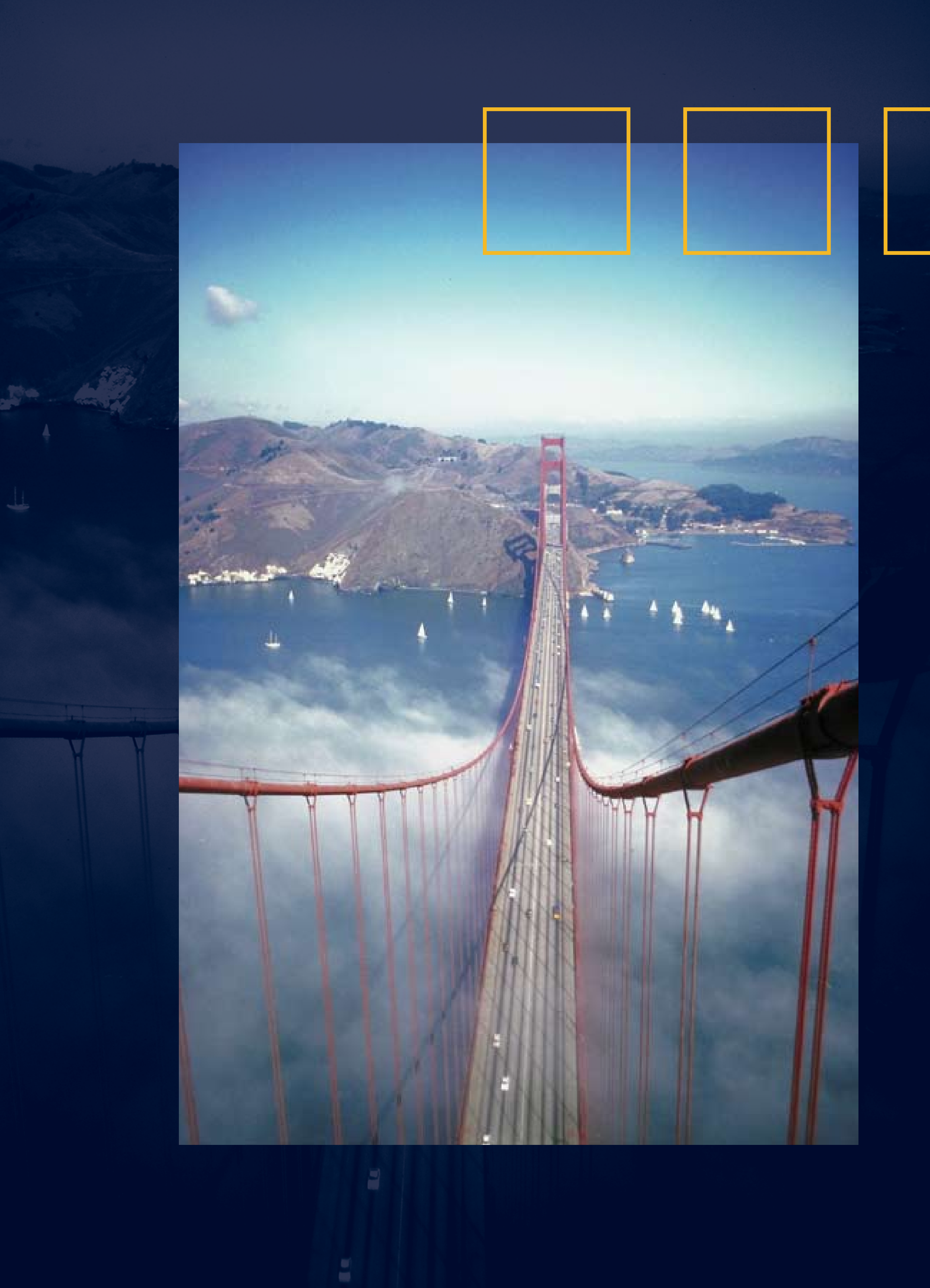

Designing Highways to Be More Likable

By Peter Samuel

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Money isn't the real obstacle to better roads. Rather, the problem is that our governments have built a dysfunctional system of taxes and grants for roads that can't address their most costly and annoying deficiency—congestion. The array of indirect charges governments levy on motorists to fill their transportation trust funds—the gas taxes, license and registration fees, and dedicated regional sales taxes—don't address the problem. Unlike flexible toll rates, they can't help manage traffic; they can't tap the willingness of motorists to pay for a quick, reliable trip; and they can't generate revenues proportionate to the problem and where the problem is located.

