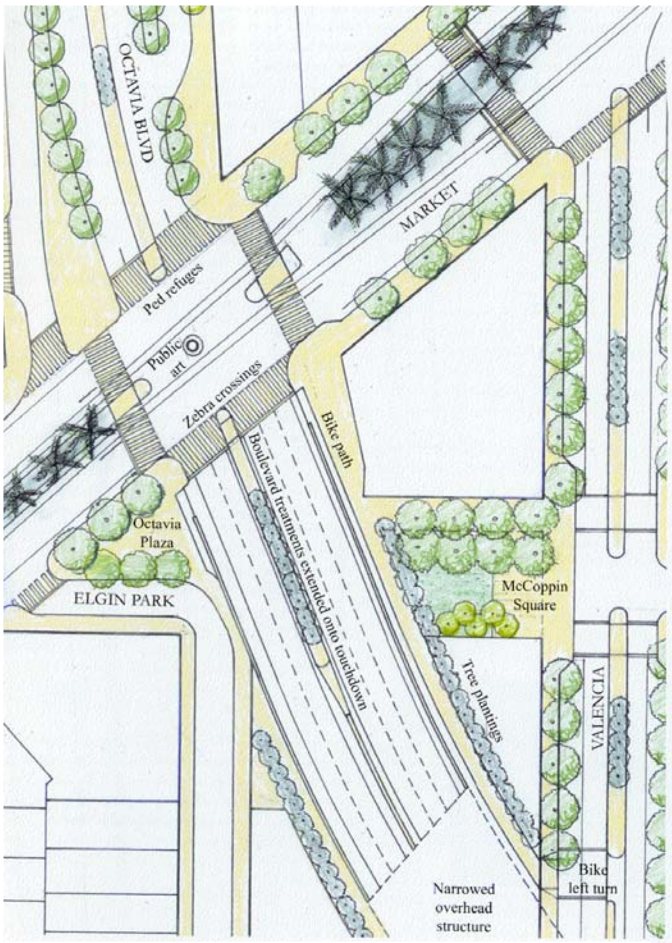
The Central Freeway, a truncated spur off the interstate system in the Civic Center area of San Francisco, was built as part of the state's Trafficways Plan of the 1950's. In the area between Mission and Golden Gate streets it was a double deck structure which crossed Market Street, the historic axis of the city, at Octavia St. and created a visual barrier between upper and lower Market Street. The Hayes Valley neighborhood, which wound up in the shadow of the unflattering structure, was quickly blighted by the presence of the freeway, and it remained that way for over 40 years. In 1989, the Loma Prieta Earthquake severely damaged the top deck, which was finally demolished in 1996. In a succession of votes and countervotes over a period of three years, the San Francisco electorate finally chose to demolish the remaining freeway deck and transform it into a boulevard. The boulevard will connect to new freeway touchdown ramps at Octavia and Market St. State legislation transferred ownership of the land to the City of San Francisco, on the condition that the proceeds of the sale of the freed up parcels would be used to pay for the boulevard and related transportation and traffic calming projects. The opportunity was therefore twofold: to replace a freeway with a transportation facility more in keeping



Octavia Boulevard. Cross section. Source: Market and Octavia Plan.

with the scale of the city and the neighborhoods it serves, and to create a new neighborhood by building housing on the freed up parcels along the new boulevard alignment.

Octavia Boulevard was designed to segregate freeway-bound traffic from local circulation and parking. The cross section of the boulevard shows a total of 8 lanes. Four are in the center of the boulevard, separated by a landscaped median. To each side of the center section there are two local access lanes, also separated from the center section by a 9ft wide landscaped median. The two local access lanes are designed as the pedestrian realm of the boulevard. This is where cars move slowly and deliberately, whether looking for parking or minding the pedestrians and bikers that are sharing the road with them. The center section is designed to include multiple turn lanes at a couple of key intersections, to ensure that traffic to and from the freeway is duly accommodated.



Context-sensitive design at the intersection of Market and Octavia. Boulevard treatments have been extended into the freeway ramp. Source: Market and Octavia Neighborhood Plan. San Francisco.

A lot of detail went into the design of the intersection at Market Street, where the newly built Caltrans ramps will touch down. The objective was to reject the notion of a freeway off-ramp right in the middle of the city and create instead an urban intersection, where the freeway leg of the intersection resembled the other legs. This objective was accomplished through implementation of a few design changes to the touchdown structure. Shoulders were reduced to 4 ft at the foot of the touchdown ramp, to create a narrower crossing for pedestrians walking along Market Street. Crash cushions were relocated farther into the ramp, to remove them from the intersection itself, and it was decided to continue the aesthetic treatment of the boulevard (trees, lighting fixtures, etc) into the touchdown ramp itself, for a distance of about 70 feet. The touchdown ramp also includes a bicycle path, and the design makes provisions for restoring the urban fabric behind the structure itself.