We need to leave behind the old tax-and-grant approach embodied in the six-year highway funding bills and directly charge for road use via tolls and area road pricing. Road financing will cease to be a problem once the provision of road service is normalized by being brought into the regular marketplace and funded with the money motorists will pay directly for such service.

No one speaks of the lack of money to build electric power plants or natural gas lines or computer factories or the like, because all these entities raise money through direct charges for their goods and services, and because the international capital markets will support investment in potentially profitable projects. Free-flowing roads will be profitable.

London—in essence, everywhere it is seriously applied. With market-clearing toll rates, we can manage roads so that free-flow conditions and quick, reliable travel times prevail even at times of greatest demand. By preventing the breakdown of traffic flow into inefficient stop-and-go travel, a managed capacity of 1,800 to 2,000 vehicles per lane per hour can flow safely and comfortably at 65 or 70 mph. Unmanaged, unpriced traffic, meanwhile, breaks down to an unstable flow at average speeds of 20 mph and throughput of only 1,200 vehicles per lane per hour.

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The bigger obstacle to progress is the widespread fatalism about the problem of congestion, the notion that there's nothing much we can do about the state of the roads, that no matter what we do they'll fill up and get clogged—call it the "Downs Syndrome" after The Brookings Institution's dogged guru of congestion fatalism, Anthony Downs.[1]

Variable pricing of roads is a sure vaccine against the dreaded Downs Syndrome and a certain cure for those who have contracted it. Indeed, variable pricing is working its magic every day on 91 Express Lanes and I-15 in California, I-394 in Minnesota, I-25 in Denver, in Singapore and in central

It's a complete no-brainer. Not only do operators of managed lanes have the potential to gain very healthy toll rates at peak travel times—the Orange County Transportation Authority, for example, is getting its top toll rates close to $1.00 per mile—but they'll be offering about 50 percent more capacity than the free-lanes competition when demand is greatest. Thanks to electronic toll collection technologies, the cure for the Downs Syndrome is at hand, thoroughly tested, readily imple-

mented, and available to be applied in communities that truly want to solve the road congestion problem.

In areas with severe congestion, strong population growth, and significant development, we need new capacity along with road pricing, capacity in the form of new highways and more highway lanes. Pricing itself has the potential to reveal the strength of customer demand for extra capacity. Where customers are clearly prepared to pay tolls sufficient to fund extra capacity, it is economically efficient to provide it.

Part of the problem in proposing new highways is that people don't like roads much. At best, they regard them as an unfortunate necessity, like drains and sewers. Roads don't arouse much enthusiasm in and of themselves. The toll-roads agency in Southern California ran a marketing campaign a couple of years back with the tagline "Is it wrong to love a road?" The agency picked that phrase because so many of its customers had astonished it by saying, "We love your road."[2] The customers loved the road once it was built and operating and providing them

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with quick, hassle-free journeys. Many of these same people had opposed the road when it was being planned. They probably had feared the paving over of hillsides in place of rustic grassy and tree-lined areas, vehicle noise, and the various aesthetic downsides of a road versus a naturalistic area.

We do love many of our great road bridges. The Golden Gate Bridge is said to be the most photographed manmade construct in the United States. And on the East Coast, the Brooklyn Bridge is an object of huge national affection and pride. The dramas of its construction are an epic described in popular books, DVDs, and TV documentaries. Thousands of artists have painted it. Tourists come to walk it. By contrast, for most Americans, "freeway" is a dirty word and a number of state highway departments are discouraging its use.

This distaste for freeways stems partly from people envisioning them when they're overloaded with traffic and become, in common parlance, "elongated parking lots." In such instances, people are viewing freeways in an irritable frame of mind. When a road designed for 70 mph is operating at an average speed of 20 mph, it seems dysfunctional. (It is dysfunctional.) Any place that one encounters negative experiences on a regular basis, one is likely to loathe. So the first priority in getting customers to like roads better concerns not aesthetics but performance. We need to minimize people's bad experiences on the road, managing travel so that motorists get to where they want to go in a smooth, uninterrupted fashion. If motorists have time to study the details of the road carefully and up close, it isn't being managed properly. Roads are for moving people along briskly.

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Congestion, like any form of queuing, is a matter of road capacity not being adequate to meet demand at the prices being charged. The remedy is some combination of increased capacity and better management of demand with variable prices. Where open road tolling has eliminated the bane of toll roads—the stop-to-pay toll booths and the associated queuing in broad, ugly toll plazas—the tolling industry has shaken off one of its historic handicaps. The application of variable pricing to prevent the overloading of roads in peak periods now enables toll roads to perform better than free roads.

Finding More Space for Roads

The strength of roadways is their ubiquity and diversity, ranging from giant expressways and parkways to signalized arterials, commercial main streets, collector roads, semi-rural two-laners, residential streets, and alleys. The largest expressways[3] are dramatic constructs of gargantuan dimensions whose interchanges, many levels high, are so large they can become the visually defining objects in a whole metropolitan area.

Life is full of trade-offs. Many people who don't much like the look of urban expressways will nonetheless use them for the convenience they provide. But these giant roads are bound to evoke passionate reactions.

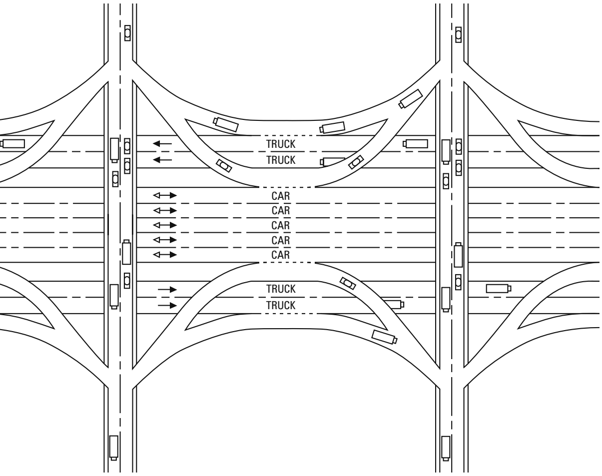
Nationally, expressways total about 57,000 miles, or just 2.3 percent of the total center-line length of all roads, but they do 31 percent of the "work" as measured by vehicle miles traveled on an average day. In urban areas, the 24,620 miles of expressways do 35 percent of the urban road work; 57,272 miles of major surface arterials do another 23 percent of the work.

Studies of trip generation in contemporary American cities have shown that providing a high level of road service entails meeting certain rather clearly defined highway needs:

- Expressways of four to eight lanes on a grid about three to five miles apart; and
- Arterials feeding those expressway interchanges and providing subexpressway mobility.

The trip-generation data suggest that these arterials need only be four travel lanes wide if they occur at half-mile intervals. As the arterials are spaced farther apart, however, they need to be built wider to handle the traffic. When they are spaced much more than half a mile apart, trip-generation modeling dictates that arterials need six travel lanes.[4] Very few American cities meet these criteria, and our traffic problems reflect the shortfalls.

Most of the increase in highway capacity in the past couple of decades in American cities has come from the rebuilding and enlargement of highways. Original grass medians in expressways have been paved to provide new lanes inside. Often, expressways have been widened outward, too, so that 8- and even 10-laners are common in several states.



Marcuson's proposal for converting an 8-lane all-vehicles expressway into 12 lanes comprising 8 lanes of cars-only and 4 lanes trucks.

Many people find such wide highways overwhelming in scale. They see in them an ugliness they don't find in a 4-lane expressway. The 8- and 10-laners also deliver volumes of traffic at interchanges that are difficult to handle without connecting arterials and surface intersections of as many as 9 lanes, including turning lanes. The human scale is lost amid such complexity. Pedestrians and cyclists appear out of place crossing these structures, yet providing grade separations for them is impractical.

Ideally, we would have smaller-scale expressways but on a much denser grid, but history bequeaths us networks that are difficult to change except incrementally. That said, in most developed areas new routes can be made, if there's a will to do so, from existing paths such as old railroad rights of way that are little used, high-voltage power-line corridors, ugly flood-control channels, and strips of low-intensity service industry whose bulldozing would be no loss.

Many people contend that "there's no space left" for adding lanes. If space for roads is important enough, however, it can be manufactured by one of three methods:

- Buying and converting real estate to space for roadways;
- Elevating new roadways within an existing right of way; and
- Going underground.

The choice of which method to pursue will depend on relative costs and local context, including, very importantly, community acceptance. Buying extra rights of way in cities is usually expensive and generates major opposition, but in some places it is still feasible.

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Elevated Expressways

In a dense urban setting with multiple cross streets, most expressways are either raised up as an elevated structure or depressed below ground level. That's because having many cross streets raised over a surface expressway is too awkward and costly.

Elevated expressways were built early on in many U.S. downtowns, but in recent years some have been torn down and relocated or not replaced.

Reduced dimensions. Adding a second deck to an existing expressway is often advocated but not often implemented. One reason for this is that such projects typically require a much higher second deck than might be thought at first glance.