The lower deck of the Central Freeway, scheduled for demolition in late March, was a two-lane elevated road that delivered all the traffic to the intersection of Fell and Laguna where it was often delayed in a long queue. When the boulevard is complete, it is predicted that it will function at about the same level or better than the freeway, thanks to its ability to take advantage of the connections to the street grid. But what will be radically different is the fact that there will be a new community along this boulevard, a community whose transportation needs will be met by the boulevard; a community, in sum, which will live with traffic but will no longer be overrun by traffic.

Services for Special Needs Groups: The Disabled, The Elderly and Children

An active community is an inclusive community, a community that provides comparable accessibility to all. An accessible transportation system provides the ultimate mix of opportunities for everyone to participate in community life. Transportation planners and engineers in the U.S. are generally familiar with the basic requirements imposed on the design of transportation projects by the Americans with Disabilities Act (ADA). Paratransit services present a number of challenges, starting with the rising costs of providing services.

Provision of mobility to the growing numbers of elderly baby boomers who no longer drive is a major concen in the U.S. The population age 65 and older will grow by 60% in the next 20-years. During the decade from 2020 to 2030, more than one in five Americans (about 50 million people) will be over age 65. It will be interesting to see how the baby boomer generation settles into retirement. If the increases in mobility demands that characterized this generation are carried over into retirement (in the form of a more active lifestyle than that of previous generations of retirees) this could put tremendous strain on existing transportation services for the elderly, and force a re-evaluation of how they should be provided.

People 85 and older are emerging as the fastest growing segment of our driving population. In fact, there is a fast developing field of research dealing with the consequences of driving cessation. More than 75 percent of today's elderly population lives in the suburbs, where the automobile is often the only transportation option.[23] Given society's overwhelming dependence on the automobile, it should come as no surprise that study after study shows that driving cessation is correlated to a greatly diminished ability to get around. Many elderly in these circumstances end up isolated from their support safety nets. Loss of mobility is a serious health and quality of life issue for older people.

Interestingly, the whole field of planning for transportation services for the elderly is still evolving, and there are some very basic questions that have yet to be tackled adequately. A 2001 study in Sweden points to the need to better understand this segment of the traveling public: "it is not clear how…old age should be defined: by chronological age or major life events like retirement or widowhood. Generally speaking, chronological age is a poor indicator of functional capabilities or lifestyle."[24]

This very basic question goes to the heart of issues like defining eligibility criteria for paratransit or other special services mandated by the ADA. This, in turn, has important implications for the discussion of options for investment in future transit service improvements and for the analysis of equity in the distribution of transit services. In San Francisco, for example, the paratransit program has grown over 8 percent per year for the past few years in a row.

As transit continues to lose ridership in the non-peak (non-commute) market segments around the country, it is essential to understand how to adapt fixed route services to the needs of at least the physically able elderly, to encourage them to use this option, which can be many times more cost effective than door-to-door van or taxi services. This is particularly critical when one considers that the vast majority of baby boomer retirees were not transit users during their employed lives, for the most part had little or no experience using transit for any purpose, and probably have a hard time imagining themselves choosing a bus, which they may perceive as slow, unreliable and potentially unsafe (particularly after dark) over an ADA subsidized cab ride, which feels closest to driving.

The rethinking of paratransit services is likely to also affect the discussion of funding for such services. At least one source points out that over 55 percent of all public funds available for elderly transportation come from human services programs.[25]

Children are at the other end of the spectrum. While the elderly are becoming a formidable constituency and will likely exert considerable influence over the process to shape public transportation services in the next decade, children will continue to depend on adults to have their needs properly recognized and comprehensively addressed. Children and young people are major users of their local environments, but they are typically excluded from discussion about transportation planning: they can only take the role of problem or of victim. Providing good transportation services for our children and youth is a tremendously important societal task, in order to foster the development of active and engaged communities. In the US today, children who have had little or no exposure to public transportation are far and away the norm. Two generations of Americans have grown up with their mothers driving them to school and to extracurricular activities. In California, the Safe Routes to School Program is trying to help reverse some of this situation, making sure that children have the choice of bicycling or walking safely to school.

Exposing our children to a more balanced array of transportation choices, so that they may carry that awareness into adulthood, is perhaps the cheapest investment we can make, but it may be our single most important contribution to creating, fostering and maintaining active communities in the decades to come.

Notes:

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[23] J. Coughlin and A. Lacombe, *Transportation and Our Aging Population*, Volpe Transportation Journal, p.43, Spring 1997, Washington, D.C.

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