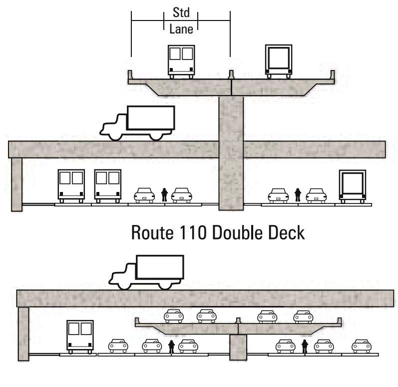
To accommodate modern tractor trailers, general-purpose traffic lanes these days are built for 16-foot overhead clearance, allowing 2 feet for signage above 14-foot-tall trucks. To that 16 feet, up to 6 feet are added for the thickness of the bridging structure, so the second deck has to be 22 feet higher than the first. Add cross streets to the structure and suddenly there's a 44-foot difference. With some parapet walls, you're up to 48 feet, almost the height of a five-story building.

Civil engineers Joel Marcuson and Gary Alstot have suggested (separately) that on high-volume urban expressways, cars and other low-height vehicles should run at two levels while trucks run at a single level.[5] The French are practicing the same principle of separating vehicles by height in the A86 West tunnel in Paris. With a height limit of 8 feet 4 inches, they can accommodate two levels of cars in the same-size tunnel as permits only one level of trucks.

An American standard for overhead clearance for light vehicles would have to be 10 feet, given the number of vans and SUVs in this country's vehicle fleet. But with two decks and a thinner girder depth, the double-decker for light vehicles could be kept to, say, 28 feet below cross streets—much less intrusive and less expensive than 44 feet.

Cofiroute, the French toll operator, is building a double-deck tunnel for low vehicles with an overhead clearance of 8 feet 4 inches (2.55 meters), providing two travel lanes and a breakdown lane on each level. Tunnel-boring machines are now available with diameters of up to 46 feet (14 meters), allowing greater height, which would be advisable in any U.S. application.

Alstot's diagram showing a less intrusive form of doubledecking.



Going Underground

Despite the best efforts of designers, in many areas surface and elevated roads will be regarded as visual blights and unwanted barriers. However elegant the architecture of an elevated roadway, if it has a certain mass and spread, there is bound to be a gloomy underside to it. In these cases, undergrounding needs to be considered.

The high cost of truck delays is likely to make some truck-only facilities viable for tunneling where other designs are unacceptable.

Major U.S. tunnels. America's recent experience with tunneling has been discouraging. The Big Dig in Boston was a well-conceived project, but it was poorly managed and costs spiraled out of control, from $3 billion to an estimated $14.6 billion. Arguably, the major reason for the excess cost was the perverse incentives of cost-plus project management and an apparently bottomless pit of federal and state grants to pay for the overruns. Although managed in its later years by the Massachusetts Turnpike Commission, it is not a toll project (the Ted Williams Tunnel excepted), so it had little of the budgetary discipline that toll financing entails.

Currently, several major U.S. tunnel projects are being studied or planned:

- Riverside–Orange County connection under Cleveland National Forest in California;
- Coronado tunnel to San Diego Naval Base;
- Missing link tunnel for I-710 through South Pasadena, Calif.;
- Glendale to Palmdale tunnel under the San Gabriel Mountains in California;
- Hampton Roads, Va., Third Crossing;
- Port of Miami Tunnel in Florida; and
- Undergrounding of the elevated Gowanus Expressway (I-278) in Brooklyn, N.Y.

The high cost of truck delays is likely to make some truck-only facilities viable for tunneling[6] where other designs are unacceptable. This is especially the case in New York City, where many expressways ("parkways") exclude trucks. Especially troubling is the lack of modern tractor-trailer (accommodating 14-foot-high, 53-foot-long trailers) access to lower and midtown Manhattan and the poor truck routes between New Jersey's ports and distribution centers and Brooklyn, Queens, and Long Island—an area with a population of 7 million. Truck routes to Kennedy Airport are appalling, equally so for the truckers who must drive them and for the communities through which the trucks must pass.

Neglected Rights of Way

Lack of right of way in cities is the most common objection to adding new links to the urban expressway network. Yet, legal constraints and mental blocks often inhibit making use of certain urban corridors, notably railroad rights of way and power-line easements, for highway purposes. If we could overcome these legal and mind-set obstacles, some of these urban rights of way could provide important new routes for much-needed highway capacity.

Pricing can play into the design with rights of way. Take, for example, a proposed direct highway link between Los Angeles International Airport (LAX) and downtown Los Angeles that would follow the diagonal of an abandoned railroad right of way across the existing freeway grid. At low toll rates, there might be demand for eight lanes in peak hours because of the advantages of this direct route and its avoidance of major interchanges. As a general-purpose highway, however, such a link would require at least a 140-foot right of way (eight 12-foot travel lanes plus four 10-foot shoulder lanes and a median divider). Railroad rights of way are typically 50 to 100 feet wide. Within that space, it is possible to fit four to six lanes. Purchase of extra right of way is possible, but only at a high price, both monetarily and in terms of community opposition.

Bridge spans and tunnels have diseconomies of scale in the sense that the per-foot cost of a bridge span or tunnel arch increases more than proportionately with size. There are thus major cost advantages to keeping the scale small and the cross section tight. By the same token, the higher the toll, the less the traffic will be. Thus, any such design should be centered around the crossover point at which the cost of extra roadway capacity will just be supported by the willingness to pay for that extra capacity in tolls. In dense developed areas with high real estate costs, such as Los Angeles, it is likely that compact specialized facilities at high toll rates will work best.

An LAX-to-downtown-L.A. facility would likely work best, then, as a premium service facility charging $5 to $10 per vehicle trip ($0.50 to $1.00 per mile). It could have a maximum of two tight lanes in each direction,

with no shoulder. It might also exclude trucks while supporting cabs, mini-buses, package vans, limos, and cars. A detailed study of alternative designs, their costs, and the willingness to pay would be needed to arrive at the optimum design, but high toll rates could produce a more acceptable design than would a low-toll or free facility.

In Maryland, use of a long power-line reservation has been suggested for providing right of way for an extension of I-95 inside the Capital Beltway five miles to the District of Columbia line. From there, it is proposed to go underground for about a mile to the Metro subway's Red Line, which it would parallel as far as New York Avenue, where it would link to the existing I-395 spur built under the Mall in front of the Capitol.

I-95 was originally planned to extend through the District in the 1960s, but unfortunately planners adopted an arrogant bulldoze-homes approach. Using powers of eminent domain, they calculated that it would be cheaper to condemn whole blocks of houses than to purchase right of way from a railroad and an electric company. This created vast political turmoil. The I-95-inside-the-Beltway project was therefore defeated. But that area of Maryland and the District have suffered economically ever since from the lack of good highway connections to the northeast.

Costs alone shouldn't rule out any form of construction. The question is whether the benefits of the project outweigh the costs. Not building roads and denying mobility incurs heavy costs too. It limits the jobs people can get and the educational, social, and recreational facilities they can access and denies employers specialized labor and services. Motorists are willing to pay very high toll charges in some cases to get a quick, reliable, and hassle-free journey. Highways are being put underground many places now precisely because the benefits outweigh the costs, high though those costs may be.

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Rethinking Traditional Design Standards

Many of the innovative highway design ideas discussed above resulted from designers thinking "outside the manual"—for example, fitting two decks of roadway into a tunnel that could accommodate only one deck (and half as many lanes), or designing some routes exclusively for trucks. The U.S. highway design standards of the 20th century have generally served us well. But by standardizing all limited-access highways based on amply dimensioned general-purpose lanes suited for all kinds of vehicles and all sorts of drivers, they have seriously constrained our ability to add needed capacity to the urban expressway network. In this section, we look more closely at design standards and suggest increased flexibility.

Breakdown lanes. We now build a continuous breakdown shoulder on at least the right side wherever it can be done without exorbitant cost. If there are more than about three lanes per direction, there is often a left-side breakdown shoulder, as well. Their principal purpose is to provide a margin of pavement for disabled vehicles or vehicles damaged in collisions. If built to full depth and strength, these shoulders can also be used as temporary travel lanes when there is repaving work to be done on the regular lanes. However, full-time breakdown lanes add to the width and expense of, or reduce the capacity of, a roadway, especially in tight urban conditions. Fortunately, it may be possible in the future to implement intelligent transportation systems that safely close a lane to traffic only when there is a disabled vehicle or obstacle ahead, thereby allowing all lanes to be used in normal conditions. Attempts are being made now to implement this technology in road tunnels.

Lane widths. The actual width of lanes on our roads varies a great deal. Ten feet was a well-established lane width in the early days of the automobile. Through the first half of the 20th century, there was a gradual widening until the Pennsylvania Turnpike established 12 feet as the gold standard in 1940. We shouldn't be dogmatic about 12-foot lanes, however.

The Holland Tunnel opened in New York City in 1927 and has 20-foot-wide roadways with 10-foot lanes. Similarly, the 1928 Goethals Bridge (which carries I-278 linking the New Jersey Turnpike to the Staten Island Expressway) has a 42-foot roadway carrying four expressway lanes of 10.25 feet each. The Lincoln Tunnel, the busiest U.S. tunnel, has three tubes, each 21.50 feet wide, or 10.75 feet per lane.

It is a testament to the flexibility of the automobile/roadway system that many of these early facilities remain in heavy use. The Goethals, despite its 10.25-foot lanes, is a major truck route between New Jersey and New York. That 10.25 feet is widely regarded as uncomfortable and unsafe at speed, especially with trucks. Trucks have gotten wider and faster since the days of 10-foot lanes. Today, 8.5-foot-wide trucks are allowed in the United States—and that doesn't include their sideview mirrors—so these narrow lanes provide barely a foot of clearance to the lane stripes on either side. Europe's maximum vehicle width of 8.37 feet is very similar to what U.S. rules dictate.[7]

The best-selling car in the United States, the Toyota Camry, is 5.9 feet wide, and one of the widest SUVs, the Ford Excursion, is 6.7 feet wide.[8] America's light vehicles—cars, pickups, vans, and SUVs—will fit in 10-foot lanes. The New Jersey Turnpike adopted 11-foot lanes as standard for its no-trucks southern segment of the Garden State Parkway, including the new 15-lane Driscoll Bridge over the Raritan River. Eleven feet is also a common striping standard for many lanes on freeways in the Los Angeles area. In the A86 West toll tunnelway in France, workers are building a double-deck, cars-only roadway in an internal diameter of 34 feet, leaving space for three lanes (one initially a breakdown lane) of about 10 feet each. There will be an overhead clearance of only 8.4 feet, ensuring that only low vehicles can enter.[9]

Car–truck separation. U.S. federal highway aid policy[10] (via the Federal Highway Administration) has been to support only mixed-traffic (general-purpose) facilities for the more than 50 years since the agency came on the scene with the beginnings of the Interstate Highway System in 1956. That put a stop to further development of the cars-only parkways that had developed around New York, Connecticut, and the Washington, D.C., area. If these federal constraints can be loosened, it should be possible to develop new cars-only parkways as long as separate provision is made for trucks.[11]

As well as being more pleasant and safer for car drivers, parkways can be built with narrower lanes and lower overhead clearance at underpasses. Without the pounding of heavy trucks, they can be built with lighter pavement and will last longer. Cars have better power-to-weight ratios, as well, enabling them to accelerate more quickly and brake in shorter distances than heavy trucks. This allows an all-cars road to be designed with more forgiving standards for sight distances, curvature, grades, and ramp design. (Many early parkways took these latter allowances to an extreme.[12])

Even with more modern standards than the original ones, parkways can be fitted into an urban environment more easily than can an all-vehicles expressway. Many early parkways blended into the course of a river or creek and great attention was paid to melding them into the natural landscape by employing top landscape architects. The emphasis was on making the roadway fit the landscape. As a result, parkways like the Saw Mill River Parkway and the Hutchinson River Parkway in Westchester County, N.Y., meander pleasantly, making their way around natural obstacles. There has been some effort to revive aspects of this early landscape approach in recent years under the rubric of "context-sensitive design."[13] One aspect of this approach is a serious effort to incorporate a local aesthetic into the detailing of highway projects. This has led to several projects being made

better and gaining community acceptance they might not have been able to obtain without it.[14]

Improving Urban Arterials

Arterials[15] are the next level of highway down from expressways, with the major distinction being that arterials lack the access control and grade separation that characterize expressways. In urban areas, arterials comprise some 57,200 center-line miles, so they are much more widespread than urban interstates (14,700 miles) and other urban expressways (9,230 miles). The arterials in urban areas see substantial vehicle miles traveled (VMT)—about two-thirds the VMT of all urban expressways.

Though less data are collected on arterials than expressways, arterial congestion seems to be growing along with expressway congestion. Herbert Levinson notes that early cities were often laid out with arterials at half-mile intervals—the near city areas of Chicago, Los Angeles, and Miami are examples—but in the age of expressways, it has become the norm to have arterials on only a one-mile grid in the suburbs, and many of these lack continuity.[16] Levinson makes a rather persuasive argument, however, that suburbs have changed dramatically since the traffic calculations that set the one-mile spacing. Car ownership has extended to almost all adults of driving age, suburban densities have increased in many places, and workplaces have dispersed to the suburbs, all generating levels of traffic best handled by arterials on a half-mile grid.

One of the most effective road safety measures that can be taken is to upgrade a surface arterial to an expressway.

Arterials are also very dangerous compared with urban expressways—11.50 fatalities per billion vehicle miles versus 6.09 fatalities for urban expressways. Thus, arterials are about 1.9 times as dangerous as expressways.

One of the most effective road safety measures that can be taken is to upgrade a surface arterial to an expressway. If arterials were as safe as expressways (as measured by fatalities per billion miles traveled), only 2,613 people would have been killed on them in 2003 compared with the actual number of 4,925, a saving of 2,312 lives.[17] That's not very different from averting a 9/11 attack each year.

Clearly, both reducing congestion

and saving lives in urban areas will be served by road improvements that focus on making arterials more like expressways. In many cases, the aim should be straightforward: to upgrade arterials to expressways by adding full access control and grade separation. Alternatively, expressways can be built to take all but local traffic off the arterials.

Needless to say, there are limits to such conversions. Arterials provide a considerable amount of local access that expressways can't provide—unless they're built Texas-style with frontage roads. That requires a wide right of way to provide expressway-style lanes for through traffic and other lanes for local access. Levinson argues for what he calls parallel "strategic arterials" wherever real expressways are more than five miles apart. These arterials would have limited access and four or six lanes, divided with grade separation or interchanges at other strategic arterials but surface intersections elsewhere. The Bay Area in California has a number of such facilities, called "expressways" there, to distinguish them from full-fledged "freeways." Levinson argues that if arterials or at least collector roads could be made continuous on a half-mile grid, many of the horrendous congestion problems of arterials on a one-mile grid could be avoided.

A Better Future

In her recent book *The Substance of Style*, author Virginia Postrel focuses on the pervasive role of aesthetics in modern society.[18] The aesthetics of objects, she writes, "offers pleasure and signals meaning" since it is "personal expression and social communication." She adds that because the aesthetic character "shows rather than tells," it works in a subliminal, associative way, its impact immediate and often emotional. This was indeed the case with one of our most famous road bridges. John van der Zee's account of the campaign for the construction of the Golden Gate Bridge describes its final design as being shaped collaboratively by Chicago engineer Charles A. Ellis and Bay Area architect Irving Foster Morrow.[19]

Ellis exploited new understanding of ways to slim the size of the proposed

bridge's towers with new mathematical approaches to "right-sizing" them to withstand the forces they would have to handle. Morrow's stroke of genius was to follow through on Ellis's work to introduce the subtle stepping of the towers. The result of this was, in van der Zee's words, to "give the finished bridge its fascinating, painterly sense of perspective, so that, seen head on, each tower seems instead a row of towers of ascending height, extending away in depth behind the first one."

Joseph Strauss, the relentless promoter of the bridge, commissioned the best local artists to do oil and watercolor paintings of the proposed structure, which were reproduced in reports, brochures, and posters. A lantern slide show—the PowerPoint of the 1920s—was also used at many of the hundreds of presentations Strauss gave to local groups. There was a huge political battle with ferry interests and other opponents who exploited the not-unreasonable fear that failure of the bridge might leave local taxpayers to foot an enormous bill. It went to popular ballot.

As van der Zee describes the battle: "Against this well-organized and substantially financed opposition, the bridge proponents wielded their most powerful weapon: the bridge itself. Even in the simplified caricatures of editorial cartoons, the bridge looked slender, graceful—and strikingly original."

The economic arguments regarding the bridge, which opened in 1937, were inconclusive, but the engineering was risky, with towers atop a major earthquake fault and within a channel with wild tidal currents and storms. And it was more than twice the span of any existing suspension bridge, so there was an enormous jump in scale from the proven. Strauss, however, managed to successfully present the bridge as a symbol of a confident striving for a better future.

At ballot, the bridge won by more than three to one in all six tax districts. Van der Zee wrote: "It was ultimately, in the privacy of the polling booth, an emotional decision, and the emotion in this case proved overwhelming...." Design was central to that positive emotion.

> Roads are primarily for movement, and the most beautiful road becomes tedious if it is viewed in frustrating stop-and-go conditions.

We need to build more beautiful roads, bringing back architects, landscapers, and designers to play a major role as they did for the 1920s and 1930s parkways of New York and Connecticut. They need to be built to respond to local aesthetic themes and sensibilities. Sometimes it is as simple as recruiting local artists. There are encouraging examples of this in the major new highways of Phoenix, where desert and Native American themes are reflected in the colors, textures, motifs, and landscaping of the roads. In Texas, the "lone star" is cast by formwork into the piers of sweeping ramps and highlighted in distinctive coloring.

But important as aesthetics are, the fundamentals of design must usually also provide sufficient roadway capacity for safe, reliable journeys at close to the speed motorists are comfortable driving. Roads are primarily for movement, and the most beautiful road becomes tedious if it is viewed in frustrating stop-and-go conditions. This brings the argument full circle to the original point, that design, planning, and pricing must all be brought to bear in determining the future of our roadways.

Peter Samuel is editor of TOLLROADSnews, a Web-based news service, and senior fellow at the Reason Foundation, Los Angeles. He lives in and works out of Frederick, Md. He studied economics, city planning, and landscape design, briefly taught economics, and has engaged in different kinds of journalism as well as public policy writing. He has specialized in writing about roads since 1995, when he founded the print publication Toll Roads Newsletter, which in 2003 became TOLLROADSnews. He may be reached at petersamuel@mac.com.

Endnotes

1 Downs' epistle of fatalism, *Stuck in Traffic*, has gone through several editions. His solution to congestion, which makes him probably the most quoted expert on the subject, is for motorists to buy a more comfortable car equipped with a CD player and a cell phone and to relax and just accept the stop-and-go. This funny line gets him on air and in print repeatedly, year after year, with a joke that never gets stale. Trouble is, a lot of people take it seriously.

2 "Is It Wrong to Love a Road?" TOLLROADSnews 2005.11.23; see http://www.tollroadsnews.com.

3 We follow usage in the eastern United States, the Midwest, and Texas in calling the top tier of roads "expressways." They are fully grade-separated, access-controlled roads that have the FHWA Functional System classification of "Interstates" or "Other Freeways and Expressways." Expressways may be free or tolled. In the western U.S. and among engineers, the term "expressway" is often used to denote a second-tier signalized arterial, and the term "freeway" is used for a fully grade-separated and access-controlled road, but this creates confusion because a "free"

way seems to preclude toll roads. The Texas Department of Transportation's solution to this semantic dilemma has been to adopt the term "expressway" as the generic term for all the top-tier roads, and we follow their lead. We use the term "surface arterial" for the second-tier road, the word "surface" indicating the lack of grade separations: intersections are at grade, or on the surface.

4 "Street Spacing and Scale," Herbert S. Levinson, Transportation Research Board Circular E-C019, Urban Street Symposium, TRB, December 2000. See http://gulliver.trb.org/publications/circulars/ec019/ec019.pdf.

5 "How to Build Our Way Out of Congestion," Peter Samuel, January 1999, www.rppi.org/ps250.doc.

6 The term "tunnel" as used here covers fully underground roads, whether built as cut-and-cover—essentially a lidded trench—or as a driven tunnel mined from an entrance portal or shaft. Cut-and-cover construction, being closer to the surface, is well suited to short tunnels and at the entrances to longer tunnels. Driven tunnels have the advantage of being able to go below utilities, thereby avoiding a major component of cut-and-cover construction costs. They are also less disruptive during construction.

7 See European Conference of Ministers of Transport, http://www.cemt.org/topics/road/dimens.pdf.

8 Car widths are available from manufacturer Web sites under "specifications and dimensions."

9 They want to retain the option of running all three lanes as travel lanes, but they plan to open with two travel lanes and one breakdown lane on each level. See http://www.a86ouest.com/a86ouest/gb/.

10 The National Park Service has its own policy, which has been to deny trucks access to parkways under its control while also vigorously resisting any expansion of capacity on parkways.

11 Around New York City, no special provision was made for trucks when the area's many parkways were built. The predictable result is that heavy trucks now clog the few all-vehicles expressways and are often forced to use boulevards, avenues, and other surface streets.

12 The worst feature was the "sudden death" entry with no space for a merge at speed. Most of these entries had to have a stop sign. Most have since been rebuilt with a reasonable merge lane.

13 See FHWA materials on context-sensitive design at http://www.fhwa.dot.gov/csd/.

14 Joseph Passonneau, a former dean of architecture at Washington University in St. Louis, Mo., is a veteran of highway architecture, his outstanding work over several decades having been acknowledged with a Presidential Award in 2000. He was heavily involved in the designs for the Glenwood Canyon viaduct, which allowed I-70 to be completed through the Rocky Mountains. A younger practitioner, Alex Krieger, professor of urban design at Harvard Design School, has been involved in many recent successfully completed context-sensitive design projects through his firm, Chan Krieger & Associates, Cambridge, Mass. See www.chankrieger.com.

15 Urban arterials, as we style them in the United States, fall under the FHWA's "other principal arterials" Functional System designation.

16 "Street Spacing and Scale," Herbert S. Levinson, Transportation Research Board Circular E-C019, Urban Street Symposium, TRB, December 2000. See http://gulliver.trb.org/publications/circulars/ec019/ec019.pdf.

17 Calculations from National Highway Statistics files fi20.xls and vsm2.xls.

18 *The Substance of Style: How the Rise of Aesthetic Value Is Remaking Commerce, Culture and Consciousness*, Virginia Postrel, HarperCollins Publishers, 2003.

19 *The Gate: The True Story of the Design and Construction of the Golden Gate Bridge*, John van der Zee, Simon & Schuster, 1986, pages 116 to 130.